Electrical Products Division Report

Title:
NMCK-V CONVERSION OF BONDED END CAPS TO MOLDED ROUND END CAPS

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I. PURPOSE

The bonded end caps presently used in the NMCK-V kits and designated NMCK-XXX-Bonded will be obsolete due to the bonding equipment being dismantled. Molded caps designated 101A110 through 101A150-52/144 which are similar to those used in the NPKV stub connection kits will replace the bonded caps. The purpose of this test is to evaluate the physical integrity and electrical insulation capability of the new kits using the molded caps after being subjected to a high temperature environment (see Appendix 1, Test Plan). This test combined with the environmental type test Wyle Report 58722-1 performed on similar configurations, would provide reasonable assurance that the new NMCK-V kits can perform their intended function of insulating and sealing when used in these tested configurations.

II. SUMMARY

In accordance with 10 CFR Part 50, Appendix B, Section lll, "Design Control" and IEEE 323-1974, Section 6.5.3, "Extrapolation", testing was conducted in accordance with the Raychem test plan (Appendix 1) to ensure that at elevated temperatures the end cap would not move away (squeeze off) from the splice assembly. During the high temperature environment, the maximum movement of the two constructions tested was 3/4 inches from the original location. This movement is not considered squeezing off or away from the assembly. This movement is attributed to the end cap wanting to continue shrinking at elevated temperatures. Because the end cap is being held out by the substrate and cannot shrink circumferentially, it will shorten. The electrical testing performed met or exceeded the requirements given in the test plan.

The evaluation of similar configurations (NPKV kits) that were environmental type tested in accordance with the guidelines of IEEE Standards 323, 1974 and 383, 1974 (Wyle Report 58722-1), concluded that the same report applies to the NMCK-V with a round end cap. Therefore no further qualification is required.

III. CONCLUSION

The results (Table 1) of this test program combined with the environmental type test results (Wyle Report 58722-1) provide reasonable assurance that the new NMCK-V kits can perform their intended function of insulating and sealing when used in these tested configurations.

IV. TEST SPECIMENS

Two constructions consisting of three specimens each, which represented the maximum and minimum diameter use range for the NMCK-4V-35-00 kit, were assembled in accordance with installation instructions (PII-57000). In Wyle Report 58722-1, the NPKV that was tested used a 101A062-52/144 end cap. This end cap is the smallest used in the NPKV series kits. The 101A140-52/144 used in this test represents next to the largest size of end caps and would be representative of the other four sizes to be used in the NMCK-V series kits. These constructions consisted of the following components and are shown in Figure 1:

Construction 1	Construction 2
101A140-52/144 End Cap	101A140-52/144 End Cap
302A845-52/144 Breakout	302A845-52/144 Breakout
WCSF-1000U Bolt Pad	WCSF-1000U Bolt Pad
500MCM cable, O.D. 0.99"	WCSF-300-3N Cable Shim
Burndy YA34-2LN Connector	2AWG cable, O.D. 0.40"
	Burndv YA2CN Connector

Both the 500MCM and the 2AWG cables were insulated with XLPE.

V. FUNCTIONAL TESTS (Baseline Data)

All specimens were immersed in room temperature tap water for 24 hours. After 24 hours, the specimens were measured for insulation resistance (IR) at 500V d-c. After being energized for one minute, readings were taken. Voltage withstand tests were conducted at 2200V a-c for five minutes. The voltage applied was between the cable conductor and water ground plane. The results are given in Table 1.

Vl. HIGH TEMPERATURE ENVIRONMENT

The high temperature environment consisted of placing the specimens in an air circulating oven at 150 °C for 16 hours. The cables were marked to indicate the starting position of the end caps. Then the specimens were suspended in the oven in a vertical position such that the open end of the end caps faced upward and not touching the bottom of the oven. The position of the oven controlling thermocouple was located approximately in the center. After 16 hours at 150 degrees C, the specimens were removed from the oven and allowed to cool. The specimens were then inspected for any movement of the end cap.

(VI. Cont)

After inspection, the specimens were again immersed in water for 24 hours and measured for insulation resistance and voltage withstand tests performed. The results are given in Table 1. These results are recorded in Raychem Laboratory Notebook number 14278.

Table 1 - Test Results

	Baseline Data		**After High Temperature Environment**	
	IR (Ω)	Voltage Withstand	IR(Ω)	Voltage Withstand
Sample # Construction 1				
1	$1.3X10^{12}$	P	$1.5X10^{12}$	P
2	$1.5X10^{12}$	P	$5.9X10^{12}$	P
3	$4.5X10^{11}$	P	$1.5X10^{12}$	P
Sample # Construction 2				
4	$5.0X10^{11}$	P	$8.0X10^{12}$	P
5	$4.5X10^{12}$	P	$2.6X10^{12}$	P
6	$1.0X10^{13}$	P	$1.0X10^{12}$	P

Table 2 - List of Data Acquisition Instruments and Equipment

Instrument/Equip.	Manufacturer	Model # & Serial #	Calibration Cycle	Next Calibration
Megohmeter	General Radio	1864 EQC 110	Annual	4/28/95
AC Hipot	Associated Research	4030 EHV 113	Annual	2/27/96
Oven	Blue M	EQC 288	Annual	11/9/95

Note: All instruments and equipment were in calibration at the time testing was conducted.

Calibration was performed in accordance with the requirements of MIL- STD-45662-A and against standards traceable to the National Institute of Standards and Technology using industry accepted methods. Calibration records are kept on file at Raychem, Newark, Delware.

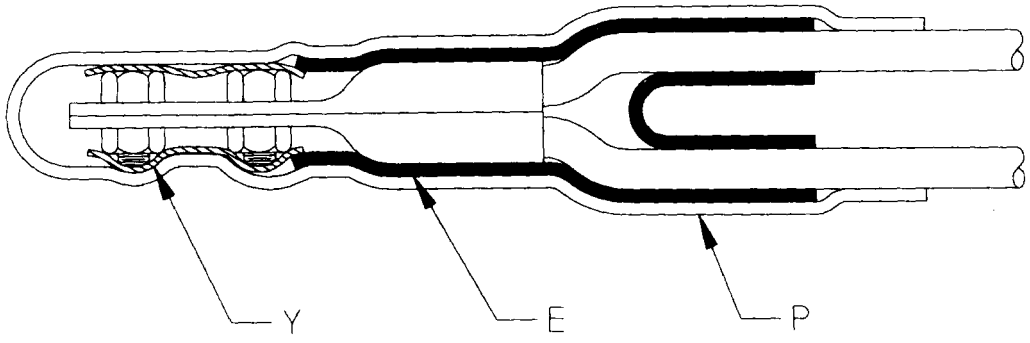
Figure 1

Sample Construction

Construction 1

Components Key

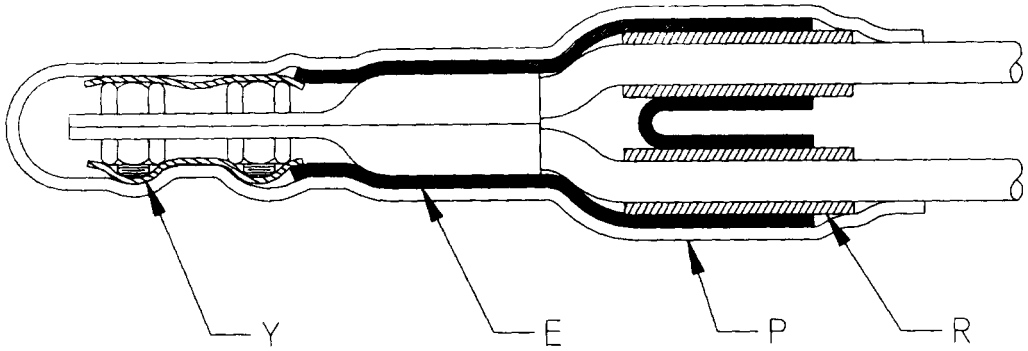
Y - Bolt Pad
P - End Cap
E- Breakout



Construction 2

Components Key

Y - Bolt Pad
P - End Cap
E - Breakout
R - Cable Shim



Note: Position of components approximately located as shown.

Appendix 1

Test Plan

Test Plan For Evaluating the NMCK-V Low Voltage Stub connection Kit Using a Molded Cap

1.0 Purpose

One of the components of the low voltage NMCK-V stub connection kits is a WCSF bonded cap. In anticipation of changing the bonded cap to a molded cap, and in accordance with 10 CFR 50, Appendix B, it is necessary to evaluate the performance of the molded cap in a high temperature environment to ensure that it will not squeeze off. By using a molded end cap for the NMCK-V, the configuration is similar to the NPKV series kits.

In Wyle Report 58722-1, the NPKV that was tested used a 101A062-52/144 end cap. This end cap is the smallest used in the NPKV series kits. The 101A140-52/144 used for the NMCK-4V-35-00 represents next to the largest size of end caps and would be representative of the other four sizes to be used for the NMCK-V series kits.

The evaluation of similar configurations conclude that results of environmental type tests done in accordance with the guidelines of IEEE Standards 323, 1974 and 383, 1974 apply to the NMCK-V with a molded end cap without further requalification.

2.0 Materials and Sample Construction

2.1 Materials

2.1.1 Test material shall meet the requirements of Raychem Specifications PPS 3010/7, 3011/8, SCD-48019, SCD-37001 and SCD48015.

2.1.2 The cable shall be rated at 600V and the insulation type shall be XLPE.

2.2. Sample Construction in accordance with PII-57000 (Figure 1)

2.2.1 Test specimens shall be constructed in accordance with the standard installation instructions for the kits used in this test. Figure 1 illustrates the construction and list the materials to be tested. There shall be three (3) specimens each of two constructions. One construction will consists of cable representing the maximum diameter use range for the NMCK4V-35-00 and the other construction shall represent the minimum diameter use range. Upon completion of the construction, the position of the molded cap shall be noted by placing a mark on the cable.

(NMCK test plan cont.)

3.0 Test Sequence

3.1 The test sequence shall consist of the following:

Table 1

Sequence	Test	Section
1	Inspection	4.0
2	Water Immersion	5.0
3	Functional Test	6.0
4	High Temperature Environment	7.0
5	Inspection	4.0
6	Water Immersion	5.0
7	Functional Test	6.0
8	Inspection	4.0

4.0 Inspection

Where indicated in the test sequence, the test specimens shall be visually inspected and their condition noted. At sequence 5, the position of the molded cap shall be noted with reference to the mark placed on the test specimens prior to the start of the test.

5.0 Water Immersion

Test specimens shall be immersed in tap water at room temperature for 24 hours. All parts of the test specimens shall be at least 12 inches below the surface of the water.

6.0 Functional Tests
6.1 Insulation Resistance (ASTM D257)

The insulation resistance shall be measured at 500V dc. in water at room temperature after one minute of electrification time.
Requirement: R> 1E1↑9Ω(ANSI C-119.1-1986)

6.2 Voltage Withstand

The voltage withstand test shall be conducted in tap water at room temperature using equipment as described in ASTM D149. 2200 volts ac. shall be applied for five minutes. Note: The insulation thickness of the cables selected precludes voltage withstand tests at 80V/mil as recommended by IEEE 383,1974.

Requirement: No breakdown (ANSI C119.1-1986)

7.0 High Temperature Environment

The test specimens shall be placed in an air circulating oven at 150 deg. C for 16 hours. The test specimens shall be mounted in such a way the open end of the cap is facing upward.

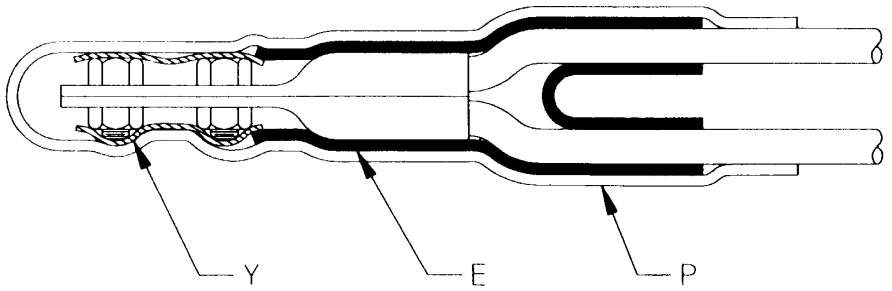
Requirement: There shall be no squeeze off

Figure 1
Sample Construction

Construction 1

Components
Key
P- 101A140-52/144 Molded Cap
Y- WCSF-1000-3U Bolt Pad
E- 302A845-52/144 Cable Breakout
500mcm Cable (O.D. 0.99") XLPE Insulation

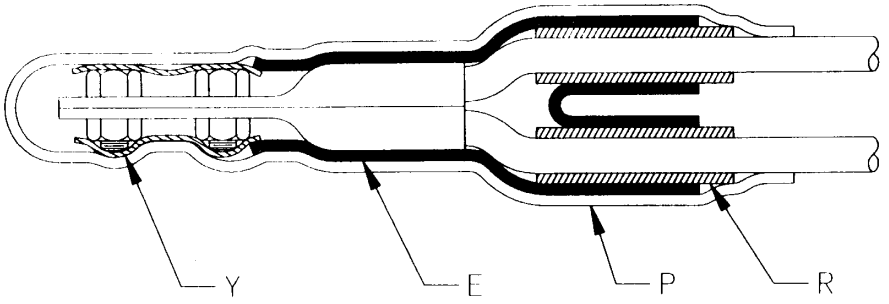
Connector
Burndy YA342LN 2-hole NEMA



Construction 2

Components
Key
P- 101A140-52/144 Molded Cap
Y- WCSF-1000-3U Bolt Pad
E- 302A845-52/144 Cable Breakout
R- WCSF-300-3N Shim
#2AWG Cable (O.D. 0.40") XLPE Insulation

Connector
Burndy YA2C2N 2-hole NEMA



(NMCK test plan cont.)

8.0 Report

A test report shall be written at the conclusion of the testing. This test report shall include the following:

1. Objective
2. Equipment tested
3. Description of test facility (test setup) and instrumentation used including calibration records reference
4. Test data and accuracy (results)
5. Test Procedures
6. Summary, conclusions, and recommendations
7. Supporting data (if any)
8. Approval signature and date

(NMCK test plan cont.)

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