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Prototype Test Report - Quadri*Sil Suspension Insulators – 5/8” Rod
January 15, 2018

Report Number: R17-09-01

Prototype Testing
ANSI C29.12-2013
Quadri*Sil Suspension Insulators – 5/8” Rod
R17-09-01

Introduction:

Sample Quadri*Sil suspension insulators with a core diameter of 5/8” were subjected to prototype testing. The tests were conducted using protocols established by ANSI C29.12-2013 / ANSI C29.11-2012. The samples were manufactured with Hubbell proprietary silicone rubber.

Details:

A summary of the tests performed and their results is contained in Table 1.

Test Name	Standard/Clause	Request Number
Tests on Interfaces and Connection of End Fittings	ANSI C29.12 / 8.1 ANSI C29.11 / 7.1	E17-01-08
Core Time-Load Test	ANSI C29.12 / 8.2 ANSI C29.11 / 7.2	M17-01-19
Housing Tracking and Erosion Test	ANSI C29.12 / 8.3 ANSI C29.11 / 7.3	G18-01-01
Dye Penetration Test	ANSI C29.12 / 8.4.1 ANSI C29.11 / 7.4.1	E17-01-10
Water Diffusion Test	ANSI C29.12 / 8.4.2 ANSI C29.11 / 7.4.2	E17-01-11
Flammability Test	ANSI C29.12 / 8.5 ANSI C29.11 / 7.5	E17-11-21

Table 1

Discussion:

The tests were performed as prescribed in ANSI C29.12-2013 and ANSI C29.11-2012. All testing was successfully completed. Individual reports are attached for reference.

Conclusions:

The Quadri*Sil suspension insulators with Hubbell proprietary silicone rubber passed all of the required tests for qualification to ANSI C29.12-2013.



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Tests on Interfaces and Connection of End Fittings
ANSI C29.11 – Clause 7.1 / IEC 61109 – Clause 11.2
Quadri*Sil Suspension Insulator – 5/8” rod
E17-01-08

Introduction:

Three samples of Quadri*Sil Suspension insulators with a core diameter of 5/8” and made with Hubbell proprietary silicone rubber were tested using the protocol described in ANSI C29.11, clause 7.1 / IEC 61109 – Clause 11.2. The three insulators were catalog number S030032S000.

Test Protocol:

The test protocol of the standard follows:

7.1 Tests on Interfaces and Connection of End Fittings

- 7.1.1 *Test Specimens.* Three suspension insulators shall be tested. The insulation length (metal-to-metal spacing) shall be at least 800 mm (31.5 in) in length to be valid for all lengths. If insulators less than 800 mm (31.5 in) in length are tested, the tests are only considered valid for insulators up to the length tested. The end fittings and weathershed geometry shall be representative of production insulators. The insulators shall first be subjected to the appropriate routine tests defined within the applicable standard.
- 7.1.2 *Low-Frequency Dry Flashover Voltage Test.* The low frequency dry flashover voltage will be obtained for one test specimen as described in section 8.2.1. This specimen will be used as a reference for the verification tests in section 7.1.6.
- 7.1.3 *Sudden Load Release Test.* With the insulator stabilized within a temperature range of -20 °C to -25 °C (-4 to -13 °F), a tensile load shall be applied increasing from zero to a value equal to 30 % of the SML and shall be held for a minimum of 15 seconds, after which the load shall be released suddenly and in a manner which does not significantly increase the mass of the released end. Each test specimen shall be subjected to five sudden load releases.
- 7.1.4 *Thermal Mechanical Test.* The insulators shall be loaded at ambient temperature to at least 5 % of the SML for 1 minute. During this time, the length of the insulators shall be measured either directly or by means of fixed reference points on the end fittings. This will be the reference length. The measurement accuracy shall be at least +0.5 mm (\pm 0.02 in).
The insulators shall be submitted to thermal variations from -35 °C \pm 5 K to + 50 °C \pm 5 K (-31 °F \pm 9 °F to 122 °F \pm 9 °F) as shown in Figure 3, while under the permanent mechanical load of the RTL value as shown in Figure 3. The time at each temperature shall be at least 8 hours per cycle. The tests may be conducted in any suitable medium. At the end of thermal cycling, the insulators shall be allowed to reach ambient temperature and the length shall again be measured using the same load as for the reference length. The length measured shall be the same as the reference length +2mm (\pm 0.079 in).

NOTE: The test may be interrupted for maintenance for a total duration of 4 hours.



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- 7.1.5 *Water Penetration Test. The test specimens shall be immersed in boiling tap water for 42 hours (de-ionized water with 0.1 % NaCl or tap water adjusted to a conductivity of 1650 μ S/cm at 20 °C to 25 °C (68 °F to 77 °F). At the end of boiling, the insulators shall remain in the vessel until the water cools to approximately 50°C (122 °F). This temperature shall be maintained until the verification tests start.*
- 7.1.6 *Verification Tests. The verification tests consist of the sequence of tests described in 7.1.6.1 through 7.1.6.3, and are used to verify that the insulators have not been damaged by the previous tests. They shall all be completed within 48 hours.*
- 7.1.6.1 *Visual. The housing shall be inspected visually. No cracks are permitted.*
- 7.1.6.2 *Linearly Rising Front Chopped Impulse Voltage Test. If the test specimen has an insulating length less than or equal to 500 mm (19.7 in) the voltage is applied between the end fittings. If the test specimen has an insulating length greater than 500 mm (19.7 in), electrodes consisting of clips made of a copper strip approximately 20 mm (0.79 in) wide and less than 1 mm (0.039 in) thick shall be banded around the test specimen creating approximately equal test sections 500 mm (19.7 in) or less in length. The voltage is then applied separately to each section. The entire length of the insulator shall be tested. An impulse voltage with a front steepness of at least 1000 kV/microsecond shall be applied to each test section. Each test section shall be stressed with 25 impulses of positive polarity and 25 impulses of negative polarity. Each impulse shall cause an external flashover of the test section, no puncture shall occur. Following the test, any temporary electrode(s) used to form the test sections shall be removed.*
- 7.1.6.3 *Low-Frequency Dry Flashover Voltage Test. The low frequency dry flashover voltage shall be determined once more for each specimen using the procedure given in section 7.1.2. The average flashover voltage for each test specimen shall be at least 90 % of the value determined in section 7.1.2. Each test specimen shall be individually subjected to 80 % of its average flashover voltage as determined in section 7.1.2. The voltage shall be maintained for 30 minutes. No puncture shall occur and the temperature of the shank measured immediately after the test shall not be more than 10 °C (18 °F) above ambient.*

Test Results:

Clause 7.1.1 – Test specimens:

The samples evaluated were catalog number S030032S0000 with an S.M.L. of 30,000 lbf. A copy of the sales drawing is included as Figure 1. All of the insulators had been subjected to the standard tensile proof test.

Clause 7.1.2 – Low-Frequency Dry Flashover Voltage Test:

A reference sample was obtained for comparative purposes. The initial flashover values are as follows, all flashovers were corrected in accordance with ANSI/IEEE #4.



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	Reference
Bar (cmHg)	73.2
Temp dry (°F)	73.2
Rel. Hum. (%)	20.4

Table 1

Corrected Flashovers

Flashover No.	Reference
1	353
2	345
3	333
4	341
5	335
6	341
7	326
8	340
9	345
10	329
Average Flashover	339

Table 2

Clause 7.1.3 – Sudden Load Release Test:

The three sample insulators were cooled to -25°C. They were then removed from the thermal chamber and loaded in the Baldwin-Southwark tensile test machine to a minimum of 9,000 lbf and subjected to five load releases using the load trip mechanism (see Table 3).

Sample No.	Load 1	Load 2	Load 3	Load 4	Load 5
1	9,100	9,150	9,150	9,040	9,020
2	9,130	9,010	9,140	9,120	9,130
3	9,040	9,150	9,020	9,080	9,120

Table 3

No failures occurred.

Clause 7.1.4 – Thermal Mechanical Test:

The insulators were loaded to at least 1,500 lbf and a reference length was measured. The thermal mechanical test was performed in the Therm-o-tron. The load was applied using an air over oil pump to one sample at a time. Following removal from the Therm-o-tron, the samples were loaded to a minimum of 1,500 lbf again and the reference length was re-measured. Data is contained in Table 4.



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Sample No.	Pre-thermal Ref Load (lbs)	Pre-thermal Ref Length (in)	Thermal Start Date	Thermal End Date	Thermal Chamber Load (lbs)	Post-thermal Ref. Load (lbs)	Post-thermal Ref. Length (in)
1	1,510	33.797	2/20/17	2/24/17	15,000	1,510	33.813
2	1,510	33.797	2/20/17	2/24/17	15,000	1,500	33.797
3	1,500	33.797	2/20/17	2/24/17	15,000	1,520	33.797

Table 4

The thermal chamber load was applied for 96 hours while the temperature was cycled from -35°C to + 50°C in accordance with the test protocol.

The insulator lengths did not change by more the 2 mm as a result of the loading and temperature exposure within the thermal chamber.

Clause 7.1.5 – Water Penetration Test:

The samples were immersed in boiling water in accordance with the standard. Data regarding the immersion is contained in Table 5.

Date	Time	Temperature, °C	Event
3/3/2017	6:42pm	96.3	Start boil
3/5/2017	1:42pm	96.4	End
3/9/2017	8:12pm	49.8	Samples removed

Table 5

Clause 7.1.6 – Verification Tests

Clause 7.16.1 – Visual examination:

Each of the insulators was examined. No cracks were found.

Clause 7.1.6.2 – Steep-front impulse voltage test:

Each of the insulators was subjected to a steep-front impulse voltage by sub-dividing the insulators into three sections shorter than 500 mm. All flashovers were external. The data is contained in Table 6, 7, and 8. No corrections were applied. Each section was subjected to 25 flashovers of the prescribed polarity as required by the standard.



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Sample	Sample #1					
	Line 9 sheds		Mid 10 sheds		Ground 9 sheds	
End/Pol.	Top/+	Top/-	Mid/+	Mid/-	Grd./+	Grd./-
1	325	348	329	344	326	342
2	326	346	328	352	327	344
3	327	347	331	353	327	343
4	327	347	330	351	325	344
5	326	347	330	350	328	344
6	326	347	332	351	326	344
7	326	346	331	350	328	343
8	326	346	330	352	327	344
9	325	346	330	352	327	343
10	326	345	331	351	325	344
11	326	347	330	351	327	345
12	324	346	330	351	328	344
13	325	347	330	352	328	345
14	325	348	330	351	326	344
15	328	348	330	352	327	344
16	326	346	331	352	329	345
17	325	348	331	353	328	343
18	326	348	330	353	328	344
19	326	348	331	352	327	346
20	327	348	331	352	327	344
21	326	350	330	352	327	345
22	325	349	332	353	327	344
23	324	348	330	352	327	345
24	327	348	330	352	327	345
25	325	347	331	353	327	344
	Pass	Pass	Pass	Pass	Pass	Pass

Table 6



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Sample	Sample #2					
	Line 9 sheds		Mid 10 sheds		Ground 9 sheds	
End/Pol.	Top/+	Top/-	Mid/+	Mid/-	Grd./+	Grd./-
1	322	338	327	350	324	347
2	324	343	329	349	325	343
3	323	342	330	351	326	347
4	324	343	330	350	324	348
5	325	343	330	350	324	346
6	324	346	330	352	326	347
7	324	345	329	350	326	347
8	323	344	329	349	324	347
9	324	346	328	348	326	348
10	325	345	331	350	327	348
11	324	346	329	348	323	351
12	325	341	329	349	325	347
13	323	344	329	349	325	348
14	325	346	328	349	326	349
15	325	346	330	353	325	347
16	325	344	328	350	325	347
17	324	345	330	351	325	346
18	323	344	328	351	325	349
19	326	344	329	350	325	348
20	325	343	328	349	326	346
21	324	343	329	348	324	348
22	325	343	329	350	324	348
23	325	344	331	350	325	349
24	326	341	329	349	325	349
25	324	343	328	349	327	349
	Pass	Pass	Pass	Pass	Pass	Pass

Table 7



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Sample	Sample #3					
	Line 9 sheds		Mid 10 sheds		Ground 9 sheds	
End/Pol.	Top/+	Top/-	Mid/+	Mid/-	Grd./+	Grd./-
1	325	346	332	345	326	349
2	329	348	331	349	327	349
3	325	344	331	351	327	352
4	327	346	330	352	327	349
5	327	347	331	353	326	352
6	325	347	330	354	327	351
7	325	349	330	351	328	351
8	326	345	331	351	327	350
9	326	348	330	352	328	352
10	326	347	329	350	327	352
11	328	348	330	352	326	352
12	326	347	331	351	326	349
13	328	347	330	352	328	352
14	326	347	331	352	326	349
15	328	347	329	351	328	351
16	327	348	332	350	327	350
17	327	347	330	351	327	350
18	328	347	330	352	327	349
19	329	345	330	352	328	351
20	329	347	329	353	328	352
21	328	345	331	352	327	352
22	327	348	331	352	327	350
23	327	346	329	354	327	351
24	327	346	330	354	328	350
25	328	347	330	355	327	352
	Pass	Pass	Pass	Pass	Pass	Pass

Table 8



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Clause 7.1.6.3 – Dry power frequency voltage test:

The 3 sample insulators were tested for dry flashover values and a 30-minute, 80% withstand test was performed. Data is contained in tables 9 and 10. Corrections were made in accordance with IEEE #4.

	Reference	Unit 1	Unit 2	Unit 3
Bar (cmHg)	73.2	73.2	73.2	73.2
Temp dry (°F)	73.2	73.2	73.2	73.2
Rel. Hum.	20.4	20.4	20.4	20.4

Table 9

Corrected Flashovers

Flashover No.	Reference	Unit 1	Unit 2	Unit 3		
1	353	331	327	333		
2	345	332	333	344		
3	333	328	341	330		
4	341	331	330	340		
5	335	339	336	335		
6	341	328	334	339		
7	326	335	337	337		
8	340	337	331	348		
9	345	336	330	334		
10	329	330	329	340		
Average Flashover	339	333	333	338		
30 Minute Withstand Test						
	kV	°C	kV	°C	kV	°C
Start Withstand	323	-	323	-	324	-
End Withstand	324	-	324	-	323	-
Differential from Ambient		-		-		-

Table 10

Conclusions:

The Quadri*Sil insulators manufactured with Hubbell proprietary silicone rubber met the requirements of the test protocol of the tests on the interfaces and connection of end fittings.



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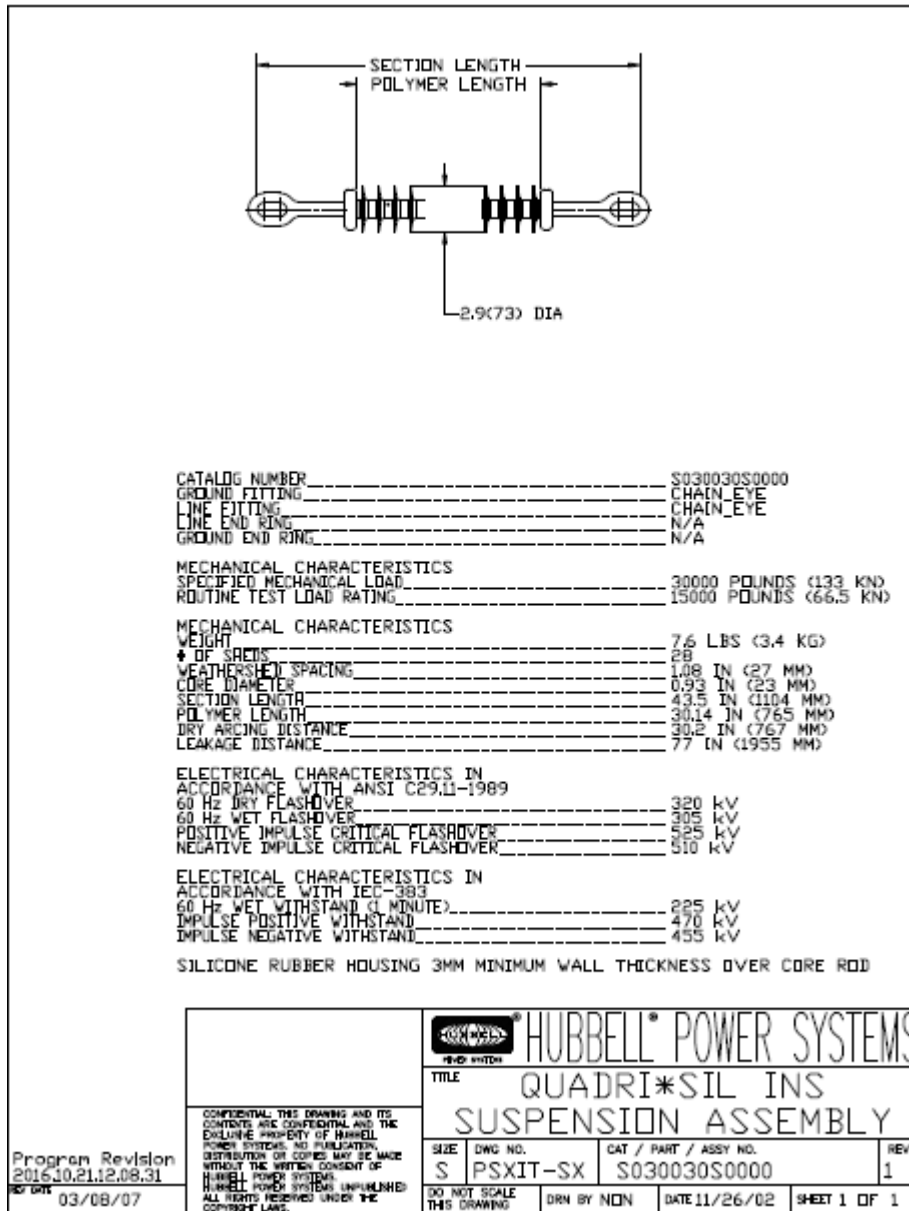


Figure 1



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Core Time-Load Test
ANSI C29.11 – Clause 7.2
Quadri*Sil Suspension Insulators – 5/8” Rod
M17-01-19

Introduction:

Two samples of S030032S0000 insulators were tested using the protocol described in ANSI C29.11, clause 7.2. The two insulators were Quadri*Sil suspension with a core diameter of 5/8” and manufactured with Hubbell proprietary silicone rubber.

Test Protocol:

The test protocol of the standard follows:

7.2 Core Time-Load Test

- 7.2.1 *Test Specimen. Six insulators shall be tested. The insulation length (metal-to-metal spacing) shall not be less than 800 mm or the longest length to be manufactured, whichever is less. The end fittings shall have a grip to the core that is representative of production insulators, but the coupling zone may be modified to avoid failure of the end fittings.*
- 7.2.2 *Determination of the Average Failing Load of the Core. Three of the test specimens shall be tested in tension. The tensile load shall be increased rapidly but smoothly from 0 to 75% of the expected mechanical failing load, and then shall be gradually increased to failure in a time of 30 to 90 seconds. Failure shall be by fracture or complete pull-out of the core. Failure of an end fitting within the coupling zone shall require testing of additional test specimens until three core failures (fracture or complete pull-out) are obtained.*
- 7.2.3 *Core Time Load Test. Three test specimens shall be subjected to a tensile load of 60% of the average failing load obtained in 7.2.2. This load shall be maintained for 96 hours without failure.*

Test Results:

As prescribed, three samples were subjected to an ultimate tensile strength test. The results were as listed in Table 1.

Sample No.	Catalog Number	Failure Load, lbf	Comments
1	S030032S0000	32,059	Bottom fitting pulled off
2	S030032S0000	32,675	Top fitting pulled off
3	S030032S0000	31,988	Top fitting pulled off
		Average: 32,241	

Table 1

Based upon the average, the applied time-load was 19,345 lbf. This load was applied to three additional samples for 96 hours. No failures occurred.



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The remaining three samples were tested in accordance with clause 7.2.3. The three samples were linked in series and loaded within the horizontal 300,000 lb. load frame. Loading was continued for 96 hours. Details are contained in Table 2 and Figure 1.

Sample Number	Applied Load (lbf)	Comments
4	19,345	Pass
5	19,345	Pass
6	19,345	Pass

Table 2

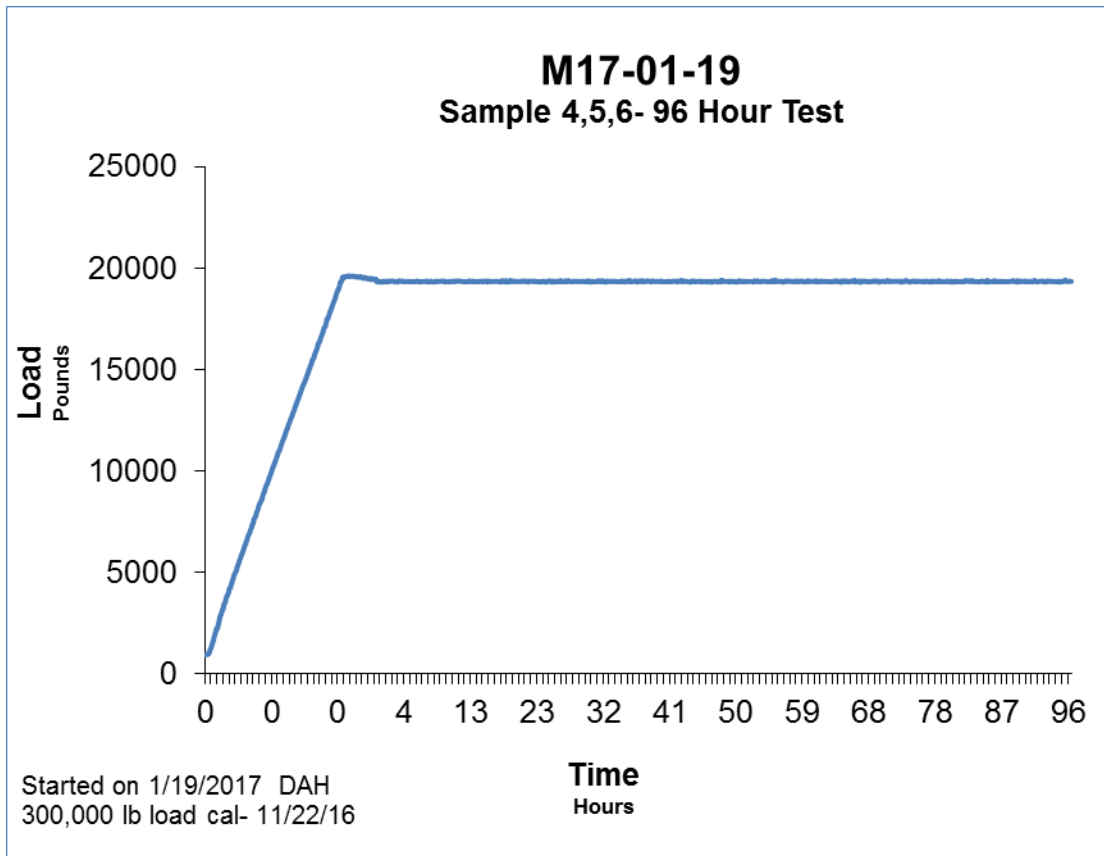


Figure 1

Conclusions:

The samples of the Quadri*Sil suspension insulators with a 5/8” core diameter met the requirements of the core time-load test as prescribed by ANSI C29.11 clause 7.2.



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Housing Tracking and Erosion Test ANSI C29.11-Clause 7.3 / IEC 62217-2012 Quadri*Sil Suspension Insulators – 5/8” Rod G18-01-01

Introduction:

Two samples of Quadri*Sil suspension insulators with shed assembly part number PSPITS630298SSAAA molded with Hubbell proprietary silicone rubber were tested using the protocol described in ANSI C29.11, clause 7.3 / IEC 62217-2012 Clause 9.3.3.

Test Protocol:

The test protocol of the standard follows:

7.3 Housing Tracking and Erosion Test

7.3.1 Test Specimen. Two insulators of identical design shall be tested. The specimen length shall be chosen such that the leakage distance falls between 484 mm and 800 mm (19 in to 31.5 in). If these insulators cannot be produced on the production line, special test specimens of essentially identical design profile and identical material shall be made that meet the leakage distance requirements. The insulators or special test specimens shall be fitted with standard production end fittings

7.3.2 Test Chamber. The test is carried out in a moisture-sealed corrosion-proof chamber, the volume of which shall not exceed 15 m³ (530 ft³). An aperture of not more than 80 cm² (12.4 in²) shall be provided for the natural exhaust air.

A turbo sprayer (room humidifier) of constant spraying capacity shall be used as the water atomizer, forming water droplets of a size of 5 µm to 10 µm. Alternatively, nozzles producing water droplets of the same size may be used. The sprayer or nozzles are mounted close to the bottom of the chamber and spray upwards towards the roof of the chamber. The fog shall fill the chamber and not be directly sprayed onto the test specimens. A solution of NaCl and deionized water shall be supplied to the sprayer (reference 7.3.3). It is not permitted to re-circulate the water.

7.3.2.1 Sample Mounting. The test specimens shall be cleaned with de-ionized water before starting the test. One test specimen shall be tested mounted horizontally (at approximately half the height of the chamber) and the second shall be mounted vertically. There shall be a clearance of at least 200 mm between the roof of the chamber and a test specimen, a clearance of at least 100 mm between the side walls of the chamber and a test specimen and at least 400 mm between parallel test specimens. Note: Up to two pairs of test specimens can be tested simultaneously.

7.3.2.2 Fog Calibration. The calibration shall be carried out at the start of each test. At least two clean collecting receptacles with a collecting area of 8000 mm² ± 2000 mm² (12.4 in² ± 3.1 in²) and a maximum height of 100 mm (3.94 in) each are placed as close as practical to the position of the ends of the test object. The receptacles shall be positioned in such a way that they are not shielded by the test specimens and to avoid dripping from the construction elements of the chamber or another source.



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They shall collect between 1.5 ml and 2.0 ml of precipitation per hour (corrected to 8000 mm² (12.4 in²) collecting area) averaged over a minimum period of 16 h according to IEC 60068-2-11.

Note: The flow rate necessary to obtain such precipitation (typically of the order of 0.3 l/m³h) should be noted. (The water flow rate is defined in liters per hour and per cubic meter of the test chamber volume.) Subsequently during the test, the flow rate should be checked at least every 100 h and remain within ± 25 % of the initial value.

7.3.3 Test Conditions. *The following conditions shall be maintained for the 1000-hour duration of the test:*

7.3.3.1 Test Voltage. *The test voltage in kilovolts is adjusted to the actual leakage distance of the test specimens determined by dividing the leakage distance in millimeters by 34.6 (equal to a specific leakage distance of 20 mm/kV). The test circuit when loaded with a continuous resistive current of 250 mA (r.m.s.) during 1 second on the high voltage side shall experience a maximum voltage drop of 5 %. The protection level shall be set at 1 A (r.m.s.).*

7.3.3.2 Temperature. *The ambient temperature within the chamber shall be 20 °C ± 5 °C.*

7.3.3.3 Saline Solution. *The amount of salt to add to the deionized water shall be as follows:*

Shank diameter Mm	Initial NaCl content of water Kg/m ³	
	l/p ≤ 3	l/p > 3
< 50	8 ± 0.4	4 ± 0.2
50 to 150	4 ± 0.2	2 ± 0.1
> 150	2 ± 0.1	1 ± 0.1

l/p is the leakage distance divided by the arcing distance.

Table 2

Note: For insulators with longer leakage per length, the initial NaCl content is reduced in order to avoid flashovers during the 1000 h test. This reduction in salinity is not regarded as decreasing the severity of the tracking and erosion test but chosen to avoid unnecessary interruptions of the procedure.

If more than one flashover occurs at the initial NaCl content, the test shall be re-started at a halved value of the NaCl content. The insulators are washed by tap water and the test re-started within 8 h (interruption times shall not be counted as part of the test duration). This may be repeated until interruptions no longer occur. The application of any of the above measures shall be noted.

The numbers of flashovers and trip-outs shall be recorded and noted in the test report.

7.3.4 Evaluation. *The test specimens of identical design shall be assessed together. The evaluation of the samples shall be in accordance with the applicable product standard.*



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Test Results:

The samples evaluated were shed assembly part number PSPITS630298SSAAA. The smallest insulator that can be manufactured would include 20 weathersheds. These insulators only utilized 8 weathersheds and so had one end with a normal seal, with the opposite seal filled with RTV at the end fitting.

The test results are shown in Table 1.

Test Samples	Applied voltage (kV)	Creepage distance (mm)	Test Duration (h)	Test Results
1	21.8	655	1000	PASS
2	21.8	655	1000	PASS

Table 1

Conclusion:

The samples of the Quadri*Sil suspension insulators met the requirements of the Housing Tracking and Erosion test according to ANSI C29.11 clause 7.3 / IEC 62217-2012 Clause 9.3.3. Pictures are displayed below as Picture 1 and 2.



Picture 1 – Set-up and condition before test

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Picture 2 – Condition after 1000 hours Tracking and Erosion

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Dye Penetration test
ANSI C29.11 Clause 7.4.1
Quadri*Sil Suspension Insulator – 5/8” Rod
E17-01-10

Introduction:

The dye penetration test was performed on samples of Quadri*Sil suspension insulators, catalog number S030032S0000. The insulator was manufactured with Hubbell proprietary silicone rubber.

Test Protocol.

The test was performed in accordance with ANSI C29.11 clause 7.4.1

7.4.1 Dye Penetration Test

7.4.1.1 Test specimens

Ten core samples shall be cut from an insulator. The length of the samples shall be 10 mm ± 0.5 mm. They shall be cut nominally 90° to the axis of the core with diamond-coated circular saw blade under cool running water. The cut surfaces shall be smoothed with a 180-grit abrasive cloth. The cut ends shall be clean and approximately parallel

7.4.1.2 Test

The samples shall be placed on a layer of steel or glass balls in a vessel with the fiber vertical. The balls shall be of the same diameter and in the range of 1 mm to 2 mm. The dye, composed 1% alcohol solution of a red/violet Methin dye (such as Astrazon or Basonil), or fuschin dye is poured into the vessel until its level is 2 mm to 3 mm (0.079 in to 0.118 in) above the top of the balls

7.4.1.3 Evaluation

The time for the dye to rise through the samples by capillarity shall be more than 15 minutes.

Test Results:

The characteristics of the samples and the results of the dye penetration test are contained in table 1.

Sample #	Dye Penetration 15 mins	Pass/ Fail	Rod Height (mm)
1	X	Pass	9.50
2	X	Pass	10.26
3	X	Pass	9.75
4	X	Pass	10.36
5	X	Pass	9.78
6	X	Pass	9.96
7	X	Pass	9.90
8	X	Pass	9.98
9	X	Pass	9.51
10	X	Pass	9.52

Table 3



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Picture 1: Test samples after 15 mins

Conclusion:

All of the samples of the Quadri*Sil suspension insulator with 5/8" core diameter and Hubbell proprietary silicone rubber met the requirements of the dye penetration test.

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Water Diffusion
ANSI C29.11 Clause 7.4.2
Quadri*Sil Suspension Insulator – 5/8” Rod
Catalog Number S030032S0000
E17-01-11

Introduction:

The water diffusion test was performed on samples of Quadri*Sil suspension insulator, catalog number S030032S0000. The insulator was manufactured with a 5/8” core diameter and Hubbell proprietary silicone rubber.

Test Protocol:

The test was performed in accordance with ANSI C29.11 clause 7.4.2

7.4.2 Water diffusion test

7.4.2.1 Test Specimen

Six samples shall be cut from an insulator. The housing material may be removed from the core, but removal is not mandatory. The length of the specimens shall be 30 mm \pm 0.5 mm. They shall be cut 90 degrees to the axis of the core with a diamond coated circular saw blade under cool running water. The cut surfaces shall be smoothed with a 180-grit abrasive cloth. The cut ends shall be clean and parallel.

7.4.2.2 Pre-stressing

The surfaces of the specimens shall be cleaned with isopropyl alcohol and filter paper immediately before boiling. The specimens shall be boiled in de-ionized water with 0.1% by weight NaCl in a glass container for 100 hours \pm 0.5 hours. Only one core material may be boiled at one time.

After boiling, the specimens shall be removed from the salt water and placed into tap water in a glass container at room temperature for at least 15 minutes. The following test shall begin within 3 hours of removal of the specimens from the salt water.

7.4.2.3 Test

The test arrangement is shown in Figure 6. Immediately before the test, the specimens shall be removed from the water and their surfaces dried with filter paper. The specimens shall be placed between the electrodes and the voltage increased at a rate of approximately 1 kV per second to a value of 12 kV where it shall remain for 1 minute.

7.4.2.3 Evaluation

No puncture or surface flashover is allowed. The current during the whole test shall not exceed 1mA r.m.s.



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Test Results:

Date	01/19/17
Start boiling	01/19/17 @ 12:15 PM
Completed boiling	01/23/17 @ 4:20 PM
NaCl concentration	0.1% by weight
Total Hours boiling	100

Sample details and test results are contained in Table 1.

Sample No.	Start Testing	Sample No.	VOLTAGE KV RMS	I total (peak) (μ A)	I (rms) (mA)	Time (min.)	Results Pass / Fail
T-1	4:35 PM	29.90	12	32	-	1	Pass
T-2		36.14	12	33	-	1	Pass
T-3		29.42	12	33	-	1	Pass
M-1		28.86	12	32	-	1	Pass
M-2		29.70	12	33	-	1	Pass
M-3		29.82	12	32	-	1	Pass
B-1		30.16	12	33	-	1	Pass
B-2		29.85	12	32	-	1	Pass
B-3	5:15 PM	29.74	12	32	-	1	Pass

Table 4



Picture 5: Samples sectioned from the top, middle, and bottom of insulator sample

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Picture 2: Samples are boiled and checked for temperature



Picture 3: Samples are cooled for 15 minutes in tap water before electrical testing



Picture 4: Samples are dried with filter paper and placed between electrodes

Conclusion

All of the samples of Quadri*Sil suspension insulator manufactured with a 5/8” core diameter and Hubbell proprietary silicone rubber met the requirements of the water diffusion test.

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FLAMMABILITY
ANSI C29.11 Clause 7.5
Quadri*Sil Suspension Insulator silicone rubber material sample
E17-11-21

Introduction:

The flammability test was performed on samples of Quadri*Sil suspension insulator proprietary silicone rubber material plaques sized according to the IEC 60695-11-10 specifications.

Test Protocol:

The test was performed in accordance with ANSI C29.11 clause 7.5 which calls for the procedure as described in IEC 60695-11-10.

7.5 Flammability Test

The manufacturer shall test and provide information on the ignition and self-extinguishing properties of the elastomeric materials of the insulator. The test specimen and procedure shall be according to IEC 60695-11-10. The evaluation shall be as defined in the appropriate product standard.

Test Results:

Vertical Burn Test	Sample	T1 (time of after flame 1)	T2 (time of after flame 2)	T3 (time of afterglow)	Classification	Thickness (mm)
Samples conditioned at 70C for 168 hrs. 70C start- 11/22/17 @ 11:30A, Out of oven on 11/29/17 @ 11:35A and into desiccant. Out of desiccant @3:30P on 11/29/17, tested within 30 mins.						
70C Conditioned Samples	1	0	0	0	Meets V-0	6.52
	2	0	0	0	Meets V-0	6.79
	3	0	0	1	Meets V-0	6.53
	4	0	0	1	Meets V-0	6.61
	5	0	0	1	Meets V-0	6.85
Conditioned at 23C and 50% RH. 23C and 50% start- 11/27/17 @ 8:30A. Taken out for test on 11/29/17 @ 10:30A.						
50% humidity/ 23C conditioned samples	6	0	0	1	Meets V-0	6.81
	7	0	0	0	Meets V-0	6.55
	8	0	0	0	Meets V-0	6.55
	9	0	0	1	Meets V-0	6.83
	10	0	0	0	Meets V-0	6.56



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Picture 1: Test Set-up



Picture 2 & 3: Sample condition after test

Conclusions:

All of the samples of the Quadri*Sil suspension insulator proprietary silicone rubber material met the requirements of the flammability test with a V0 rating.