



Raychem CFSM and CNSM Heat Shrink Reinforced Wraparound Cable Repair System

1. SCOPE

1.1. Content

This specification covers the performance, tests, and quality requirements for Raychem CFSM and CNSM reinforced heat shrink cable repair system consisting of a heat shrink sleeve with a layer of hotmelt sealant and a closure system of metal channels with or without metal clips. The outer surface of the sleeve is treated with a temperature-indicating system to facilitate uniform heating during installation. The CNSM sleeve material is a reinforced composite laminate and the CFSM is a reinforced composite laminate with an integral metal barrier.

1.2. Qualification

When tests are performed on the subject product line, procedures specified in 3.5 shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

2. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the latest edition of the document applies. In the event of conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and commercial standard and specifications, this specification shall take precedence.

2.1. TE Connectivity Documents

501-160730	CNSM, CFSM Qualification Test Report
LV_CA_HS_CNSM	Product Drawing CNSM
LV_CA_HS_CFSM	Product Drawing CFMSM

2.2. Commercial Standards and Specifications

EN 50393	European Standard – Test methods and requirements for accessories for use on distribution cables of rated voltage 0.6/1.0 (1.2) kV
ANSI C119.1	American Standard – Sealed Insulated Underground Connector Systems Rated 600 V
IEC 60684-2	International Standard – Flexible insulating sleeving – Part 2: Methods of test

3. REQUIREMENTS

3.1. Design and Construction

Product shall be of the design, construction, materials and physical dimensions specified on the applicable product drawing.

3.2. Materials

Materials used in the construction of this product shall be as specified on the applicable TE drawing.

Sleeve: crosslinked polyolefine with a reinforced composite laminate

Integral metal barrier: Aluminum (CFMSM only)

Hot-melt sealant: polyamide based

Closure system: stainless steel

3.3. Ratings

Voltage Rating: 0.6/1.0 (1.2) kV as defined in EN 50393 Clause 5 ‘Electrical characteristics’

Temperature Rating: (-30 to +100)°C

3.4. Performance Requirements and Test Description

The product should meet the electrical, mechanical and environmental performance requirements specified in Table 1. All tests shall be performed at ambient environmental conditions otherwise specified.

3.5. Test Requirements and Procedure Summary

3.5.1 Sleeve Material

Test Description	Requirement	Procedure
Electrical		
Dielectric strength	12 kV/mm min.	IEC 60684-2
Volume resistivity	1 x 10 ¹² Ohms cm min.	IEC 60684-2
Mechanical		
Hardness	50 Shore-D	IEC 60684-2
Bursting Strength	3000N min.	ISO 3303-A
Bursting Strength after Accelerated Heat Aging (7 days at 150°C)	2000N min.	ISO 3303-A
Environmental		
UV Stability	2.5% carbon black content min.	IEC 60684-2
Low Temperature Flexibility 4 hrs at (-40±3)°C	No cracking	IEC 60684-2
Water Absorption 336 hrs at (23±2)°C	0.3% max.	IEC 60684-2
Corrosion effect (16hrs 150°C)	No corrosion	ASTM D2671 § 93
Content of Hazardous Substances	EU RoHS compliant	EU Restriction on Hazardous Substances Directive
Content of Substances of Very High Concern	EU REACH compliant	EU REACH regulation
Halogen content	Low Halogen, Low Bromine/Chlorine and BFR/CFR/PVC Free	Industrial standards definition in IEC 61249-2, IPC-4101, JPCA-ES-01, JEDEC/ECA joint Standard JS709A

Table 1

3.5.2 Hot-melt Sealant

Test Description	Requirement	Procedure
Electrical		
Dielectric strength	14 kV/mm min.	IEC 60684-2
Volume resistivity	1 x 10 ¹⁰ Ohms cm min.	IEC 60684-2
Mechanical		
Peel Strength on PO-X	100N/25mm min.	IEC 60684-2
Peel Strength on Cu	50N/25mm min.	IEC 60684-2
Peel Strength on Al	75N/25mm min.	IEC 60684-2
Environmental		
Softening Point (Ring-And-Ball)	100°C	ASTM E28-99
Low Temperature Flexibility 4 hrs at (-30±3)°C	No cracking	IEC 60684-2
Water Absorption 24hrs at (23±2)°C	1.0% max.	IEC 60684-2
Corrosion effect (16hrs 150°C)	No corrosion	ASTM D2671 § 93
Content of Hazardous Substances	EU RoHS compliant	EU Restriction on Hazardous Substances Directive
Content of Substances of Very High Concern	EU REACH compliant	EU REACH regulation
Halogen content	Low Halogen, Low Bromine/Chlorine and BFR/CFR/PVC Free	Industrial standards definition in IEC 61249-2, IPC-4101, JPCA-ES-01, JEDEC/ECA joint Standard JS709A

Table 2

3.5.3 Finished Product

3.5.4

Test Description	Requirement	Procedure
General		
Examination of product as supplied	Meet requirements of product drawing	Visual, dimensional and functional per applicable inspection plan.
Examination of product after free recovery	Meet requirements of product drawing	Shrinking of samples in preheated air oven 175°C ± 5°C for 20 minutes.
Split Test	No splitting	Installation with torch on maximum diameter of the application range as per product installation instructions
Longitudinal shrinkage	-10% to +5% max.	IEC 60684-2

Table 3

Test Description	Requirement	Procedure
Electrical		
AC voltage withstand in air (1 min at 4 kV)	No failure	EN 50393
Insulation resistance in air (1 min at 1000 V DC)	50 Ohms min.	EN 50393
Heating cycle in air	63 cycles	EN 50393
Heating cycle in water	63 cycles	EN 50393
AC voltage withstand immersed (1 min at 4 kV)	No failure	EN 50393
Insulation resistance immersed	50 Ohms min.	EN 50393
Insulation resistance (1 min at 1000 V DC)	1 x 10 ⁹ Ohms min. or 90% of the initial recorded value	ANSI C119.1
AC Voltage withstand (1 min at 2.2 kV)	No failure	ANSI C119.1
Current cycle immersed	50 cycles	ANSI C119.1
Leakage current	1000 mA max.	ANSI C119.1
Mechanical		
Flexing	10 flex cycles	ANSI C119.1
Twisting	5 twist cycles	ANSI C119.1
Environmental		
Water immersion	24 hours at 25°C ± 5°C	ANSI C119.1
Heat conditioning	72 hours at 90°C ± 5°C	ANSI C119.1
Cold conditioning	4 hours at -18°C ± 5°C	ANSI C119.1
Content of Hazardous Substances	EU RoHS compliant	EU Restriction on Hazardous Substances Directive
Content of Substances of Very High Concern	EU REACH compliant	EU REACH regulation
Halogen content	Low Halogen, Low Bromine/Chlorine and BFR/CFR/PVC Free	Industrial standards definition in IEC 61249-2, IPC-4101, JPCA-ES-01, JEDEC/ECA joint Standard JS709A
Conflict of Minerals	The SEC defines Conflict Minerals as tin (Sn), tungsten (W), tantalum (Ta) and gold (Au). These four minerals are collectively referred to as 3TG.	TEC-01-56

Table 3 (continued)

NOTE

Shall meet visual requirements, show no physical damage, and meet requirements of additional tests as specified in the Product Qualification and Requalification Test Sequence shown in Table 4.

3.6. Product Qualification and Requalification Test Sequence

TEST OR EXAMINATION	TEST GROUP ^(a)			
	1 Sleeve	2 Hot-melt sealant	3 Finished product (European standard)	4 Finished product (American standard)
	TEST SEQUENCE ^(b)			
Examination of product as supplied			(*)	(*)
Examination of product after free recovery			(*)	(*)
Split Test			(*)	(*)
Longitudinal shrinkage			(*)	(*)
Installation with torch			(*)	(*)
Dielectric strength	(*)	(*)		
Volume resistivity	(*)	(*)		
Bursting Strength	(*)			
Bursting Strength after Accelerated Heat Aging	(*)			
Peel Strength on PO-X		(*)		
Peel Strength on Cu		(*)		
Peel Strength on Al		(*)		
Softening Point		(*)		
UV Stability	(*)			
Water Absorption	(*)	(*)		
Low Temperature Flexibility	(*)	(*)		
Corrosion effect	(*)	(*)		
AC voltage withstand in air			1	
Insulation resistance in air			2	
Heating cycle in air			3	
Heating cycle in water			4	
Water immersion				1,7,12
Heat conditioning				4
Cold conditioning				9
Current cycle immersed				14
AC voltage withstand immersed			5	3,16
Insulation resistance immersed			6	2,8,13,15

Table 4

TEST OR EXAMINATION	TEST GROUP ^(a)			
	1 Sleeve	2 Hot-melt sealant	3 Finished product (European standard)	4 Finished product (American standard)
	TEST SEQUENCE ^(b)			
Flexing				5,10
Twisting				6,11
Leakage current				17
Examination			7	18

Table 4 (continued)



NOTE

(a) See paragraph 4.2.

(b) Numbers indicate sequence in which tests are performed.

(*) Tests can be run in parallel.

4. QUALITY ASSURANCE PROVISIONS

4.1. Test Conditions

Unless otherwise specified, all the tests shall be performed in any combination of the following test conditions shown in Table 5.

Temperature	15°C – 35°C
Relative Humidity	45% – 75%
Atmospheric Pressure	86.6 – 106.6 kPa

Table 5

4.2. Qualification Testing

A. Specimen Selection

Specimens shall be prepared in accordance with applicable instruction sheets and shall be selected at random from current production. Test requirements in Table 1 and Table 2 are independent of the size of the product when the materials used are the same across the full range.

Test Group 1: specimens of sleeve material

Test Group 2: specimens of hot-melt sealant

Test Groups 3 and 4: specimens of finished product CFMS and CNSM reinforced Heat Shrink Wraparound Cable Repair System. Number of samples and cable cross-section selection as defined in EN 50393.

B. Test Sequence

Qualification inspection shall be verified by testing specimens as specified in Table 4.

4.3. Requalification Testing

If changes significantly affecting form, fit or function are made to the product or manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality and reliability engineering.

4.4. Supplier First Article Approval (FAA)/Production Part Approval Process (PPAP)

External Suppliers shall use TE Supplier Portal e-PPAP application to support the initial qualification (FAA/PPAP) process. The e-PPAP application is available at the Supplier Portal: <https://supplier.te.com>

Based on an initial qualification request a new FAAR/PPAP request shall be raised, which receives a unique FAAR/PPAP number. The approved documents from the FAAR/PPAP shall be stored in TE Connectivity document repository.

In the course of FAA/PPAP, following information/documentation has to be provided to TE Connectivity from the supplier:

- A. Design Record
- B. Dimensional Results
- C. Material & Performance Test Results
- D. Sample Production Parts
- E. Part Submission Warrant
- F. Packaging Instructions

Products shall first be accepted, when measurements performed by supplier and TE Connectivity both prove agreement of product dimensions and aspects with requirements defined in specification.

4.5. Acceptance

Acceptance is based on verification that the product meets the 'General' requirements in 3.5.3. Failures attributed to equipment, test setup or operator deficiencies shall not disqualify the product. If product failure occurs, corrective action shall be taken, and specimens resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

4.6. Routine Testing

The supplier shall undergo a routine test procedure before the product is provided to TE Connectivity to confirm its conformance to defined quality aspects, ensure correct operation and verify performance. Routine tests must be carried out on every product batch.

- A. Dimensions as per product drawing
- B. Split test with torch as per 3.5.3
- C. Longitudinal shrinkage as per 3.5.3

4.7. Quality Conformance Inspection

The applicable quality inspection plan shall specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.