



**Raychem**  
from TE Connectivity

## Energy Development Report (EDR)

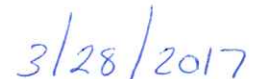
EDR-5625, Rev. 0

Nuclear Advanced Reactor EQ pH Submergence Supplement  
Title:

152  
Pages:


Prepared By:  
Erik Schaefer  
Nuclear Product Specialist

  
Signature

  
Date:


Reviewed By:  
Robert Kyles  
Sr R&D/Product Dvl Engineer

  
Signature

  
Date:

Reviewed By:  
Jonathan Cornelius  
Nuclear Product Manager

  
Signature

  
Date:




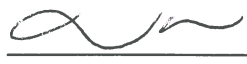
## RSCC QUALIFICATION TEST REPORT QR-1603


IN SUPPORT OF THE CHEMICAL COMPATIBILITY TEST OF TE CONNECTIVITY  
NUCLEAR CABLE ACCESSORIES AND RSCC NUCLEAR QUALIFIED LOW AND  
MEDIUM VOLTAGE CABLES IN SUPPORT OF AP1000 QUALIFICATION


REVISION: 0


DATE: 3/28/2017

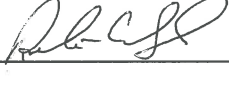
Prepared by   
Eric Rasmussen  
Director of Engineering  
Date 3-28-2017

Reviewed by   
Robert Konnik  
Chief Technology Officer  
Date 3/28/17

Approved by   
David Murphy  
Director of Quality Assurance  
Date 3/28/17

Reviewed by   
Dan Masakowski  
Director of Materials Development  
Date 3/28/17

Reviewed by  F02  
Robert Fleming  
Director of Nuclear Development  
Date 3-28-2017

Approved by   
Robert Gehm  
Manager Applications Engineering  
Date 3-28-2017



RSCC Wire & Cable LLC  
20 Bradley Park Road  
East Granby, CT 06026

Phone: (860) 653-8300  
Fax: (860) 653-8301  
Web: [www.r-scc.com](http://www.r-scc.com)



## TABLE OF CONTENTS

REVISION LOG .....	3
1.0 PURPOSE.....	4
2.0 RADIATION AND THERMAL AGING.....	4
3.0 TEST SAMPLES .....	4
4.0 SAMPLE PREPARATION PRIOR TO ENVIRONMENTAL EXPOSURE TESTING.....	5
5.0 ENVIRONMENTAL EXPOSURE TESTING .....	6
6.0 MARGIN .....	10
7.0 POST ENVIRONMENTAL EXPOSURE TESTING.....	10
8.0 ANTICIPATED VARIANCES (ANOMALIES).....	17
9.0 UNANTICIPATED VARIANCES (ANOMALIES).....	18
10.0 PASS/FAIL CRITERIA .....	23
11.0 REFERENCED DOCUMENTS.....	24
APPENDIX I: ACIDIC EXPOSURE ENVIRONMENTAL TEST DATA .....	25
APPENDIX II: BASIC EXPOSURE ENVIRONMENTAL TEST DATA.....	30
APPENDIX III: ACIDIC EXPOSURE INSULATION RESISTANCE MEASUREMENTS .....	35
APPENDIX IV: BASIC EXPOSURE INSULATION RESISTANCE MEASUREMENTS.....	36
APPENDIX V: ACIDIC EXPOSURE POST ENVIRONMENTAL TEST RESULTS.....	37
APPENDIX VI: BASIC EXPOSURE POST ENVIRONMENTAL TEST RESULTS .....	42
APPENDIX VII: ANOMALY REPORTS .....	47
APPENDIX VIII: CALIBRATION RECORDS.....	62
APPENDIX IX: TEST REPORT FOR RADIATION AND THERMAL AGING.....	104



## REVISION LOG

<u>Revision #</u>	<u>Date</u>	<u>Description of Revision</u>	<u>Affected Pages</u>
0	3/28/2017	Initial Issue	All Pages



## 1.0 PURPOSE

The program conducted a series of predetermined environmental conditions and tests in accordance with sections 7 – 9 followed by final acceptance tests in accordance with section 6 which were all in accordance with the requirements of section 11 of Raychem Nuclear Products AP1000 Test Plan, Revision 1.

Results of this test program can be utilized independently and to reinforce the conclusions of previous Kerite and RSCC Class 1E qualification reports.

## 2.0 RADIATION AND THERMAL AGING

Radiation and thermal aging of the test samples was completed by Kinectrics and is documented within Kinectrics test report: *Test Report for Radiation and Thermal Aging of Nuclear Cable Accessories*, May 31, 2016. The test report can be found in Appendix IX.

## 3.0 TEST SAMPLES

Sample	Sample ID	Sample Description	Sample AWG	Acidic Solution Environmental Exposure		Basic Solution Environmental Exposure	
				Primary	Backup	Primary	Backup
1	VS-HIGH-A60-1	V-Splice - Aged 60 years	#14			X	
2	VS-HIGH-A60-2	V-Splice - Aged 60 years	#14				X
3	VS-HIGH-NA-3	V-Splice - Not Aged	#14			X	
4	VS-HIGH-NA-4	V-Splice - Not Aged	#14				X
5	VS-LOW-A60-5	V-Splice - Aged 60 years	#14	X			
6	VS-LOW-A60-6	V-Splice - Aged 60 years	#14		X		
7	VS-LOW-NA-7	V-Splice - Not Aged	#14	X			
8	VS-LOW-NA-8	V-Splice - Not Aged	#14		X		
9	ILSCC-HIGH-A60-9	In-Line Splice with Crimp Connector- Aged 60 years	#14			X	
10	ILSCC-HIGH-A60-10	In-Line Splice with Crimp Connector- Aged 60 years	#14				X
11	ILSCC-HIGH-NA-11	In-Line Splice with Crimp Connector- Not Aged	#14			X	
12	ILSCC-HIGH-NA-12	In-Line Splice with Crimp Connector- Not Aged	#14				X
13	ILSCC-LOW-A60-13	In-Line Splice with Crimp Connector- Aged 60 years	#14	X			
14	ILSCC-LOW-A60-14	In-Line Splice with Crimp Connector- Aged 60 years	#14		X		
15	ILSCC-LOW-NA-15	In-Line Splice with Crimp Connector- Not Aged	#14	X			
16	ILSCC-LOW-NA-16	In-Line Splice with Crimp Connector- Not Aged	#14		X		
17	BBIT-N-HIGH-A60-17	BBIT – N – Aged 60 years	#6			X	
18	BBIT-N-HIGH-A60-18	BBIT – N – Aged 60 years	#6				X



19	BBIT-N-HIGH-NA-19	BBIT – N – Not Aged	#6			X	
20	BBIT-N-HIGH-NA-20	BBIT – N – Not Aged	#6				X
21	BBIT-N-LOW-A60-21	BBIT – N – Aged 60 years	#6	X			
22	BBIT-N-LOW-A60-22	BBIT – N – Aged 60 years	#6		X		
23	BBIT-N-LOW-NA-23	BBIT – N – Not Aged	#6	X			
24	BBIT-N-LOW-NA-24	BBIT – N – Not Aged	#6		X		
25	NJRT-HIGH-A-25	NJRT – Aged 60 years	3/C-#14			X	
26	NJRT-HIGH-A-26	NJRT – Aged 60 years	3/C-#14	X			
27	NJRT-HIGH-NA-27	NJRT – Not Aged	7/C-#14				X
28	NJRT-HIGH-NA-28	NJRT – Not Aged	3/C-#14			X	
29	NJRT-LOW-A-29	NJRT – Aged 60 years	7/C-#14				X
30	NJRT-LOW-A-30	NJRT – Aged 60 years	7/C-#14		X		
31	NJRT-LOW-NA-31	NJRT – Not Aged	3/C-#14	X			
32	NJRT-LOW-NA-32	NJRT – Not Aged	3/C-#14		X		

#### 4.0 SAMPLE PREPARATION PRIOR TO ENVIRONMENTAL EXPOSURE TESTING

The primary samples were prepared for their specified environmental exposure test. The backup samples remained in reserve and used if it was deemed necessary.

TE Connectivity (formerly Raychem) heat shrink tubes were used to splice the 14 AWG samples to extension leads. A of minimum of 10 cumulative feet of each sample was mounted on a metal environmental test mandrel. The mandrel consisted of two circular rings supported by eight equally spaced ½” stainless pipes, which resulted in an approximate circumscribed diameter of 24 inches. The extension leads and ends of the 6 AWG samples were passed though the chamber’s penetrations. The spliced sections remained inside the chamber. The mandrel was installed in the chamber oriented horizontal to the mandrel axis. All samples were oriented to expose the majority of their surface area to the environmental conditions.

Thermocouples within the chamber were positioned in the front, back, middle, and top of the chamber. After final inspection the vessel was closed and sealed for the duration of the test.





Figure 1: Samples on mandrel prior to acidic environmental exposure



Figure 2: Samples on mandrel prior to basic environmental exposure

## 5.0 ENVIRONMENTAL EXPOSURE TESTING

Two sequential exposures were performed on two separate sample sets as delineated in the table in section 2.0 of this test report. The first exposure consisted of an acidic spray followed by a submergence period. The second exposure consisted of a basic spray followed by a submergence period. The environmental test chamber and chemical spray system was flushed with water between the acidic and basic environmental exposures. Both environmental exposures followed identical profiles with exception to the chemical compositions.



In accordance with IEEE 383-2003 Paragraph 6.6.4, the samples were stabilized at the pre-environmental exposure temperature with rated voltage applied for one hour prior to the start of the accident transient. The pre environmental exposure temperature was between 120°F and 200°F with steam applied to the chamber jacket. Steam was not supplied to the chamber during the stabilization period. The intended environmental exposure follows:

Time (seconds)	Temperature (°F)
0	RT
300	265
86,400	265
2,592,000	165

The chamber was isolated for the duration of the exposure. Steam was only applied to the chamber jacket in order to maintain temperature. High pressure air was supplied to the chamber, when necessary, in order to maintain pressure at or above 19.8 PSIG for the duration of the test.

Each environmental exposure was performed for a period of 30 days. Throughout the environmental exposure, the high voltage applied to the 6 AWG samples and leakage current was measured and recorded at least daily except for weekends and holidays. Temperature, pressure, and the low voltage applied to the 14 AWG samples and leakage current was measured continuously using a data logger. The data logger sampling rate during the ramp and peak was 2 seconds and 1 minute at all other times.

Environmental temperature, pressure, voltage, and leakage current measurement results for the acidic and basic exposures can be found in Appendix I and Appendix II respectively.

The flow rate of the chemical spray prior to and upon conclusion of the spray exposure periods was measured and recorded. Horizontal surface area of the test chamber was 8 ft<sup>2</sup>. A rate of 0.15 gallons/ft<sup>2</sup>·min resulted in a minimum required flow rate of 1.2 gpm.

Cumulative spray exposure was for a minimum duration of 24 hours and consisted of either an acidic or basic spray solution respective to the environmental exposure.

1<sup>st</sup> Environmental Exposure Spray Solution Composition (Acidic):

0.407 molar H<sub>3</sub>BO<sub>3</sub> (4375 ppm Boron)  
pH = 5.021

2<sup>nd</sup> Environmental Exposure Spray Solution Composition (Basic):

0.021% NaOH  
pH = 11.525



Initial volume of each solution was 15 gallons and was added in to the reservoir tank.

The pH of the chemical spray was measured and recorded prior to the environmental exposure test. Since the chamber remained as an isolated or closed system for the duration of the test, then the spray composition was not be diluted by condensation or concentrated by evaporation.

The acidic exposure spray flow was commenced at the time of the ramp with a flow rate of 1.317 gpm. The acidic spray exposure was secured following 24.5 hours with a flow rate of 1.477 gpm. The basic exposure spray flow was commenced at the time of the ramp with a flow rate of 1.435 gpm. The basic spray exposure was secured following 24.8 hours with a flow rate of 1.513 gpm.

Following completion of the chemical spray solution exposure, the chamber drain was isolated and the spray system was used to fill the chamber and submerge the splice samples. A series of chemical mixes were added in sequence to the reservoir tank. The chamber was filled until the splices were submerged. Verification of submergence was done by visual inspection through the chamber viewing windows. The 29 day period of submergence commenced once an adequate fluid level within the chamber was reached.

#### 1<sup>st</sup> Environmental Exposure Submergence Solution Composition (Acidic):

15 gallons (acidic spray solution)  
0.407 molar  $\text{H}_3\text{BO}_3$  (4375 ppm Boron)  
pH = 5.021

30 gallons  
0.407 molar  $\text{H}_3\text{BO}_3$  (4375 ppm Boron)  
pH = 4.973

30 gallons  
0.407 molar  $\text{H}_3\text{BO}_3$  (4375 ppm Boron)  
pH = 4.920

2 gallons  
0.407 molar  $\text{H}_3\text{BO}_3$  (4375 ppm Boron)  
pH = 4.845

#### 2<sup>nd</sup> Environmental Exposure Submergence Solution Composition (Basic):

15 gallons (basic spray solution)  
0.021% NaOH  
pH = 11.525



30 gallons  
0.021% NaOH  
pH = 11.561

30 gallons  
0.021% NaOH  
pH = 11.688

Insulation resistance measurements were made on each sample during peak transient of the environmental exposure profile. Insulation resistance measurements were made prior to and following environmental exposures. Individual conductors were energized and measurements made at 500 VDC negative after one minute in accordance with ICEA T-27-581 Paragraph 2.3. Measurements were for engineering information only.

Insulation resistance measurement results for the acidic and basic exposures can be found in Appendix III and Appendix IV respectively.

With the exception of the insulation resistance measurements, the 6 AWG medium voltage samples were electrically energized at 5,000 V AC ( $\phi/\phi$ ) or equivalently 2,887 V AC ( $\phi/G$ ) and the 14 AWG low voltage samples were electrically energized at 600 V AC ( $\phi/G$ ).

Samples are expected to function electrically within the specified electrical parameters throughout the environmental exposure simulation for the required operating time. Any anomalies or deviations to the specified parameters were documented and analyzed in section 8.0 of this report. The test duration was extended as required to account for time outside the stated temperature profile except during ramps and prior to temperature and pressure stabilizing following a ramp and voltage parameters except for the time to perform insulation resistance measurements.

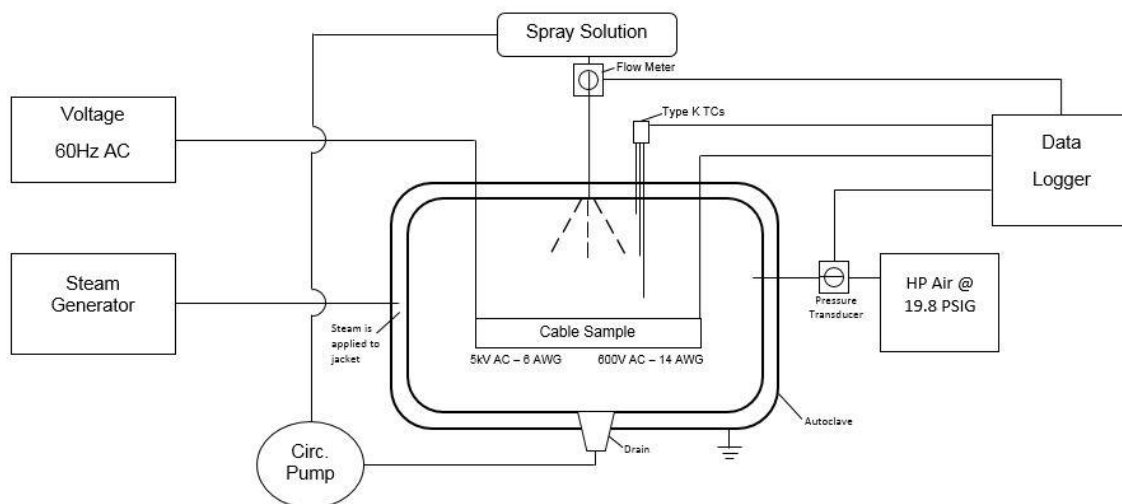


Figure 3: Representative diagram of test chamber and instrumentation



## 6.0 MARGIN

Margin was added to the following parameters for additional conservatism. These values are in accordance with IEEE 323-1974 Paragraph 6.3.1.5 and IEEE 323-2003 Paragraph 6.3.1.6 except as noted.

- A. Temperature: The recommended +8°C (14.4°F) was included in the intended profile.
- B. Pressure: The recommended +10% was included in the intended profile.
- C. Voltage: +/- 10 % tolerance is recommended. For cable, higher voltage is conservative as this provides higher voltage stress. Therefore, the minus 10 % tolerance is not necessary. The plus 10 % tolerance was used.
- D. Current: Consideration is not made for current in IEEE 323-1974 and IEEE 323-2003. The samples were only energized with voltage for the purpose of this test.
- E. Frequency: 5% variation for frequency is recommended. Voltage and current supplies are derived from local utility power. Frequency was nominal 60 Hz with variation as determined by the utility.
- F. Vibration: Wire and cable is not subject to seismic effects. The 20 times bend test performed upon completion of the environmental profile demonstrates a retention of a degree of flexibility.
- G. Equipment Operating Time: Minimum environmental exposure duration is 30 days. Arrhenius techniques can be used to extend mission time to 1 year. The period of submergence cannot be accelerated.
- H. Chemical Spray: pH and composition is used without additional margin.

## 7.0 POST ENVIRONMENTAL EXPOSURE TESTING

Following completion of each environmental exposure, the chamber was drained and allowed to cool before opening.



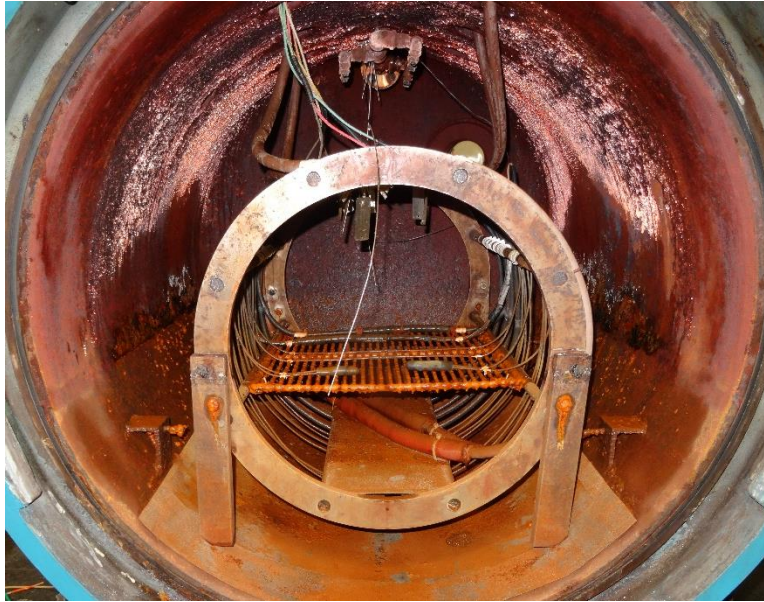


Figure 4: Samples on mandrel post acidic environmental exposure

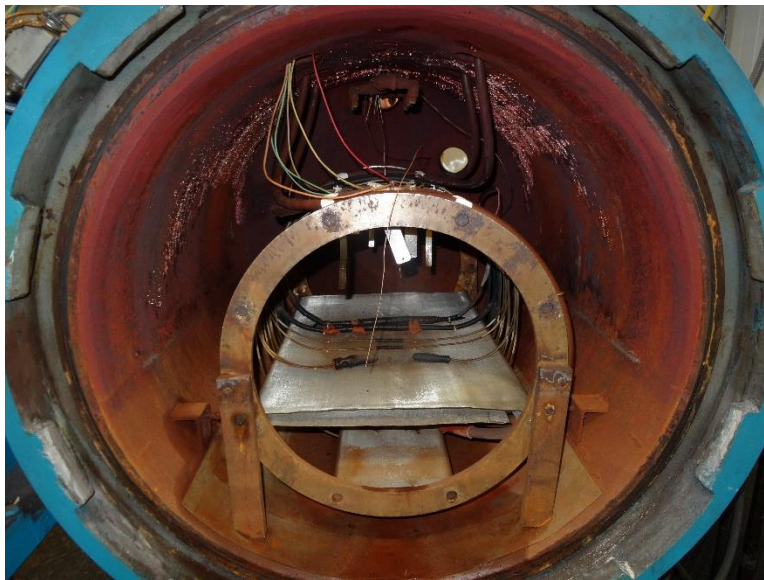


Figure 5: Samples on mandrel post basic environmental exposure

An evaluation of each sample was performed that includes:

- A. A visual examination of each sample was performed to determine physical condition relative to mechanical damage.
- B. With the samples remaining on the mandrel, the mandrel was submerged in water and allowed to soak for 24 hours at room temperature ( $25 \pm 5^{\circ}\text{C}$ ). The insulation resistance of each sample was measured in accordance with ICEA T-27-581 Paragraph 2.3. While immersed the conductor was energized with negative 500 VDC for one minute with the



shield (as applicable) and water at ground potential for one minute. This test was performed for engineering information only.

- C. A demonstration of the margin of flexibility was conducted in accordance with IEEE-383-1974 Paragraph 2.4.4 and IEEE 383-2003 Section 6.4.2. Samples were straightened and recoiled around a mandrel with a diameter slightly less than 20 times the sample diameter. Samples were wrapped at least one complete revolution around the mandrel. Samples were then removed from the mandrel without straightening and remained in coils approximately equal to the mandrel's diameter. Visual examination of each sample was performed to determine the physical condition of each sample after the mandrel bend test.



Figure 6: Sample 5 straighten and 20 times bend (acidic exposure)



Figure 7: Sample 7 straighten and 20 times bend (acidic exposure)





Figure 8: Sample 13 straighten and 20 times bend (acidic exposure)

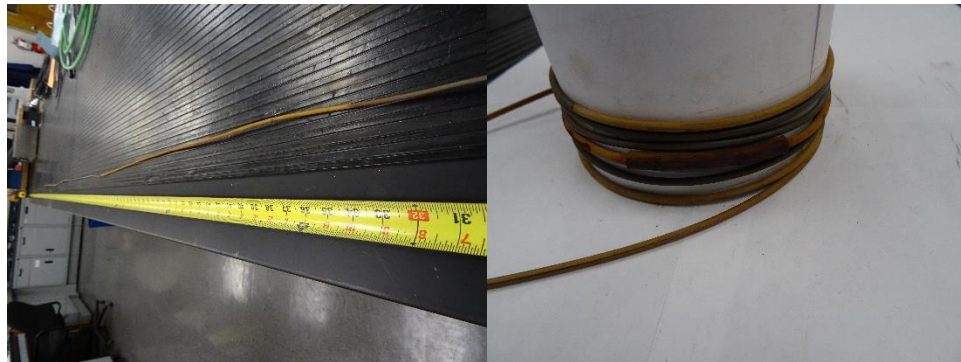


Figure 9: Sample 15 straighten and 20 times bend (acidic exposure)



Figure 10: Sample 21 straighten and 20 times bend (acidic exposure)



Figure 11: Sample 23 straighten and 20 times bend (acidic exposure)





Figure 12: Sample 26 straighten and 20 times bend (acidic exposure)



Figure 13: Sample 31 straighten and 20 times bend (acidic exposure)



Figure 14: Sample 1 straighten and 20 times bend (basic exposure)



Figure 15: Sample 3 straighten and 20 times bend (basic exposure)





Figure 16: Sample 9 straighten and 20 times bend (basic exposure)



Figure 17: Sample 11 straighten and 20 times bend (basic exposure)



Figure 18: Sample 17 straighten and 20 times bend (basic exposure)



Figure 19: Sample 19 straighten and 20 times bend (basic exposure)





Figure 20: Sample 25 straighten and 20 times bend (basic exposure)



Figure 21: Sample 28 straighten and 20 times bend (basic exposure)

- D. An AC voltage withstand test was conducted in accordance with ICEA T-27-581 Paragraph 2.2. Samples were placed in room temperature tap water and allowed to soak for 1 hour. Each single conductor sample was electrically tested submerged. Each cable was subjected to 80 volts/mil of insulation AC average stress for five minutes, conductor to shield and water at ground.
- E. The insulation resistance of each sample was measured in accordance with ICEA T-27-581 Paragraph 2.3. While immersed the conductor was energized with negative 500 VDC for one minute with the shield (as applicable) and water at ground potential for one minute. This test was performed for engineering information only.



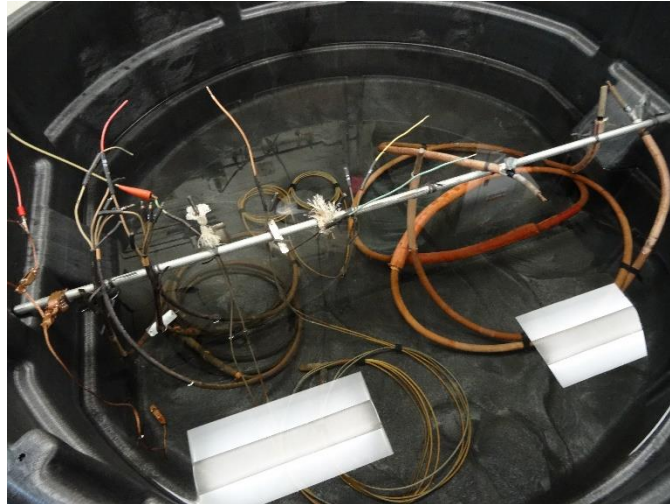


Figure 22: Acidic exposure samples submerged



Figure 23: Basic exposure samples submerged

Post environmental test results for the acidic and basic exposures can be found in Appendix V and Appendix VI respectively.

#### 8.0 ANTICIPATED VARIANCES (ANOMALIES)

The test parameters included in this test report that detailed the environmental exposure profile were test goals. The ramp rate and prior to temperature and pressure stabilizing following a ramp were on a “best effort” basis. Absolute control of the environmental exposure profile was not practical, therefore, test personnel attempted to maintain the test temperature slightly above the specified profile.

Samples were electrically energized at their rated voltage with the exception of the short time periods when periodic insulation resistance measurements are performed during the environmental exposure test.



Insulation resistance measurements which were taken during the environmental profile included a parallel resistance resulting from sample connections to extension cable that exits the test chamber. A portion of the extension cable was exposed to the chamber environment and a portion was not. Reported values are understood to be “greater than” since the parallel resistance must result in a lower value than actual presented by the sample alone.

Leakage current was monitored and reported. However, since the units which measure leakage current were not and cannot be calibrated, then the values reported were understood to be relative and information only.

#### 9.0 UNANTICIPATED VARIANCES (ANOMALIES)

##### Anomaly 2016-17:

On June 17<sup>th</sup>, following completion of the 24 hour spray period and when making the transition from the 24 hour spray period to the 29 day submergence period, the amount of boric acid solution on hand was inadequate to fully submerge the splice samples.

The test was suspended. Voltage was secured to the samples. Steam was secured to the environmental test chamber and it was allowed to cool down. On June 20<sup>th</sup>, sufficient boric acid solution was obtained and the samples were submerged fully within the chamber. Voltage was reapplied to the samples. The chamber was heated and returned to the required profile temperature of 265°F at 3:27 pm.

The period of time the test was secured represents additional conservatism and will not be integrated into the 29 day submergence period.

##### Anomaly 2016-18:

On June 20<sup>th</sup> at 4:28 pm, the voltage set which was connected to samples 5 and 7 tripped off. An attempt was made to reset the voltage set and re-energize the samples at which time the set immediately tripped off. No further attempts were made to re-energize samples 5 and 7 in order to prevent any further electrical damage.

The test continued as planned with samples 5 and 7 un-energized and an evaluation was performed upon completion of the environmental exposure.

##### Anomaly 2016-19:

On June 30<sup>th</sup> at 9:25 am, data logging of temperature, pressure, and the low voltage applied to the 14 AWG samples and leakage current stopped due to an unknown reason. The data logging failure was discovered and was restored on July 5<sup>th</sup> at 2:58 pm.



The test profile was reprogrammed and test parameters restored to the point in time when data logging stopped. The period of time that data logging was suspended was not integrated into the 29 day submergence period and represents additional conservatism.

#### Anomaly 2016-20:

On July 8<sup>th</sup> at 12:55 pm, the voltage set which was connected to samples 26 and 31 tripped off. An attempt was made to reset the voltage set and re-energize the samples at which time the set immediately tripped off. No further attempts were made to re-energize samples 26 and 31 in order to prevent any further electrical damage.

The test continued as planned with samples 26 and 31 un-energized and an evaluation was performed upon completion of the environmental exposure.

#### Anomaly 2016-21:

On July 20<sup>th</sup> at 7:30 pm, the temperature within the chamber dropped below the programmed temperature of 184°F and reached a low of 118°F by 8:58 am on July 21<sup>st</sup>. The drop in temperature was due to a malfunction of the small steam generator. The small steam generator was repaired and the temperature within the chamber returned to the programmed value of 184°F by 10:30 am on July 21<sup>st</sup>.

The environmental exposure profile was extended 900 minutes at the temperature segment in order to account for the time period the temperature within the chamber was below the intended profile of 184°F.

#### Anomaly 2016-22:

On July 27<sup>th</sup> while performing insulation resistance measurements on the tests samples on the mandrel immersed in tap water, the temperature of the water was measured and recorded at 18.7°C. The temperature of the water for insulation resistance measurements on the tests samples is required to be at 25 ±5°C per TE Connectivity's test plan.

Typically, IR measurement are corrected and reported to a specified temperature of 15.6°C using a correction factor, based on the temperature during the IR measurement and the coefficient value of the insulating material(s). Although the 18.7°C temperature of the water was below the required minimum temperature of 20°C, there is no detrimental effect on the IR measurement of the samples or the measured value because the temperature of the IR measurements was very close to the reported corrected temperature of 15.6°C, thereby reducing the correction factor value closer to 1 which results in a more accurate measurement.

#### Anomaly 2016-23:



On August 11<sup>th</sup> at 11:41 am, the voltage set connected to samples 25 and 28 tripped off. An attempt was made to reset the voltage set and re-energize the samples at which time the set immediately tripped off. No further attempts were made to re-energize samples 25 and 28 in order to prevent any further electrical damage.

The test continued as planned with samples 25 and 28 un-energized and an evaluation was performed upon completion of the environmental exposure.

#### Anomaly 2016-24:

On July 27<sup>th</sup>, during the submerged insulation resistance measurements, sample 7 and the red and black single conductors of sample 26 measured zero resistance indicating a shorted condition.

On July 28<sup>th</sup>, during the AC voltage withstand test and following insulation resistance measurement, the red and black single conductors of sample 26 did not hold voltage and measured zero resistance respectively indicating a shorted condition.

Following the initial insulation resistance measurement and removal of the samples from the mandrel, it was discovered that the lead wire which was connected to sample 7 was shorted to the mandrel. The lead wire was affixed to the mandrel with tape directly over an open hole. The lead wire insulation deformed and shorted to the mandrel due to irregular stress points. The portion of the lead wire was removed and the sample performed satisfactorily during the remainder of the post environmental tests. The faulty lead wire is also attributed to be the cause of anomaly 2016-18.

(Further amplification) The following photographs show the deformation to the lead wire which caused sample 7 to fault.



Figure 24: Sample 7 deformation





Figure 25: Sample 7 taped to mandrel over open hole

An evaluation was performed in order to disposition the cause of the anomalies associated with sample 26 (which included anomaly 2016-20). The evaluation yielded no conclusive evidence. Further evaluation may be performed by TE connectivity following return of the sample to their facility.

#### Anomaly 2016-25:

On August 14<sup>th</sup> at 5:00 am, the plant experienced a momentary loss of power which caused the voltage sets that supply voltage to the samples to de-energize and the steam valves to close which resulted in a loss of steam to the chamber jacket causing the temperature and pressure within the chamber to drop below the required profile. This condition was found during daily logging on August 15<sup>th</sup> at 7:30 am with the chamber at an average temperature of 107°F. Voltage was re-applied to the samples at 8:28 am. Steam was supplied to the chamber jacket at 8:42 am. The test profile was reprogrammed into system. Temperature within the chamber returned to the required temperature of 260°F at 10:00 am on August 15<sup>th</sup> and the system was placed into auto mode.

The test profile was reprogrammed and test parameters restored to the point in time during the test when the loss of plant power occurred. The period of time the samples were without the required applied voltage and the temperature and pressure within the chamber were below the required profile was not integrated into the 29 day submergence period and represents additional conservatism.

#### Anomaly 2016-26:

On August 26<sup>th</sup> at 3:00 pm, the LOCA test lab was shut down due to a planned power outage. On August 29<sup>th</sup> at 7:30 am the LOCA test lab was restarted and temperature with the chamber was at an average temperature of 107°F. Voltage was re-applied to the samples at 8:40 am. Steam was supplied to the chamber jacket at 8:52 am. The test profile was reprogrammed into system. Temperature within the chamber returned to the required temperature of 226°F at 1:00 pm on August 29<sup>th</sup> and system was placed into auto mode.



The test profile was reprogrammed and test parameters restored to the point in time during the test when the loss of plant power occurred. The period of time the samples were without the required applied voltage and the temperature and pressure within the chamber were below the required profile was not integrated into the 29 day submergence period and represents additional conservatism.

#### Anomaly 2016-27:

On September 3<sup>rd</sup> at 10:34 pm, the plant experienced a momentary loss of power which caused the voltage sets that supply voltage to the samples to de-energize, the computer system to shut down which resulted in loss of data logging, and the steam valves to close which resulted in loss of steam to the chamber jacket causing the temperature within the chamber to drop below the required profile. This condition was found during daily logging on Sept 6<sup>th</sup> at 8:05 am with the chamber at an average temperature of 200°F. Voltage was re-applied to the samples at 8:13 am. Steam was supplied to the chamber jacket at 8:14 am. The test profile was reprogrammed into system. Temperature within the chamber returned to the required temperature of 205°F at 11:30 am on Sept 6<sup>th</sup> and system was placed into auto mode.

The test profile was reprogrammed and test parameters restored to the point in time during the test when the loss of plant power occurred. The period of time the samples were without the required applied voltage and the temperature and pressure within the chamber were below the required profile was not integrated into the 29 day submergence period and represents additional conservatism.

#### Anomaly 2016-28:

On Sept 11<sup>th</sup> at 1:50 am, the temperature within the chamber dropped below the programmed temperature of 191°F and reached a low of 86°F by 10:40 am on Sept 12<sup>th</sup>. The drop in temperature was due to a malfunction of the small steam generator. The small steam generator was repaired and the temperature within the chamber returned to the programmed value of 191°F by 4:00 pm on Sept 12<sup>th</sup>.

The test profile was reprogrammed and test parameters restored to the point in time during the test when the steam generator malfunction occurred. The environmental exposure profile was extended 320 minutes at the temperature segment to account for the time period the temperature within the chamber was below the intended profile of 191°F.

#### Anomaly 2016-30:

On September 28<sup>th</sup>, during the submerged insulation resistance measurements, the black single conductor of sample 25 measured zero resistance indicating a shorted condition.



On October 6<sup>th</sup>, during the AC voltage withstand test and following insulation resistance measurement, the red, white, and black single conductors of sample 25 did not hold voltage and measured zero resistance respectively indicating a shorted condition.

An evaluation was performed in order to disposition the cause of the anomalies associated with sample 25 (which included anomaly 2016-23). The evaluation yielded no conclusive evidence. Further evaluation may be performed by TE Connectivity following the return of the sample to their facility.

#### Anomaly 2016-31:

During the final compilation of the environment profile and while generating the qualification report, it was discovered that approximately 19 hours of data between June 30<sup>th</sup> and July 5<sup>th</sup> was not accounted for. The necessary data falls within the period following July 1<sup>st</sup> at 1:24 PM for a duration of 19 hours 39 minutes and 31 seconds. This time period was included within anomaly report 2016-19. This anomaly report amends anomaly report 2016-19.

There is sufficient evidence that the chamber and system was operating within the prescribed parameters during the approximate 19 hour time frame following July 1st at 1:24 PM when the operator had restarted the system and re-energized all of the samples. Following the holiday weekend, the operator performed his daily inspection and logged voltage and leakage current on July 5<sup>th</sup> at 3:03 pm. It is reasonable to conclude that the system was operating within the prescribed parameters between the two above noted time periods with the only exception that the data was not being logged by the system. Furthermore, the trend, or specifically the notable increase, in the level of leakage current for samples 26 and 31 supports this assertion.

Anomaly reports can be found in Appendix VII.

#### 10.0 PASS/FAIL CRITERIA

Qualification is considered fulfilled upon the successful completion of the environmental exposure test by successful withstand of the continuous (with previously noted exceptions) applications of rated voltage for the duration of the environmental exposure and completion of an AC voltage withstand test (five minutes of 80 volts/mil AC average stress) from conductor to shield (as applicable) and water following a 20 times mandrel bend and one hour submergence in water.

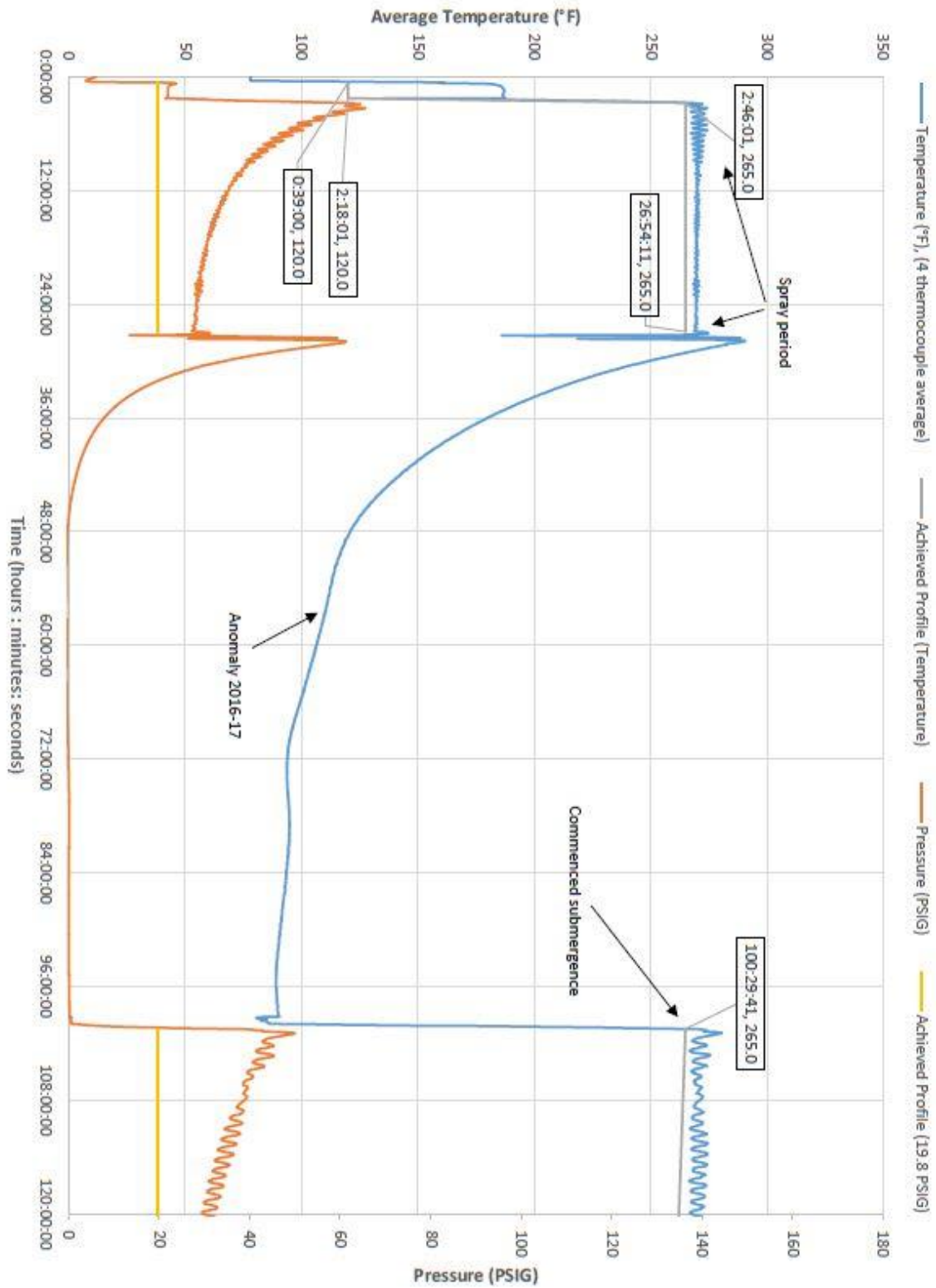


## 11.0 REFERENCED DOCUMENTS

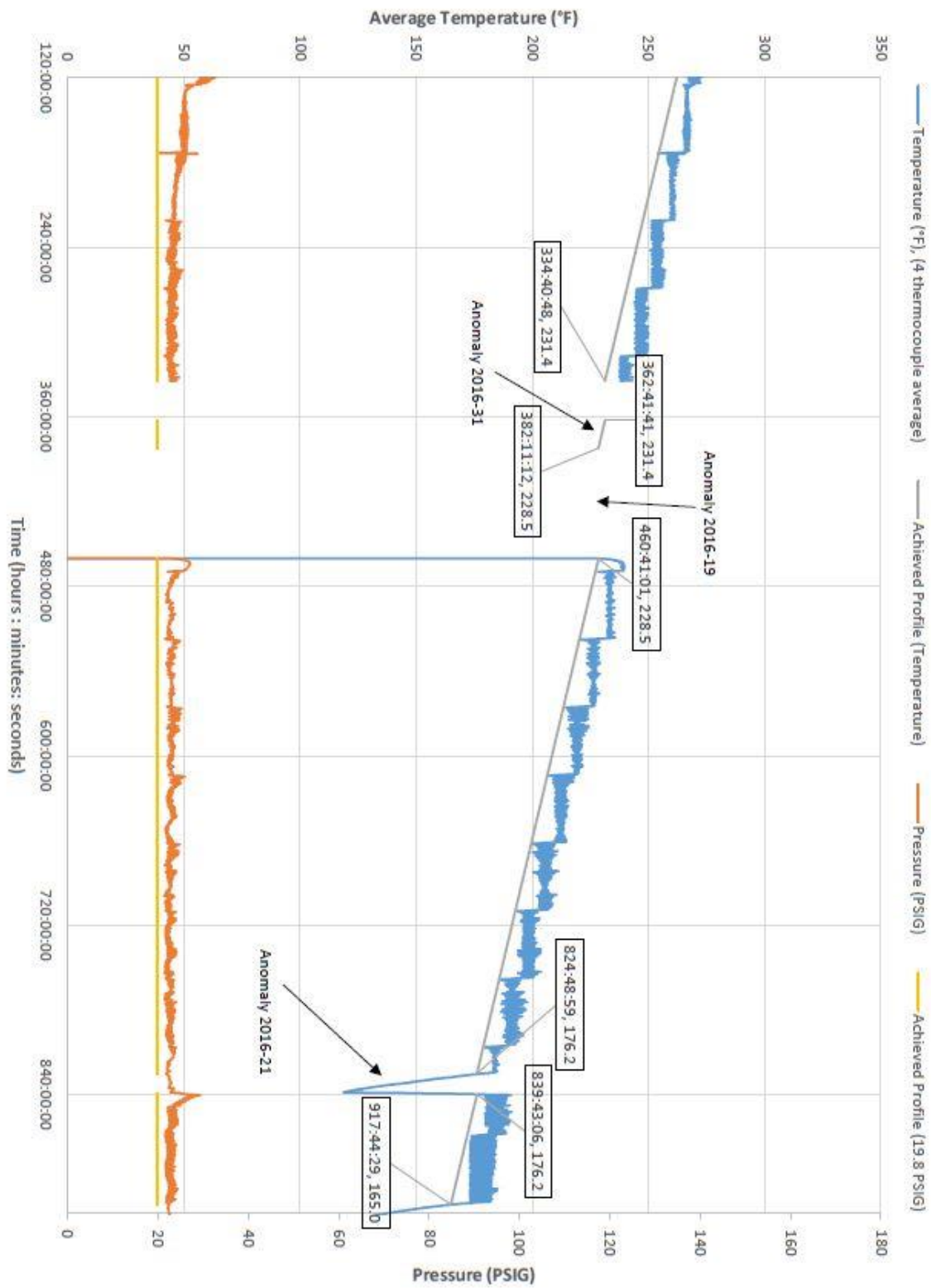
1. IEEE 101-1987 (R2004) – *IEEE Guide for the Statistical Analysis of Thermal Life Test Data*
2. IEEE 323-1974 & 1983 – *Standard for qualifying Class 1E Equipment for Nuclear Power Generating Stations*
3. IEEE 383-1974 – *Standard for Type Test of Class 1E Electric Cables Field Splices, and Connections for Nuclear Power Generating Stations*
4. IEEE 323-2003 – *Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations*
5. IEEE 383-2003 – *Standard for Qualifying Class 1E Electric Cable and Field Splices for Nuclear Power Generating Stations*
6. ICEA T-27-581 (NEMA WC 53) – *Standard Test Methods for Extruder Dielectric Power Control Instrumentation and Portable Cables for test - 2008*
7. ISO/IEC 17025:2005 - *General Requirements for the Competence of Testing and Calibration Laboratories*
8. RSCC Calibration Procedure Manual, Procedure #072DI103 (Latest Revision)
9. RSCC Qualification Test Procedure Manual for Class 1E Qualification Tests, Procedure #041DI109 (Latest Revision)
10. Nuclear Regulatory Guide 1.131 dated August, 1977
11. Nuclear Regulatory Commission Guide 0588
12. Nuclear Regulatory Commission 10 CFR Part 50
13. Nuclear Regulatory Commission 10 CFR Part 21
14. Nuclear Regulatory Guide 1.211 dated April, 2009
15. TE Connectivity Energy Division - *Nuclear Cable Accessories AP-1000 Qualification Test Plan Test Method and Sample Description*, March 10, 2015
16. Kinectrics Inc. – *Test Report for Radiation and Thermal Aging of Nuclear Cable Accessories*, May 31, 2016
17. RSCC Qualification Test Plan TP-1602 - *In Support of the Chemical Compatibility Test of TE Connectivity Nuclear Cable Accessories and RSCC Nuclear Qualified Low and Medium Voltage Cables in Support of AP1000 Qualification*, June 15, 2016



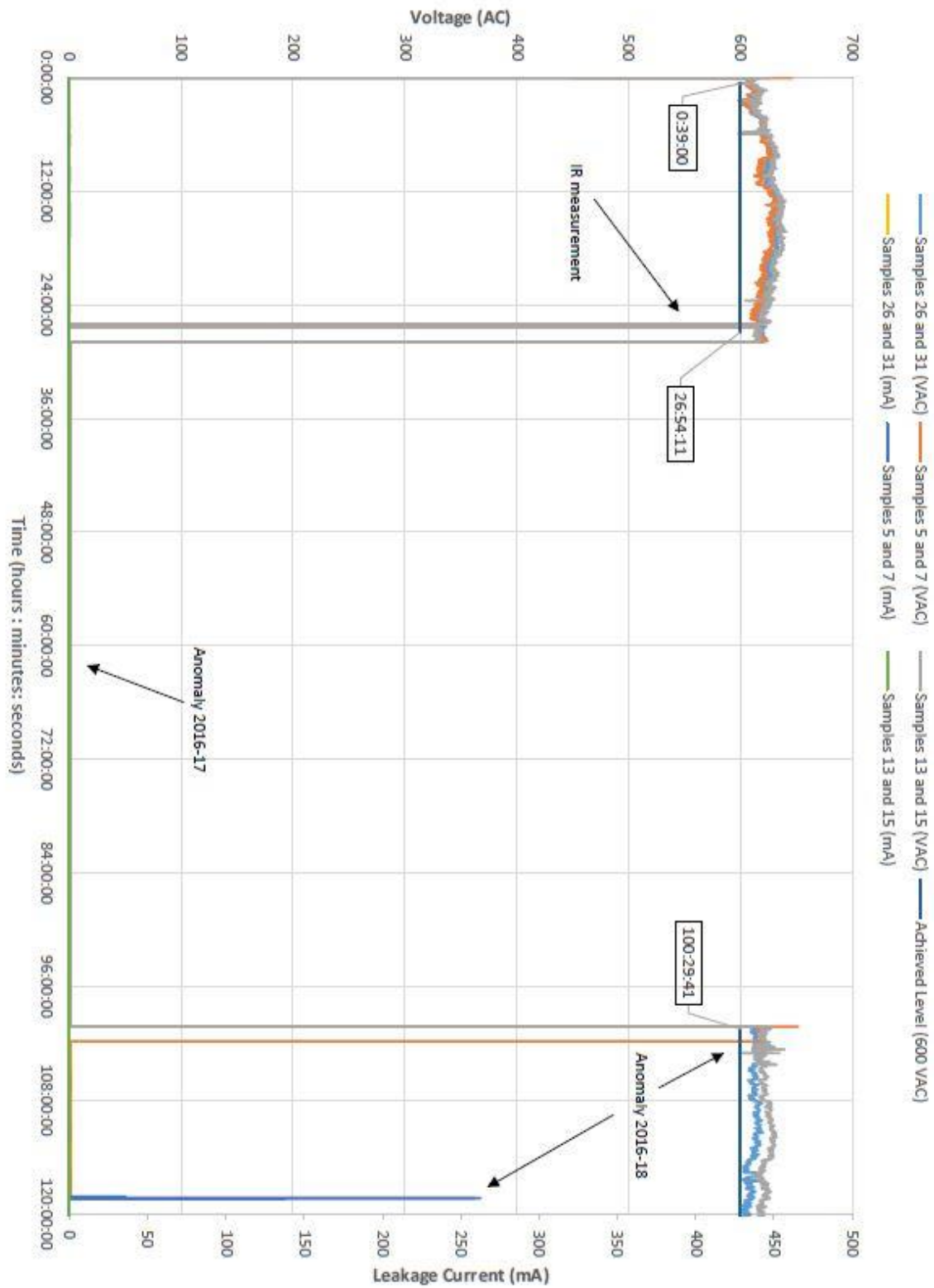
# APPENDIX I: ACIDIC EXPOSURE ENVIRONMENTAL TEST DATA



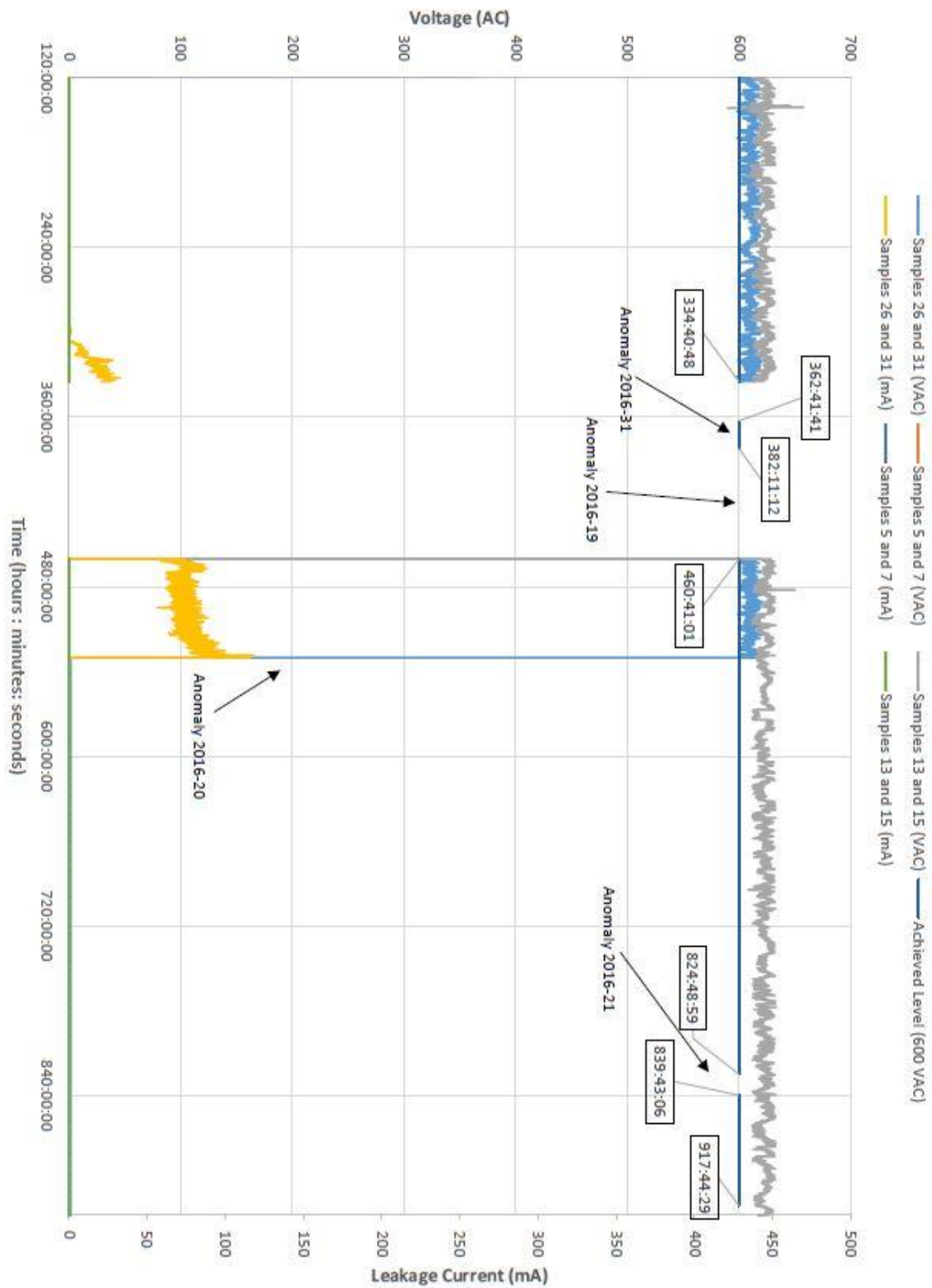














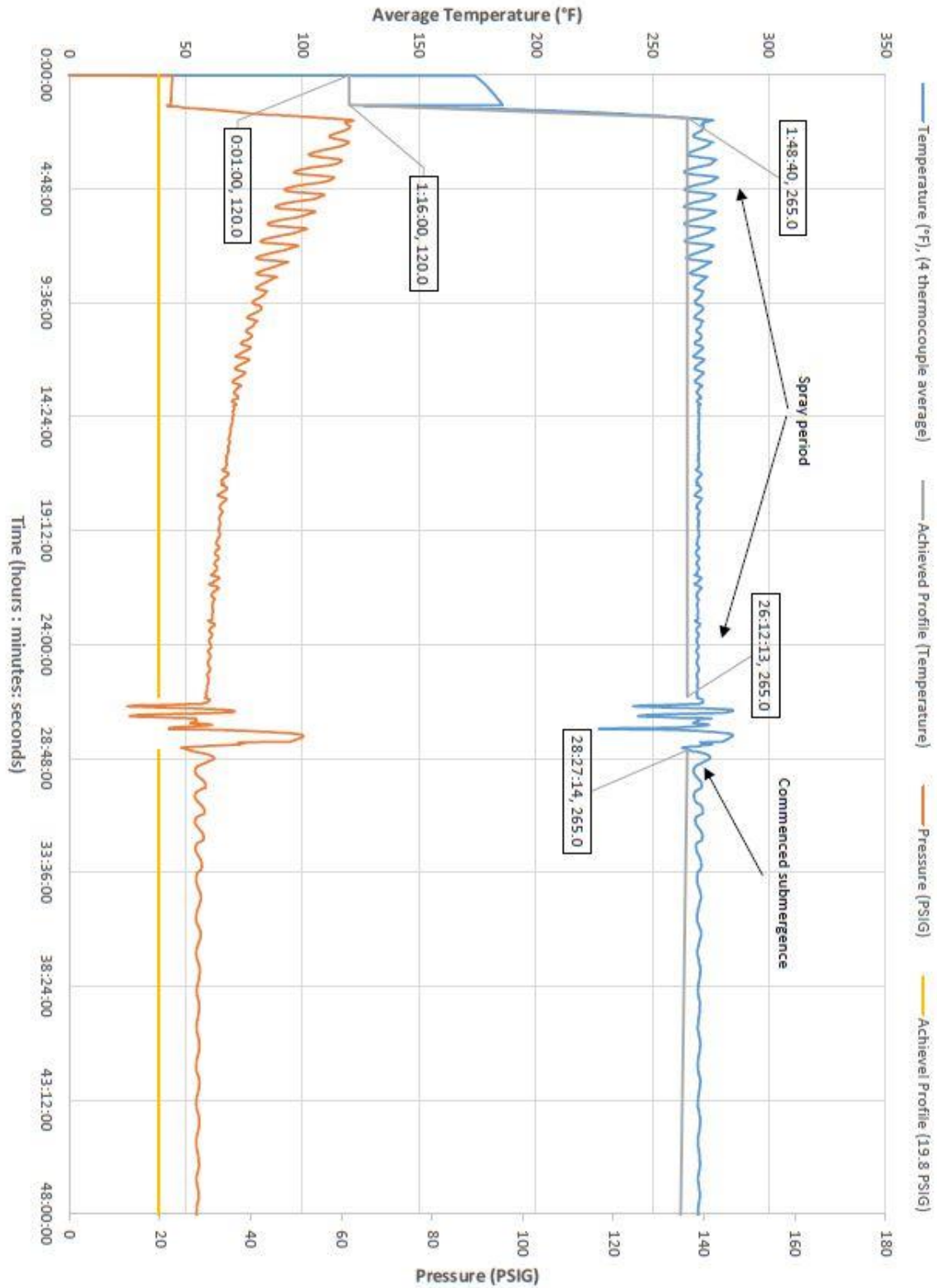
Voltage and Leakage Current Measurements During Acidic Environmental Exposure for Samples 21 and 23			
Time and Date	Voltage (Volts AC)	Leakage Current (mA)	Chamber Temperature
6/16/2016 at 1:10 PM	3,000	0	Pre-exposure - Ambient Temperature
6/17/2016 at 7:48 AM	3,000	0	270°F
↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ WITH SPRAY ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑			
↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ SUBMERGED ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓			
6/23/2016 at 10:15 AM	3,000	0	267°F
6/24/2016 at 8:30 AM	3,000	0	260.5°F
6/27/2016 at 7:45 AM	3,100	0	253.4°F
6/28/2016 at 8:20 AM	3,100	0	247.3°F
6/29/2016 at 10:15 AM	3,100	0	248°F
6/30/2016 at 9:11 AM	3,100	0	241.3°F
7/1/2016 at 1:24 PM	3,000	0	(Anomaly 2016-19) No data available
7/5/2016 at 3:03 PM	3,000	0	228.6°F
7/6/2016 at 8:27 AM	3,000	0	232.5°F
7/7/2016 at 8:29 AM	3,000	0	233.5°F
7/8/2016 at 7:27 AM	3,000	0	228°F
7/11/2016 at 9:15 AM	3,000	0	219.6°F
7/12/2016 at 7:55 AM	3,000	0	211.1°F
7/13/2016 at 8:41 AM	3,000	0	211.9°F
7/15/2016 at 8:57 AM	3,000	0	204.8°F
7/18/2016 at 9:31 AM	3,000	0	190°F
7/19/2016 at 8:50 AM	3,000	0	192°F
7/20/2016 at 8:13 AM	3,000	0	184°F
7/21/2016 at 7:08 AM	3,000	0	124.4°F
7/22/2016 at 8:53 AM	3,000	0	187.5°F
7/25/2016 at 10:39 AM	3,000	0	104°F

By: R. A. Gehm

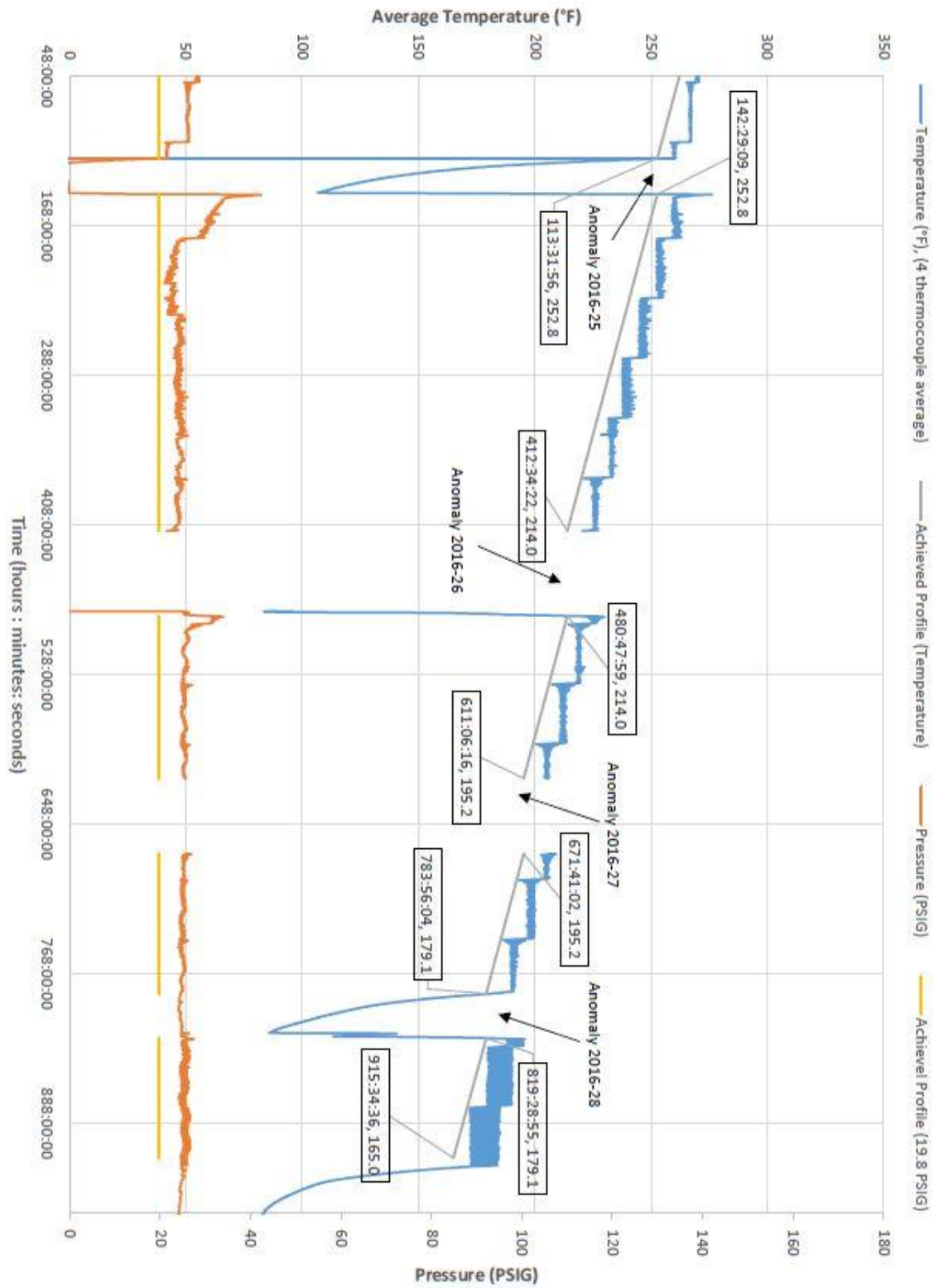
Hipotronics AC Test Set  
Serial Number: 76-25885  
Model: 705-5  
Calibration Date: 3/18/16  
Calibration Due: 3/31/17  
By: JO



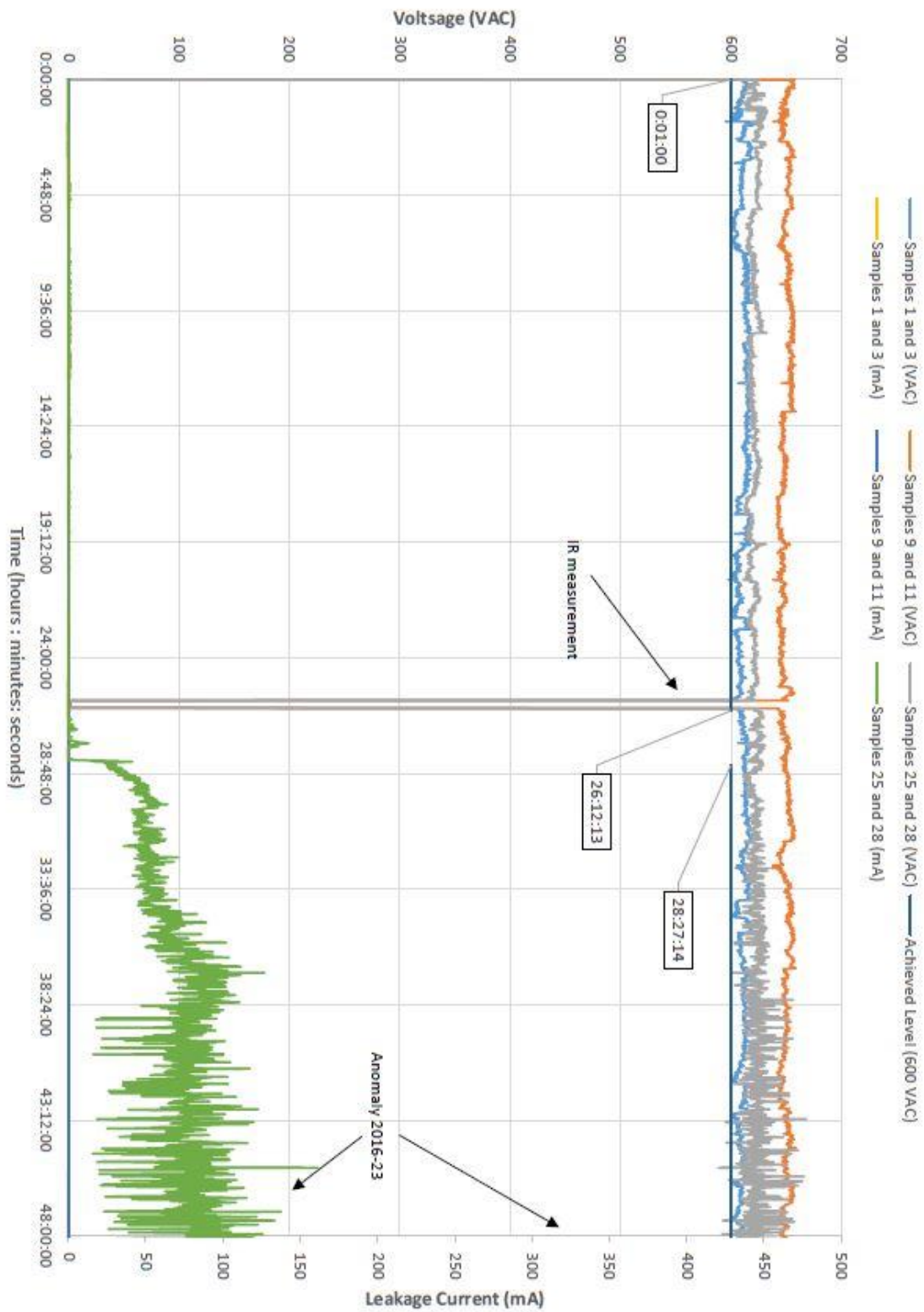
## APPENDIX II: BASIC EXPOSURE ENVIRONMENTAL TEST DATA

















Voltage and Current Measurements During Basic Environmental Exposure for Samples 17 and 19			
Time and Date	Voltage (Volts AC)	Leakage Current (mA)	Chamber Temperature
8/9/2016 at 10:10 AM	3,000	0	Pre-exposure - Ambient Temperature
8/10/2016 at 1:36 PM	3,000	0	269.3°F
↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ WITH SPRAY ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑			
↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ SUBMERGED ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓			
8/11/2016 at 8:01 AM	3,100	0	270°F
8/12/2016 at 8:42 AM	3,100	0	267.2°F
8/16/2016 at 7:44 AM	3,100	0	263.2°F
8/17/2016 at 8:15 AM	3,100	0	254°F
8/18/2016 at 7:37 AM	3,100	0	253.7°F
8/19/2016 at 8:33 AM	3,100	0	247.5°F
8/22/2016 at 7:45 AM	3,100	0	241.3°F
8/23/2016 at 7:49 AM	3,100	0	234°F
8/24/2016 at 7:29 AM	3,100	0	232.9°F
8/25/2016 at 7:31 AM	3,100	0	226°F
8/26/2016 at 8:33 AM	3,100	0	226°F
8/29/2016 at 8:40 AM	3,100	0	95.1°F
8/29/2016 at 1:05 PM	3,100	0	229.9°F
8/30/2016 at 9:05 AM	3,100	0	219.4°F
8/31/2016 at 8:27 AM	3,100	0	218.2°F
9/1/2016 at 10:13 AM	3,100	0	212.4°F
9/2/2016 at 10:03 AM	3,100	0	212.3°F
9/6/2016 at 8:12 AM	3,100	0	(Anomaly 2016-27) No data available
9/6/2016 at 11:32 AM	3,100	0	207.3°F
9/7/2016 at 2:55 PM	3,100	0	198.2°F
9/8/2016 at 9:35 AM	3,100	0	199.4°F
9/9/2016 at 9:21 AM	3,100	0	189.2°F
9/13/2016 at 8:41 AM	3,100	0	180.1°F
9/14/2016 at 8:54 AM	3,100	0	185.1°F
9/15/2016 at 8:11 AM	3,100	0	173.2°F
9/16/2016 at 8:30 AM	3,100	0	182.2°F
9/19/2016 at 10:28 AM	3,100	0	79.5°F

By: R. A. Gehm

Hipotronics AC Test Set  
 Serial Number: 76-25885  
 Model: 705-5  
 Calibration Date: 3/18/16  
 Calibration Due: 3/31/17  
 By: JO



### APPENDIX III: ACIDIC EXPOSURE INSULATION RESISTANCE MEASUREMENTS

Insulation Resistance (IR) Measurements During Acidic Environmental Exposure			
Time and Date	Sample	IR (Ω)	Chamber Temperature
6/16/2016 at 9:05 AM	TP-1602-005	> 10      Teraohms	Pre-exposure - Ambient Temperature
	TP-1602-007		
	TP-1602-013	> 10      Teraohms	
	TP-1602-015		
	TP-1602-024	> 10      Teraohms	
	TP-1602-031		
	TP-1602-021	> 10      Teraohms	
	TP-1602-023	> 10      Teraohms	
6/17/2016 at 12:41 PM	TP-1602-005	240.882      Megohms	270°F
	TP-1602-007		
	TP-1602-013	239.510      Megohms	
	TP-1602-015		
	TP-1602-024	3.186      Megohms	
	TP-1602-031		
	TP-1602-021	209.449      Megohms	
	TP-1602-023	230.637      Megohms	
↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ WITH SPRAY ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑			
↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ SUBMERGED ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓			
7/26/2016 at 9:05 AM	TP-1602-005	Overload	Post-exposure - Ambient Temperature
	TP-1602-007		
	TP-1602-013	> 10      Teraohms	
	TP-1602-015		
	TP-1602-024	Overload	
	TP-1602-031		
	TP-1602-021	> 10      Teraohms	
	TP-1602-023	> 10      Teraohms	

By: R. A. Gehm

All measurements were taken on each sample while in the LOCA chamber

500 VDC negative for 1 minute

Included sample, splices, and extension leads

Quad Tech IR Bridge

Serial Number: 9150249

Model: 1865

Calibration Date: 3/18/16

Calibration Due: 3/31/17

By: JO

3/28/2017

- 35 of 151 -

QR-1603 R0



## APPENDIX IV: BASIC EXPOSURE INSULATION RESISTANCE MEASUREMENTS

Insulation Resistance (IR) Measurements During Basic Environmental Exposure			
Time and Date	Sample	IR ( $\Omega$ )	LOCA Temperature
8/9/2016 at 9:10 AM	TP-1602-001	183.932      Gigohms	Pre-exposure - Ambient Temperature
	TP-1602-003		
	TP-1602-009	454.316      Gigohms	
	TP-1602-011		
	TP-1602-025	257.325      Gigohms	
	TP-1602-028		
	TP-1602-017	> 10      Teraohms	
	TP-1602-019	> 10      Teraohms	
8/10/2016 at 1:20 PM	TP-1602-001	257.055      Megohms	270°F
	TP-1602-003		
	TP-1602-009	226.489      Megohms	
	TP-1602-011		
	TP-1602-025	Overload	
	TP-1602-028		
	TP-1602-017	222.861      Megohms	
	TP-1602-019	193.569      Megohms	
↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ WITH SPRAY ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑			
↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ SUBMERGED ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓			
9/19/2016 at 10:35 AM	TP-1602-001	49.484      Gigohms	Post-exposure - Ambient Temperature
	TP-1602-003		
	TP-1602-009	24.128      Gigohms	
	TP-1602-011		
	TP-1602-025	Overload	
	TP-1602-028		
	TP-1602-017	156.707      Gigohms	
	TP-1602-019	65.117      Gigohms	

By: R. A. Gehm

All measurements were taken on each sample while in the LOCA chamber

500 VDC negative for 1 minute

Included sample, splices, and extension leads

Quad Tech IR Bridge

Serial Number: 9150249

Model: 1865

Calibration Date: 3/18/16

Calibration Due: 3/31/17

By: JO



## APPENDIX V: ACIDIC EXPOSURE POST ENVIRONMENTAL TEST RESULTS

Visual Inspection Post Acidic Environmental Exposure			
Sample Number	Sample Description	Sample Length, feet	Visual
5	1/C 14 AWG V-Splice - Aged	18	No apparent mechanical damage visible. Sample appears to be visibly unchanged.
7	1/C 14 AWG V-Splice - Unaged	18	No apparent mechanical damage visible. V-Splice appears to be expanded at the entrance of the wires.
13	1/C 14 AWG In-Line Splice - Aged	16	No apparent mechanical damage visible.
15	1/C 14 AWG In-Line Splice - Unaged	16	No apparent mechanical damage visible.
26	3/C 14 AWG Jacket Repair - Aged	16	No apparent mechanical damage visible. Tape repair is split from both ends. The split is approximately 3 inches long exposing the cable and singles underneath.
31	3/C 14 AWG Jacket Repair - Unaged	16	No apparent mechanical damage visible. Tape repair appears to be visibly unchanged.
21	1/C 6 AWG BBIT Splice - Aged	11	No apparent mechanical damage visible.
23	1/C 6 AWG BBIT Splice - Unaged	11	No apparent mechanical damage visible.

By: *R. A. Gehm*

Date: 7/28/2016



Insulation Resistance (IR) Measurement Post Acidic Environmental Exposure on Mandrel				
Sample Number	Sample Description	Conductor	Sample Length, feet	Measured IR, TΩ at 18.7°C
5	1/C 14 AWG V-Splice - Aged	1	18	0.313749
7	1/C 14 AWG V-Splice - Unaged	1	18	Overload
13	1/C 14 AWG In-Line Splice - Aged	1	16	0.217242
15	1/C 14 AWG In-Line Splice - Unaged	1	16	2.576
26	3/C 14 AWG Jacket Repair - Aged	Red	16	Overload
		White	16	0.188262
		Black	16	Overload
31	3/C 14 AWG Jacket Repair - Unaged	Red	16	3.678
		White	16	4.097
		Black	16	3.286
21	1/C 6 AWG BBIT Splice - Aged	1	11	0.779165
23	1/C 6 AWG BBIT Splice - Unaged	1	11	1.217

500 VDC negative for 1 minute

By: R. A. Gehm

Tested conductor to water, shield (if applicable), and ground submerged following 1 hour soak

Date: 7/27/2016

IR Meter

Digital Thermometer Type K

Quadtech

Omega

S/N: 08220657

Model: HH501DK

M/N: 1865

S/N : 05000007

Calibration Date: 5/16/16

Calibration Date: 10/14/15

Calibration Due: 5/31/17

Calibration Due: 10/31/16

By: JO

By: JO



20x Bend Test					
Sample Number	Sample Description	Sample Length, feet	Required Mandrel Diameter, inches	Actual Mandrel Diameter, inches	Number of Wraps on the Mandrel
5	1/C 14 AWG V-Splice – Aged	18	12.4	12	3
7	1/C 14 AWG V-Splice – Unaged	18	14	12	3
13	1/C 14 AWG In-Line Splice – Aged	16	5.4	5	7
15	1/C 14 AWG In-Line Splice – Unaged	16	5.7	5	6
26	3/C 14 AWG Jacket Repair – Aged	16	12.4	11	2
31	3/C 14 AWG Jacket Repair – Unaged	16	11.1	11	3
21	1/C 6 AWG BBIT Splice – Aged	11	25	20	1
23	1/C 6 AWG BBIT Splice – Unaged	11	24	20	1

By: R. A. Gehm

Date: 7/28/2016

Visual Inspection Post 20x Bend Test			
Sample Number	Sample Description	Sample Length, feet	Visual
5	1/C 14 AWG V-Splice - Aged	18	No apparent mechanical damage visible
7	1/C 14 AWG V-Splice - Unaged	18	No apparent mechanical damage visible
13	1/C 14 AWG In-Line Splice - Aged	16	No apparent mechanical damage visible
15	1/C 14 AWG In-Line Splice - Unaged	16	No apparent mechanical damage visible
26	3/C 14 AWG Jacket Repair - Aged	16	No apparent mechanical damage visible
31	3/C 14 AWG Jacket Repair - Unaged	16	No apparent mechanical damage visible
21	1/C 6 AWG BBIT Splice - Aged	11	No apparent mechanical damage visible
23	1/C 6 AWG BBIT Splice - Unaged	11	No apparent mechanical damage visible

By: R. A. Gehm

Date: 7/28/2016



AC Voltage Withstand Test Post 20x Bend Test						
Sample Number	Sample Description	Conductor	Sample Length, feet	Voltage/Duration	Pass/ Fail	Leakage Current, mA
5	1/C 14 AWG V-Splice - Aged	1	18	2400 VAC for 5 minutes	Pass	1.0
7	1/C 14 AWG V-Splice - Unaged	1	18	2400 VAC for 5 minutes	Pass	1.0
13	1/C 14 AWG In-Line Splice - Aged	1	16	2400 VAC for 5 minutes	Pass	1.0
15	1/C 14 AWG In-Line Splice - Unaged	1	16	2400 VAC for 5 minutes	Pass	1.0
26	3/C 14 AWG Jacket Repair - Aged	Red	16	2400 VAC for 5 minutes	No	MAX
		White	16	2400 VAC for 5 minutes	Pass	2.0
		Black	16	2400 VAC for 5 minutes	No	MAX
31	3/C 14 AWG Jacket Repair - Unaged	Red	16	2400 VAC for 5 minutes	Pass	1.0
		White	16	2400 VAC for 5 minutes	Pass	1.0
		Black	16	2400 VAC for 5 minutes	Pass	1.0
21	1/C 6 AWG BBIT Splice - Aged	1	11	9500 VAC for 5 minutes	Pass	3.0
23	1/C 6 AWG BBIT Splice - Unaged	1	11	9500 VAC for 5 minutes	Pass	2.0

Tested conductor to water, shield (if applicable), and ground submerged following 1 hour soak

By: *R. A. Gehm*

Date: 7/28/2016

AC Test Set

Hipotronics

S/N: 78-31422

M/N: 7100-5

Calibration Date: 3/2/16

Calibration Due: 3/31/17

By: JO

AC Test Set

Hipotronics

S/N: 7962-00

M/N: 710-1

Calibration Date: 6/13/16

Calibration Due: 6/30/17

By: JO

Timer

S/N: LAB 1

M/N: N/A

Calibration Date: 3/17/16

Calibration Due: 3/31/17

By: JO



Insulation Resistance (IR) Measurement Post 20x Bend Test				
Sample Number	Sample Description	Conductor	Sample Length, feet	Measured IR, TΩ at 21.5°C
5	1/C 14 AWG V-Splice - Aged	1	18	0.221070
7	1/C 14 AWG V-Splice - Unaged	1	18	0.099073
13	1/C 14 AWG In-Line Splice - Aged	1	16	0.149588
15	1/C 14 AWG In-Line Splice - Unaged	1	16	0.046812
26	3/C 14 AWG Jacket Repair - Aged	Red	16	Overload
		White	16	0.000417196
		Black	16	Overload
31	3/C 14 AWG Jacket Repair - Unaged	Red	16	3.883
		White	16	3.678
		Black	16	4.381
21	1/C 6 AWG BBIT Splice - Aged	1	11	0.600498
23	1/C 6 AWG BBIT Splice - Unaged	1	11	1.080

500 VDC negative for 1 minute

By: R. A. Gehm

Tested conductor to water, shield (if applicable), and ground submerged following 1 hour soak

Date: 7/28/2016

IR Meter

Digital Thermometer Type K

Quadtech

Omega

S/N: 08220657

Model: HH501DK

M/N: 1865

S/N : 05000007

Calibration Date: 5/16/16

Calibration Date: 10/14/15

Calibration Due: 5/31/17

Calibration Due: 10/31/16

By: JO

By: JO



## APPENDIX VI: BASIC EXPOSURE POST ENVIRONMENTAL TEST RESULTS

Visual Inspection Post Basic Environmental Exposure			
Sample Number	Sample Description	Sample Length, feet	Visual
1	1/C 14 AWG V-Splice - Aged	18	No apparent mechanical damage visible. Sample appears to be visibly unchanged.
3	1/C 14 AWG V-Splice - Unaged	18	No apparent mechanical damage visible. V- Splice appears to be expanded at the entrance of splices.
9	1/C 14 AWG In-Line Splice - Aged	16	No apparent mechanical damage visible.
11	1/C 14 AWG In-Line Splice - Unaged	16	No apparent mechanical damage visible.
25	3/C 14 AWG Jacket Repair - Aged	16	No apparent mechanical damage visible. Tape repair is split from both ends. The splits are approximately 3 inches long exposing the cable and singles underneath tape repair.
28	3/C 14 AWG Jacket Repair - Unaged	16	No apparent mechanical damage visible. Tape repair appears to be visibly unchanged with the exception of the red mastic sealant that has extruded out the ends of the repair and between the tape in one location.
17	1/C 6 AWG BBIT Splice - Aged	11	No apparent mechanical damage visible.
19	1/C 6 AWG BBIT Splice - Unaged	11	No apparent mechanical damage visible. Red mastic sealant has extruded out both ends of the splice.

By: R. A. Gehm

Date: 10/3/2016



Insulation Resistance (IR) Measurement Post 20x Bend Test on Mandrel				
Sample Number	Sample Description	Conductor	Sample Length, feet	Measured IR, TΩ at 20.4°C
1	1/C 14 AWG V-Splice - Aged	1	18	19.093
3	1/C 14 AWG V-Splice - Unaged	1	18	1.478
9	1/C 14 AWG In-Line Splice - Aged	1	16	0.151
11	1/C 14 AWG In-Line Splice - Unaged	1	16	0.825
25	3/C 14 AWG Jacket Repair - Aged	Red	16	0.000000678
		White	16	0.000003446
		Black	16	Overload
28	3/C 14 AWG Jacket Repair - Unaged	Red	16	3.276
		White	16	2.498
		Black	16	3.552
17	1/C 6 AWG BBIT Splice - Aged	1	11	0.061579
19	1/C 6 AWG BBIT Splice - Unaged	1	11	1.020

500 VDC negative for 1 minute

By: R. A. Gehm

Tested conductor to water, shield (if applicable), and ground submerged following 1 hour soak

Date: 9/28/2016

IR Meter

Digital Thermometer Type K

Quadtech

Omega

S/N: 08220657

Model: HH501DK

M/N: 1865

S/N : 05000007

Calibration Date: 5/16/16

Calibration Date: 10/14/15

Calibration Due: 5/31/17

Calibration Due: 10/31/16

By: JO

By: JO



20x Bend Test					
Sample Number	Sample Description	Sample Length, feet	Required Mandrel Diameter, inches	Actual Mandrel Diameter, inches	Number of Wraps on the Mandrel
1	1/C 14 AWG V-Splice - Aged	18	12.4	12	2.5
3	1/C 14 AWG V-Splice - Unaged	18	14	12	2.5
9	1/C 14 AWG In-Line Splice - Aged	16	5.4	5	10
11	1/C 14 AWG In-Line Splice - Unaged	16	5.6	5	10
25	3/C 14 AWG Jacket Repair - Aged	16	12.6	11	4.5
28	3/C 14 AWG Jacket Repair - Unaged	16	11.6	11	4.5
17	1/C 6 AWG BBIT Splice - Aged	11	22.6	20	1
19	1/C 6 AWG BBIT Splice - Unaged	11	22.4	20	1

By: R. A. Gehm

Date: 10/6/2016

Visual Inspection Post 20x Bend Test			
Sample Number	Sample Description	Sample Length, feet	Visual
1	1/C 14 AWG V-Splice - Aged	18	No apparent mechanical damage visible
3	1/C 14 AWG V-Splice - Unaged	18	No apparent mechanical damage visible
9	1/C 14 AWG In-Line Splice - Aged	16	No apparent mechanical damage visible
11	1/C 14 AWG In-Line Splice - Unaged	16	No apparent mechanical damage visible
25	3/C 14 AWG Jacket Repair - Aged	16	No apparent mechanical damage visible
28	3/C 14 AWG Jacket Repair - Unaged	16	No apparent mechanical damage visible
17	1/C 6 AWG BBIT Splice - Aged	11	No apparent mechanical damage visible
19	1/C 6 AWG BBIT Splice - Unaged	11	No apparent mechanical damage visible

By: R. A. Gehm

Date: 10/6/2016



AC Voltage Withstand Test Post 20x Bend Test						
Sample Number	Sample Description	Conductor	Sample Length, feet	Voltage/Duration	Pass/ Fail	Leakage Current, mA
1	1/C 14 AWG V-Splice - Aged	1	18	2400 VAC for 5 minutes	Pass	2.0
3	1/C 14 AWG V-Splice - Unaged	1	18	2400 VAC for 5 minutes	Pass	2.0
9	1/C 14 AWG In-Line Splice - Aged	1	16	2400 VAC for 5 minutes	Pass	2.0
11	1/C 14 AWG In-Line Splice - Unaged	1	16	2400 VAC for 5 minutes	Pass	2.0
25	3/C 14 AWG Jacket Repair - Aged	Red	16	2400 VAC for 5 minutes	No	MAX
		White	16	2400 VAC for 5 minutes	No	MAX
		Black	16	2400 VAC for 5 minutes	No	MAX
28	3/C 14 AWG Jacket Repair - Unaged	Red	16	2400 VAC for 5 minutes	Pass	2.0
		White	16	2400 VAC for 5 minutes	Pass	2.0
		Black	16	2400 VAC for 5 minutes	Pass	2.0
17	1/C 6 AWG BBIT Splice - Aged	1	11	9500 VAC for 5 minutes	Pass	3.0
19	1/C 6 AWG BBIT Splice - Unaged	1	11	9500 VAC for 5 minutes	Pass	3.0

Tested conductor to water, shield (if applicable), and ground submerged following 1 hour soak

By: R. A. Gehm

Date: 10/6/2016

AC Test Set

Hipotronics

S/N: 78-31422

M/N: 7100-5

Calibrated Date: 3/2/16

Calibration Due: 3/31/17

By: JO

AC Test Set

Hipotronics

S/N: 7962-00

M/N: 710-1

Calibrated Date: 6/13/16

Calibration Due: 6/30/17

By: JO

Timer

S/N: LAB 1

M/N: N/A

Calibration Date: 3/17/16

Calibration Due: 3/31/17

By: JO



Insulation Resistance (IR) Measurement Post 20x Bend Test				
Sample Number	Sample Description	Conductor	Sample Length, feet	Measured IR, TΩ at 19.3°C
1	1/C 14 AWG V-Splice - Aged	1	18	2.370
3	1/C 14 AWG V-Splice - Unaged	1	18	1.693
9	1/C 14 AWG In-Line Splice - Aged	1	16	1.612
11	1/C 14 AWG In-Line Splice - Unaged	1	16	3.847
25	3/C 14 AWG Jacket Repair - Aged	Red	16	Overload
		White	16	Overload
		Black	16	Overload
28	3/C 14 AWG Jacket Repair - Unaged	Red	16	2.313
		White	16	1.450
		Black	16	3.276
17	1/C 6 AWG BBIT Splice - Aged	1	11	0.279
19	1/C 6 AWG BBIT Splice - Unaged	1	11	1.216

500 VDC negative for 1 minute

By: R. A. Gehm

Tested conductor to water, shield (if applicable), and ground submerged following 1 hour soak

Date: 10/6/2016

IR Meter

Digital Thermometer Type K

Quadtech

Omega

S/N: 08220657

Model: HH501DK

M/N: 1865

S/N : 05000007

Calibration Date: 5/16/16

Calibration Date: 10/14/15

Calibration Due: 5/31/17

Calibration Due: 10/31/16

By: JO

By: JO



## APPENDIX VII: ANOMALY REPORTS

This page has intentionally been left blank.



# **NOTICE OF ANOMALY**

Notice No.: 2016-17

Date: June 17, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Corbin Lissabet

Category: Specimen Procedure  
✓ Test Equipment Other

Date of  
Anomaly: June 20, 2016

Part Name: Splice and Cable Samples in Chamber

Part No.: N/A

Test: Environmental Exposure Testing

I.D. No.: 5,7,13,15,21,23,26,31

Specification: TP-1602 R0

Paragraph No.: Section 4.0

## **REQUIREMENTS:**

The first chemical spray solution will be initiated upon commencement of the ramp and continue for 24 cumulative hours. Following completion of the chemical spray solution exposure, the chamber drain will be isolated and the spray system will be used to fill the chamber and submerge the splice samples. A series of chemical mixes will be added in sequence to the reservoir tank. The chamber will be filled until the splices are submerged. The 29 day period of submergence will commence once the adequate fluid level within the chamber is reached.

## **DESCRIPTION OF ANOMALY:**

On June 17th, following completion of the 24 hour spray period and when making the transition from the 24 hour spray period to the 29 day submergence period, the amount of boric acid solution on hand was inadequate to fully submerge the splice samples.

The test was suspended. Voltage was secured to the samples. Steam was secured to the environmental test chamber and it was allowed to cool down. On June 20th, sufficient boric acid solution was obtained and the samples were submerged fully within the chamber. Voltage was reapplied to the samples. The chamber was heated and returned to the required profile temperature of 265°F at 3:27 pm.

## **DISPOSITION/COMMENTS/RECOMMENDATIONS:**

The period of time the test was secured represents additional conservatism and will not be integrated into the 29 day submergence period.

REPORTABLE PER 10CFR21: ✓ NO YES (If yes see Procedure 010SP004)

Verification:

Chief  
Technology Officer: [Signature]

\*Test Witness: [Signature]

Quality Assurance: [Signature]

Dir. Materials  
Development: [Signature]

Manager Applications  
Engineering: [Signature]

Dir. of  
Engineering: [Signature]

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



# **NOTICE OF ANOMALY**

Notice No.: 2016-18

Date: July 6, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert Gehm

Category: ☒ Specimen ☐ Procedure  
☐ Test Equipment ☐ Other

Date of Anomaly: June 20, 2016

Part Name: Splice and Cable Samples in Chamber

Part No.: N/A

Test: Environmental Exposure Testing

I.D. No.: 5 and 7

Specification: TP-1602 R0

Paragraph No.: Section 4.0

## **REQUIREMENTS:**

With the exception of the insulation resistance measurements, the 6 AWG medium voltage samples will be electrically energized at 5,000 V AC (ø/ø) or equivalently 2,887 V AC (ø/G) and the 14 AWG low voltage samples will be electrically energized at 600 V AC (ø/G).

## **DESCRIPTION OF ANOMALY:**


On June 20th at 4:28 PM, the voltage set which was connected to samples 5 and 7 tripped off. An attempt was made to reset the voltage set and re-energize the samples at which time the set immediately tripped off. No further attempts were made to re-energize samples 5 and 7 in order to prevent any further electrical damage.

## **DISPOSITION/COMMENTS/RECOMMENDATIONS:**

The test will continue as planned with samples 5 and 7 unenergized and an evaluation will be performed upon completion of the environmental exposure.

REPORTABLE PER 10CFR21: ☒ NO ☐ YES (If yes see Procedure 010SP004)

Verification: \_\_\_\_\_

Chief Technology Officer: 

\*Test Witness: \_\_\_\_\_

Dir. Materials Development: 

Quality Assurance: 

Dir. of Engineering: 

Manager Applications Engineering: 

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



# NOTICE OF ANOMALY

Notice No.: 2016-19

Date: July 6, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert Gehm

Category: Specimen Procedure  
✓ Test Equipment Other

Date of  
Anomaly: June 30, 2016

Part Name: Splice and Cable Samples in Chamber

Part No.: N/A

Test: Environmental Exposure Testing

I.D. No.: 5,7,13,15,21,23,26,31

Specification: TP-1602 R0

Paragraph No.: Section 4.0

## REQUIREMENTS:

Temperature, pressure, and the low voltage applied to the 14 AWG samples and leakage current will be measured continuously using a data logger.

## DESCRIPTION OF ANOMALY:

On June 30th at 9:25 AM, data logging of temperature, pressure, and the low voltage applied to the 14 AWG samples and leakage current stopped due to an unknown reason. The data logging failure was discovered and was restored on July 5th at 2:58 PM.

## DISPOSITION/COMMENTS/RECOMMENDATIONS:

The test profile was reprogrammed and test parameters restored to the point in time when data logging stopped. The period of time that data logging was suspended will not be integrated into the 29 day submergence period and represents additional conservatism.

REPORTABLE PER 10CFR21: ✓ NO YES (If yes see Procedure 010SP004)

Verification:

Chief  
Technology Officer: [Signature]

\*Test Witness: [Signature]

Quality Assurance: [Signature]

Dir. Materials  
Development: [Signature]

Manager Applications  
Engineering: [Signature]

Dir. of  
Engineering: [Signature]

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



# **NOTICE OF ANOMALY**

Notice No.: 2016-20 Date: July 11, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert Gehm

Category: ☒ Specimen ☐ Procedure Date of Anomaly: July 8, 2016

☐ Test Equipment ☐ Other

Part Name: Splice and Cable Samples in Chamber Part No.: N/A

Test: Environmental Exposure Testing I.D. No.: 26 and 31

Specification: TP-1602 R0 Paragraph No.: Section 4.0

## **REQUIREMENTS:**

With the exception of the insulation resistance measurements, the 6 AWG medium voltage samples will be electrically energized at 5,000 V AC (ø/ø) or equivalently 2,887 V AC (ø/G) and the 14 AWG low voltage samples will be electrically energized at 600 V AC (ø/G).

## **DESCRIPTION OF ANOMALY:**

On July 8th at 12:55 PM, the voltage set which was connected to samples 26 and 31 tripped off. An attempt was made to reset the voltage set and re-energize the samples at which time the set immediately tripped off. No further attempts were made to re-energize samples 26 and 31 in order to prevent any further electrical damage.

## **DISPOSITION/COMMENTS/RECOMMENDATIONS:**

The test will continue as planned with samples 26 and 31 unenergized and an evaluation will be performed upon completion of the environmental exposure.

REPORTABLE PER 10CFR21: ☒ NO ☐ YES (If yes see Procedure 010SP004)

Verification:	Chief Technology Officer: <u>[Signature]</u>
*Test Witness: <u>[Signature]</u>	Dir. Materials Development: <u>[Signature]</u>
Quality Assurance: <u>[Signature]</u>	Dir. of Engineering: <u>[Signature]</u>
Manager Applications Engineering: <u>[Signature]</u>	

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



# **NOTICE OF ANOMALY**

Notice No.: 2016-21 Date: July 21, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert A. Gehm

Category: Specimen Procedure Date of Anomaly: July 20, 2016  
✓ Test Equipment Other

Part Name: Splice and Cable Samples in Chamber Part No.: N/A

Test: Environmental Exposure Testing I.D. No.: 5,7,13,15,21,23,26,31

Specification: TP-1602 R0 Paragraph No.: Section 4.0

## **REQUIREMENTS:**

The intended environmental exposure profile is described below:

Time (seconds)	Temperature (°F)
86,400	265
2,592,000	165

## **DESCRIPTION OF ANOMALY:**

On July 20th at 7:30 PM, the temperature within the chamber dropped below the programed temperature of 184°F and reached a low of 118°F by 8:58 AM on July 21st. The drop in temperature was due to a malfunction of the small steam generator. The small steam generator was repaired and the temperature within the chamber returned to the programed value of 184°F by 10:30 AM on July 21st.

## **DISPOSITION/COMMENTS/RECOMMENDATIONS:**

The environmental exposure profile will be extended 900 minutes at this temperature segment to account for the time period the temperature within the chamber was below the intended profile of 184°F.

REPORTABLE PER 10CFR21: ✓ NO YES (If yes see Procedure 010SP004)

Verification: Chief Technology Officer: [Signature]

\*Test Witness: \_\_\_\_\_

Quality Assurance: [Signature] Dir. Materials Development: [Signature]

Manager Applications Engineering: [Signature] Dir. of Engineering: [Signature]

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



<b>NOTICE OF ANOMALY</b>			
Notice No.: <u>2016-22</u>		Date: <u>August 3, 2016</u>	
Project/Plan No.: <u>TP-1602 R0</u>			
Notification Made To: <u>Eric Rasmussen and David Murphy</u>			
Notification Made By: <u>Robert A. Gehm</u>			
Category: _____ Specimen <input checked="" type="checkbox"/> Procedure		Date of Anomaly: <u>July 27, 2016</u>	
_____ Test Equipment _____ Other			
Part Name: <u>Splice and Cable Samples in Tap Water</u>		Part No.: <u>N/A</u>	
Test: <u>Functional Tests - Insulation Resistance</u>		I.D. No.: <u>5,7,13,15,21,23,26,31</u>	
Specification: <u>Raychem AP1000 Test Plan Rev. 1</u>		Paragraph No.: <u>Section 6.2</u>	
<b>REQUIREMENTS:</b>			
6.2 Insulation Resistance			
Test samples shall be immersed for 24 hours in tap water at room temperature, 25 ±5°C.			
<b>DESCRIPTION OF ANOMALY:</b>			
On July 27th while performing insulation resistance measurements on the tests samples on the mandrel immersed in tap water, the temperature of the water was measured and recorded at 18.7°C. The temperature of the water for insulation resistance measurements on the tests samples is required to be at 25 ±5°C per Raychem's test plan.			
<b>DISPOSITION/COMMENTS/RECOMMENDATIONS:</b>			
Typically IR measurement are corrected and reported to a specified temperature of 15.6°C using a correction factor, based on the temperature during the IR measurement and the coefficient value of the insulating material(s). Although the 18.7°C temperature of the water was below the required minimum temperature of 20°C, there is no detrimental effect on the IR measurement of the samples or the measured value because the temperature of the IR measurements were very close to the reported corrected temperature of 15.6°C, thereby reducing the correction factor value closer to 1 which results in a more accurate measurement.			
REPORTABLE PER 10CFR21: <input checked="" type="checkbox"/> NO <input type="checkbox"/> YES (If yes see Procedure 010SP004)			
Verification:		Chief Technology Officer: _____	
*Test Witness: _____			
Quality Assurance: <u>[Signature]</u>		Dir. Materials Development: <u>[Signature]</u>	
Manager Applications Engineering: <u>[Signature]</u>		Dir. of Engineering: <u>[Signature]</u>	

RSQA 294 Rev 1 (9/14)



# **NOTICE OF ANOMALY**

Notice No.: 2016-23 Date: August 11, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert Gehm

Category: ☒ Specimen ☐ Procedure Date of Anomaly: August 11, 2016

☐ Test Equipment ☐ Other

Part Name: Splice and Cable Samples in Chamber Part No.: N/A

Test: Environmental Exposure Testing I.D. No.: 25 and 28

Specification: TP-1602 R0 Paragraph No.: Section 4.0

## **REQUIREMENTS:**

With the exception of the insulation resistance measurements, the 6 AWG medium voltage samples will be electrically energized at 5,000 V AC (ø/ø) or equivalently 2,887 V AC (ø/G) and the 14 AWG low voltage samples will be electrically energized at 600 V AC (ø/G).



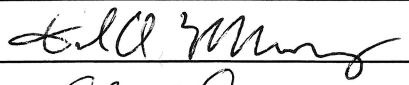

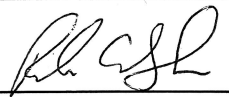
## **DESCRIPTION OF ANOMALY:**

On August 11th at 11:41 AM, the voltage set connected to samples 25 and 28 tripped off. An attempt was made to reset the voltage set and re-energize the samples at which time the set immediately tripped off. No further attempts were made to re-energize samples 25 and 28 in order to prevent any further electrical damage.

## **DISPOSITION/COMMENTS/RECOMMENDATIONS:**

The test will continue as planned with samples 25 and 28 unenergized and an evaluation will be performed upon completion of the environmental exposure.

REPORTABLE PER 10CFR21: ☒ NO ☐ YES (If yes see Procedure 010SP004)

Verification:	Chief Technology Officer: <u></u>
*Test Witness: _____	Dir. Materials Development: <u></u>
Quality Assurance: <u></u>	Dir. of Engineering: <u></u>
Manager Applications Engineering: <u></u>	

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



# NOTICE OF ANOMALY

Notice No.: 2016-24

Date: August 15, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert Gehm

Category: ☒ Specimen ☐ Procedure  
☐ Test Equipment ☐ Other

Date of Anomaly: July 7 and 8, 2016

Part Name: Splice and Cable Samples

Part No.: N/A

Test: Post Environmental Exposure Testing

I.D. No.: 7 and 26 25 and 28 11/23/16

Specification: AP1000 Test Plan Rev. 1 and TP-1602 R0

Paragraph No.: Section 6.2 and 6.0

## REQUIREMENTS:

The insulation resistance of all samples shall be measured after 24 hours of water immersion while they immersed. DC voltage of 500 volts shall be applied for 1 minute while the measurement is taken. (AP1000 Test Plan Rev.1 Section 6.2)  
 An AC voltage withstand test will be conducted in accordance with ICEA T-27-581 Paragraph 2.2. Samples will be placed in room temperature tap water and allowed to soak for 1 hour. Each single conductor sample will be electrically tested submerged. Each cable will be subjected to 80 volts/mil of insulation AC average stress for five minutes, conductor to shield and water at ground. (TP-1602 R0 Section 6.0)  
 The insulation resistance of each sample will be measured in accordance with ICEA T-27- 581 Paragraph 2.3. While immersed the conductor will be energized with negative 500 VDC for one minute with the shield (as applicable) and water at ground potential for one minute. This test is performed for engineering information only. (TP-1602 R0 Section 6.0)

## DESCRIPTION OF ANOMALY:

On July 27th, during the submerged insulation resistance measurements, sample 7 and the red and black single conductors of sample 26 measured zero resistance indicating a shorted condition.  
 On July 28th, during the AC voltage withstand test and following insulation resistance measurement, the red and black single conductors of sample 26 did not hold voltage and measured zero resistance respectively indicating a shorted condition.

## DISPOSITION/COMMENTS/RECOMMENDATIONS:

Following the initial insulation resistance measurement and removal of the samples from the mandrel, it was discovered that the lead wire which was connected to sample 7 was shorted to the mandrel. The lead wire was affixed to the mandrel with tape directly over an open hole. The lead wire insulation deformed and shorted to the mandrel due to irregular stress points. The portion of the lead wire was removed and the sample performed satisfactorily during the remainder of the post environmental tests. The faulty lead wire is also attributed to be the cause of anomaly 2016-18.  
 An evaluation was performed in order to disposition the cause of the anomalies associated with sample 26 (which includes anomaly 2016-20). The evaluation yielded no conclusive evidence. Further evaluation may be performed by TE connectivity following return of the sample to their facility.

REPORTABLE PER 10CFR21: ☒ NO ☐ YES (If yes see Procedure 010SP004)

Verification:

Chief Technology Officer: [Signature]

\*Test Witness: [Signature]

Quality Assurance: [Signature]

Dir. Materials Development: [Signature]

Manager Applications Engineering: [Signature]

Dir. of Engineering: [Signature]

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



# **NOTICE OF ANOMALY**

Notice No.: 2016-25 Date: August 17, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert Gehm

Category: Specimen Procedure

Date of

☒ Test Equipment Other

Anomaly: August 14, 2016

Part Name: Splice and Cable Samples

Part No.: N/A

Test: Environmental Exposure Testing

I.D. No.: 1,3,9,11,17,19,25,28

Specification: TP-1602 R0

Paragraph No.: Section 4.0

## **REQUIREMENTS:**

With the exception of the insulation resistance measurements, the 6 AWG medium voltage samples will be electrically energized at 5,000 V AC (ø/ø) or equivalently 2,887 V AC (ø/G) and the 14 AWG low voltage samples will be electrically energized at 600 V AC (ø/G).

High pressure air will be supplied to the chamber, when necessary, in order to maintain pressure at or above 19.8 PSIG for the duration of the test.

The intended environmental exposure profile is described below:

Time (seconds)	Temperature (°F)
86,400	265
2,592,000	165

## **DESCRIPTION OF ANOMALY:**

On August 14th at 5:00 AM, the plant experienced a momentary loss of power which caused the voltage sets that supply voltage to the samples to de-energize and the steam valves to close which resulted in a loss of steam to the chamber jacket causing the temperature and pressure within the chamber to drop below the required profile. This condition was found during daily logging on August 15th at 7:30 AM with the chamber at an average temperature of 107°F. Voltage was re-applied to the samples at 8:28 AM. Steam was supplied to the chamber jacket at 8:42 AM. The test profile was reprogrammed into system. Temperature within the chamber returned to the required temperature of 260°F at 10:00 AM on August 15th and system was placed into auto mode.

## **DISPOSITION/COMMENTS/RECOMMENDATIONS:**

The test profile was reprogrammed and test parameters restored to the point in time during the test when the loss of plant power occurred. The period of time the samples were without the required applied voltage and the temperature and pressure within the chamber were below the required profile will not be integrated into the 29 day submergence period and represents additional conservatism.

REPORTABLE PER 10CFR21: ☒ NO ☐ YES (If yes see Procedure 010SP004)

Verification:

Chief

Technology Officer: [Signature]

\*Test Witness:

Dir. Materials Development: [Signature]

Quality Assurance: [Signature]

Dir. of Engineering: [Signature]

Manager Applications Engineering: [Signature]

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



# NOTICE OF ANOMALY

Notice No.: 2016-26

Date: August 29, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert Gehm

Category: Specimen Procedure

Date of

Test Equipment Other

Anomaly: August 26, 2016

Part Name: Splice and Cable Samples

Part No.: N/A

Test: Environmental Exposure Testing

I.D. No.: 1,3,9,11,17,19,25,28

Specification: TP-1602 R0

Paragraph No.: Section 4.0

## REQUIREMENTS:

With the exception of the insulation resistance measurements, the 6 AWG medium voltage samples will be electrically energized at 5,000 V AC (Ø/Ø) or equivalently 2,887 V AC (Ø/G) and the 14 AWG low voltage samples will be electrically energized at 600 V AC (Ø/G).

High pressure air will be supplied to the chamber, when necessary, in order to maintain pressure at or above 19.8 PSIG for the duration of the test.

The intended environmental exposure profile is described below:

Time (seconds)	Temperature (°F)
86,400	265
2,592,000	165

## DESCRIPTION OF ANOMALY:

On August 26th at 3:00 PM, the LOCA test lab was shutdown due to a planned power outage. On August 29th at 7:30 AM the LOCA test lab was restarted and temperature with the chamber was at an average temperature of 107°F. Voltage was re-applied to the samples at 8:40 AM. Steam was supplied to the chamber jacket at 8:52 AM. The test profile was reprogrammed into system. Temperature within the chamber returned to the required temperature of 226°F at 1:00 PM on August 29th and system was placed into auto mode.

## DISPOSITION/COMMENTS/RECOMMENDATIONS:

The test profile was reprogrammed and test parameters restored to the point in time during the test when the loss of plant power occurred. The period of time the samples were without the required applied voltage and the temperature and pressure within the chamber were below the required profile will not be integrated into the 29 day submergence period and represents additional conservatism.

REPORTABLE PER 10CFR21: ☒ NO ☐ YES (If yes see Procedure 010SP004)

Verification:

Chief

Technology Officer: 

\*Test Witness: 

Dir. Materials Development: 

Quality Assurance: 

Dir. of Engineering: 

Manager Applications Engineering: 

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



# **NOTICE OF ANOMALY**

Notice No.: 2016-27 Date: September 6, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert Gehm

Category: Specimen Procedure Date of Anomaly: September 3, 2016  
✓ Test Equipment Other

Part Name: Splice and Cable Samples Part No.: N/A

Test: Environmental Exposure Testing I.D. No.: 1,3,9,11,17,19,25,28

Specification: TP-1602 R0 Paragraph No.: Section 4.0

## **REQUIREMENTS:**

With the exception of the insulation resistance measurements, the 6 AWG medium voltage samples will be electrically energized at 5,000 V AC (ø/ø) or equivalently 2,887 V AC (ø/G) and the 14 AWG low voltage samples will be electrically energized at 600 V AC (ø/G).

Temperature, pressure, and the low voltage applied to the 14 AWG samples and leakage current will be measured continuously using a data logger.

High pressure air will be supplied to the chamber, when necessary, in order to maintain pressure at or above 19.8 PSIG for the duration of the test.

The intended environmental exposure profile is described below:

Time (seconds)	Temperature (°F)
86,400	265
2,592,000	165

## **DESCRIPTION OF ANOMALY:**

On September 3rd at 10:34 PM, the plant experienced a momentary loss of power which caused the voltage sets that supply voltage to the samples to de-energize, the computer system to shut down which resulted in loss of data logging, and the steam values to close which resulted in loss of steam to the chamber jacket causing the temperature within the chamber to drop below the required profile. This condition was found during daily logging on Sept 6th at 8:05 AM with the chamber at an average temperature of 200°F. Voltage was re-applied to the samples at 8:13 AM. Steam was supplied to the chamber jacket at 8:14 AM. The test profile was reprogrammed into system. Temperature within the chamber returned to the required temperature of 205°F at 11:30 AM on Sept 6th and system was placed into auto mode.

## **DISPOSITION/COMMENTS/RECOMMENDATIONS:**

The test profile was reprogrammed and test parameters restored to the point in time during the test when the loss of plant power occurred. The period of time the samples were without the required applied voltage and the temperature and pressure within the chamber were below the required profile will not be integrated into the 29 day submergence period and represents additional conservatism.

REPORTABLE PER 10CFR21: ✓ NO YES (If yes see Procedure 010SP004)

Verification: Chief Technology Officer: [Signature]

\*Test Witness: [Signature]

Quality Assurance: [Signature] Dir. Materials Development: [Signature]

Manager Applications Engineering: [Signature] Dir. of Engineering: [Signature]

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



## NOTICE OF ANOMALY

Notice No.: 2016-28 Date: Sept 12, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert A. Gehm

Category: \_\_\_\_\_ Specimen \_\_\_\_\_ Procedure \_\_\_\_\_ Date of  
 \_\_\_\_\_ ✓ \_\_\_\_\_ Test Equipment \_\_\_\_\_ Other \_\_\_\_\_ Anomaly: Sept 11, 2016

Date of Anomaly: Sept 11, 2016

Part Name: Splice and Cable Samples in Chamber Part No.: N/A

Part No.: N/A

Test: Environmental Exposure Testing I.D. No.: 1.3.9.11.17.19.25.28

I.D. No.: 1,3,9,11,17,19,25,28

Specification: TP-1602 R0 Paragraph No.: Section 4.0

Paragraph No.: Section 4.0

### REQUIREMENTS:

The intended environmental exposure profile is described below:

Time (seconds)	Temperature (°F)
86,400	265
2,592,000	165

## DESCRIPTION OF ANOMALY:

On Sept 11th at 1:50 AM, the temperature within the chamber dropped below the programed temperature of 191°F and reached a low of 86°F by 10:40 AM on Sept 12th. The drop in temperature was due to a malfunction of the small steam generator. The small steam generator was repaired and the temperature within the chamber returned to the programed value of 191°F by 4:00 PM on Sept 12th.

## DISPOSITION/COMMENTS/RECOMMENDATIONS:

The test profile was reprogrammed and test parameters restored to the point in time during the test when the steam generator malfunction occurred. The environmental exposure profile will be extended 320 minutes at this temperature segment to account for the time period the temperature within the chamber was below the intended profile of 191°F.

REPORTABLE PER 10CFR21: ✓ NO        YES (If yes see Procedure 010SP004)

**Verification:**

Chief  
Technology Officer:  For

\*Test Witness: \_\_\_\_\_

Dir. Materials Development: *J. Masakawa*

Quality Assurance: 

Manager Applications  
Engineering: 

Dir. of  
Engineering: \_\_\_\_\_

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



# **NOTICE OF ANOMALY**

Notice No.: 2016-30

Date: November 29, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert Gehm

Category: ☒ Specimen ☐ Procedure  
☐ Test Equipment ☐ Other

Date of Anomaly: August 11, 2016

Part Name: Splice and Cable Samples

Part No.: N/A

Test: Post Environmental Exposure Testing

I.D. No.: 25

Specification: AP1000 Test Plan Rev. 1 and TP-1602 R0

Paragraph No.: Section 6.2 and 6.0

## **REQUIREMENTS:**

The insulation resistance of all samples shall be measured after 24 hours of water immersion while they immersed. DC voltage of 500 volts shall be applied for 1 minute while the measurement is taken. (AP1000 Test Plan Rev.1 Section 6.2)  
 An AC voltage withstand test will be conducted in accordance with ICEA T-27-581 Paragraph 2.2. Samples will be placed in room temperature tap water and allowed to soak for 1 hour. Each single conductor sample will be electrically tested submerged. Each cable will be subjected to 80 volts/mil of insulation AC average stress for five minutes, conductor to shield and water at ground. (TP-1602 R0 Section 6.0)  
 The insulation resistance of each sample will be measured in accordance with ICEA T-27- 581 Paragraph 2.3. While immersed the conductor will be energized with negative 500 VDC for one minute with the shield (as applicable) and water at ground potential for one minute. This test is performed for engineering information only. (TP-1602 R0 Section 6.0)

## **DESCRIPTION OF ANOMALY:**

On September 28th, during the submerged insulation resistance measurements, the black single conductor of sample 25 measured zero resistance indicating a shorted condition.  
 On October 6th, during the AC voltage withstand test and following insulation resistance measurement, the red, white and black single conductors of sample 25 did not hold voltage and measured zero resistance respectively indicating a shorted condition.

## **DISPOSITION/COMMENTS/RECOMMENDATIONS:**

An evaluation was performed in order to disposition the cause of the anomalies associated with sample 25 (which includes anomaly 2016-23). The evaluation yielded no conclusive evidence. Further evaluation may be performed by TE connectivity following return of the sample to their facility.

REPORTABLE PER 10CFR21: ☒ NO ☐ YES (If yes see Procedure 010SP004)

Verification:

Chief Technology Officer: [Signature]

\*Test Witness: \_\_\_\_\_

Dir. Materials Development: [Signature]

Quality Assurance: [Signature]

Dir. of Engineering: [Signature]

Manager Applications Engineering: [Signature]

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



# NOTICE OF ANOMALY

Notice No.: 2016-31

Date: November 29, 2016

Project/Plan No.: TP-1602 R0

Notification Made To: Eric Rasmussen and David Murphy

Notification Made By: Robert A. Gehm

Category: Specimen Procedure

Date of

✓ Test Equipment Other

Anomaly: July 5, 2016

Part Name: Splice and Cable Samples in Chamber

Part No.: N/A

Test: Environmental Exposure Testing

I.D. No.: 1,3,9,11,17,19,25,28

Specification: TP-1602 R0

Paragraph No.: Section 4.0

## REQUIREMENTS:

The intended environmental exposure profile is described below:

Time (seconds)	Temperature (°F)
86,400	265
2,592,000	165

Temperature, pressure, and the low voltage applied to the 14 AWG samples and leakage current will be measured continuously using a data logger.

## DESCRIPTION OF ANOMALY:

During the final compilation of the environment profile and while generating the qualification report, it was discovered that approximately 19 hours of data between June 30th and July 5th was not accounted for. The necessary data falls within the period following July 1st at 1:24 PM for a duration of 19 hours 39 minutes and 31 seconds. This time period was included within anomaly report 2016-19. This anomaly report amends anomaly report 2016-19.

## DISPOSITION/COMMENTS/RECOMMENDATIONS:

There is sufficient evidence that the chamber and system was operating within the prescribed parameters during the approximate 19 hour time frame following July 1st at 1:24 PM when the operator had restarted the system and re-energized all of the samples. Following the holiday weekend, the operator performed his daily inspection and logged voltage and leakage current on July 5th at 3:03 PM. It is reasonable to conclude that the system was operating within the prescribed parameters between the two above noted time periods with the only exception that the data was not being logged by the system. Furthermore, the trend, or specifically the notable increase, in the level of leakage current for samples 26 and 31 supports this assertion.

REPORTABLE PER 10CFR21: ✓ NO YES (If yes see Procedure 010SP004)

Verification:

Chief  
Technology Officer: [Signature] For

\*Test Witness: [Signature]

Quality Assurance: [Signature]

Dir. Materials  
Development: [Signature]

Manager Applications  
Engineering: [Signature]

Dir. of  
Engineering: [Signature]

\* Test Witness personnel may be any one of the verifiers indicated above.

RSQA 294 Rev 1 (9/14)



## APPENDIX VIII: CALIBRATION RECORDS

This page has intentionally been left blank.





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID Test 76-25885	Approved Yes
Gage S/N 76-25885	As Found Condition In
Description 5 kV AC Test Set	
Procedure No. 10	
Model No. 705-5	
Unit of Meas. kV AC	
Manufacturer Hipotronics	
Cal. Date 3/18/2016	
Next Due 3/31/2017	
Cal. Freq. 12.00 End of Month	
Location Loca Chamber	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature 68
	Humidity 21

Standard ID	01) .2 kV	Uncertainty	Units	KiloVolts	Type	V
Limited Use?	No	Minimum	0.15	Nominal	0.2	Maximum 0.25
Ref Type	Kilovoltmeter	Before	0.178	Accuracy	-0.022	Fail Before No
		After	0.178	Accuracy	-0.022	Fail After No

Gage ID of Standard STD 62

Std Due Date 1/31/2017

Gage S/N NJ002804

Model No. 149-10A

NIST No.

Low Scale

Standard ID	02) .4 kV	Uncertainty	Units	KiloVolts	Type	V
Limited Use?	No	Minimum	0.35	Nominal	0.4	Maximum 0.45
Ref Type	Kilovoltmeter	Before	0.39	Accuracy	-0.01	Fail Before No
		After	0.39	Accuracy	-0.01	Fail After No

Gage ID of Standard STD 62

Std Due Date 1/31/2017

Gage S/N NJ002804

Model No. 149-10A

NIST No.

Low Scale

Standard ID	03) .6 kV	Uncertainty	Units	KiloVolts	Type	V
Limited Use?	No	Minimum	0.55	Nominal	0.6	Maximum 0.65
Ref Type	Kilovoltmeter	Before	0.596	Accuracy	-0.004	Fail Before No
		After	0.596	Accuracy	-0.004	Fail After No

Calibration Certificate Report With Measurements



Gage ID of Standard		STD 62		Gage S/N		NJ002804		Model No.		149-10A		NIST No.	
Std Due Date		1/31/2017											
Low Scale													
Standard ID	04) .8 kV	Uncertainty		Units		KiloVolts		Type		V			
Limited Use?	No	Minimum		0.75		Nominal		0.8		Maximum		0.85	
Ref Type	Kilovoltmeter	Before		0.792		Accuracy		-8.000000000		Fail Before		No	
		After		0.792		Accuracy		-8.000000000		Fail After		No	
Gage ID of Standard		STD 62		Gage S/N		NJ002804		Model No.		149-10A		NIST No.	
Std Due Date		1/31/2017											
Low Scale													
Standard ID	05) 1 kV	Uncertainty		Units		KiloVolts		Type		V			
Limited Use?	No	Minimum		0.95		Nominal		1		Maximum		1.05	
Ref Type	Kilovoltmeter	Before		1		Accuracy		0		Fail Before		No	
		After		1		Accuracy		0		Fail After		No	
Gage ID of Standard		STD 62		Gage S/N		NJ002804		Model No.		149-10A		NIST No.	
Std Due Date		1/31/2017											
Low Scale													
Standard ID	06) .5 kV	Uncertainty		Units		KiloVolts		Type		V			
Limited Use?	No	Minimum		0.375		Nominal		0.5		Maximum		0.625	
Ref Type	Kilovoltmeter	Before		0.447		Accuracy		-0.053		Fail Before		No	
		After		0.447		Accuracy		-0.053		Fail After		No	
Gage ID of Standard		STD 62		Gage S/N		NJ002804		Model No.		149-10A		NIST No.	
Std Due Date		1/31/2017											
Medium Scale													
Standard ID	07) 1 kV	Uncertainty		Units		KiloVolts		Type		V			
Limited Use?	No	Minimum		0.875		Nominal		1		Maximum		1.125	
Ref Type	Kilovoltmeter	Before		0.948		Accuracy		-0.052		Fail Before		No	
		After		0.948		Accuracy		-0.052		Fail After		No	
Gage ID of Standard		STD 62		Gage S/N		NJ002804		Model No.		149-10A		NIST No.	
Std Due Date		1/31/2017											
Medium Scale													
Standard ID	08) 1.5 kV	Uncertainty		Units		KiloVolts		Type		V			
Limited Use?	No	Minimum		1.375		Nominal		1.5		Maximum		1.625	
Ref Type	Kilovoltmeter	Before		1.428		Accuracy		-7.200000000		Fail Before		No	
		After		1.428		Accuracy		-7.200000000		Fail After		No	
Gage ID of Standard		STD 62		Gage S/N		NJ002804		Model No.		149-10A		NIST No.	
Std Due Date		1/31/2017											
Medium Scale													
Standard ID	09) 2 kV	Uncertainty		Units		KiloVolts		Type		V			
Limited Use?	No	Minimum		1.875		Nominal		2		Maximum		2.125	
Ref Type	Kilovoltmeter	Before		1.915		Accuracy		-0.085		Fail Before		No	
		After		1.915		Accuracy		-0.085		Fail After		No	
Gage ID of Standard		STD 62		Gage S/N		NJ002804		Model No.		149-10A		NIST No.	
Std Due Date		1/31/2017											
Medium Scale													
Standard ID	10) 2.5 kV	Uncertainty		Units		KiloVolts		Type		V			
Limited Use?	No	Minimum		2.375		Nominal		2.5		Maximum		2.625	
Ref Type	Kilovoltmeter	Before		2.41		Accuracy		-8.999999999		Fail Before		No	

Calibration Certificate Report With Measurements



After 2.41 Accuracy -8.999999999 Fail After No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
Medium Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	11) 1 kV	Uncertainty		Units	KiloVolts	Type	V
Limited Use?	No	Minimum	0.75	Nominal	1	Maximum	1.25
Ref Type	Kilovoltmeter	Before	0.907	Accuracy	-0.093	Fail Before	No
		After	0.907	Accuracy	-0.093	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	12) 2 kV	Uncertainty		Units	KiloVolts	Type	V
Limited Use?	No	Minimum	1.75	Nominal	2	Maximum	2.25
Ref Type	Kilovoltmeter	Before	1.898	Accuracy	-0.102	Fail Before	No
		After	1.898	Accuracy	-0.102	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	13) 3 kV	Uncertainty		Units	KiloVolts	Type	V
Limited Use?	No	Minimum	2.75	Nominal	3	Maximum	3.25
Ref Type	Kilovoltmeter	Before	2.853	Accuracy	-0.147	Fail Before	No
		After	2.853	Accuracy	-0.147	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	14) 4 kV	Uncertainty		Units	KiloVolts	Type	V
Limited Use?	No	Minimum	3.75	Nominal	4	Maximum	4.25
Ref Type	Kilovoltmeter	Before	3.82	Accuracy	-0.18	Fail Before	No
		After	3.82	Accuracy	-0.18	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	15) 4.5 kV	Uncertainty		Units	KiloVolts	Type	V
Limited Use?	No	Minimum	4.25	Nominal	4.5	Maximum	4.75
Ref Type	Kilovoltmeter	Before	4.3	Accuracy	-0.2	Fail Before	No
		After	4.3	Accuracy	-0.2	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	16) 5.0 kV	Uncertainty		Units	KiloVolts	Type	V
Limited Use?	No	Minimum	4.75	Nominal	5	Maximum	5.25
Ref Type	Kilovoltmeter	Before	4.76	Accuracy	-0.24	Fail Before	No
		After	4.76	Accuracy	-0.24	Fail After	No

Gage ID of Standard SRD 62  
Std Due Date

Gage S/N Model No. NIST No.



## Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	3/18/2016	1:31:11 PM	Signed
John O'Dell	3/18/2016	1:31:13 PM	Unsigned
John O'Dell	3/18/2016	1:31:58 PM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID Test 8909-6	Approved Yes
Gage S/N 8909-6	As Found Condition In
Description 2 kV AC Test Set	
Procedure No. 10	
Model No. 702-.5	
Unit of Meas. kV AC	
Manufacturer Hipotronics	
Cal. Date 5/23/2016	
Next Due 5/31/2017	
Cal. Freq. 12.00 End of Month	
Location Loca Chamber	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature 72
	Humidity 22

Standard ID	01) .1 kV	Uncertainty	Units	kV	Type	V
Limited Use?	No	Minimum	0.9424	Nominal	0.992	Maximum 1.0416
Ref Type	Kilovoltmeter	Before	1.04	Accuracy	0.048	Fail Before No
		After	1.04	Accuracy	0.048	Fail After No

Gage ID of Standard	STD 62	Gage S/N	NJ002804	Model No.	149-10A	NIST No.
Std Due Date	1/31/2017					

Standard ID	02) .2 kV	Uncertainty	Units	kV	Type	V
Limited Use?	No	Minimum	0.1938	Nominal	0.204	Maximum 0.2142
Ref Type	Kilovoltmeter	Before	0.21	Accuracy	6.0000000000	Fail Before No
		After	0.21	Accuracy	6.0000000000	Fail After No

Gage ID of Standard	STD 62	Gage S/N	NJ002804	Model No.	149-10A	NIST No.
Std Due Date	1/31/2017					

Standard ID	03) .3 kV	Uncertainty	Units	kV	Type	V
Limited Use?	No	Minimum	0.283575	Nominal	0.2985	Maximum 0.313425
Ref Type	Kilovoltmeter	Before	0.304	Accuracy	0.0055	Fail Before No
		After	0.304	Accuracy	0.0055	Fail After No

Calibration Certificate Report With Measurements



Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	04) .4 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.38152	Nominal	0.4016	Maximum	0.42168
Ref Type	Kilovoltmeter	Before	0.407	Accuracy	5.3999999999	Fail Before	No
		After	0.407	Accuracy	5.3999999999	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	05) .5 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.479085	Nominal	0.5043	Maximum	0.529515
Ref Type	Kilovoltmeter	Before	0.509	Accuracy	4.7000000000	Fail Before	No
		After	0.509	Accuracy	4.7000000000	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	06) .6 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.574655	Nominal	0.6049	Maximum	0.635145
Ref Type	Kilovoltmeter	Before	0.608	Accuracy	3.0999999999	Fail Before	No
		After	0.608	Accuracy	3.0999999999	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	07) .8 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.765415	Nominal	0.8057	Maximum	0.845985
Ref Type	Kilovoltmeter	Before	0.808	Accuracy	2.3000000000	Fail Before	No
		After	0.808	Accuracy	2.3000000000	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	08) 1.0kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.95475	Nominal	1.005	Maximum	1.05525
Ref Type	Kilovoltmeter	Before	1.007	Accuracy	0.002	Fail Before	No
		After	1.007	Accuracy	0.002	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

### Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	5/23/2016	11:53:24 AM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID Test 8909-5	Approved Yes
Gage S/N 8909-5	As Found Condition In
Description 2 kV AC Test Set	
Procedure No. 10	
Model No. 702-.5	
Unit of Meas. kV AC	
Manufacturer Hipotronics	
Cal. Date 5/23/2016	
Next Due 5/31/2017	
Cal. Freq. 12.00 End of Month	
Location Loca Chamber	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature 72
	Humidity 22

Standard ID	01) .1 kV	Uncertainty	Units	kV	Type	V
Limited Use?	No	Minimum	0.096425	Nominal	0.1015	Maximum 0.106575
Ref Type	Kilovoltmeter	Before	0.105	Accuracy	3.4999999999	Fail Before No
		After	0.105	Accuracy	3.4999999999	Fail After No

Gage ID of Standard	STD 62	Gage S/N	NJ002804	Model No.	149-10A	NIST No.
Std Due Date	1/31/2017					

Standard ID	02) .2 kV	Uncertainty	Units	kV	Type	V
Limited Use?	No	Minimum	0.18677	Nominal	0.1966	Maximum 0.20643
Ref Type	Kilovoltmeter	Before	0.204	Accuracy	7.3999999999	Fail Before No
		After	0.204	Accuracy	7.3999999999	Fail After No

Gage ID of Standard	STD 62	Gage S/N	NJ002804	Model No.	149-10A	NIST No.
Std Due Date	1/31/2017					

Standard ID	03) .3 kV	Uncertainty	Units	kV	Type	V
Limited Use?	No	Minimum	0.29811	Nominal	0.3138	Maximum 0.32949
Ref Type	Kilovoltmeter	Before	0.322	Accuracy	8.1999999999	Fail Before No
		After	0.322	Accuracy	8.1999999999	Fail After No

Calibration Certificate Report With Measurements



Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	04) .4 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.3743	Nominal	0.394	Maximum	0.4137
Ref Type	Kilovoltmeter	Before	0.402	Accuracy	8.0000000000	Fail Before	No
		After	0.402	Accuracy	8.0000000000	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	05) .5 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.475	Nominal	0.5	Maximum	0.525
Ref Type	Kilovoltmeter	Before	0.504	Accuracy	0.004	Fail Before	No
		After	0.504	Accuracy	0.004	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	06) .6 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.56905	Nominal	0.599	Maximum	0.62895
Ref Type	Kilovoltmeter	Before	0.6	Accuracy	0.001	Fail Before	No
		After	0.6	Accuracy	0.001	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	07) .8 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.75943	Nominal	0.7994	Maximum	0.83937
Ref Type	Kilovoltmeter	Before	0.796	Accuracy	-3.3999999999	Fail Before	No
		After	0.796	Accuracy	-3.3999999999	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	08) 1.0 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.949905	Nominal	0.9999	Maximum	1.049895
Ref Type	Kilovoltmeter	Before	0.99	Accuracy	-9.9000000000	Fail Before	No
		After	0.99	Accuracy	-9.9000000000	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

### Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	5/23/2016	11:26:58 AM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID Test 8909-4	Approved Yes
Gage S/N 8909-4	As Found Condition In
Description 2 kV AC Test Set	
Procedure No. 10	
Model No. 702-.5	
Unit of Meas. kV AC	
Manufacturer Hipotronics	
Cal. Date 5/23/2016	
Next Due 5/31/2017	
Cal. Freq. 12.00 End of Month	
Location Loca Chamber	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature 72
	Humidity 22

Standard ID	01) .1 kV	Uncertainty	Units	kV	Type	V
Limited Use?	No	Minimum	0.09614	Nominal	0.1012	Maximum 0.10626
Ref Type	Kilovoltmeter	Before	0.101	Accuracy	-1.999999999	Fail Before No
		After	0.101	Accuracy	-1.999999999	Fail After No

Gage ID of Standard	STD 62	Gage S/N	NJ002804	Model No.	149-10A	NIST No.
Std Due Date	1/31/2017					

Standard ID	02) .2 kV	Uncertainty	Units	kV	Type	V
Limited Use?	No	Minimum	0.1862	Nominal	0.196	Maximum 0.2058
Ref Type	Kilovoltmeter	Before	0.204	Accuracy	7.999999999	Fail Before No
		After	0.204	Accuracy	7.999999999	Fail After No

Gage ID of Standard	STD 62	Gage S/N	NJ002804	Model No.	149-10A	NIST No.
Std Due Date	1/31/2017					

Standard ID	03) .3 kV	Uncertainty	Units	kV	Type	V
Limited Use?	No	Minimum	0.29279	Nominal	0.3082	Maximum 0.32361
Ref Type	Kilovoltmeter	Before	0.319	Accuracy	0.0108	Fail Before No
		After	0.319	Accuracy	0.0108	Fail After No

Calibration Certificate Report With Measurements



Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	04) .4 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.38152	Nominal	0.4016	Maximum	0.42168
Ref Type	Kilovoltmeter	Before	0.411	Accuracy	9.3999999999	Fail Before	No
		After	0.411	Accuracy	9.3999999999	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	05) .5 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.472435	Nominal	0.4973	Maximum	0.522165
Ref Type	Kilovoltmeter	Before	0.506	Accuracy	8.6999999999	Fail Before	No
		After	0.506	Accuracy	8.6999999999	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	06) .6 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.5738	Nominal	0.604	Maximum	0.6342
Ref Type	Kilovoltmeter	Before	0.612	Accuracy	8.0000000000	Fail Before	No
		After	0.612	Accuracy	8.0000000000	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	07) .8 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.75772	Nominal	0.7976	Maximum	0.83748
Ref Type	Kilovoltmeter	Before	0.806	Accuracy	8.4000000000	Fail Before	No
		After	0.806	Accuracy	8.4000000000	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	08) 1.0 kV	Uncertainty		Units	kV	Type	V
Limited Use?	No	Minimum	0.95399	Nominal	1.0042	Maximum	1.05441
Ref Type	Kilovoltmeter	Before	1.011	Accuracy	6.7999999999	Fail Before	No
		After	1.011	Accuracy	6.7999999999	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017

Gage S/N NJ002804 Model No. 149-10A NIST No.

### Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	5/23/2016	11:44:52 AM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID Test 7962-00	Approved Yes
Gage S/N 7962-00	As Found Condition In
Description 10 kV AC Test Set	
Procedure No. 10	
Model No. 710-1	
Unit of Meas. kV AC	
Manufacturer Hipotronics	
Cal. Date 6/13/2016	
Next Due 6/30/2017	
Cal. Freq. 12.00 End of Month	
Location Q.C. Lab - Main Building	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature 65
	Humidity 42

Standard ID	01) .5 kV	Uncertainty	Units	kV AC	Type	V
Limited Use?	No	Minimum	0.375	Nominal	0.5	Maximum 0.625
Ref Type	Kilovoltmeter	Before	0.387	Accuracy	-0.113	Fail Before No
		After	0.387	Accuracy	-0.113	Fail After No

Gage ID of Standard	STD 62	Gage S/N	NJ002804	Model No.	149-10A	NIST No.
Std Due Date	1/31/2017					
Low Scale						

Standard ID	02) 1.0 kV	Uncertainty	Units	kV AC	Type	V
Limited Use?	No	Minimum	0.875	Nominal	1	Maximum 1.125
Ref Type	Kilovoltmeter	Before	0.944	Accuracy	-5.600000000	Fail Before No
		After	0.944	Accuracy	-5.600000000	Fail After No

Gage ID of Standard	STD 62	Gage S/N	NJ002804	Model No.	149-10A	NIST No.
Std Due Date	1/31/2017					
Low Scale						

Standard ID	03) 1.5 kV	Uncertainty	Units	kV AC	Type	V
Limited Use?	No	Minimum	1.375	Nominal	1.5	Maximum 1.625
Ref Type	Kilovoltmeter	Before	1.462	Accuracy	-0.038	Fail Before No
		After	1.462	Accuracy	-0.038	Fail After No

Calibration Certificate Report With Measurements



Gage ID of Standard		STD 62					
Std Due Date		1/31/2017		Gage S/N NJ002804		Model No. 149-10A	
Low Scale						NIST No.	
Standard ID	04) 2.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	1.875	Nominal	2	Maximum	2.125
Ref Type	Kilovoltmeter	Before	1.981	Accuracy	-1.899999999	Fail Before	No
		After	1.981	Accuracy	-1.899999999	Fail After	No
Gage ID of Standard		STD 62					
Std Due Date		1/31/2017		Gage S/N NJ002804		Model No. 149-10A	
Low Scale						NIST No.	
Standard ID	05) 2.5 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	2.375	Nominal	2.5	Maximum	2.625
Ref Type	Kilovoltmeter	Before	2.516	Accuracy	0.016	Fail Before	No
		After	2.516	Accuracy	0.016	Fail After	No
Gage ID of Standard		STD 62					
Std Due Date		1/31/2017		Gage S/N NJ002804		Model No. 149-10A	
Medium Scale						NIST No.	
Standard ID	06) 1.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	0.75	Nominal	1	Maximum	1.25
Ref Type	Kilovoltmeter	Before	0.867	Accuracy	-0.133	Fail Before	No
		After	0.867	Accuracy	-0.133	Fail After	No
Gage ID of Standard		STD 62					
Std Due Date		1/31/2017		Gage S/N NJ002804		Model No. 149-10A	
Medium Scale						NIST No.	
Standard ID	07) 2.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	1.75	Nominal	2	Maximum	2.25
Ref Type	Kilovoltmeter	Before	1.853	Accuracy	-0.147	Fail Before	No
		After	1.853	Accuracy	-0.147	Fail After	No
Gage ID of Standard		STD 62					
Std Due Date		1/31/2017		Gage S/N NJ002804		Model No. 149-10A	
Medium Scale						NIST No.	
Standard ID	08) 3.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	2.75	Nominal	3	Maximum	3.25
Ref Type	Kilovoltmeter	Before	2.876	Accuracy	-0.124	Fail Before	No
		After	2.876	Accuracy	-0.124	Fail After	No
Gage ID of Standard		STD 62					
Std Due Date		1/31/2017		Gage S/N NJ002804		Model No. 149-10A	
Medium Scale						NIST No.	
Standard ID	09) 4.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	3.75	Nominal	4	Maximum	4.25
Ref Type	Kilovoltmeter	Before	3.948	Accuracy	-0.052	Fail Before	No
		After	3.948	Accuracy	-0.052	Fail After	No
Gage ID of Standard		STD 62					
Std Due Date		1/31/2017		Gage S/N NJ002804		Model No. 149-10A	
Medium Scale						NIST No.	
Standard ID	10) 5.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	4.75	Nominal	5	Maximum	5.25
Ref Type	Kilovoltmeter	Before	5.011	Accuracy	1.100000000	Fail Before	No

Calibration Certificate Report With Measurements



After 5.011 Accuracy 1.1000000000 Fail After No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	11) 2.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	1.5	Nominal	2	Maximum	2.5
Ref Type	Kilovoltmeter	Before	1.702	Accuracy	-0.298	Fail Before	No
		After	1.702	Accuracy	-0.298	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	12) 4.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	3.5	Nominal	4	Maximum	4.5
Ref Type	Kilovoltmeter	Before	3.748	Accuracy	-0.252	Fail Before	No
		After	3.748	Accuracy	-0.252	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	13) 6.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	5.5	Nominal	6	Maximum	6.5
Ref Type	Kilovoltmeter	Before	5.827	Accuracy	-0.173	Fail Before	No
		After	5.827	Accuracy	-0.173	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	14) 8.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	7.5	Nominal	8	Maximum	8.5
Ref Type	Kilovoltmeter	Before	7.925	Accuracy	-7.500000000	Fail Before	No
		After	7.925	Accuracy	-7.500000000	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

Standard ID	15) 10.0 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	9.5	Nominal	10	Maximum	10.5
Ref Type	Kilovoltmeter	Before	9.927	Accuracy	-7.300000000	Fail Before	No
		After	9.927	Accuracy	-7.300000000	Fail After	No

Gage ID of Standard STD 62  
Std Due Date 1/31/2017  
High Scale

Gage S/N NJ002804 Model No. 149-10A NIST No.

### Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	6/13/2016	8:34:25 AM	Signed





# RSCC Wire & Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

<b>Gage ID</b> Scale 0900000001 <b>Gage S/N</b> 0900000001 <b>Description</b> Digital Scale <b>Procedure No.</b> 24 <b>Model No.</b> MRW-3LB <b>Unit of Meas.</b> grams <b>Manufacturer</b> Tree <b>Cal. Date</b> 10/16/2015 <b>Next Due</b> 10/31/2016 <b>Cal. Freq.</b> 12.00 End of Month <b>Location</b> Q.C. Lab - Main Building	<b>Approved</b> Yes <b>As Found Condition</b> In
---	---

### Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

### Findings

### Environmental Conditions

	<b>Temperature</b> 72 <b>Humidity</b> 37
--	---

<b>Standard ID</b> 01) 1g	<b>Uncertainty</b>	<b>Units</b> g	<b>Type</b> V
<b>Limited Use?</b> No	<b>Minimum</b> 0.95038	<b>Nominal</b> 1.0004	<b>Maximum</b> 1.05042
<b>Ref Type</b> Gram Weights	<b>Before</b> 1	<b>Accuracy</b> -3.999999999	<b>Fail Before</b> No
	<b>After</b> 1	<b>Accuracy</b> -3.999999999	<b>Fail After</b> No

<b>Gage ID of Standard</b> STD 14	<b>Gage S/N</b> 5660	<b>Model No.</b>	<b>NIST No.</b> 822-275872-11
<b>Std Due Date</b> 4/30/2018			

<b>Standard ID</b> 02) 2g	<b>Uncertainty</b>	<b>Units</b> g	<b>Type</b> V
<b>Limited Use?</b> No	<b>Minimum</b> 1.900285	<b>Nominal</b> 2.0003	<b>Maximum</b> 2.100315
<b>Ref Type</b> Gram Weights	<b>Before</b> 2	<b>Accuracy</b> -3.000000000	<b>Fail Before</b> No
	<b>After</b> 2	<b>Accuracy</b> -3.000000000	<b>Fail After</b> No

<b>Gage ID of Standard</b> STD 14	<b>Gage S/N</b> 5660	<b>Model No.</b>	<b>NIST No.</b> 822-275872-11
<b>Std Due Date</b> 4/30/2018			

<b>Standard ID</b> 03) 5g	<b>Uncertainty</b>	<b>Units</b> g	<b>Type</b> V
<b>Limited Use?</b> No	<b>Minimum</b> 4.749905	<b>Nominal</b> 4.9999	<b>Maximum</b> 5.249895
<b>Ref Type</b> Gram Weights	<b>Before</b> 5	<b>Accuracy</b> 9.999999999	<b>Fail Before</b> No
	<b>After</b> 5	<b>Accuracy</b> 9.999999999	<b>Fail After</b> No

Calibration Certificate Report With Measurements



Gage ID of Standard STD 14  
 Std Due Date 4/30/2018 Gage S/N 5660 Model No. NIST No. 822-275872-11

Standard ID	04) 10g	Uncertainty	Units	g	Type	V	
Limited Use?	No	Minimum	9.5	Nominal	10	Maximum	10.5
Ref Type	Gram Weights	Before	10	Accuracy	0	Fail Before	No
		After	10	Accuracy	0	Fail After	No

Gage ID of Standard STD 14  
 Std Due Date 4/30/2018 Gage S/N 5660 Model No. NIST No. 822-275872-11

Standard ID	05) 20g	Uncertainty	Units	g	Type	V	
Limited Use?	No	Minimum	19.00038	Nominal	20.0004	Maximum	21.00042
Ref Type	Gram Weights	Before	20	Accuracy	-3.999999999	Fail Before	No
		After	20	Accuracy	-3.999999999	Fail After	No

Gage ID of Standard STD 14  
 Std Due Date 4/30/2018 Gage S/N 5660 Model No. NIST No. 822-275872-11

Standard ID	06) 50g	Uncertainty	Units	g	Type	V	
Limited Use?	No	Minimum	47.49924	Nominal	49.9992	Maximum	52.49916
Ref Type	Gram Weights	Before	50.05	Accuracy	5.079999999	Fail Before	No
		After	50.05	Accuracy	5.079999999	Fail After	No

Gage ID of Standard STD 14  
 Std Due Date 4/30/2018 Gage S/N 5660 Model No. NIST No. 822-275872-11

Standard ID	07) 100g	Uncertainty	Units	g	Type	V	
Limited Use?	No	Minimum	95.000095	Nominal	100.0001	Maximum	105.000105
Ref Type	Gram Weights	Before	100.05	Accuracy	4.989999999	Fail Before	No
		After	100.05	Accuracy	4.989999999	Fail After	No

Gage ID of Standard STD 14  
 Std Due Date 4/30/2018 Gage S/N 5660 Model No. NIST No. 822-275872-11

Standard ID	08) 200g	Uncertainty	Units	g	Type	V	
Limited Use?	No	Minimum	190.00076	Nominal	200.0008	Maximum	210.00084
Ref Type	Gram Weights	Before	200.05	Accuracy	4.920000000	Fail Before	No
		After	200.05	Accuracy	4.920000000	Fail After	No

Gage ID of Standard STD 14  
 Std Due Date 4/30/2018 Gage S/N 5660 Model No. NIST No. 822-275872-11

Standard ID	09) 500g	Uncertainty	Units	g	Type	V	
Limited Use?	No	Minimum	475.00646	Nominal	500.0068	Maximum	525.00714
Ref Type	Gram Weights	Before	500.1	Accuracy	9.320000000	Fail Before	No
		After	500.1	Accuracy	9.320000000	Fail After	No

Gage ID of Standard STD 14  
 Std Due Date 4/30/2018 Gage S/N 5660 Model No. NIST No. 822-275872-11

Standard ID	10) 1000g	Uncertainty	Units	g	Type	V	
Limited Use?	No	Minimum	950.0057	Nominal	1000.006	Maximum	1050.0063
Ref Type	Gram Weights	Before	1000.1	Accuracy	9.400000000	Fail Before	No



		<b>After</b>	1000	<b>Accuracy</b>	-5.999999999	<b>Fail After</b>	No
<b>Gage ID of Standard</b>	STD 14						
<b>Std Due Date</b>	4/30/2018	<b>Gage S/N</b>	5660	<b>Model No.</b>		<b>NIST No.</b>	822-275872-11
<b>Standard ID</b>	11) 1200g	<b>Uncertainty</b>		<b>Units</b>	g	<b>Type</b>	V
<b>Limited Use?</b>	No	<b>Minimum</b>	1140.00646	<b>Nominal</b>	1200.0068	<b>Maximum</b>	1260.00714
<b>Ref Type</b>	Gram Weights	<b>Before</b>	1200.1	<b>Accuracy</b>	0.0931999999	<b>Fail Before</b>	No
		<b>After</b>	1200.1	<b>Accuracy</b>	0.0931999999	<b>Fail After</b>	No
<b>Gage ID of Standard</b>	STD 14						
<b>Std Due Date</b>	4/30/2018	<b>Gage S/N</b>	5660	<b>Model No.</b>		<b>NIST No.</b>	822-275872-11
<b>Standard ID</b>	12) 1350g	<b>Uncertainty</b>		<b>Units</b>	g	<b>Type</b>	V
<b>Limited Use?</b>	No	<b>Minimum</b>	1282.5095	<b>Nominal</b>	1350.01	<b>Maximum</b>	1417.5105
<b>Ref Type</b>	Gram Weights	<b>Before</b>	1350.1	<b>Accuracy</b>	8.9999999999	<b>Fail Before</b>	No
		<b>After</b>	1350.1	<b>Accuracy</b>	8.9999999999	<b>Fail After</b>	No
<b>Gage ID of Standard</b>	STD 14						
<b>Std Due Date</b>	4/30/2018	<b>Gage S/N</b>	5660	<b>Model No.</b>		<b>NIST No.</b>	822-275872-11

**Calibrated By Electronic Signature**

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	10/16/2015	7:32:23 AM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID Scale 50010118	Approved Yes
Gage S/N 50010118	As Found Condition In
Description Digital Scale	
Procedure No. 24	
Model No. ES50R	
Unit of Meas. Lbs	
Manufacturer Ohaus	
Cal. Date 10/14/2015	
Next Due 10/31/2016	
Cal. Freq. 12.00 End of Month	
Location R & D - Kripes Road	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

Temperature 75
Humidity 41

Standard ID 1) .5 lbs	Uncertainty	Units lbs	Type V
Limited Use? No	Minimum 0.4752014	Nominal 0.500212	Maximum 0.5252226
Ref Type Weight Set	Before 0.5	Accuracy -2.119999999	Fail Before No
	After 0.5	Accuracy -2.119999999	Fail After No

Gage ID of Standard STD 43	Gage S/N TSW	Model No. Troemner Slotted Weights	NIST No.
Std Due Date 10/31/2017			

Standard ID 2) 5 lbs	Uncertainty	Units lbs	Type V
Limited Use? No	Minimum 4.7504085	Nominal 5.00043	Maximum 5.2504515
Ref Type Weight Set	Before 4.95	Accuracy -5.042999999	Fail Before No
	After 4.95	Accuracy -5.042999999	Fail After No

Gage ID of Standard STD 43	Gage S/N TSW	Model No. Troemner Slotted Weights	NIST No.
Std Due Date 10/31/2017			

Standard ID 3) 10 lbs	Uncertainty	Units lbs	Type V
Limited Use? No	Minimum 9.50095	Nominal 10.001	Maximum 10.50105

Calibration Certificate Report With Measurements



Ref Type	Weight Set	Before	9.95	Accuracy	-5.100000000	Fail Before	No
		After	9.95	Accuracy	-5.100000000	Fail After	No

Gage ID of Standard STD 43  
Std Due Date 10/31/2017

Gage S/N	TSW	Model No.	Troemner Slotted Weights	NIST No.
----------	-----	-----------	--------------------------------	----------

Standard ID	4) 20 lbs	Uncertainty		Units	lbs	Type	V
Limited Use?	No	Minimum	19.000665	Nominal	20.0007	Maximum	21.000735
Ref Type	Weight Set	Before	19.95	Accuracy	-5.069999999	Fail Before	No
		After	19.95	Accuracy	-5.069999999	Fail After	No

Gage ID of Standard STD 43  
Std Due Date 10/31/2017

Gage S/N	TSW	Model No.	Troemner Slotted Weights	NIST No.
----------	-----	-----------	--------------------------------	----------

20A

Standard ID	5) 40 lbs	Uncertainty		Units	lbs	Type	V
Limited Use?	No	Minimum	38.001045	Nominal	40.0011	Maximum	42.001155
Ref Type	Weight Set	Before	39.9	Accuracy	-0.101100000	Fail Before	No
		After	39.9	Accuracy	-0.101100000	Fail After	No

Gage ID of Standard STD 43  
Std Due Date 10/31/2017

Gage S/N	TSW	Model No.	Troemner Slotted Weights	NIST No.
----------	-----	-----------	--------------------------------	----------

Standard ID	6) 50 lbs	Uncertainty		Units	lbs	Type	V
Limited Use?	No	Minimum	47.50171	Nominal	50.0018	Maximum	52.50189
Ref Type	Weight Set	Before	49.85	Accuracy	-0.151800000	Fail Before	No
		After	49.85	Accuracy	-0.151800000	Fail After	No

Gage ID of Standard STD 43  
Std Due Date 10/31/2017

Gage S/N	TSW	Model No.	Troemner Slotted Weights	NIST No.
----------	-----	-----------	--------------------------------	----------

50A

Standard ID	7) 100 lbs	Uncertainty		Units	lbs	Type	V
Limited Use?	No	Minimum	95.00665	Nominal	100.007	Maximum	105.00735
Ref Type	Weight Set	Before	99.8	Accuracy	-0.207000000	Fail Before	No
		After	99.8	Accuracy	-0.207000000	Fail After	No

Gage ID of Standard STD 43  
Std Due Date 10/31/2017

Gage S/N	TSW	Model No.	Troemner Slotted Weights	NIST No.
----------	-----	-----------	--------------------------------	----------

### Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	10/14/2015	3:21:10 PM	Signed





AN A2LA ACCREDITED CALIBRATION LABORATORY

PAGE 1 OF 2

## RALCO, INC.

81 STATE STREET NORTH HAVEN CT 06473

TEL: 203-239-6558 FAX: 203-239-6625

### *Certificate of Calibration*

CUSTOMER: RSCC WIRE & CABLE LLC

P.O.# 161415

ADDRESS: 20 BRADLEY PARK ROAD

CITY, STATE: EAST GRANBY, CT 06026

TEST # 90558

☐ CUSTOMER FACILITY

☒ RALCO

TEST DATE: 7/27/16

DESCRIPTION: DISPLAY/PLATFORM SCALE, MEASURETEK, MODEL#12R981/PS-102-200

SERIAL NO: 091500183

I.D. # N/A

RATED ACCURACY: Per Mfr's Manual

**THE SUBJECT ITEM WAS CALIBRATED USING THE FOLLOWING CALIBRATION PROCEDURE:**

☐ MANUFACTURER'S MANUAL

☒ ANSI/ASME PROCEDURE (SEE DATA SHEET)

This is to certify that the calibration of the above has been performed in compliance with the calibration systems requirements of ANSI / NCSL Z540-1-1994 and is traceable to N.I.S.T. and S.I. Units.

Test were conducted at an ambient temperature of  $20 \pm 5^{\circ}\text{C}$  and R.H. under 75%

RALCO, INC.  
*Robert C. Cuddeback*

APPROVED AUG 09 2016  
JD

BY \_\_\_\_\_

Laboratory Manager

CONDITION OF EQUIPMENT RECEIVED:

☒ IN TOLERANCE

☐ OUT OF TOLERANCE

☐ INOPERABLE

CALIBRATION PROCEDURE HAS BEEN MODIFIED

☐ SEE REPORT

☐ \*LIMITED CALIBRATION

NOTE: THIS CERTIFICATE SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT WRITTEN APPROVAL BY RALCO, INC.

MEASUREMENT UNCERTAINTY IS EXPRESSED AT A CONFIDENCE LEVEL OF 95% (COVERAGE FACTOR  $k=2$ )

BEST UNCERTAINTY, SEE SCOPE

ALL COMPLIANCE STATEMENTS ARE BASED ON ACTUAL MEASUREMENTS FROM OEM SPECIFICATIONS OR CUSTOMER'S REQUESTED TOLERANCES. NO UNCERTAINTIES CONSIDERATION HAS BEEN TAKEN INTO ACCOUNT FOR COMPLIANCE STATEMENTS.

THIS CERTIFICATE OF CALIBRATION AND ALL ASSOCIATED RESULTS APPLY ONLY TO THE ABOVE NAMED ITEM.





# RALCO, INC

TEL: 203-239-6558 \* 81 STATE STREET \* NORTH HAVEN, CT 06473 \* FAX: 203-239-6625

## TEST REPORT

CUSTOMER: RSCC CONTROL # N/A

Page 2 of 2

DESC: DISPLAY / PLATFORM SCALE MFR: MEASURETEK

Test Date: 7/27/16

MODEL: 12R981 / PS-102-200 SERIAL # 091500183

☐ On-site ☒ In-house

OUNCES ☐ POUNDS ☒ GRAMS ☐ KILOGRAMS ☐ TEST # 90558

WEIGHT #	NOMINAL	MEASURED	UNC. K=2	NOMINAL	MEASURED
	50.00 Lbs	50.0	± 0.006 LBS		
	100.00 Lbs	100.0	± 0.006 LBS		
	150.00 Lbs	150.0	± 0.006 LBS		
	200.00 Lbs	200.0	± 0.006 LBS		
	250.00 Lbs	250.0	± 0.006 LBS		
	300.00 Lbs	300.0	± 0.006 LBS		
	350.00 Lbs	350.0	± 0.006 LBS		
	400.00 Lbs	400.0	± 0.006 LBS		
	440.00 Lbs	440.0	± 0.006 LBS		

APPROVED AUG 09 2016  
30

Standards used to Calibrate Equipment

ID#	Cal. Date	Cal. DueDate	ID#	Cal. Date	Cal. DueDate
RA2003	3/1/2011	3/1/2017	RA2189	3/1/2011	3/1/2017
RA2004	3/1/2011	3/1/2017	RA2190	3/1/2011	3/1/2017
RA2005	3/1/2011	3/1/2017	RA2191	3/1/2011	3/1/2017
RA2006	3/1/2011	3/1/2017	RA2224	3/1/2011	3/1/2017
RA2009	3/1/2011	3/1/2017			
RA2010	3/1/2011	3/1/2017			
RA2011	3/1/2011	3/1/2017			
			FORM: 12R981 PS-102-200		

CONDITION OF EQUIPMENT RECEIVED:

BEFORE ☒

AFTER ☐

IN TOLERANCE ☒

OUT OF TOLERANCE ☐

INOPERABLE ☐

DAMAGED ☐

\*CALIBRATION PROCEDURE HAS BEEN MODIFIED ☐

TECHNICIAN acai/k





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID DglThmMtr 05000007	Approved Yes
Gage S/N 05000007	As Found Condition In
Description Digital Thermometer Indicator	
Procedure No. 9	
Model No. HH501DK	
Unit of Meas. °C, °F	
Manufacturer Omega	
Cal. Date 10/14/2015	
Next Due 10/31/2016	
Cal. Freq. 12.00 End of Month	
Location Q.C. Lab - Main Building	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

Uncertainty of Measurement = +/- 2.06 Deg C	Temperature 75
	Humidity 41

## Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	10/14/2015	2:50:32 PM	Signed
John O'Dell	10/14/2015	2:54:55 PM	Unsigned
John O'Dell	10/14/2015	2:59:50 PM	Signed
John O'Dell	4/26/2016	2:05:35 PM	Unsigned
John O'Dell	4/26/2016	2:08:11 PM	Signed
John O'Dell	4/26/2016	2:12:39 PM	Unsigned
John O'Dell	4/26/2016	2:13:03 PM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID	Time LAB 1	Approved	Yes
Gage S/N	LAB 1	As Found Condition	In
Description	Timer		
Procedure No.	4		
Model No.			
Unit of Meas.	Mins / Secs		
Manufacturer	China		
Cal. Date	3/17/2016		
Next Due	3/31/2017		
Cal. Freq.	12.00	End of Month	
Location	R. A. Gehm / R&D Lab		

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature	74
	Humidity	26

Standard ID	1) 1	Uncertainty		Units	min	Type	V
Limited Use?	No	Minimum	0.95	Nominal	1	Maximum	1.05
Ref Type	Digital Stopwatch	Before	0.991	Accuracy	-9.000000000	Fail Before	No
		After	0.991	Accuracy	-9.000000000	Fail After	No

Gage ID of Standard	STD 8						
Std Due Date	5/31/2016	Gage S/N	B39427	Model No.	460	NIST No.	

Standard ID	2) 2	Uncertainty		Units	min	Type	V
Limited Use?	No	Minimum	1.9	Nominal	2	Maximum	2.1
Ref Type	Digital Stopwatch	Before	1.992	Accuracy	-8.000000000	Fail Before	No
		After	1.992	Accuracy	-8.000000000	Fail After	No

Gage ID of Standard	STD 8						
Std Due Date	5/31/2016	Gage S/N	B39427	Model No.	460	NIST No.	

Standard ID	3) 3	Uncertainty		Units	min	Type	V
Limited Use?	No	Minimum	2.85	Nominal	3	Maximum	3.15
Ref Type	Digital Stopwatch	Before	2.993	Accuracy	-7.000000000	Fail Before	No
		After	2.993	Accuracy	-7.000000000	Fail After	No

Calibration Certificate Report With Measurements



Gage ID of Standard	STD 8	Gage S/N	B39427	Model No.	460	NIST No.
Std Due Date	5/31/2016					
Standard ID	4) 4	Uncertainty		Units	min	Type V
Limited Use?	No	Minimum	3.8	Nominal	4	Maximum 4.2
Ref Type	Digital Stopwatch	Before	3.995	Accuracy	-4.999999999	Fail Before No
		After	3.995	Accuracy	-4.999999999	Fail After No
Gage ID of Standard	STD 8	Gage S/N	B39427	Model No.	460	NIST No.
Std Due Date	5/31/2016					
Standard ID	5) 5	Uncertainty		Units	min	Type V
Limited Use?	No	Minimum	4.75	Nominal	5	Maximum 5.25
Ref Type	Digital Stopwatch	Before	4.994	Accuracy	-6.000000000	Fail Before No
		After	4.994	Accuracy	-6.000000000	Fail After No
Gage ID of Standard	STD 8	Gage S/N	B39427	Model No.	460	NIST No.
Std Due Date	5/31/2016					
Standard ID	6) 10	Uncertainty		Units	min	Type V
Limited Use?	No	Minimum	9.5	Nominal	10	Maximum 10.5
Ref Type	Digital Stopwatch	Before	9.993	Accuracy	-6.999999999	Fail Before No
		After	9.993	Accuracy	-6.999999999	Fail After No
Gage ID of Standard	STD 8	Gage S/N	B39427	Model No.	460	NIST No.
Std Due Date	5/31/2016					
Standard ID	7) 15	Uncertainty		Units	min	Type V
Limited Use?	No	Minimum	14.25	Nominal	15	Maximum 15.75
Ref Type	Digital Stopwatch	Before	14.994	Accuracy	-6.000000000	Fail Before No
		After	14.994	Accuracy	-6.000000000	Fail After No
Gage ID of Standard	STD 8	Gage S/N	B39427	Model No.	460	NIST No.
Std Due Date	5/31/2016					
Standard ID	8) 20	Uncertainty		Units	min	Type V
Limited Use?	No	Minimum	19	Nominal	20	Maximum 21
Ref Type	Digital Stopwatch	Before	19.993	Accuracy	-7.000000000	Fail Before No
		After	19.993	Accuracy	-7.000000000	Fail After No
Gage ID of Standard	STD 8	Gage S/N	B39427	Model No.	460	NIST No.
Std Due Date	5/31/2016					
Standard ID	9) 30	Uncertainty		Units	min	Type V
Limited Use?	No	Minimum	28.5	Nominal	30	Maximum 31.5
Ref Type	Digital Stopwatch	Before	29.996	Accuracy	-4.000000000	Fail Before No
		After	29.996	Accuracy	-4.000000000	Fail After No
Gage ID of Standard	STD 8	Gage S/N	B39427	Model No.	460	NIST No.
Std Due Date	5/31/2016					

Calibrated By Electronic Signature

Calibration Certificate Report With Measurements



Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	3/17/2016	2:40:41 PM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID Test 78-31422	Approved Yes
Gage S/N 78-31422	As Found Condition In
Description 100 kV AC Test Set	
Procedure No. 10	
Model No. 7100-5	
Unit of Meas. kV AC	
Manufacturer Hipotronics	
Cal. Date 3/2/2016	
Next Due 3/31/2017	
Cal. Freq. 12.00 End of Month	
Location Q.C. Lab - Main Building	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

Low scale only and up to 20 kV	Temperature 70
	Humidity 30

Standard ID	01) 5 kV	Uncertainty	Units	kV AC	Type	V
Limited Use?	No	Minimum	4.00	Nominal	5.00	Maximum 6.00
Ref Type	Kilovoltmeter	Before	4.80	Accuracy	-0.20	Fail Before No
		After	4.80	Accuracy	-0.20	Fail After No

Gage ID of Standard	STD 1	Gage S/N	5000-1051	Model No.	KV50A	NIST No.	821/266717-02
Std Due Date	7/31/2017						
Low Scale							

Standard ID	02) 10 kV	Uncertainty	Units	kV AC	Type	V
Limited Use?	No	Minimum	9.00	Nominal	10.00	Maximum 11.00
Ref Type	Kilovoltmeter	Before	10.50	Accuracy	0.50	Fail Before No
		After	10.50	Accuracy	0.50	Fail After No

Gage ID of Standard	STD 1	Gage S/N	5000-1051	Model No.	KV50A	NIST No.	821/266717-02
Std Due Date	7/31/2017						
Low Scale							

Standard ID	03) 15 kV	Uncertainty	Units	kV AC	Type	V
Limited Use?	No	Minimum	14.00	Nominal	15.00	Maximum 16.00
Ref Type	Kilovoltmeter	Before	15.75	Accuracy	0.75	Fail Before No
		After	15.75	Accuracy	0.75	Fail After No

Calibration Certificate Report With Measurements



Gage ID of Standard	STD 1				
Std Due Date	7/31/2017	Gage S/N	5000-1051	Model No.	KV50A
Low Scale				NIST No.	821/266717-02

Standard ID	04) 20 kV	Uncertainty		Units	kV AC	Type	V
Limited Use?	No	Minimum	19.00	Nominal	20.00	Maximum	21.00
Ref Type	Kilovoltmeter	Before	21.00	Accuracy	1.00	Fail Before	No
		After	21.00	Accuracy	1.00	Fail After	No

Gage ID of Standard	STD 1				
Std Due Date	7/31/2017	Gage S/N	5000-1051	Model No.	KV50A
Low Scale				NIST No.	821/266717-02

### Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	3/2/2016	9:14:11 AM	Signed
John O'Dell	3/4/2016	9:19:51 AM	Unsigned
John O'Dell	3/4/2016	9:19:59 AM	Signed
John O'Dell	5/6/2016	8:49:56 AM	Unsigned
John O'Dell	5/6/2016	8:50:06 AM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID	PressTransducer LSPT-7	Approved	Yes
Gage S/N	LSPT-7	As Found Condition	In
Description	200 PSI Pressure Transducer		
Procedure No.	7		
Model No.	PX313-200G5V		
Unit of Meas.	psi		
Manufacturer	Omega		
Cal. Date	3/18/2016		
Next Due	3/31/2017		
Cal. Freq.	12.00	End of Month	
Location	Loca Chamber		

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature	65
	Humidity	30

Standard ID	1) 5	Uncertainty	Units	psi	Type	V
Limited Use?	No	Minimum	4.75	Nominal	5	Maximum 5.25
Ref Type	Pressure Gauge	Before	4.8	Accuracy	-0.2	Fail Before No
		After	4.8	Accuracy	-0.2	Fail After No

Gage ID of Standard	STD 33	Gage S/N	AG-3-1	Model No.	NIST No.	263934 8/00
Std Due Date	12/30/2016					

Standard ID	10) 180	Uncertainty	Units	psi	Type	V
Limited Use?	No	Minimum	171	Nominal	180	Maximum 189
Ref Type	Pressure Gauge	Before	178.5	Accuracy	-1.5	Fail Before No
		After	178.5	Accuracy	-1.5	Fail After No

Gage ID of Standard	STD B6	Gage S/N	B6	Model No.	NIST No.	263934 8/00
Std Due Date	12/30/2016					

Standard ID	2) 20	Uncertainty	Units	psi	Type	V
Limited Use?	No	Minimum	19	Nominal	20	Maximum 21
Ref Type	Pressure Gauge	Before	20.4	Accuracy	0.3999999999	Fail Before No
		After	20.4	Accuracy	0.3999999999	Fail After No

Calibration Certificate Report With Measurements



Gage ID of Standard STD 33  
 Std Due Date 12/30/2016 Gage S/N AG-3-1 Model No. NIST No. 263934 8/00

Standard ID	3) 40	Uncertainty		Units	psi	Type	V
Limited Use?	No	Minimum	38	Nominal	40	Maximum	42
Ref Type	Pressure Gauge	Before	40.2	Accuracy	0.2000000000	Fail Before	No
		After	40.2	Accuracy	0.2000000000	Fail After	No

Gage ID of Standard STD 33  
 Std Due Date 12/30/2016 Gage S/N AG-3-1 Model No. NIST No. 263934 8/00

Standard ID	4) 60	Uncertainty		Units	psi	Type	V
Limited Use?	No	Minimum	57	Nominal	60	Maximum	63
Ref Type	Pressure Gauge	Before	60	Accuracy	0	Fail Before	No
		After	60	Accuracy	0	Fail After	No

Gage ID of Standard STD 33  
 Std Due Date 12/30/2016 Gage S/N AG-3-1 Model No. NIST No. 263934 8/00

Standard ID	5) 80	Uncertainty		Units	psi	Type	V
Limited Use?	No	Minimum	76	Nominal	80	Maximum	84
Ref Type	Pressure Gauge	Before	80.2	Accuracy	0.2000000000	Fail Before	No
		After	80.2	Accuracy	0.2000000000	Fail After	No

Gage ID of Standard STD 33  
 Std Due Date 12/30/2016 Gage S/N AG-3-1 Model No. NIST No. 263934 8/00

Standard ID	6) 100	Uncertainty		Units	psi	Type	V
Limited Use?	No	Minimum	95	Nominal	100	Maximum	105
Ref Type	Pressure Gauge	Before	99.9	Accuracy	-9.999999999	Fail Before	No
		After	99.9	Accuracy	-9.999999999	Fail After	No

Gage ID of Standard STD B6  
 Std Due Date 12/30/2016 Gage S/N B6 Model No. NIST No. 263934 8/00

Standard ID	7) 120	Uncertainty		Units	psi	Type	V
Limited Use?	No	Minimum	114	Nominal	120	Maximum	126
Ref Type	Pressure Gauge	Before	120.3	Accuracy	0.2999999999	Fail Before	No
		After	120.3	Accuracy	0.2999999999	Fail After	No

Gage ID of Standard STD B6  
 Std Due Date 12/30/2016 Gage S/N B6 Model No. NIST No. 263934 8/00

Standard ID	8) 140	Uncertainty		Units	psi	Type	V
Limited Use?	No	Minimum	133	Nominal	140	Maximum	147
Ref Type	Pressure Gauge	Before	140.4	Accuracy	0.4000000000	Fail Before	No
		After	140.4	Accuracy	0.4000000000	Fail After	No

Gage ID of Standard STD B6  
 Std Due Date 12/30/2016 Gage S/N B6 Model No. NIST No. 263934 8/00

Standard ID	9) 160	Uncertainty		Units	psi	Type	V
Limited Use?	No	Minimum	152	Nominal	160	Maximum	168
Ref Type	Pressure Gauge	Before	160.6	Accuracy	0.5999999999	Fail Before	No

Calibration Certificate Report With Measurements



		After	160.6	Accuracy	0.5999999999	Fail After	No
Gage ID of Standard	STD B6						
Std Due Date	12/30/2016	Gage S/N	B6	Model No.		NIST No.	263934 8/00

---

## Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	3/18/2016	9:59:52 AM	Signed

---





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID	DigitalTempInd Loca-Temp	Approved	Yes
Gage S/N	Loca-Temp	As Found Condition	In
Description	Digital Temperature Indicator		
Procedure No.	51		
Model No.			
Unit of Meas.	°F		
Manufacturer	Omega/Rockbestos		
Cal. Date	6/15/2016		
Next Due	6/30/2017		
Cal. Freq.	12.00	End of Month	
Location	Loca Chamber		

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature	77
	Humidity	22

Standard ID	01) TC-08	Uncertainty	Units	°F	Type	V
Limited Use?	No	Minimum	98.2	Nominal	100	Maximum 101.8
Ref Type	Dry Well Calibrator	Before	98.6	Accuracy	-1.400000000	Fail Before No
		After	98.6	Accuracy	-1.400000000	Fail After No

Gage ID of Standard	STD 77					
Std Due Date	10/31/2016	Gage S/N	B49299	Model No.	9100S	NIST No.

Standard ID	02) TC-08	Uncertainty	Units	°F	Type	V
Limited Use?	No	Minimum	198.2	Nominal	200	Maximum 201.8
Ref Type	Dry Well Calibrator	Before	198.5	Accuracy	-1.5	Fail Before No
		After	198.5	Accuracy	-1.5	Fail After No

Gage ID of Standard	STD 77					
Std Due Date	10/31/2016	Gage S/N	B49299	Model No.	9100S	NIST No.

Standard ID	03) TC-08	Uncertainty	Units	°F	Type	V
Limited Use?	No	Minimum	298.2	Nominal	300	Maximum 301.8
Ref Type	Dry Well Calibrator	Before	299.8	Accuracy	-0.199999999	Fail Before No
		After	299.8	Accuracy	-0.199999999	Fail After No

Calibration Certificate Report With Measurements



Gage ID of Standard STD 77  
Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

Standard ID	04) TC-08	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	398.2	Nominal	400	Maximum	401.8
Ref Type	Dry Well Calibrator	Before	399.8	Accuracy	-0.199999999	Fail Before	No
		After	399.8	Accuracy	-0.199999999	Fail After	No

Gage ID of Standard STD 77  
Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

Standard ID	05) TC-008	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	498.2	Nominal	500	Maximum	501.8
Ref Type	Dry Well Calibrator	Before	499.6	Accuracy	-0.399999999	Fail Before	No
		After	499.6	Accuracy	-0.399999999	Fail After	No

Gage ID of Standard STD 77  
Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

Standard ID	06) TC-09	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	98.2	Nominal	100	Maximum	101.8
Ref Type	Dry Well Calibrator	Before	100	Accuracy	0	Fail Before	No
		After	100	Accuracy	0	Fail After	No

Gage ID of Standard STD 77  
Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

Standard ID	07) TC-09	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	198.2	Nominal	200	Maximum	201.8
Ref Type	Dry Well Calibrator	Before	200.1	Accuracy	9.999999999	Fail Before	No
		After	200.1	Accuracy	9.999999999	Fail After	No

Gage ID of Standard STD 77  
Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

Standard ID	08) TC-09	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	298.2	Nominal	300	Maximum	301.8
Ref Type	Dry Well Calibrator	Before	299.7	Accuracy	-0.300000000	Fail Before	No
		After	299.7	Accuracy	-0.300000000	Fail After	No

Gage ID of Standard STD 77  
Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

Standard ID	09) TC-09	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	398.2	Nominal	400	Maximum	401.8
Ref Type	Dry Well Calibrator	Before	399	Accuracy	-1	Fail Before	No
		After	399	Accuracy	-1	Fail After	No

Gage ID of Standard STD 77  
Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

Standard ID	10) TC-09	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	498.2	Nominal	500	Maximum	501.8
Ref Type	Dry Well Calibrator	Before	499	Accuracy	-1	Fail Before	No

Calibration Certificate Report With Measurements



		After	499	Accuracy	-1	Fail After	No
Gage ID of Standard	STD 77						
Std Due Date	10/31/2016	Gage S/N	B49299	Model No.	9100S	NIST No.	
Standard ID	11) TC-10	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	98.2	Nominal	100	Maximum	101.8
Ref Type	Dry Well Calibrator	Before	98.8	Accuracy	-1.2	Fail Before	No
		After	98.8	Accuracy	-1.2	Fail After	No
Gage ID of Standard	STD 77						
Std Due Date	10/31/2016	Gage S/N	B49299	Model No.	9100S	NIST No.	
Standard ID	12) TC-10	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	198.2	Nominal	200	Maximum	201.8
Ref Type	Dry Well Calibrator	Before	199.1	Accuracy	-0.900000000	Fail Before	No
		After	199.1	Accuracy	-0.900000000	Fail After	No
Gage ID of Standard	STD 77						
Std Due Date	10/31/2016	Gage S/N	B49299	Model No.	9100S	NIST No.	
Standard ID	13) TC-10	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	298.2	Nominal	300	Maximum	301.8
Ref Type	Dry Well Calibrator	Before	298.9	Accuracy	-1.100000000	Fail Before	No
		After	298.9	Accuracy	-1.100000000	Fail After	No
Gage ID of Standard	STD 77						
Std Due Date	10/31/2016	Gage S/N	B49299	Model No.	9100S	NIST No.	
Standard ID	14) TC-10	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	398.2	Nominal	400	Maximum	401.8
Ref Type	Dry Well Calibrator	Before	398.2	Accuracy	-1.800000000	Fail Before	No
		After	398.2	Accuracy	-1.800000000	Fail After	No
Gage ID of Standard	STD 77						
Std Due Date	10/31/2016	Gage S/N	B49299	Model No.	9100S	NIST No.	
Standard ID	15) TC-10	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	498.2	Nominal	500	Maximum	501.8
Ref Type	Dry Well Calibrator	Before	498.9	Accuracy	-1.100000000	Fail Before	No
		After	498.9	Accuracy	-1.100000000	Fail After	No
Gage ID of Standard	STD 77						
Std Due Date	10/31/2016	Gage S/N	B49299	Model No.	9100S	NIST No.	
Standard ID	16) TC-11	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	98.2	Nominal	100	Maximum	101.8
Ref Type	Dry Well Calibrator	Before	98.6	Accuracy	-1.400000000	Fail Before	No
		After	98.6	Accuracy	-1.400000000	Fail After	No
Gage ID of Standard	STD 77						
Std Due Date	10/31/2016	Gage S/N	B49299	Model No.	9100S	NIST No.	
Standard ID	17) TC-11	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	198.2	Nominal	200	Maximum	201.8



Ref Type	Dry Well Calibrator	Before	198.2	Accuracy	-1.800000000	Fail Before	No
		After	198.2	Accuracy	-1.800000000	Fail After	No

Gage ID of Standard STD 77

Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

Standard ID	18) TC-11	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	298.2	Nominal	300	Maximum	301.8
Ref Type	Dry Well Calibrator	Before	299	Accuracy	-1	Fail Before	No
		After	299	Accuracy	-1	Fail After	No

Gage ID of Standard STD 77

Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

Standard ID	19) TC-11	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	398.2	Nominal	400	Maximum	401.8
Ref Type	Dry Well Calibrator	Before	399.2	Accuracy	-0.800000000	Fail Before	No
		After	399.2	Accuracy	-0.800000000	Fail After	No

Gage ID of Standard STD 77

Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

Standard ID	20) TC-11	Uncertainty		Units	°F	Type	V
Limited Use?	No	Minimum	498.2	Nominal	500	Maximum	501.8
Ref Type	Dry Well Calibrator	Before	499	Accuracy	-1	Fail Before	No
		After	499	Accuracy	-1	Fail After	No

Gage ID of Standard STD 77

Std Due Date 10/31/2016

Gage S/N B49299

Model No. 9100S

NIST No.

### Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	6/16/2016	12:09:31 PM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID Megmtr 08220657	Approved Yes
Gage S/N 08220657	As Found Condition In
Description 50k - 200T ohms Megohmmeter	
Procedure No. 13	
Model No. 1865	
Unit of Meas. ohms	
Manufacturer Quad Tech	
Cal. Date 5/16/2016	
Next Due 5/31/2017	
Cal. Freq. 12.00 End of Month	
Location Q.C. Lab - Main Building	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature 72
	Humidity 36

Standard ID	01) 50V	Uncertainty	Units	volts	Type	V
Limited Use?	No	Minimum	45	Nominal	50	Maximum 55
Ref Type	Digital Multimeter	Before	50	Accuracy	0	Fail Before No
		After	50	Accuracy	0	Fail After No

Gage ID of Standard	STD 34	Gage S/N	7228050	Model No.	8060A	NIST No.	263934 8/00
Std Due Date	5/31/2016						

Standard ID	02) 100V	Uncertainty	Units	volts	Type	V
Limited Use?	No	Minimum	90	Nominal	100	Maximum 110
Ref Type	Digital Multimeter	Before	100	Accuracy	0	Fail Before No
		After	100	Accuracy	0	Fail After No

Gage ID of Standard	STD 34	Gage S/N	7228050	Model No.	8060A	NIST No.	263934 8/00
Std Due Date	5/31/2016						

Standard ID	03) 200V	Uncertainty	Units	volts	Type	V
Limited Use?	No	Minimum	180	Nominal	200	Maximum 220
Ref Type	Digital Multimeter	Before	200.1	Accuracy	9.9999999999	Fail Before No
		After	200.1	Accuracy	9.9999999999	Fail After No

Calibration Certificate Report With Measurements



Gage ID of Standard STD 34  
 Std Due Date 5/31/2016 Gage S/N 7228050 Model No. 8060A NIST No. 263934 8/00

Standard ID	04) 250V	Uncertainty		Units	volts	Type	V
Limited Use?	No	Minimum	225	Nominal	250	Maximum	275
Ref Type	Digital Multimeter	Before	250.4	Accuracy	0.4000000000	Fail Before	No
		After	250.4	Accuracy	0.4000000000	Fail After	No

Gage ID of Standard STD 34  
 Std Due Date 5/31/2016 Gage S/N 7228050 Model No. 8060A NIST No. 263934 8/00

Standard ID	05) 500V	Uncertainty		Units	volts	Type	V
Limited Use?	No	Minimum	450	Nominal	500	Maximum	550
Ref Type	Digital Multimeter	Before	499.8	Accuracy	-0.1999999999	Fail Before	No
		After	499.8	Accuracy	-0.1999999999	Fail After	No

Gage ID of Standard STD 34  
 Std Due Date 5/31/2016 Gage S/N 7228050 Model No. 8060A NIST No. 263934 8/00

Standard ID	06) 1000V	Uncertainty		Units	volts	Type	V
Limited Use?	No	Minimum	900	Nominal	1000	Maximum	1100
Ref Type	Digital Multimeter	Before	1000.5	Accuracy	0.5	Fail Before	No
		After	1000.5	Accuracy	0.5	Fail After	No

Gage ID of Standard STD 34  
 Std Due Date 5/31/2016 Gage S/N 7228050 Model No. 8060A NIST No. 263934 8/00

Standard ID	07) 1.0M	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	0.891	Nominal	0.99	Maximum	1.089
Ref Type	Megohm Resistors	Before	0.9832	Accuracy	-6.8000000000	Fail Before	No
		After	0.9832	Accuracy	-6.8000000000	Fail After	No

Gage ID of Standard STD 2  
 Std Due Date 9/29/2017 Gage S/N 0001 Model No. NIST No.

Standard ID	08) 5.0M	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	4.815	Nominal	5.35	Maximum	5.885
Ref Type	Megohm Resistors	Before	5.282	Accuracy	-6.7999999999	Fail Before	No
		After	5.282	Accuracy	-6.7999999999	Fail After	No

Gage ID of Standard STD 2  
 Std Due Date 9/29/2017 Gage S/N 0001 Model No. NIST No.

Standard ID	09) 100.0M	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	90	Nominal	100	Maximum	110
Ref Type	Megohm Resistors	Before	99.885	Accuracy	-0.1149999999	Fail Before	No
		After	99.885	Accuracy	-0.1149999999	Fail After	No

Gage ID of Standard STD 2  
 Std Due Date 9/29/2017 Gage S/N 0001 Model No. NIST No.

Standard ID	10) 1.0G	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	0.909	Nominal	1.01	Maximum	1.111
Ref Type	Megohm Resistors	Before	1.01	Accuracy	0	Fail Before	No

Calibration Certificate Report With Measurements



		After	1.01	Accuracy	0	Fail After	No
Gage ID of Standard	STD 2						
Std Due Date	9/29/2017	Gage S/N	0001	Model No.		NIST No.	
Standard ID	11) 10.0G	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	9	Nominal	10	Maximum	11
Ref Type	Megohm Resistors	Before	9.954	Accuracy	-4.599999999	Fail Before	No
		After	9.954	Accuracy	-4.599999999	Fail After	No
Gage ID of Standard	STD 2						
Std Due Date	9/29/2017	Gage S/N	0001	Model No.		NIST No.	
Standard ID	12) 100.0G	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	89.1	Nominal	99	Maximum	108.9
Ref Type	Megohm Resistors	Before	108.883	Accuracy	9.883	Fail Before	No
		After	108.883	Accuracy	9.883	Fail After	No
Gage ID of Standard	STD 2						
Std Due Date	9/29/2017	Gage S/N	0001	Model No.		NIST No.	
Standard ID	13) 1.0T	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	0.774	Nominal	0.86	Maximum	0.946
Ref Type	Megohm Resistors	Before	0.886	Accuracy	0.026	Fail Before	No
		After	0.886	Accuracy	0.026	Fail After	No
Gage ID of Standard	STD 2						
Std Due Date	9/29/2017	Gage S/N	0001	Model No.		NIST No.	
Standard ID	14) 10.0T	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	7.02	Nominal	7.8	Maximum	8.58
Ref Type	Megohm Resistors	Before	7.987	Accuracy	0.187	Fail Before	No
		After	7.987	Accuracy	0.187	Fail After	No
Gage ID of Standard	STD 2A						
Std Due Date	9/29/2017	Gage S/N	0001-1	Model No.		NIST No.	

## Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	5/16/2016	10:05:03 AM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID Megmtr 9150249	Approved Yes
Gage S/N 9150249	As Found Condition In
Description 50k - 200T ohms Megohmmeter	
Procedure No. 13	
Model No. 1865	
Unit of Meas. ohms	
Manufacturer Quad Tech	
Cal. Date 3/18/2016	
Next Due 3/31/2017	
Cal. Freq. 12.00 End of Month	
Location Loca Chamber	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature 66
	Humidity 29

Standard ID	01) 50V	Uncertainty	Units	volts	Type	V
Limited Use?	No	Minimum	45	Nominal	50	Maximum 55
Ref Type	Digital Multimeter	Before	50.1	Accuracy	0.1000000000	Fail Before No
		After	50.1	Accuracy	0.1000000000	Fail After No

Gage ID of Standard	STD 34	Gage S/N	7228050	Model No.	8060A	NIST No.	263934 8/00
Std Due Date	5/31/2016						

Standard ID	02) 100V	Uncertainty	Units	volts	Type	V
Limited Use?	No	Minimum	90	Nominal	100	Maximum 110
Ref Type	Digital Multimeter	Before	100.2	Accuracy	0.2000000000	Fail Before No
		After	100.2	Accuracy	0.2000000000	Fail After No

Gage ID of Standard	STD 34	Gage S/N	7228050	Model No.	8060A	NIST No.	263934 8/00
Std Due Date	5/31/2016						

Standard ID	03) 200V	Uncertainty	Units	volts	Type	V
Limited Use?	No	Minimum	180	Nominal	200	Maximum 220
Ref Type	Digital Multimeter	Before	200.2	Accuracy	0.1999999999	Fail Before No
		After	200.2	Accuracy	0.1999999999	Fail After No

Calibration Certificate Report With Measurements



Gage ID of Standard STD 34  
 Std Due Date 5/31/2016 Gage S/N 7228050 Model No. 8060A NIST No. 263934 8/00

Standard ID	04) 250V	Uncertainty		Units	volts	Type	V
Limited Use?	No	Minimum	225	Nominal	250	Maximum	275
Ref Type	Digital Multimeter	Before	251.3	Accuracy	1.3000000000	Fail Before	No
		After	251.3	Accuracy	1.3000000000	Fail After	No

Gage ID of Standard STD 34  
 Std Due Date 5/31/2016 Gage S/N 7228050 Model No. 8060A NIST No. 263934 8/00

Standard ID	05) 500V	Uncertainty		Units	volts	Type	V
Limited Use?	No	Minimum	450	Nominal	500	Maximum	550
Ref Type	Digital Multimeter	Before	501.1	Accuracy	1.1000000000	Fail Before	No
		After	501.1	Accuracy	1.1000000000	Fail After	No

Gage ID of Standard STD 34  
 Std Due Date 5/31/2016 Gage S/N 7228050 Model No. 8060A NIST No. 263934 8/00

Standard ID	06) 1000V	Uncertainty		Units	volts	Type	V
Limited Use?	No	Minimum	900	Nominal	1000	Maximum	1100
Ref Type	Digital Multimeter	Before	1001.3	Accuracy	1.2999999999	Fail Before	No
		After	1001.3	Accuracy	1.2999999999	Fail After	No

Gage ID of Standard STD 34  
 Std Due Date 5/31/2016 Gage S/N 7228050 Model No. 8060A NIST No. 263934 8/00

Standard ID	07) 1.0M	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	0.891	Nominal	0.99	Maximum	1.089
Ref Type	Megohm Resistors	Before	0.998	Accuracy	8.0000000000	Fail Before	No
		After	0.998	Accuracy	8.0000000000	Fail After	No

Gage ID of Standard STD 2  
 Std Due Date 9/29/2017 Gage S/N 0001 Model No. NIST No.

Standard ID	08) 5.0M	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	4.815	Nominal	5.35	Maximum	5.885
Ref Type	Megohm Resistors	Before	5.3	Accuracy	-4.9999999999	Fail Before	No
		After	5.3	Accuracy	-4.9999999999	Fail After	No

Gage ID of Standard STD 2  
 Std Due Date 9/29/2017 Gage S/N 0001 Model No. NIST No.

Standard ID	09) 100.0M	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	90	Nominal	100	Maximum	110
Ref Type	Megohm Resistors	Before	99.838	Accuracy	-0.1620000000	Fail Before	No
		After	99.838	Accuracy	-0.1620000000	Fail After	No

Gage ID of Standard STD 2  
 Std Due Date 9/29/2017 Gage S/N 0001 Model No. NIST No.

Standard ID	10) 1.0G	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	0.909	Nominal	1.01	Maximum	1.111
Ref Type	Megohm Resistors	Before	1.01	Accuracy	0	Fail Before	No

Calibration Certificate Report With Measurements



		After	1.01	Accuracy	0	Fail After	No
Gage ID of Standard	STD 2						
Std Due Date	9/29/2017	Gage S/N	0001	Model No.		NIST No.	
Standard ID	11) 10.0G	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	9	Nominal	10	Maximum	11
Ref Type	Megohm Resistors	Before	9.952	Accuracy	-0.048	Fail Before	No
		After	9.952	Accuracy	-0.048	Fail After	No
Gage ID of Standard	STD 2						
Std Due Date	9/29/2017	Gage S/N	0001	Model No.		NIST No.	
Standard ID	12) 100.0G	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	89.1	Nominal	99	Maximum	108.9
Ref Type	Megohm Resistors	Before	98.784	Accuracy	-0.215999999	Fail Before	No
		After	98.784	Accuracy	-0.215999999	Fail After	No
Gage ID of Standard	STD 2						
Std Due Date	9/29/2017	Gage S/N	0001	Model No.		NIST No.	
Standard ID	13) 1.0T	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	0.774	Nominal	0.86	Maximum	0.946
Ref Type	Megohm Resistors	Before	0.922	Accuracy	6.200000000	Fail Before	No
		After	0.922	Accuracy	6.200000000	Fail After	No
Gage ID of Standard	STD 2						
Std Due Date	9/29/2017	Gage S/N	0001	Model No.		NIST No.	
Standard ID	14) 10.0T	Uncertainty		Units	ohms	Type	V
Limited Use?	No	Minimum	7.02	Nominal	7.8	Maximum	8.58
Ref Type	Megohm Resistors	Before	7.99	Accuracy	0.19	Fail Before	No
		After	7.99	Accuracy	0.19	Fail After	No
Gage ID of Standard	STD 2A						
Std Due Date	9/29/2017	Gage S/N	0001-1	Model No.		NIST No.	

## Calibrated By Electronic Signature

Signature Name	Signature Date	Signature Time	Signature Mode
John O'Dell	3/18/2016	10:52:08 AM	Signed





## RSCC Wire &amp; Cable LLC

20 Bradley Park Road

East Granby, CT 06026

## Certificate of Calibration

Gage ID Totalizer 113	Approved Yes
Gage S/N 113	As Found Condition In
Description Totalizer	
Procedure No. 50	
Model No. 3120 Totalizer	
Unit of Meas. Gallons	
Manufacturer Invalco	
Cal. Date 5/20/2016	
Next Due 5/31/2017	
Cal. Freq. 12.00 End of Month	
Location Loca Chamber	

## Certification Statement

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

## Findings

## Environmental Conditions

	Temperature 72
	Humidity 22

Standard ID	Gallons Per Minute	Uncertainty	Units	Type	V
Limited Use?	No	Minimum	0.95	Nominal	1
Ref Type	Scale	Before	0.96	Accuracy	-0.04
		After	0.96	Accuracy	-0.04

Gage ID of Standard Scale 50010118

Std Due Date 10/31/2016

Gage S/N 50010118

Model No. ES50R

NIST No.

1 Gallon = 8.34lbs

Standard ID	Gallons Per Minute 2	Uncertainty	Units	Type	V
Limited Use?	No	Minimum	1.425	Nominal	1.5
Ref Type	Scale	Before	1.48	Accuracy	-0.02
		After	1.48	Accuracy	-0.02

Gage ID of Standard Scale 50010118

Std Due Date 10/31/2016

Gage S/N 50010118

Model No. ES50R

NIST No.

## Calibrated By Electronic Signature

Signature Name      Signature Date      Signature Time      Signature Mode

Calibration Certificate Report With Measurements



---

John O'Dell

7/21/2016

6:49:40 AM

Signed



## APPENDIX IX: TEST REPORT FOR RADIATION AND THERMAL AGING

This page has intentionally been left blank.





**KINECTRICS INC.**

**TEST REPORT FOR RADIATION AND THERMAL AGING  
OF  
NUCLEAR CABLE ACCESSORIES**

**May 31, 2016**

**Kinectrics Test Report: K-115342-RA-0001 R00**

**TE Connectivity PO Number N23481**

Prepared by:  
Jon Winebrenner  
Test Manager  
Kinectrics US Inc.

Date: MAY 31, 2016

Reviewed by:  
Jeremy Owen  
Engineer, NPQ  
Kinectrics Inc.

Date: May 31, 2016

Quality Assurance by:  
Robert Burns  
Kinectrics Inc.

Date: 01 June 2016

Approved by:  
Garry Chapman, P.E.  
Director-US Nuclear Programs  
Kinectrics US Inc.

Date: 1 June 2016

Accepted by:  
TE Connectivity Representative

Date: 28 March 2017



# REVISION LOG

REV NO	ISSUE DATE	PREPARED BY	REVIEWED BY		APPROVED BY
00	May 31, 2016	J.Winebrenner	J. Owen	R. Burns	G. Chapman

# REVISION HISTORY

REVISION NUMBER	SECTION/ PARAGRAPH	PAGE	DESCRIPTION
00	All	All	Initial Issue



## Table of Contents

1.0	SCOPE.....	4
1.1	Test Specimen Description.....	4
1.2	Applicable References.....	5
2	TEST REQUIREMENTS .....	5
2.1	Test Sequence .....	5
2.2	Margins .....	5
2.3	Test Procedure Acceptance Criteria.....	5
2.3.1	Visual Inspection.....	5
3	TEST PROGRAM SUMMARY .....	6
3.1	Receipt Inspection (32 samples) .....	6
3.2	Radiation Aging .....	6
3.3	Thermal Aging .....	6
3.4	Post Aging Inspection .....	7
4	TEST EQUIPMENT .....	7
4.1	Instrument Calibration .....	7
5	QUALITY ASSURANCE .....	7
6	CONCLUSION .....	7
	Appendix A : Kinectrics Test Procedure ,K-115342-PSWI-0001 Rev 0.....	8
	Appendix B : Receipt and Inspection.....	21
	Appendix C : Radiation Certification.....	30
	Appendix D : Thermal Aging Plot and M&TE.....	33
	Appendix E : Post Aging Inspection.....	36
	Appendix F : Photographs.....	41



## **1.0 SCOPE**

The scope of this project was to subject 16 representative samples of Raychem's Nuclear Grade Cable Splice Accessories to irradiation and thermal aging. The sample cable splice accessories were irradiated and thermally aged in accordance with the test procedure and applicable sections of IEEE 323-1974 and IEEE 383-1974. A total of 32 samples were supplied by the customer however only 16 were required for this aging program. The remaining samples were placed back in their original shipping container for customer use.

This test program was performed at Kinectrics Inc. in Toronto, Ontario Canada, an independent test laboratory, under 10CFR50 Appendix B and 10CFR21.

### **1.1 Test Specimen Description**

Below is the customer supplied summary of the 4 types of test specimens.

#### **V-type Wire Splice with 2 Wires (NPKV)**

This series of splices were constructed using a #14 AWG insulated wire, spliced together using ring tongue lugs, secured with bolts, washers and nuts with breakout body shim (WCSF-200-18/5-1U), conductor sealing breakout (302A812-52-10/144-N) with an outer sealing end cap (101A062-52/144-N).

#### **In-Line Splice- with Crimp Connector (14 AWG)**

This sample type was assembled using approved crimp connectors and WCSF-070-6/2-3(N) with 1" (25 mm) seal lengths.

#### **BBIT-N**

This sample type was constructed using shielded #6 AWG wire. The shield was not connected thru the splice to simulate a motor lead cable connection. An appropriate connector was used to form an in-line splice.

#### **Nuclear Grade NJRT Jacket Repair Sealing Tape**

This sample type was constructed using multi-conductor #14 AWG cable with a Hypalon jacket. The jacket and insulation was removed, and the conductor exposed over a 0.25 inch region. Note: This sample type was constructed from both 3 and 7 conductor wire. Sample numbers 25 and 26 were made from 3 conductor wire, samples 29 and 30 were made using 7 conductor wire. See table 1 for additional information.



## **1.2 Applicable References**

- IEEE Standard 323-1974, “IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generation Stations”
- IEEE Standard 383-1974, “IEEE Standard to Type Test of Class 1E Electric Cables, Filed Splices and Connections for Nuclear Power Generating Stations”
- 10 CFR 21, “Reporting of Defects and Noncompliance”
- 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants”
- TE test procedure, “Nuclear Cable Accessories AP-1000 Qualification Test Plan, Test Method and Sample Description, Rev.1” dated 23 June, 2015.
- Customer Purchase Order N23481, Dated Sept.1 , 2015

## **2 TEST REQUIREMENTS**

### **2.1 Test Sequence**

The specimens were tested to the following test sequence:

- Receipt Inspection
- Radiation Aging
- Thermal Aging
- Post Aging Final Inspection

Note: No functional testing was conducted for this program.

### **2.2 Margins**

The following margin was applied to the simulation test parameters:

Radiation Aging: +10% of dose per IEEE 323.

### **2.3 Test Procedure Acceptance Criteria**

#### **2.3.1 Visual Inspection**

Physical integrity of the test specimens shall be evaluated by visual examination. The splice material must remain intact throughout the aging process.



### 3 TEST PROGRAM SUMMARY

#### 3.1 Receipt Inspection (32 samples)

The test specimens were visually inspected for damage and photographed. Tags were attached to each specimen indicating the Kinectrics Project Test Specimen Number as defined in table 1. Results of the receipt inspection, test specimen descriptions and Kinectrics assigned serial numbers were recorded on Kinectrics form QF10-1 "Record of Inspection of Incoming Items". See Appendix B for completed incoming inspection forms.

**Table 1: Test Specimens**

Name	Quantity	Required tag Number	Specimen for this program	Un-Aged Samples (For customer use)
V-type wire splice with 2 wires (NPKV)	8	K-115342-01 thur 08	1,2,5,6	3,4,7,8
In-Line Splice- with Crimp Connector	8	K-115342-09 thur 16	9,10,13,14	11,12,15,16
BBIT-N	8	K-115342-17 thur 24	17,18,21,22	19,20,23,24
Nuclear Grade NJRT Jacket Repair Sealing Tape	8	K-115342-25 thur 32	25,26,29,30	27,28,31,32

#### 3.2 Radiation Aging

The test specimens were exposed to a Co-60 source of gamma radiation for a minimum dose of 25.3 MRad. This dose includes +10% of dose per IEEE 323, +10% for processing variability margin. The irradiation dose rate did not exceed 1 MRad per hour. The specimens were irradiated on a vertical wall mount cable tray with the ends of each sample (~1-2 feet) shielded to protect them from radiation exposure. The specimens were rotated as required during the irradiation process to ensure uniform dose. The specimens were not energized during the radiation process. See Appendix C for irradiation certification.

#### 3.3 Thermal Aging

The test specimens were thermally aged to the customer defined service life of 60 years at 150°C. The samples were mounted on horizontal mounted trays. The test sample splices were positioned in the approximate middle of the oven to minimize the amount of thermal exposure to the outer jacketed wire cable. Appendix E provides the post aging inspection reports of each test sample. Photographs located in Appendix F provide views of the samples prior to and after the aging process.



**Table 2**  
**Accumulated thermal aging time @ 150°C vs. required**

Sample ID	TE Sample ID #s Ref. Table 1	Required Aging Time (Hours)	Actual Aging Time (Hours)
V-type wire splice with 2 wires (NPKV)	1,2,5,6	<b>1221 (-0 + 12 hours)</b>	<b>1222.16</b>
In-Line Splice- with Crimp Connector	9,10,13,14	<b>1379 (-0 + 12 hours)</b>	<b>1384.72</b>
BBIT-N	17,18,21,22	<b>1503 (-0 + 12 hours)</b>	<b>1506.80</b>
Nuclear Grade NJRT Jacket Repair Sealing Tape	25,26,29,30	<b>1379 (-0 + 12 hours)</b>	<b>1384.72</b>

### **3.4 Post Aging Inspection**

Upon completion of the aging program all samples were inspected for defects caused by the aging program. Post aging photographs were taken of defects noted during this process. See Appendix E for visual inspection test data and Appendix F for photographs.

## **4 TEST EQUIPMENT**

### **4.1 Instrument Calibration**

All measuring and test equipment calibration was verified prior to use in accordance with Kinectrics' quality program. Calibration equipment and standards used in performing all calibrations is traceable to National or International measurement bodies (e.g. National Research Council Canada (NRCC) or National Institute of Standards and Technology (NIST)).

## **5 QUALITY ASSURANCE**

The test program was performed in accordance with Kinectrics Nuclear QA Program, Revision I, which complies with the requirements of 10CFR50 Appendix B. Forms for this work were prepared according to Kinectrics QA requirements.

## **6 CONCLUSION**

The cable splice specimens completed the test program in accordance with the customer PO, the approved test procedure and all codes, standards and references imposed on the program. Physical integrity of the test specimens was evaluated by visual examination. The splice material remained intact throughout the aging process. Photographs and data are included in the Appendices that follow.



# Appendix A

Kinectrics Test Procedure

K-115342-PSWI-0001 R00





KINETRICS INC.

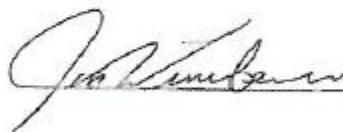
TEST PROCEDURE FOR RADIATION AND THERMAL AGING  
OF  
NUCLEAR CABLE ACCESSORIES

October 15, 2015

TE Connectivity PO Number N23481

Kinectrics Test Procedure: K-115342-PSWI-0001 R00

Prepared by:  
Jon Winebrenner  
Test Manager  
Kinectrics US Inc.

 Date: Oct 15, 2015

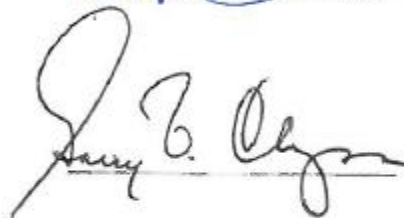
*for* Reviewed by:  
Dave Marttila, P. Eng.  
Engineer, NPQ  
Kinectrics Inc.

 Date: Oct. 16, 2015

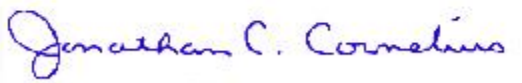
Quality Assurance by:  
Cid Doan  
Quality Assurance  
Kinectrics US Inc.

 Date: 20 OCT 2015

Approved by:  
Garry Chapman, P.E.  
Director-US Nuclear Programs  
Kinectrics US Inc.

 Date: 20 Oct 2015

Accepted by:  
TE Connectivity Representative

 Date: 22 Oct. 2015



## REVISION LOG

REV NO	ISSUE DATE	PREPARED BY	REVIEWED BY		APPROVED BY
00	Oct 15, 2015	J.Winebrenner	D. Marttila	C. Doan	G. Chapman

## REVISION HISTORY

REVISION NUMBER	SECTION/ PARAGRAPH	PAGE	DESCRIPTION
00	All	All	Initial Issue



## Table of Contents

1.0 SCOPE .....	4
1.1 Test Specimen Description .....	4
1.2 Applicable References .....	5
2 TEST REQUIREMENTS .....	5
2.1 Test Sequence .....	5
2.2 Margins .....	5
2.3 Acceptance Criteria .....	5
2.3.1 Visual Inspection .....	5
3 PROCEDURE .....	6
3.1 Receipt Inspection .....	6
3.2 Radiation Aging .....	6
3.3 Thermal Aging .....	6
4 TEST EQUIPMENT .....	7
4.1 Instrument Calibration .....	7
4.2 Test Instrument Lists .....	7
5 QUALITY ASSURANCE .....	7
6 ACTION ON FAILURE TO MEET ACCEPTANCE CRITERIA .....	8
7 DOCUMENTATION .....	8

Attachment A: Specimen Figures



## **1.0 SCOPE**

The scope of this project is to subject 16 representative samples of Raychem's Nuclear Grade Cable Accessories to irradiation and thermal aging. The sample cable accessories shall be irradiated and thermally aged in accordance with this test procedure and applicable sections of IEEE 323-1974 and IEEE 383-1974.

This test program will be performed at Kinectrics Inc. in Toronto, Ontario Canada, an independent test laboratory, under 10CFR50 Appendix B and 10CFR21.

### **1.1 Test Specimen Description**

Below is a summary of the 4 types of customer supplied test specimens. Figures can be found in Attachment A.

#### **V-type Wire Splice with 2 Wires (NPKV)**

This series of splices are constructed using a #14 AWG insulated wire, spliced together using ring tongue lugs, secured with bolts, washers and nuts with breakout body shim (WCSF-200-18/5-1U), conductor sealing breakout (302A812-52-10/144-N) with an outer sealing end cap (101A062-52/144-N).

#### **In-Line Splice- with Crimp Connector (14 AWG)**

These samples are assembled using approved crimp connectors and WCSF-070-6/2-3(N) with 1" (25 mm) seal lengths.

#### **BBIT-N**

These samples are constructed using shielded #6 AWG wire. The shield was not connected thru the splice to simulate a motor lead cable connection. An appropriate connector was used to form an in-line splice.

#### **Nuclear Grade NJRT Jacket Repair Sealing Tape**

These samples are constructed using multi-conductor #14 AWG cable with a Hypalon jacket. The jacket and insulation was removed, and the conductor exposed over a 0.25 inch region. Note: This sample type is constructed from both 3 and 7 conductor wire. Actual samples for this program may be a combination of one or both types of construction. Actual sample construction used shall be identified in the final report.



## 1.2 Applicable References

- IEEE Standard 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generation Stations"
- IEEE Standard 383-1974, "IEEE Standard to Type Test of Class 1E Electric Cables, Filed Splices and Connections for Nuclear Power Generating Stations"
- 10 CFR 21, "Reporting of Defects and Noncompliance"
- 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants"
- TE test procedure, "Nuclear Cable Accessories AP-1000 Qualification Test Plan, Test Method and Sample Description, Rev.1" dated 23 June, 2015.
- Customer Purchase Order N23481, Dated Sept.1 , 2015

## 2 TEST REQUIREMENTS

### 2.1 Test Sequence

The specimens shall be tested to the following test sequence:

- Receipt Inspection
- Radiation Aging
- Thermal Aging
- Post Aging Final Inspection

Note: No functional testing will be conducted for the program.

### 2.2 Margins

The following margin has been applied to the simulation test parameters:

Radiation Aging: +10% of dose per IEEE 323.

### 2.3 Acceptance Criteria

#### 2.3.1 Visual Inspection

Physical integrity of the test specimens shall be evaluated by visual examination. The splice material must remain intact throughout the aging process.



### 3 PROCEDURE

#### 3.1 Receipt Inspection (32 samples)

Customer shall supply 32 samples total, 16 samples will become test samples for thermal and radiation aging. The remaining 16 samples (once received) shall be set aside or placed back into their original shipping container for customer use. Sample tag numbers as received shall be discarded, new numbers shall be attached which will conform to the customers Nuclear Cable Accessories AP-1000 Qualification Test Plan dated June 23, 2015.

The test specimens shall be visually inspected for damage and photographed. The specimens will be inspected to ensure they are sound and meet the manufacturer's requirements. A tag shall be attached to each specimen indicating the Kinectrics Project Test Specimen Number as defined in table 1. The results of the receipt inspection, the test specimen descriptions and serial numbers shall be recorded on Kinectrics form QF10-1 "Record of Inspection of Incoming Items". The Customer shall be informed of any obvious signs of physical damage.

**Table 1: Test Specimens**

Name	Quantity	Required tag Number	Specimen for this program	Un-Aged Samples (Do Not Age)
V-type wire splice with 2 wires (NPKV)	8	K-115342-01 thur 08	1,2,5,6	3,4,7,8
In-Line Splice- with Crimp Connector	8	K-115342-09 thur 16	9,10,13,14	11,12,15,16
BBIT-N	8	K-115342-17 thur 24	17,18,21,22	19,20,23,24
Nuclear Grade NJRT Jacket Repair Sealing Tape	8	K-115342-25 thur 32	25,26,29,30	27,28,31,32

#### 3.2 Radiation Aging

The test specimens shall be exposed to a Co-60 source of gamma radiation for a total dose of 25.3 MRad. This dose includes +10% of dose per IEEE 323, +10% for processing variability margin. The radiation dosage rate shall not exceed 1 MRad per hour and shall not fall below 0.5 MRad per hour for all exposures. The specimens shall be irradiated while on cable trays with the ends of each sample (~1-2 feet) shielded to protect them from radiation exposure. The specimens shall be rotated as required during the irradiation process to ensure uniform dose. Dosimetry shall be reported in the radiation lab final report, along with calibration data and radiation times. The specimens will not be energized during radiation aging.

#### 3.3 Thermal Aging

The test specimens shall be thermally aged for an equivalent service life of 60 years at 90 °C. The test specimens shall be thermally aged in an air-circulating oven with sufficient air changes to avoid oxygen depletion conditions. The thermal aging temperature and time shall be recorded. The timing of the aging stops when the oven heater is turned off to let the samples cool. All samples will be thermally aged flat on trays.



**Table 2**  
**Thermal Aging Requirements**

Sample ID	Required Aging Time (Hours)	TE Sample ID #s Ref. Table 1	Required Aging Temperature
V-type wire splice with 2 wires (NPKV)	<b>1221 (-0 + 12 hours)</b>	1,2,5,6	150 °C (+5, -0 °C)
In-Line Splice- with Crimp Connector	<b>1379 (-0 + 12 hours)</b>	9,10,13,14	150 °C (+5, -0 °C)
BBIT-N	<b>1503 (-0 + 12 hours)</b>	17,18,21,22	150 °C (+5, -0 °C)
Nuclear Grade NJRT Jacket Repair Sealing Tape	<b>1379 (-0 + 12 hours)</b>	25,26,29,30	150 °C (+5, -0 °C)

### 3.4 Post Aging Inspection

Upon completion of the aging program all samples shall be inspected for defects caused by the aging program. Post aging photographs shall be taken of any defects noted during this process.

## 4 TEST EQUIPMENT

### 4.1 Instrument Calibration

Prior to being used in this test program, all measuring and test equipment shall be calibrated in accordance with Kinectrics' quality program. Calibration equipment and standards used in performing all calibrations shall be traceable to National or International measurement bodies (e.g. National Research Council Canada (NRCC) or National Institute of Standards and Technology (NIST)).

### 4.2 Test Instrument Lists

All instrumentation, measuring and test equipment to be used by Kinectrics in the test program shall be recorded on Kinectrics form QF11-1 Instrumentation Sheet (or equivalent) with calibration dates and accuracies. Immediately prior to each test, a test equipment list shall be completed listing all instrumentation used in the test to obtain quantitative measurements including any that require field calibration for the specific function they monitor.

## 5 QUALITY ASSURANCE

The test program shall be performed and all reports shall be prepared in accordance with Kinectrics Nuclear QA Program, Revision I, which complies with the requirements of 10CFR50 Appendix B. Forms for this work will be prepared according to Kinectrics QA requirements and used to record all data and will be signed and reviewed.



## **6 ACTION ON FAILURE TO MEET ACCEPTANCE CRITERIA**

If, at any stage during the tests, any of the following events occur

- The test specimen fails to meet acceptance criteria
- There is a deviation from the test requirements
- There is a facility occurrence which interrupts or affects the test (i.e., loss of power, computer malfunction, etc.)
- Any other significant problems

Kinectrics will undertake the required actions as specified in Kinectrics QA Procedures. The actions may include informing the Customer representative as soon as possible and within 1 working day by either Non Conformance Report or Notice of Anomaly.

The client shall issue instructions in response to the anomaly, indicating if the tests should be stopped, continued or test procedure altered.

Note that generally tests will not be terminated early without the client's approval, unless absolutely unavoidable such as a potential risk has occurred to the test specimen or an unsafe facility condition.

## **7 DOCUMENTATION**

The test report will meet the following requirements as applicable:

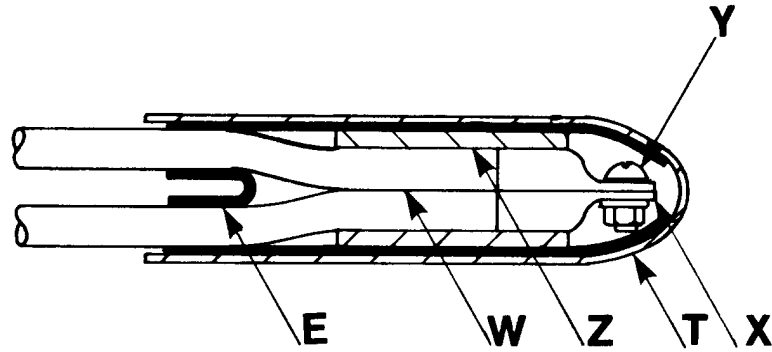
- Title page with signatures and dates
- Name and address of test facility
- Table of Contents
- Statement of test objectives
- Receipt Inspection and Results
- Test Set-Ups
- Photograph(s) showing sample mounting and orientation
- Service conditions that were simulated
- Test Procedure (by reference)
- List of all measuring and test equipment provided by Kinectrics including calibration dates (M&TE)
- Test data and results
- Conclusions
- References
- Anomalies Description and Disposition – if required



## Attachment A: Specimen Figures

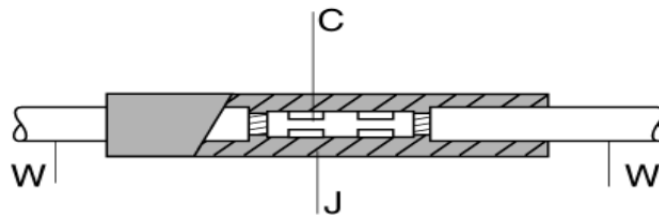
Note: Figures representative of one conductor splice.





Key	Component	Description
E	302A812-52-10/144-N	Conductor sealing breakout
Z	WCSF-200-18/5-1U	Breakout body shim
T	101A062-52/144-N	End cap
W	1/C #14 AWG wire	Single conductor wire
X	Ring tongue lugs	Ring tongue lugs
Y	Bolt, washer and nut	#8, 1/4" long

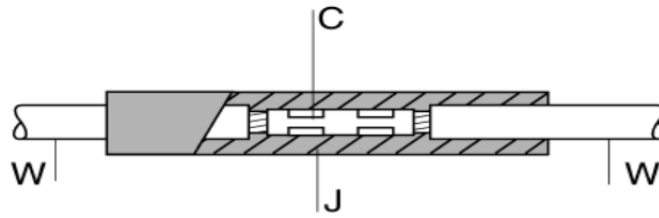
Figure A.1: V- type wire splice with 2 wires (NPKV)



Key	Component	Description
W	1/C Wire as required for test parameter	14 AWG
J	WCSF-As required for test parameter	Splice Sealing Sleeve
C	D-094-05-10-11-02 or equivalent	Crimp Connector

Figure A.2: In- Line Splice- with Crimp Connector

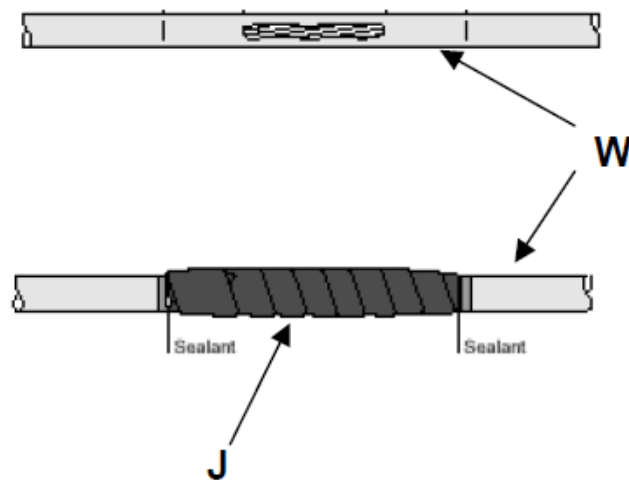




Key	Component	Description
W	1/C Wire as required for test parameter	MV Unshielded #6 Feeder/Motor Lead
J	BBIT-N-As required for test parameter	Splice Sealing Sleeve
C	Appropriate Crimp Connector	Crimp Connector

Figure A.3: BBIT-N





Key	Component	Description
W	Cable	Typical 1/C Wire splice
J	WBTF	Nuclear Jacket Repair Tape

Figure A.4: Nuclear Grade NJRT Jacket Repair Sealing Tape



## Appendix B

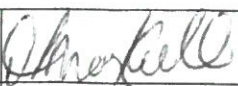

### Receipt and Inspection



# RECORD OF INSPECTION OF INCOMING ITEMS

Document K-115342-11-0001 R00

70 May 26, 2016

Section 1 (To be completed by Project Manager or Delegate)			
Inspection Record No.		K-115342 - II - 0001 R 00 (Project No. K-XXXXXX) -II - (Sequential Number XXXX) R (Rev No. XX)	
Item Description		EQ spliced specimens from Tyco	
Part No./Serial No.		Various – see page 4	
Quantity		Various – see page 4	
<input checked="" type="checkbox"/> Customer Supplied Samples / Mat'ls Received From: Tyco		<input type="checkbox"/> Purchased Items Kinectrics P.O. No.: Line Number	
		<input type="checkbox"/> Other Source Explain:	
Customer P.O. Number		N23481	
Line Number		0001	
Customer's Item Id Number		Various – see page 4	
<b>Fraudulent Inspection is Required for all Purchased Items</b> (Inspector completes page 3) If not required, check here <input checked="" type="checkbox"/> and state reason: Specimens received directly from Tyco			
Documentation To be supplied: (check all that apply)		<input type="checkbox"/> Packing List <input type="checkbox"/> MSDS <input type="checkbox"/> Certificate of Material Test Report <input type="checkbox"/> Certificate of Quality Program Registration, Authorization, Accreditation <input type="checkbox"/> Other	
		<input type="checkbox"/> Manuals, Instructions <input type="checkbox"/> Cert. of Conformance <input type="checkbox"/> Specifications, Drawings <input type="checkbox"/> Cert. of Compliance <input type="checkbox"/> Material Test Report	
<b>Item Labeling Instructions:</b>  Using <del>stainless steel</del> tags, label specimens per information provided on page 4 through 8 of this document. 20 May 26, 2016 stainless steel tags not required by test procedure.			
Lot/Batch Identification Required? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes: document details on page 2			
Section 2 (To be completed by Inspector, Reviewed by Project Manager or Delegate)			
<b>Acceptance Criteria</b>			
Correct item(s) received?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No NCR No.	
Correct quantity?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No NCR No.	
Correct packaging?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No NCR No.	
Packaging Intact (free of damage)?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No NCR No.	
Correct documentation received?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No NCR No.	
Remarks:			
Inspected by		<input checked="" type="checkbox"/> Check When Labels Complete	Date: Nov. 18, 2015
Reviewed by			Date: Nov 18, 2015



115342

→ May 26, 2016

3/28/2017



## RECORD OF INSPECTION OF INCOMING ITEMS

Document K-115-11-0001 R00

115342  
20 Aug 26, 2016

FRAUDULENT PART INSPECTION CHECKLIST			PART ID:	
INSPECTION RESULTS				
	Requirement	Result		If yes, describe deficiency
		No	Yes	
1	Is there evidence of alteration of manufacturer's name, logo, serial number or manufacturing date	<input type="checkbox"/>	<input type="checkbox"/>	
2	Configuration, dimensions, fit, finish, colour or other attributes different than spec?	<input type="checkbox"/>	<input type="checkbox"/>	
3	Markings on items or documentation missing, unusual, altered, inconsistent across the lot compared with that expected?	<input type="checkbox"/>	<input type="checkbox"/>	
4	Markings or documentation from a country other than that of the supplier?	<input type="checkbox"/>	<input type="checkbox"/>	
5	New items exhibit evidence of prior use?	<input type="checkbox"/>	<input type="checkbox"/>	
6	Performance inconsistent with supplied specifications, certification, or test data? <i>(May not be relevant at incoming inspection)</i>	<input type="checkbox"/>	<input type="checkbox"/>	
7	Documentation appears altered, incomplete, lacks expected traceability, Safety Authority (CSA, UL) or manufacturers markings?	<input type="checkbox"/>	<input type="checkbox"/>	
<p>Based on the above examination, the part is considered to be authentic.</p> <p>Yes, Item Accepted for Use: <input type="checkbox"/>      No, Item Rejected for Use (complete NCR): <input type="checkbox"/></p> <p>Remarks:</p>				
Inspected by		Date:		
Reviewed by		Date:		



## RECORD OF INSPECTION OF INCOMING ITEMS

Document K-11541I-0001 R00

115342  
→ May 26, 2016

Attachments:

The test specimens shall be visually inspected for damage and photographed. Physical integrity of the test specimens shall be evaluated by visual examination. The splice material must remain intact throughout the test.

Specimen Description	Kinectrics ID	Notes	Passed Visual Inspection (Y or N)
V-type wire splice with 2 wires (NPKV)	K-115342-01	In good condition	Y
	K-115342-02		Y
	K-115342-03		Y
	K-115342-04		Y
	K-115342-05		Y
	K-115342-06		Y



## RECORD OF INSPECTION OF INCOMING ITEMS

Document K-115-11-0001 R00

115342

20 May 26, 2016

Specimen Description	Kinectrics ID	Notes	Passed Visual Inspection (Y or N)
	K-115342-07	In good condition	Y
	K-115342-08	↓	Y

In-Line Splice with Crimp Connector	K-115342-09	In good condition	Y
	K-115342-10		Y
	K-115342-11		Y
	K-115342-12		Y
	K-115342-13		Y
	K-115342-14	↓	Y



## RECORD OF INSPECTION OF INCOMING ITEMS

Document K-115-11-0001 R00 <sup>115342</sup> 70 May 26, 2016

	K-115342-15	In good condition	y
	K-115342-16	↓	y

BBIT-N	K-115342-17	In good condition	y
	K-115342-18		y
	K-115342-19		y
	K-115342-20		y
	K-115342-21		y
	K-115342-22	↓	y



## RECORD OF INSPECTION OF INCOMING ITEMS

Document K-115-11-0001 R00 <sup>115342</sup> 70 May 26, 2016

	K-115342-23	In good condition ↓	Y
	K-115342-24		Y

Nuclear Grade NJRT Jacket Repair Sealing Tape	K-115342-25	In good condition ↓	Y
	K-115342-26		Y
	K-115342-27		Y
	K-115342-28		Y
	K-115342-29		Y
	K-115342-30		Y



## RECORD OF INSPECTION OF INCOMING ITEMS

115342  
Document K-115-II-0001 R00  
May 26, 2016

	K-115342-31	In good condition	Y
	K-115342-32	↓	Y



## Appendix C


### Radiation Certification





# COMPONENT IRRADIATION CERTIFICATION

Source Type: Cobalt 60 Gamma

Prepared for: Kinectrics Inc.		Process Run ID: 78079A		PO#: 280041561	
Required Dose (MRADS):		25.30		Rate Not to Exceed (MRADS / Hr.): 1.00	
<b>SPECIMENS:</b>					
Quantity:	Part Number:	Serial Number:		Description:	
4	K-115342	1, 2, 5, 6		V-Type Wire Splice with 2 Wires (NPKV)	
4	K-115342	9, 10, 13, 14		In-Line Spice-With Crimp Connector	
4	K-115342	17, 18, 21, 22		BBIT-N	
4	K-115342	25, 26, 29, 30		Nuclear Grade NJRT Jacket Repair Sealing Tape	
<b>DATA:</b>					
*Total Delivered Dose MRADS:		Min	25.30	Max	26.71
Dose Rate MRADS / Hr:		Min	0.828	Max	0.874
Total Exposure Hours: 30.56		Component Placement in cell:		Turn-A <input type="checkbox"/> Area B <input type="checkbox"/> Ceiling <input type="checkbox"/> Dolly <input checked="" type="checkbox"/>	
Component Rotation:		180° <input checked="" type="checkbox"/> Turntable Rotation: <input type="checkbox"/> None: <input type="checkbox"/>			
Date In: 12/09/15			Date Out: 12/11/15		
Total dose delivery includes total dose rate variability and dosimeter uncertainty of 10%					
<b>DOSIMETRY:</b>					
Dosimetry Type: Harwell Alanine Tape Tab			Dosimeter Batch: OAY600		
Dosimeter Calibration Date: 08/25/15			Dosimeter Calibration Due Date: 08/25/16		
Readout Instrument: Bruker e-scan Alanine Spectrometer			Readout Instrument Serial Number: 0470 - TH0036(Holder)		
Readout Instrument Calibration Date: 08/31/15			Readout Instrument Calibration Due Date: 08/31/16		
Comments: None					
<b>ATTACHMENTS:</b>					
Worksheets: <input type="checkbox"/> Drawings: <input type="checkbox"/> Notice of Anomaly: <input type="checkbox"/>					
Approved BY: 			Title: Sr. QS/RC Analyst		Date: 12-13-15

Processing location: STERIS Isomedix Services, Inc. 9 Apollo Drive Whippany, NJ 07981 Phone: 973-887-2754 Fax: 973-887-6591. The product above was processed in accordance with STERIS Isomedix Quality System requirements and the Customer approved process parameters. STERIS Isomedix Services facilities are in compliance with applicable state and federal regulations (FDA, NRC, EPA, and OSHA). STERIS Isomedix Services operates under a quality system which meets the requirements of the FDA QSR and ISO 13485:2003. STERIS Isomedix Services adheres to requirements provided through ANSI/AAMI/ISO 11137:2006.

PROC-00830

Form: 3

Rev:

10

Eff Date:

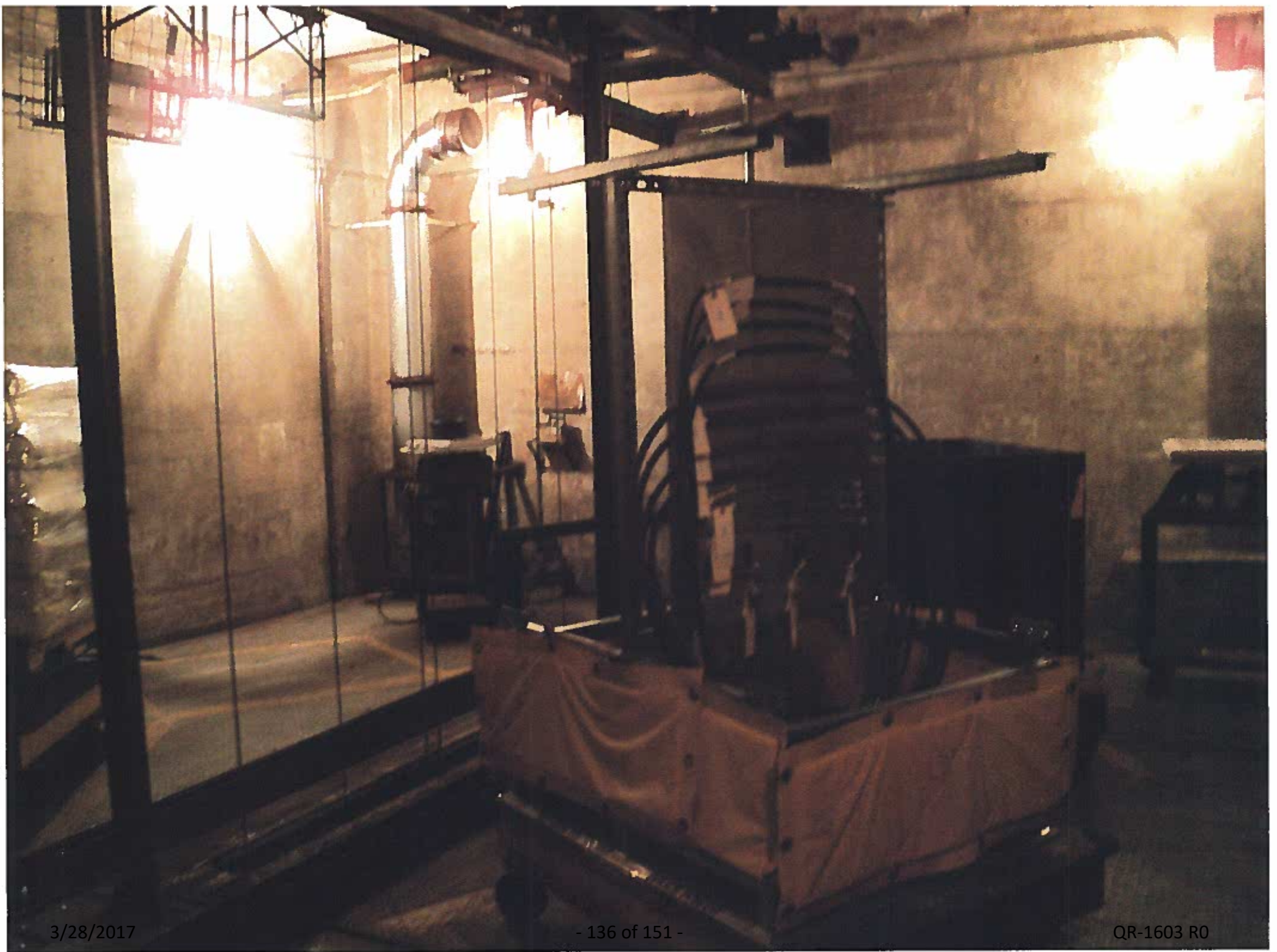
Oct 7, 2015

Status:

07e. Completed:  
Multiple or Single  
Facility

Page 1 of 1





3/28/2017

- 136 of 151 -

QR-1603 R0

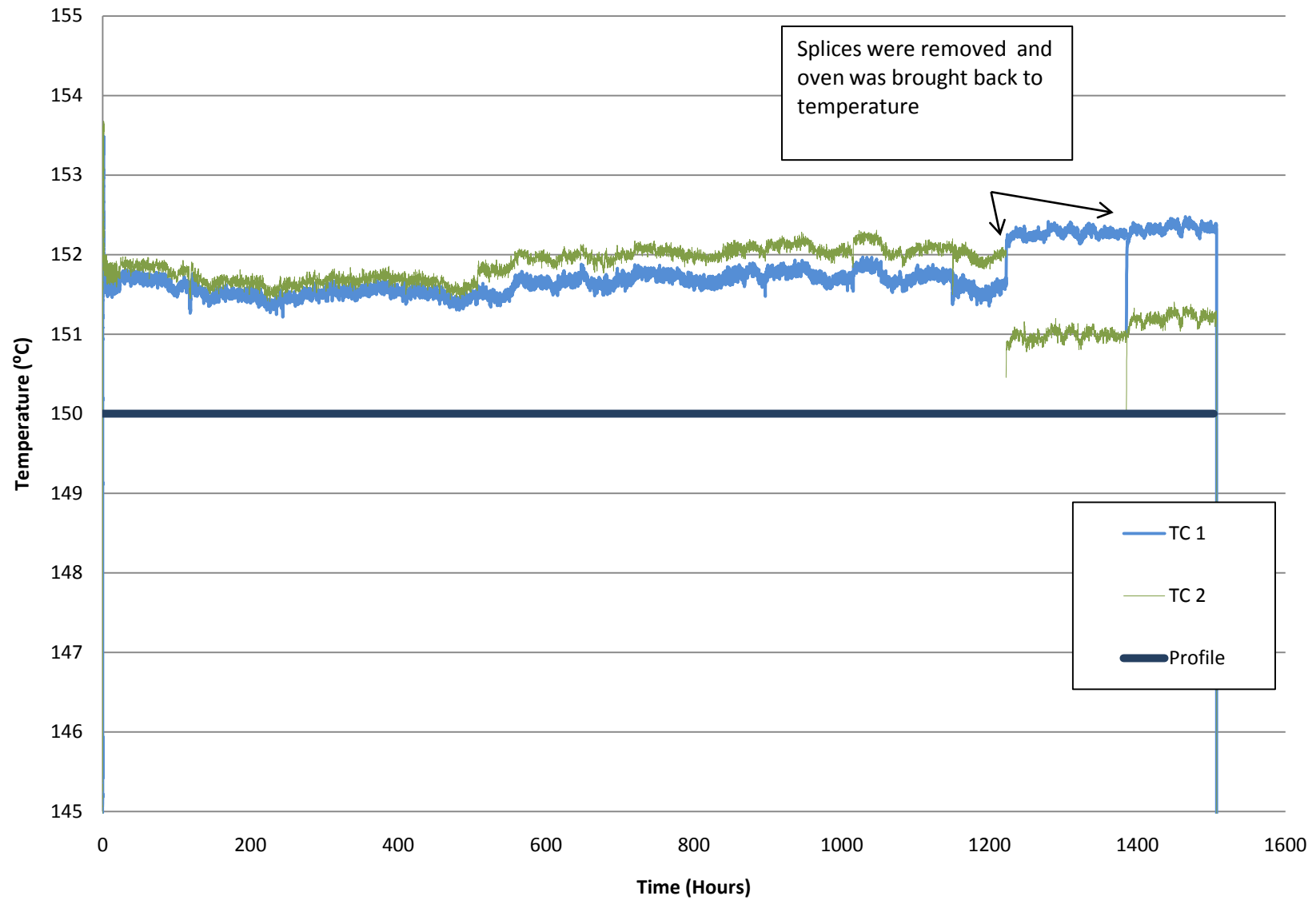


## Appendix D

### Thermal Aging Plot and M&TE



## K-115342 Thermal Aging of TE Splice at 150°C





Kinectrics  
ISO-9001  
Form: QF-11-1  
rev 12-09

## INSTRUMENT SHEET

**Test Description:** K-115342- Thermal Aging TE Connectivity EQ Splices

**Test Start Date:** Jan. 6, 2016.

**Project Number:** K-115342

**Test Finish Date:** March 21, 2016

Instrument	Equipment Number	Units Measured	Accuracy Claimed	Cal. Date	Cal. Due Date	Comment
Agilent	KIN-01472	$\Omega, ^\circ\text{C}$	$\pm 1.0 ^\circ\text{C}$	July 14, 2015	July 14, 2016	
Multiplex Card	KIN-02765	$\Omega, ^\circ\text{C}$	$\pm 1.0 ^\circ\text{C}$	July 22, 2015	July 22, 2016	
Thermocouple 1	KIN-02074	$\Omega, ^\circ\text{C}$	$\pm 0.8 ^\circ\text{C}$	Nov. 6, 2015	Nov. 6, 2016	
Thermocouple 2	KIN-01154	$\Omega, ^\circ\text{C}$	$\pm 0.8 ^\circ\text{C}$	July 9, 2015	July 9, 2016	
Fluke Process Calibrator	KIN-02133	$\Omega, ^\circ\text{C}$	$\pm 1.0 ^\circ\text{C}$	July 22, 2015	July 22, 2016	Software Validation

**Recorded:** Darryl Markell

**Date:** Jan. 5, 2016.

**Reviewed:**

**Date:**



## Appendix E

### Post Aging Inspection



## Visual Inspection Report Form

Customer: TE Connectivity

Date: Mar 24, 2016

TEST PLAN: K-115342-PSWI-0001

Specification: Rev: R00

Paragraph No: 3.4 - Post Thermal Aging Inspection

Specimen Number	Insulation/Jacket Condition*	Date
K-115342-017	Cable and splice are discoloured and feel stiff. Small indent in jacket from strain relief. Spotting of discoloration on splice. Visually, in good condition.	March 24, 2016.
K-115342-018	Cable and splice are discoloured and feel stiff. Small indent on cable jacket from strain relief. Spots of discoloration on splice here and there. Visually, in good condition.	March 24, 2016.
K-115342-021	Cable and splice are discoloured and feel stiff. Small indent on cable jacket from strain relief. Visually in good condition. <del>and trays.</del>	March 24, 2016.
K-115342-022	Cable and splice are discoloured and feel stiff. Small indent on jacket from strain relief. Discolouration formed in some spots that are worse than others. Visually, in good condition.	March 24, 2016.

\* : Inspect for whitish deposit, cracking, conductor corrosion, hardening, any other visible defects

Comments \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Recorded by: Darryl Markell  
Name

[Signature]  
Signature

Date: March 24, 2016.

Approved by: Jeremy Owen  
Name

[Signature]  
Signature

Date: April 1, 2016



### Visual Inspection Report Form

Customer: TE Connectivity

Date: Mar 18, 2016

TEST PLAN: K-115342-PSWI-0001

Specification: Rev: R00

Paragraph No: 3.4 - Post Thermal Aging Inspection

Specimen Number	Insulation/Jacket Condition*	Date
K-115342-030	Cable and splice have lots of discoloration throughout with white deposits on surface. Feels very stiff. No cracks on splice or cable.	March 18, 2016.
K-115342-029	Cable and splice have lots of discoloration with white deposits throughout. Feels very stiff. Cracks on cable on either side of the splice. One crack continued into splice, cracking the splice end.	March 18, 2016.
K-115342-025	Cable and splice have lots of discoloration with white deposits throughout. Feels very stiff. Lots of cracks in cable on either side of splice. No cracks in splice.	March 18, 2016.
K-115342-026	Cable and splice have lots of discoloration with white deposits throughout. Feels very stiff. Lots of cracks in cable on either side of splice. Small crack started in splice on one end.	March 18, 2016.

\* : Inspect for whitish deposit, cracking, conductor corrosion, hardening, any other visible defects

Comments For the cables /splice with cracks in them,  
it is hard to tell how deep the crack goes. Can not  
determine if the insulation has any cracks as well.

Recorded by: Darryl Markell  
Name

D Markell  
Signature

Date: March 18, 2016

Approved by: Jeremy Owen  
Name

JO  
Signature

Date: April 1, 2016



### Visual Inspection Report Form

Customer: TE Connectivity

Date: Mar 18, 2016

TEST PLAN: K-115342-PSWI-0001

Specification: Rev: R00

Paragraph No: 3.4 - Post Aging Inspection (Thermal)

Specimen Number	Insulation/Jacket Condition*	Date
K-115342-014	Cable and splice are discoloured and feel stiff. Visually in good condition	March 18, 2016
K-115342-013	Cable and splice are discoloured and feel stiff. Visually in good condition.	March 18, 2016.
K-115342-010	Cable and splice are discoloured and feel stiff. Visually in good condition.	March 18, 2016
K-115342-009	Cable and splice are discoloured and feel stiff. Visually in good condition	March 18, 2016

\* : Inspect for whitish deposit, cracking, conductor corrosion, hardening, any other visible defects

Comments \_\_\_\_\_

\_\_\_\_\_

Recorded by: Darryl Markell  
Name

[Signature]  
Signature

Date: March 18, 2016.

Approved by: Jeremy Owen  
Name

[Signature]  
Signature

Date: April 1, 2016



### Visual Inspection Report Form

Customer: TE Connectivity

Date: Mar 18, 2016

TEST PLAN: K-115342-PSWI-0001

Specification: Rev: R00

Paragraph No: 3.4 - Post Thermal Aging Inspection

Specimen Number	Insulation/Jacket Condition*	Date
K-115342-005	Cable and splice are discoloured and feel stiff. Splice has a white dusty discolouration. Visually in good condition.	March 18, 2016
K-115342-002	Cable and splice are discoloured and feel stiff. Splice has a white dusty discolouration. Visually in good condition.	March 18, 2016
K-115342-001	Cable and splice are discoloured and feel stiff. Splice has a white dusty discolouration. Visually in good condition.	March 18, 2016.
K-115342-006	Cable and splice are discoloured and feel stiff. Splice has a white dusty discolouration. Visually in good condition.	March 18, 2016.

\* : Inspect for whitish deposit, cracking, conductor corrosion, hardening, any other visible defects

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Recorded by: Darryl Markell  
Name

[Signature]  
Signature

Date: March 18, 2016.

Approved by: Jeremy Owen  
Name

[Signature]  
Signature

Date: April 1, 2016



# Appendix F

## Photographs





Photo F.1  
Typical View of a V-type wire splice sample



Photo F.2  
Typical View of in-line splice sample





Photo F.3  
View of BBIT-N sample



Photo F.4  
View of Jacket Repair Sealing Tape Samples



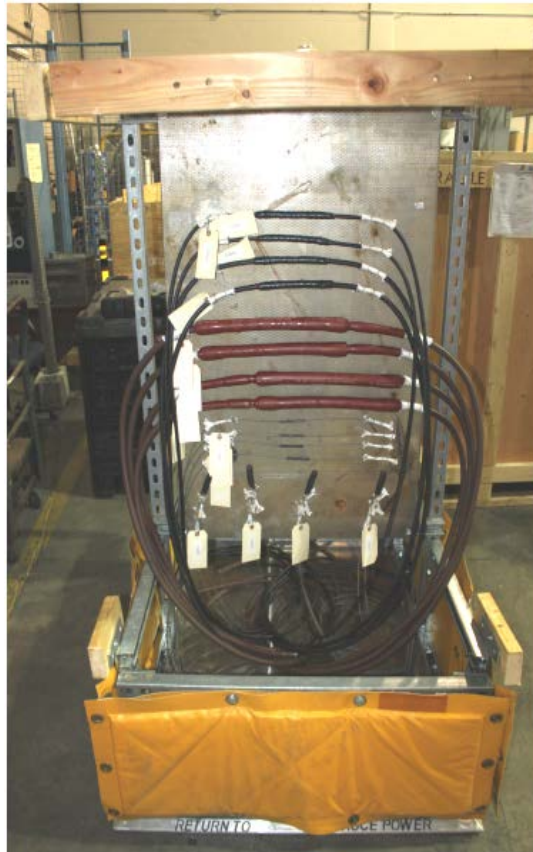


Photo F.5  
Overall mounting arrangement for irradiation aging.



Photo F.6  
Overall mounting arrangement for thermal aging  
Note: Photo taken prior to install of middle shelf used  
to support V-Type samples.



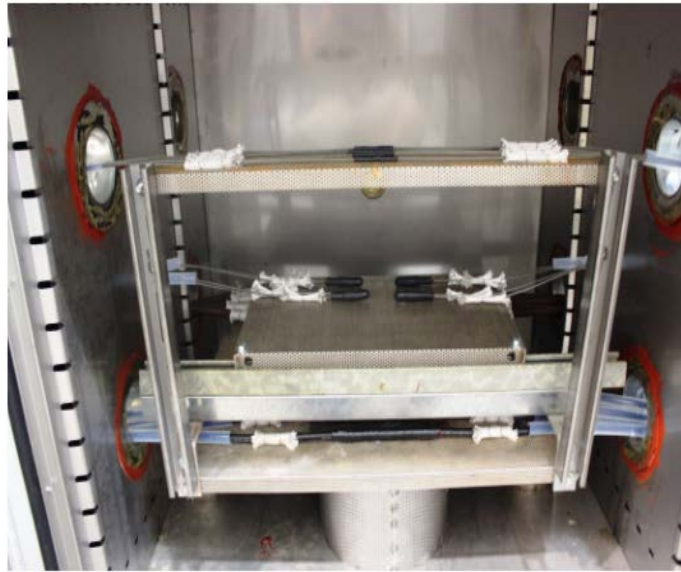


Photo F.7

Overall mounting arrangement for thermal aging  
Note: Photo taken after middle shelf installed  
to support V-Type samples



Photo F.8

Post thermal aging close up view showing cracks in the outer jacket  
material on test samples with Jacket Repair Sealing Tape





F.9

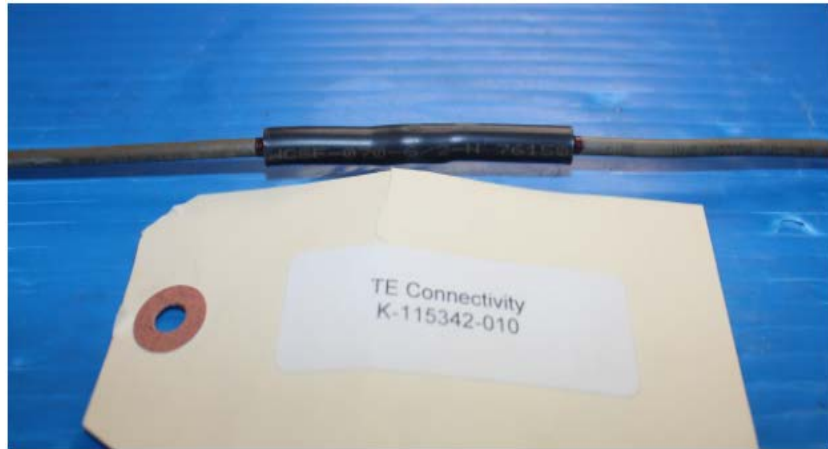
Post thermal aging view of typical V-splice test sample.



F.10

Post thermal aging view of typical BBIT-N sample





F.11  
Post thermal aging view of typical In-Line Splice sample