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# ICC-ES Report

## ESR-3433

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Reissued 02/2016  
This report is subject to renewal 02/2018.

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

**REPORT HOLDER:**

**SPLICE SLEEVE NORTH AMERICA, INC.**

**38777 WEST SIX MILE ROAD, SUITE 205  
LIVONIA, MICHIGAN 48152**

**EVALUATION SUBJECT:**

**NMB SPLICE-SLEEVE® TYPE U-X, SNX11 AND A11W SYSTEMS FOR CONNECTING  
STEEL REINFORCING BARS**



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# ICC-ES Evaluation Report

**ESR-3433**

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**DIVISION: 03 00 00—CONCRETE**  
**Section: 03 21 00—Reinforcing Steel**
**REPORT HOLDER:**
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**EVALUATION SUBJECT**
**NMB SPLICE-SLEEVE® TYPE U-X, SNX11 AND A11W  
SYSTEMS FOR CONNECTING STEEL REINFORCING  
BARS**
**1.0 EVALUATION SCOPE**
**Compliance with the following codes:**

- 2012 and 2009 *International Building Code*® (IBC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)†

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

**Properties evaluated:**

Structural

**2.0 USES**

The Splice Sleeve North America, Inc. (SSNA), NMB Splice-Sleeve Type U-X, SNX11 and A11W systems are used as mechanical splices of deformed steel reinforcing bars in reinforced concrete construction. The NMB Splice-Sleeve Type U-X, SNX11 and A11W systems comply with Section 12.14.3.2 of ACI 318-11 for the 2012 IBC (ACI 318-08 for the 2009 IBC) (ACI 318 as referenced in Section 1901.2 of the IBC) for use as tension and compression mechanical connections of deformed steel reinforcing bars. The NMB Splice-Sleeve Type U-X, SNX11 and A11W connectors are used with SS Mortar to splice ASTM A615 Grade 60, or ASTM A706 Grade 60, deformed bars, forming NMB Splice-Sleeve Type U-X, SNX11 and A11W systems, respectively. The NMB Splice-Sleeve Type U-X, SNX11 and A11W systems also comply with the Type 2 mechanical splice requirements of Section 21.1.6.1 of ACI 318-11 for the 2012 IBC (ACI 318-08 for the 2009 IBC), and are for use where Type 1 or Type 2 mechanical splices are specified by the IBC and ACI 318.

**3.0 DESCRIPTION**
**3.1 NMB Splice-Sleeve Type U-X Connectors:**

The Type U-X NMB Splice-Sleeve connectors consist of half-straight and half-tapered steel cylinders, with multiple internal ridges. The Type U-X NMB Splice-Sleeve connectors have two unequal inside-diameter and unequal outside-diameter ends (wide end and narrow end), and are used to splice two uncoated, equal-diameter, deformed steel reinforcing bars. The midsection of the interior of the sleeve is provided with a rebar stop that establishes the proper embedment length of the reinforcing bars. As an optional feature, the sleeves are also available with a set screw located on the side of the narrow end of the sleeve. The set screw temporarily attaches the sleeve to the rebar inserted in the narrow end of the sleeve prior to the installation of the grout.

The Type U-X sleeves are iron castings conforming to a proprietary specification, which is based on ASTM A536-84 (2009), with a Grade of 85-60-06 [minimum yield and tensile strengths of 60,000 and 85,000 psi (414 and 586 MPa), respectively] for all sleeve sizes greater than No. 6, and a Grade of 65-45-12 [minimum yield and tensile strengths of 45,000 and 65,000 psi (310 and 448 MPa), respectively] for 5U-X and 6U-X sleeves. The NMB Splice-Sleeve Type U-X connector configuration, dimensions, and the required rebar embedment lengths are provided in Figure 1 and Table 1.

**3.2 NMB Splice-Sleeve SNX11 Connector:**

The NMB Splice-Sleeve SNX11 connector consists of a straight steel cylinder with multiple internal ridges, and is used to splice uncoated, No. 11 deformed steel reinforcing bars. The midsection of the interior of the sleeve is provided with a rebar stop which establishes the proper embedment length of the reinforcing bars. As an optional feature, the sleeve is also available with a set screw located on the side of the narrow end of the sleeve. The set screw is used to provide temporary attachment of the sleeve to the rebar inserted in the narrow end of the sleeve prior to the installation of the grout. The sleeve is an iron casting conforming to a proprietary specification, which is based on ASTM A536-84 (2009), with a Grade of 85-60-06 [minimum yield and tensile strengths of 60,000 and 85,000 psi (414 and 586 MPa), respectively]. The NMB Splice-Sleeve SNX11 connector configuration, dimensions, and the required rebar embedment lengths are provided in Figure 2 and Table 2.

**3.3 NMB Splice-Sleeve A11W Connector:**

The A11W NMB Splice-Sleeve connector consists of a straight steel cylinder, with multiple internal ridges. The A11W NMB Splice-Sleeve connector has two unequal inside-diameter ends, and is used to splice uncoated,

No. 11 deformed steel reinforcing bars. The midsection of the interior of the sleeve is provided with a rebar stop that establishes the proper embedment length of the reinforcing bars. As an optional feature, the sleeve is also available with a set screw located on the side of the narrow end of the sleeve. The set screw temporarily attaches the sleeve to the rebar inserted in the narrow end of the sleeve prior to the installation of the grout. The A11W sleeve is an iron casting conforming to a proprietary specification, which is based on ASTM A536-84 (2009), with a Grade of 85-60-06 [minimum yield and tensile strengths of 60,000 and 85,000 psi (414 and 586 MPa), respectively]. The NMB Splice-Sleeve A11W connector configuration, dimensions, and the required rebar embedment lengths are provided in Figure 1 and Table 1.

### 3.4 SS Mortar®:

SS Mortar is a non-shrink, high-early-strength, pre-dry-mixed, cementitious grout manufactured by Splice Sleeve Japan, Ltd., at 17-1 Nihonbashi Hakozaki-Cho, Chuo-Ku, Tokyo, Japan, for Splice Sleeve North America, Inc. The mortar is packaged in 55-pound (25 kg) moisture-resistant bags, and has a shelf life of 12 months when stored in a cool dry environment.

### 3.5 Reinforcing Steel Bars:

The reinforcing steel bars must be uncoated, deformed steel reinforcing bars complying with ASTM A615 Grade 60 or ASTM A706 Grade 60.

## 4.0 DESIGN AND INSTALLATION

### 4.1 General:

The SSNA NMB Splice-Sleeve Type U-X, SNX11 and A11W systems must be designed and installed in accordance with the IBC and this evaluation report. The splice locations must be detailed on plans approved by the code official. All required spacing and concrete protection (cover) described in IBC Table 721.1(1) and Sections 7.6 and 7.7 of ACI 318 must be measured from the outside of the splice systems.

### 4.2 Preparation and Installation of NMB Splice Sleeve Type U-X, SNX11 and A11W Systems:

All reinforcement must be clean and free from loose rust, oils, dust and other foreign material. All foreign matter and water must be removed from the sleeves.

The sleeves must be prepared and installed in accordance with the applicable code, the approved construction documents, and the recommendations noted in the "NMB Splice-Sleeve System User's Manual" by SSNA.

Sleeves must be prepared by installations of rubber plug (RP), PVC grout tubes and hole seals (HS) in accordance with the manufacturer's installation instructions.

The prepared sleeve must be installed on the first rebar so that the bar end is in contact with the rebar stop inside the sleeve, to assure the specified embedment length. The embedment length of connected bars must meet the minimum embedment length requirement as shown in Figures 1 and 2 and Tables 1 and 2.

**4.2.1 Grouting:** Sleeves must be grouted with SS Mortar, which is to be mixed with clean water according to the grout manufacturer's recommendations. Grout must be proportioned so that the splice strength can be attained by achieving a minimum compressive strength of not less than 12,500 psi (86.2 MPa) for the SS Mortar in 28 days as determined by testing on grout cube

specimens in accordance with ASTM C109 and the sleeve manufacturer's recommendations.

Grout must be poured or pumped into the sleeves, depending upon the location of the sleeves.

For pre-grout (PRE) installation, the grout must be poured into the sleeves and rodded or vibrated to consolidate it. For post-grout (PG) installations, grout must be pumped into the inlet (larger) grout tube until it flows freely from the outlet (smaller) tube. Immediately after grout outflow is observed, and before the pump nozzle is removed, a rubber stopper must be inserted into the outlet grout tube. Immediately upon removal of the nozzle from the inlet grout tube, a rubber stopper must be inserted into the inlet grout tube in such a manner so as to prevent leakage of grout from the sleeve. All spaces within the sleeve must be fully penetrated with the grout, and excess grout must be removed.

**4.2.2 Grouting Testing:** Measurement of consistency of the grout is necessary in order to determine and maintain the proper amount of mixing water to assure a smooth, pumpable grout matrix. Consistency flow tests must be run by using a flow table to test the flow of batches of grout mixture in accordance with the Japanese Architectural Standard Specification (JASS) standard 15 M103, entitled "Tests for quality evaluation of self-leveling materials." The grout must flow to a diameter of 6 inches to 9<sup>1</sup>/<sub>4</sub> inches (152 to 235 mm). Grout strength must be determined by testing of 2-inch (51 mm) cube specimens in accordance with ASTM C109 and ASTM C942, and the recommendations of Splice Sleeve North America, Inc. The grout cubes must be kept in a curing box for 24 hours. During the following day, the grout cubes must be stripped from the curing box and be submerged in a container with water, which must be kept under the same condition as the jobsite until the compressive strength testing.

### 4.3 Special Inspection:

Special inspection is required in accordance with Section 1705 of the 2012 IBC (Section 1704 of the 2009 IBC). In addition to verifying installation of steel reinforcing bar splices in accordance with this report, the special inspector must verify the grade and size of reinforcing bars; reinforcing bar embedment length; coupler identification; grout identification; field preparation of components; grout mixing, grouting, curing and testing; and assembly of the components resulting in spliced bars.

## 5.0 CONDITIONS OF USE

The SSNA NMB Splice-Sleeve Type U-X, SNX11, and A11W systems 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 The splice system must be identified 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 4.3 of this report.
- 5.3 The minimum concrete cover must be in accordance with the IBC and must be measured from the outer surface of the splice connectors.
- 5.4 Splice locations must comply with applicable IBC requirements and be noted on plans approved by the code official.

- 5.5 Under the 2012 IBC, for structures regulated by Chapter 21 of ACI 318-11 (as required by 2012 IBC Section 1905.1), to splice uncoated, 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 SSNA NMB Splice-Sleeve systems, mill certificates of reinforcing bars must be submitted to the code official as evidence that the steel reinforcing bars comply with ACI 318-11 Section 21.1.5.2.
- 5.6 Under the 2009 IBC, for structures regulated by Chapter 21 of ACI 318-08 (as required by 2009 IBC Section 1908.1), to splice uncoated, deformed reinforcing bars resisting earthquake-induced flexural and axial forces in frame members, structural walls and coupling beams, with the SSNA NMB Splice-Sleeve systems, mill certificates of reinforcing bars must be submitted to the code official as evidence that the steel reinforcing bars comply with ACI 318-08 Section 21.1.5.2.
- 5.7 The NMB Splice-Sleeve Type U-X, SNX11 and A11W connectors must be used with SS Mortar manufactured by the Splice Sleeve Japan, Ltd., for Splice Sleeve North America, Inc., in accordance with the approved quality documentation.
- 5.8 The use of NMB Splice Sleeve Type U-X, SNX11 and A11W systems in fire-resistance-rated

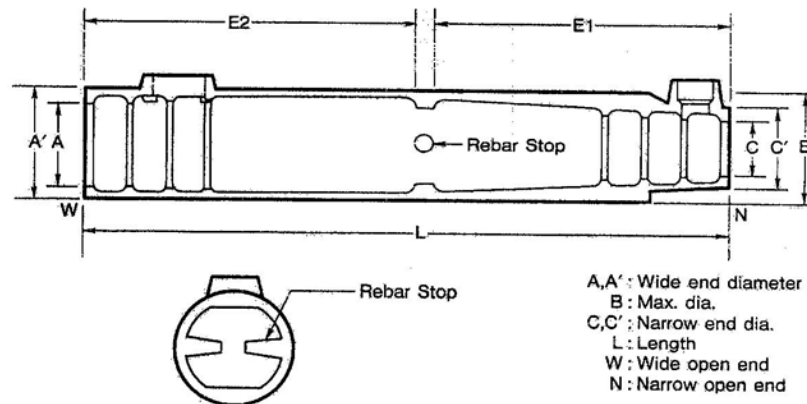
construction is outside the scope of this evaluation report.

**6.0 EVIDENCE SUBMITTED**

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Connector Systems for Steel Reinforcing Bars (AC133), dated December 2012 (editorially revised August 2013).

**7.0 IDENTIFICATION**

Each NMB Splice-Sleeve is marked with the company logo (NMB), the sleeve model and size (such as 9U-X, SNX11 and A11W), lot number, and "T2" indicating a Type 2 mechanical splice. Each container of sleeves is identified with a product label which, at a minimum, includes the report holder's name (Splice Sleeve North America, Inc.) and address, product model and size, and the ICC-ES evaluation report number (ESR-3433). Each bag of SS Mortar is marked with the report holder's name (Splice Sleeve North America, Inc.) and address, grout manufacturer's name and address, product description (NMB Splice-Sleeve System), ICC-ES evaluation report number (ESR-3433), and mixing instructions. Additionally, a lot number is printed on each bag of SS Mortar which identifies the production date and manufacturing facility.



**FIGURE 1—NMB TYPE U-X AND A11W SPLICE-SLEEVES**

TABLE 1—DIMENSIONS OF NMB TYPE U-X AND A11W SPLICE-SLEEVES

DIMENSIONS OF NMB U-X SLEEVES											REQUIRED REBAR EMBEDMENT LENGTH			
Sleeve No.	Bar Diameter (in.) [mm]	Bar Size		Sleeve Length (in.) [mm]	Narrow End Diameter (in.) [mm]		Maximum Diameter (B) (in.) [mm]	Wide End Diameter (in.) [mm]			Dowel (E1) (in.) [mm]		Dowel (E2) (in.) [mm]	
		ASTM	JIS		I.D. (C)	O.D. (C')		I.D. (A)	Total Tolerance <sup>1</sup>	O.D (A')	Min.	Max.	Min.	Max.
5U-X	0.625 [16]	#5	D1 6	9.65 [245]	0.87 [22]	1.50 [38]	1.89 [48.0]	1.26 [32.0]	0.63 [16.0]	1.89 [48.0]	4.13 [105]	4.33 [110]	4.13 [105]	4.92 [125]
6U-X	0.750 [19]	#6	D1 9	11.22 [285]	1.02 [26]	1.65 [42]	2.05 [52.0]	1.42 [36.0]	0.67 [17.0]	2.05 [52.0]	4.92 [125]	5.12 [130]	4.92 [125]	5.71 [145]
7U-X	0.875 [22]	#7	D2 2	12.80 [325]	1.14 [29]	1.77 [45]	2.36 [60.0]	1.73 [44.0]	0.86 [21.8]	2.36 [60.0]	5.71 [145]	5.91 [150]	5.71 [145]	6.50 [165]
8U-X	1.000 [25]	#8	D2 5	14.57 [370]	1.30 [33]	1.93 [49]	2.52 [64.0]	1.89 [48.0]	0.89 [22.6]	2.52 [64.0]	6.50 [165]	6.69 [170]	6.50 [165]	7.48 [190]
9U-X	1.128 [29]	#9	D2 9	16.34 [415]	1.42 [36]	2.06 [52.4]	2.67 [67.9]	2.01 [51.0]	0.89 [22.6]	2.67 [67.9]	7.40 [188]	7.56 [192]	7.40 [188]	8.35 [212]
10U-X	1.270 [32]	#10	D3 2	17.91 [455]	1.57 [40]	2.28 [58]	2.87 [73.0]	2.17 [55.0]	0.89 [22.6]	2.87 [73.0]	8.19 [208]	8.35 [212]	8.19 [208]	9.13 [232]
11U-X	1.410 [36]	#11	D3 6	19.49 [495]	1.73 [44]	2.40 [61]	3.03 [77.0]	2.32 [59.0]	0.91 [23.1]	3.03 [77.0]	8.98 [228]	9.13 [232]	8.98 [228]	9.92 [252]
14U-X	1.693 [43]	#14	D4 3	24.41 [620]	2.01 [51]	2.80 [71]	3.46 [88.0]	2.60 [66.0]	0.91 [23.1]	3.46 [88.0]	11.42 [290]	11.61 [295]	11.42 [290]	12.40 [315]
A11W	1.410 [36]	#11	D3 6	19.49 [495]	1.73 [44]	3.31 [84]	3.31 [84.0]	2.60 [66.0]	1.19 [30.2]	3.31 [84.0]	8.86 [225]	9.69 [246]	8.27 [210]	9.50 [241]

<sup>1</sup>Total tolerance is determined by subtracting bar diameter from the wide end inside diameter (A).

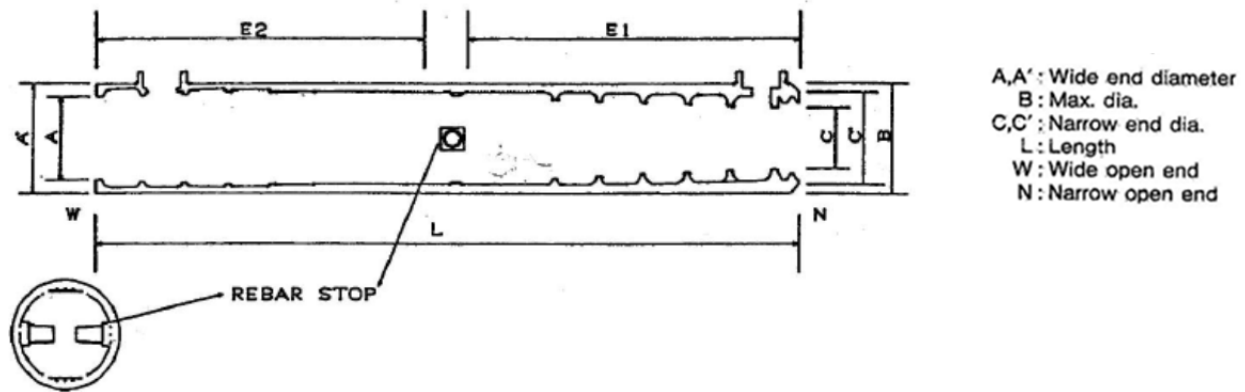


FIGURE 2—NMB SNX11 SPLICE-SLEEVE

TABLE 2—DIMENSIONS OF SNX11 SPLICE-SLEEVE

DIMENSIONS OF NMB SNX SLEEVE											REQUIRED REBAR EMBEDMENT LENGTH			
Sleeve No.	Bar Diameter (in.) [mm]	Bar Size		Sleeve Length (in.) [mm]	Narrow End Diameter (in.) [mm]		Maximum Diameter (B) (in.) [mm]	Wide End Diameter (in.) [mm]			Dowel (E1) (in.) [mm]		Dowel (E2) (in.) [mm]	
		ASTM	JIS		I.D. (C)	O.D. (C')		I.D. (A)	Total Tolerance <sup>1</sup>	O.D (A')	Min.	Max.	Min.	Max.
SNX11	1.410 [36]	#11	D3 6	19.09 [485]	1.69 [43]	3.03 [77]	3.03 [77.0]	2.32 [59]	0.91 [23.1]	3.03 [77]	8.86 [225]	9.25 [235]	8.27 [210]	9.45 [240]

<sup>1</sup>Total tolerance is determined by subtracting bar diameter from the wide end inside diameter (A).