



# S&C ELECTRIC COMPANY

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## CERTIFIED TEST ABSTRACT

### TYPE OF TEST

- Mechanical Tests
- Environmental Tests
- Water Penetration and Void Tests
- Interrupting Tests at Temperature Extremes Tests

### TYPE OF EQUIPMENT

**S&C Type XS Fuse Cutouts – Overhead Pole-Top Style**, with the following base catalog numbers and ratings:

Catalog Number	Max Voltage, kV	Cont. Current, A	Rated Interrupting Current, kA, Asym.	Rated Interrupting Current, kA, Sym.	Minimum Leakage Distance, Inches (mm)	BIL, kV
89021R10-P	15	100	10	7.1	14.764 (375)	110
89031R10-P	15	100	16	10.6		
89071R11-P	15	200	12	8		
89811R10-P	15	/	/	/		

Catalog Number	Max Voltage, kV	Cont. Current, A	Mom. Current, kA, Asym.	Minimum Leakage Distance, Inches (mm)	BIL, kV
89221R10-P	15	300	16	14.764 (375)	110

All the base catalog numbers listed above utilize 15 kV Class Type XS Fuse Cutout mountings with polymer insulators comprising of 4 sheds with an outside diameter of 92 mm and 4 sheds with an outside diameter of 108 mm.

### APPLICABLE TEST SPECIFICATIONS

IEEE C37.41-2016, *IEEE Standard Design Tests for High-Voltage (>1000 V) Fuses and Accessories*

IEEE C37.42-2016, *IEEE Standard Specifications for High-Voltage (>1000 V) Fuses and Accessories*

IEC 60282-2: 2008, *High-Voltage Fuses. Part 2 – Expulsion Fuses*

**TEST PROCEDURE AND RESULTS**

**1 Mechanical Tests**

**1.1 Mechanical Endurance at Temperature Extremes**

S&C Test Number: 18194

Successful mechanical endurance at temperature extremes test results are presented in “Table 1. Summary of Mechanical Endurance at Temperature Extremes Test Results”.

These tests were performed with 15kV Class S&C Type XS Fuse Cutout mountings (with polymer insulators comprising of 4 sheds with an outside diameter of 92 mm and 4 sheds with an outside diameter of 108 mm) with 100A Fuse Tubes (with 100T Fuse Link) & 300A Blades. The tests were conducted in accordance with procedures specified in Clause 18.1.1 of IEEE C37.41-2016.

<b>Table 1. Summary of Mechanical Endurance at Temperature Extremes Test Results</b>							
<b>Sample ID</b>	<b>Cycle 1: -40°C Completed 50 Open/Close Operations</b>	<b>Cycle 2: +40°C Completed 50 Open/Close Operations</b>	<b>Cycle 3: -40°C Completed 50 Open/Close Operations</b>	<b>Cycle 4: +40°C Completed 50 Open/Close Operations</b>	<b>Temperature- Rise Test</b>	<b>Fuse Drop Out Operation</b>	<b>Dye Penetration</b>
Sample # 1	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Sample # 2	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Sample #3	PASS	PASS	PASS	PASS	PASS	PASS	PASS

**1.2 Long-Term Deformation/Creep Tests**

S&C Test Number: 18359

Successful Long-term deformation/creep test results are presented in “Table 2. Summary of Long-Term Deformation/Creep Test Results”.

These tests were performed on devices with base catalog number 89031R10-P, which utilize a 15 kV Class S&C Type XS Fuse Cutout mounting with polymer insulators comprising of 4 sheds with an outside diameter of 92 mm and 4 sheds with an outside diameter of 108 mm. The tests were conducted in accordance with procedures specified in Clause 18.1.2 of IEEE C37.41-2016.

<b>Table 2. Summary of Long-Term Deformation/Creep Test Results</b>					
<b>Sample ID</b>	<b>Dimensional Inspection before Test</b>	<b>Period in 75°C Oven</b>	<b>Dimensional Inspection after Test</b>	<b>Temperature Rise Test</b>	<b>Drop Out Test</b>
Sample #41	PASS	8 hours	PASS	PASS	PASS
Sample #42	PASS	24 hours	PASS	PASS	PASS
Sample #43	PASS	168 hours	PASS	PASS	PASS

## 2 Environmental Tests

### 2.1 Accelerated Weathering Test

S&C Test Number: 18195

Successful accelerated weathering test results are presented in “Table 3. Summary of UVB Exposure Test Results and Requirements” and “Table 4. Summary of Power-Frequency Dry-Withstand Test Results and Requirements”.

These tests were performed on devices with base catalog number 89021R10-P, which utilize a 15 kV Class S&C Type XS Fuse Cutout mounting with polymer insulators comprising of 4 sheds with an outside diameter of 92 mm and 4 sheds with an outside diameter of 108 mm. The tests were conducted in accordance with procedures specified in Clause 18.2.2 of IEEE C37.41-2016.

Tests Condition	Requirement	Results
(a) UVB-313 lamps, 0.71W/m <sup>2</sup> , (b) 4 hours UV at 60°C BPT 0.25 hours dark + spray, 3.75 hours condensation at 50°C (c) Exposure duration: 2000 hours	The surface remains free of defects including: cracks (damage exposing the subsurface), blisters (visual surface projections), or crumbling (material removal from bulk material). All identification marks on the exterior of the insulator shall also remain visible following the test.	Pass

Power-Frequency Dry-Withstand Test (1 Min.) (tests performed on samples that successfully passed the UVB Exposure Test)				IEC 60282-2:2008 Requirements Table 4	IEEE C37.42-2016 Requirements Table 6
Test Configuration	Corrected Withstand Test Voltage (kV)			Required Withstand (kV)	Required Withstand (kV)
	Sample #1	Sample #2	Sample #3	Dry	Dry
Cutout closed Upper terminal energized Rear insert grounded	44	44	44	38	35
Cutout open Upper terminal energized Lower terminal grounded Rear insert floating	51	51	51	45	35
Cutout open Upper terminal grounded Lower terminal energized Rear insert floating	51	51	51	45	35

## 2.2 Tracking and Erosion Test

S&C Test Number: 18374

Successful tracking and erosion test results are presented in “Table 5. Summary of Tracking and Erosion Test Results”.

These tests were performed on devices with base catalog number 89021R10-P, which utilize a 15 kV Class S&C Type XS Fuse Cutout mounting with polymer insulators comprising of 4 sheds with an outside diameter of 92 mm and 4 sheds with an outside diameter of 108 mm. The tests were conducted in accordance with procedures specified in Clause 18.2.3 of IEEE C37.41-2016.

Table 5. Summary of Tracking and Erosion Test Results			
No.	Tests Description	Description & Requirement	Results
1	Tracking Wheel test	(a) Test voltage: 15*58%=8.7 kV; (b) NaCl content of water: 1.40 ± 0.06 g/l; (c) Minimum duration of test with the dip tank full: 30,000 cycles.	Pass
2	Meg-Ohm meter resistance test	≥ 3 MΩ	Pass
3	Steep front impulse voltage test	Ten positive and ten negative Steepness: ≥ 1000kV/μs	Pass
4	Power frequency flashover test	Get the reference flashover voltage	78kV
		Dry flashover voltage: ≥ 78 *90% kV=70.2kV	Pass
5	Dry Power frequency voltage test	Voltage: 78 kV*80%= 62.4 kV, 30min The maximum temperature-rise of each sample’s housing, between the sheds with respect to the temperature of the reference sample, shall be less than 10 °C.	Pass
6	Lightning impulse withstand test	Times : 15 (Positive polarity)/15 (Negative polarity) Lightning Impulse Withstand voltage: 110*80%=88 kV (Terminal-to-Ground) 121*80%=96.8 kV (Terminal-to-Terminal)	Pass

### 3 Water Penetration and Void Tests

S&C Test Number: 18377

Successful water penetration and void tests results are presented in “Table 6. Summary of Water Penetration and Voids Tests Results”.

These tests were performed on devices with base catalog number 89021R10-P which utilize a 15 kV Class S&C Type XS Fuse Cutout mounting with polymer insulators comprising of 4 sheds with an outside diameter of 92 mm and 4 sheds with an outside diameter of 108 mm. The tests were conducted in accordance with procedures specified in Clause 18.3 of IEEE C37.41-2016.

Table 6. Summary of Water Penetration and Void Tests Results			
No.	Tests Description	Description & Requirement	Results
1	Water immersion pre-stressing	Boiling for 100 hours	Pass
2	Steep-front impulse voltage test	Ten positive and ten negative Steepness: $\geq 1000\text{kV}/\mu\text{s}$	Pass
3	Power frequency flashover test	Get the reference flashover voltage	71.6kV
		Dry flashover voltage: $\geq 71.6 * 90\% \text{kV} = 64.4\text{kV}$	Pass
4	Dry power frequency voltage test	Voltage: $71.6 * 80\% = 58\text{ kV}$ , 30min The maximum temperature-rise of each sample’s housing, between the sheds with respect to the temperature of the reference sample, shall be less than 10 °C.	Pass
5	Hardness test	At the end of the boiling process, each sample shall be rinsed with deionized water and the hardness re-measured. The hardness of the outer housings shall not have changed by more than 20%.	Pass

#### 4 Interrupting Tests at Temperature Extremes

S&C Test Number: 18193

Successful interrupting tests at temperature extremes test results are presented in “Table 7. Summary of Test Series 1 (Test Duty 1) Circuit Parameters Requirements and Actual Values”, “Table 8. Summary of Interrupting Tests at Temperature Extremes Test Results”, “Table 9. Summary of Test Series 1 (Test Duty 1) Circuit Parameters Requirements and Actual Values” and “Table 10. Summary of Interrupting Tests at Temperature Extremes Test Results”.

Interrupting test series 1 (breaking test duty 1) tests were performed at Circuit #4 on devices with base catalog number 89031R10-P which utilize a 15 kV Class S&C Type XS Fuse Cutout mounting with polymer insulators comprising of 4 sheds with an outside diameter of 92 mm and 4 sheds with an outside diameter of 108 mm. These tests were conducted in accordance with procedures specified in Clause 9.2 and Clause 18.4 of IEEE C37.41-2016 and Clause 8.6 of IEC 60282-2:2008.

Circuit #4 Parameters Power Frequency: 60Hz	IEEE C37.41-2016		IEC 60282-2:2008	
	Test Series 1 Requirement	Actual	Test Duty 1 Requirement	Actual
Power-frequency Recovery Voltage (kV)	15 (+5%, 0%)	15.5	15 (+5%, 0%)	15.5
Prospective current rms Sym. (kA)	10.6 (+5%, 0%)	10.8	10.6 (+5%, 0%)	10.8
TRV Frequency	2.3(+10%, 0)	2.4	/	/
X/R	≥12	15.3	/	/
Peak Factor	1.3 (+10%, 0)	1.3	/	/
U <sub>c</sub>	/	/	≥27.6	28.0
t <sub>3</sub>	/	/	≤187	171.8
Power Factor	/	/	<0.15	0.065

Sample ID	Fuse Link Rating	0° Closing		90° Closing		140° Closing		Dye Penetration
		Temp. (°C)	Result	Temp. (°C)	Result	Temp. (°C)	Result	Result
15kV Hot	6K	44.4	Pass	43.0	Pass	40.3	Pass	Pass
15kV Cold	6K	-41.7	Pass	-40.0	Pass	-40.0	Pass	Pass
15kV Hot	100T	42.9	Pass	40.3	Pass	45.5	Pass	NA
15kV Cold	100T	-41.4	Pass	-42.9	Pass	-41.7	Pass	NA

Interrupting test series 1 (breaking test duty 1) tests were performed at Circuit #3 on devices with base catalog number 89021R10-P which utilize a 15 kV Class S&C Type XS Fuse Cutout mounting with polymer insulators comprising of 4 sheds with an outside diameter of 92 mm and 4 sheds with an outside diameter of 108 mm. These tests were conducted in accordance with procedures specified in Clause 9.2 and Clause 18.4 of IEEE C37.41-2016 and Clause 8.6 of IEC 60282-2:2008.

<b>Table 9. Summary of Test Series 1 (Test Duty 1) Circuit Parameters Requirements and Actual Values</b>				
<b>Circuit #3 Parameters Power Frequency: 60Hz</b>	<b>IEEE C37.41-2016</b>		<b>IEC 60282-2:2008</b>	
	<b>Test Series 1 Requirement</b>	<b>Actual</b>	<b>Test Duty 1 Requirement</b>	<b>Actual</b>
Power-frequency Recovery Voltage (kV)	15 (+5%, 0%)	15.61	15 (+5%, 0%)	15.61
Prospective current rms Sym. (kA)	7.1 (+5%, 0%)	7.16	7.1 (+5%, 0%)	7.16
TRV Frequency	2.3(+10%, 0)	2.32	/	/
X/R	≥8	10.48	/	/
Peak Factor	1.3 (+10%, 0)	1.31	/	/
Uc	/	/	≥27.6	27.6
t3	/	/	≤187	175.2
Power Factor	/	/	<0.15	0.095

<b>Table 10. Summary of Interrupting Tests at Temperature Extremes Test Results</b>								
Catalog No. 89021R10-P-D   Test Series 1 (Test Duty 1)   Circuit #3								
<b>Sample ID</b>	<b>Fuse Link Rating</b>	<b>0° Closing</b>		<b>90° Closing</b>		<b>140° Closing</b>		<b>Dye Penetration</b>
		<b>Temp. (°C)</b>	<b>Result</b>	<b>Temp. (°C)</b>	<b>Result</b>	<b>Temp. (°C)</b>	<b>Result</b>	<b>Result</b>
15kV Hot	6K	44.2	Pass	41.0	Pass	44.4	Pass	NA
15kV Cold	6K	-42.7	Pass	-45.1	Pass	-40.0	Pass	NA
15kV Hot	100T	43.3	Pass	40.0	Pass	43.6	Pass	NA
15kV Cold	100T	-41.7	Pass	-45.7	Pass	-40.0	Pass	NA

## **DISCUSSION**

All the tested devices listed in this Certified Test Abstract utilize the same polymer insulator and mounting live parts. Hence it can be stated that the results certifying the tested devices can be used to certify other cutouts listed at the beginning of this Certified Test Abstract, as the Fuse Tubes and Blades are interchangeable.

For interrupting tests at temperature extremes, these tests also meet the requirements of test duty 1 in breaking tests specified in IEC 60282-2: 2008.

**CONCLUSIONS**

Type XS Fuse Cutouts with Polymer insulators listed in the beginning of this Certified Test Abstract meet the tests requirements defined in Clause 18 of IEEE C37.41-2016, IEEE C37.42-2016, and test duty 1 in breaking test defined in IEC 60282-2: 2008.

**STATEMENT**

The above-stipulated conclusion is based upon tests results presented and, upon engineering experience and judgment.

STATE OF ILLINOIS )  
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COUNTY OF COOK  )

Chen Zhongyun, being sworn, states that: Chen Zhongyun is Manager — Fuse Products — Engineering Department of S&C Electric (China) Company Ltd. and is authorized to execute this certificate on behalf of S&C Electric Company; and said tests were conducted in the manner above set forth, and the results are accurately reported above.

Subscribed and sworn to before me  
this 18<sup>th</sup> day of July 2019.

S&C ELECTRIC COMPANY

Affixed hereon is my Cook County,  
Illinois Notary Public Seal

by \_\_\_\_\_

Chen Zhongyun  
Manager—Fuse Products —  
Engineering Department  
S&C Electric Company (China) Ltd.

