SPECIFICATION RW-2510

TE 108-121013

RPS and RPS-CT Product Specification

This quality assurance specification establishes the quality standard for RPS and RPS-CT, heat-shrinkable identification sleeving for identifying wire and cable. The product requirements are shown in Table 5.

The operating temperature for this product is -30°C (86°F) to +105°C (221°F).

This system is an automatic method of identifying items by printing a mark onto a sleeve. The mark is permanent upon printing.

The marker shall be fabricated from flame retarded, cross linked, polyolefin tubing, flattened and then mounted on a carrier. Or as a semi-flat continuous sleeve.

The marker system comprises specific printers and ribbons. Compliance to this specification can only be guaranteed if TE Connectivity approved printers and ribbons are used. This information can be found in TE document 411-121005 'Printer Product Ribbon Matrix Document'.

Unless specified, the tube size for qualification testing is RPS 16-10 or RPS-CT-50M-6.4.

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1 SCOPE

The tests in this specification, as made on RPS products, define the nature of a heat shrinkable marker sleeve product for cable identification. Test procedures have been selected based on the ability of that test to provide key data which can be used by an engineer to assess the suitability of an installation based on actual use.

This qualification standard will establish whether fit, form, and function of the finished product meets product design expectations.

2 REQUIREMENTS

2.1 Test requirements

This specification details the requirements for the RPS family of products. Table 6 lists Identification product requirements.

2.2 Composition, appearance, and color

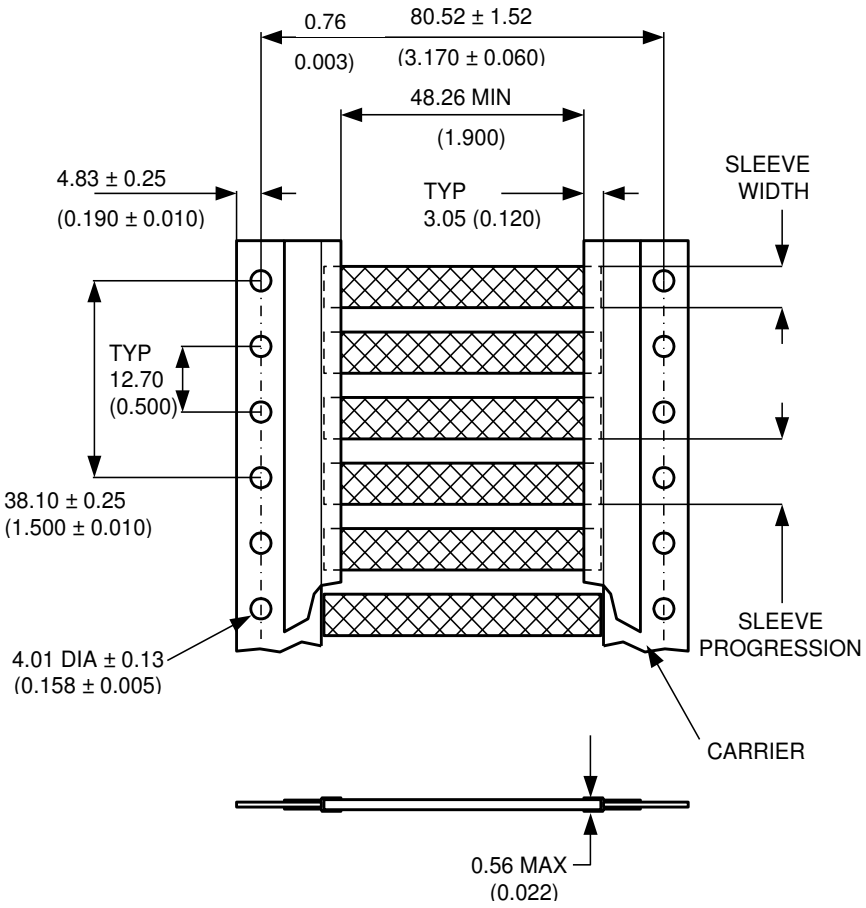
The sleeving shall be fabricated from irradiated, thermally stabilized, modified, flame retarded polyolefin compound. It shall be homogeneous and essentially free from flaws, defects, pinholes, bubbles, seams, cracks, or inclusions.
The markers shall be white or yellow as standard, other colors subject to order code.

2.3 Form

The sleeves shall be cut lengths mounted on a carrier in accordance with Figure 1 or in a continuous length as in figure 2. Dimensions shall meet table 1 for RPS and table 2 for RPS-CT.

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Figure 1. RPS format



Dimension in mm (inch)

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Figure 2: RPS-CT product

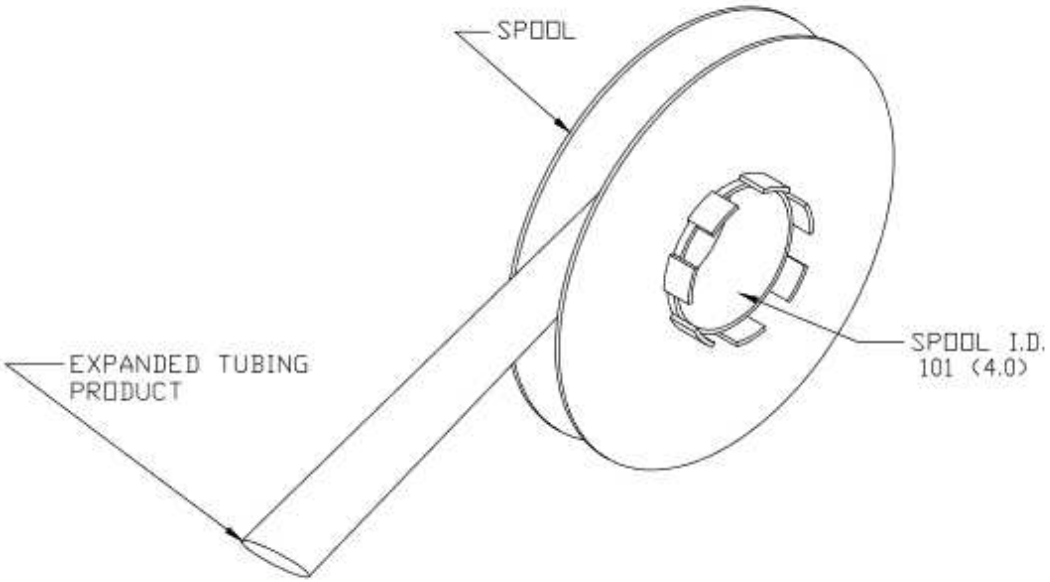
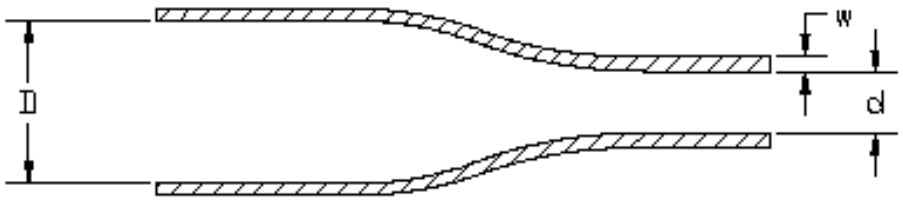


Figure 3: Product Dimensions Change During Recovery/Shrinking



Heat Shrink Product in as Supplied “D” (Expanded) and in the Recovered State “d”.

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Table 1: RPS Dimensions

Part Description	Minimum Supplied Inside Diameter mm (inches)	Maximum Recovered Inside Diameter mm (inches)	Wall Thickness after Recovery mm (inches)	Minimum sleeve flattened Width mm (inches)	Sleeve Progression mm (inches)	Nominal Sleeve Weight (g)
RPS-22-18	3.18 (0.125)	1.07 (0.042)	0.58 ± 0.08 (0.023 ± 0.003)	5.84 (0.229)	12.70 ± 0.89 (0.500 ± 0.035)	0.21
RPS-18-12	4.75 (0.187)	1.57 (0.062)	0.58 ± 0.08 (0.023 ± 0.003)	8.00 (0.315)	12.70 ± 0.89 (0.500 ± 0.035)	0.27
RPS-16-10	6.35 (0.250)	2.11 (0.083)	0.58 ± 0.08 (0.023 ± 0.003	10.7 (0.419)	16.94 ± 0.89 (0.667 ± 0.035)	0.35
RPS-8-4	9.53 (0.375)	3.18 (0.125)	0.61 ± 0.08 (0.024 ± 0.003)	15.5 (0.610)	25.40 ± 0.89 (1.000 ± 0.035)	0.50
RPS-10-2	12.70 (0.500)	4.22 (0.166)	0.61 ± 0.08 (0.024 ± 0.003)	20.4 (0.803)	29.64 ± 1.02 (1.167 ± 0.040)	0.68
RPS-6-250	19.05 (0.750)	6.35 (0.250)	0.61 ± 0.08 (0.024 ± 0.003)	30.5 (1.201)	42.34 ± 1.02 (1.667 ± 0.040)	1.02
RPS-1-400	25.4 (1.000)	8.46 (0.333)	0.64 ± 0.08 (0.025 ± 0.003)	40.4 (1.591)	50.80 ± 1.02 (2.000 ± 0.040)	1.35
RPS-400-1000	38.10 (1.500)	19.05 (0.750)	0.51 ± 0.08 (0.020 ± 0.003)	60.3 (2.374)	71.96 ± 1.02 (2.833 ± 0.040)	2.20

Table 2: RPS-CT Dimensions

Part Description	Minimum Supplied Inside Diameter mm (inches)	Maximum Recovered Inside Diameter mm (inches)	Wall Thickness after Recovery mm (inches)	Minimum sleeve flattened Width mm (inches)	Nominal Weight g/50mm
RPS-CT-50M-3.2	3.18 (0.125)	1.07 (0.042)	0.58 ± 0.08 (0.023 ± 0.003)	5.84 (0.229)	0.21
RPS-CT-50M-4.8	4.75 (0.187)	1.57 (0.062)	0.58 ± 0.08 (0.023 ± 0.003)	8.00 (0.315)	0.27
RPS-CT-50M-6.4	6.35 (0.250)	2.11 (0.083)	0.58 ± 0.08 (0.023 ± 0.003	10.7 (0.419)	0.35
RPS-CT-50M-9.5	9.53 (0.375)	3.18 (0.125)	0.61 ± 0.08 (0.024 ± 0.003)	15.5 (0.610)	0.50
RPS-CT-50M-12.7	12.70 (0.500)	4.22 (0.166)	0.61 ± 0.08 (0.024 ± 0.003)	20.4 (0.803)	0.68
RPS-CT-50M-19.0	19.05 (0.750)	6.35 (0.250)	0.61 ± 0.08 (0.024 ± 0.003)	30.5 (1.201)	1.02
RPS-CT-50M-25.4	25.4 (1.000)	8.46 (0.333)	0.64 ± 0.08 (0.025 ± 0.003)	40.4 (1.591)	1.35
RPS-CT-50M-38.1	38.10 (1.500)	19.05 (0.750)	0.51 ± 0.08 (0.020 ± 0.003)	60.3 (2.374)	2.20

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3 SAMPLE PREPARATION

3.1 Print performance test samples.

When required by the test procedure, product shall be printed using printers and ribbons specified by TE Connectivity. The full list can be found in TE document reference 411-121005 TE Identification Printer Product Ribbon Matrix.
Print random characters onto the sleeving to within approximately 6mm (0.236 inch) of both ends using Arial 10 point bold. Remove the markers from the carrier, where applicable, and test in both 'as received' and 'fully recovered' form.
The marking shall be examined for legibility in accordance with TE Document 411-121002 Print Contrast Reference Scale. The initial print contrast must be 8 or above.
Sleeves or tubing will be recovered by placing them in an air circulating oven for 3 minutes at 200±5°C (392±9°F). Specimens should be removed from the oven and allowed to cool to 23±3°C (73±5°F) for at least 4 hours before testing. Use finished sleeves / tubing, as supplied, for all other tests.
Unless otherwise specified, all tests shall be made at a temperature of 23±2°C (73±5°F).

4 TEST METHODS

4.1 Print Testing

4.1.1 Mark Adherence

Six sleeves shall be prepared as detailed in Clause 3.1, three of the samples shall be recovered. All samples shall be tested in accordance with TE test method 109-121012. Samples shall be tested using a Crockmeter fitted with an eraser with a 1kg load using the number of rubs specified in table 6.
After the Mark Adherence test, the marking shall be examined for legibility using normal reading vision. Print contrast shall be evaluated in accordance with TE Document 411-121002.

4.1.2 Solvent Resistance

Twenty-four sleeves shall be prepared as detailed in Clause 3.1. Half the samples shall be recovered in an air circulating oven then, all samples are tested in accordance with TE test method 109-121014 (MIL 202 Method 215). A set of three recovered and three as supplied sleeves are used in each fluid.
After the test the marking shall be examined for legibility using normal reading vision. Print contrast shall be evaluated in accordance with TE Document 411-121002.

4.1.3 Fluid Resistance

The test method shall be as specified in TE method 109-121039. Six sleeves prepared as in Clause 3.1, three of which are recovered, shall be completely immersed in each of the fluids for the times and at the temperatures specified in the requirements table. The volume of the fluid shall not be less than 20 times that of the specimen.
After immersion, the markers are lightly blotted with tissue paper to remove excess surface fluid and air dried at 23±2°C (73±3°F) for 45±15min. Samples are tested with a Crockmeter fitted with 'Super Twill' cloth with a total load of 1kg. After wiping, the marking shall be examined for legibility using normal reading vision. Print contrast shall be evaluated in accordance with TE Document 411-121002.

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4.2 Physical Testing

4.2.1 Dimensions and Longitudinal Change

The test method shall be as specified in TE method 109-121003.
Three marker sleeves shall be tested. The inside diameter of each shall be measured. For Longitudinal change, two-gauge marks shall be positioned 100mm apart on each sleeve. The markers shall be recovered in a fan assisted air-circulating oven at 200±5°C (392±8°F) for 3 minutes and the distance between gauge lengths and inside diameter of each shall be measured after cooling to room temperature. The longitudinal change shall be expressed as a percentage of the original gauge length. The minimum and maximum recovered wall thickness shall be determined.

4.2.2 Tensile Strength and Ultimate Elongation

The test method shall be as specified in TE method 109-121002. Test five recovered tubular specimens 125mm long. An initial jaw separation of 50mm with a gauge length of 25mm and rate of jaw separation of 508±5mm per minute shall be used.

Table 3 Mandrel dimensions for Bend Test

Part Number	Mandrel Diameter (mm)
RPS 22-18 to RPS 8-4 (RPS-CT-3.2 to RPS-CT-9.5)	7.9
RPS 10-2 to RPS 6-250 (RPS-CT-12.7 to RPS-CT-19.0)	9.5
RPS 1-400 to RPS 400-1000 (RPS-CT25.4 to RPS-CT-38.1)	11.1

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4.3 Thermal Testing

4.3.1 Heat Ageing

The test method shall be as specified in TE method 109-121008. Six sleeves shall be prepared as detailed in sections 3.1. Specimens shall be conditioned for 168 hours at 158±2°C (316±4°F) in an air circulating oven. Sleeves shall be removed and allowed to cool to room temperature for a minimum of 4 hours at 23±2°C (73±7°F).

After conditioning three samples shall be tested for Mark Adherence in accordance with section 4.1.1. The marking shall be examined for legibility using normal reading vision. Print contrast shall be evaluated in accordance with TE Document 411-121002.

The remaining three samples shall be tested for flexibility by bending 360°around a mandrel. The mandrel diameter for RPS-16-10 size tubing is 7.9mm.

4.3.2 Heat Shock

The test method shall be as specified in UL 224, condition the samples for 4hr at 180±1°C (356±2°F).

For tubing of recovered diameter of less than 8.38mm (0.330 inches) the test shall be performed on a 152mm (6 inches) length of tubing. For tubing with an inside diameter greater than 8.38mm (0.330 inches) the test shall be performed on strips 152mm (6 inches) by 12.7mm (0.5 inches) cut longitudinally from the tube.

For all tube sizes three printed samples, prepared as detailed in section 3.1 shall also be conditioned. After conditioning the three printed samples shall be tested for Mark Adherence in accordance with section 4.1.1. The marking shall be examined for legibility using normal reading vision. Print contrast shall be evaluated in accordance with TE Document 411-121002.

The three remaining 152mm (6 inches) samples shall be tested for flexibility as by bending 360°around a mandrel. Mandrel diameter for RPS-16-10 size tubing is 9.5mm (3.75 inches).

4.3.3 Low Temperature Flexibility

The test method shall be as specified in TE method 109-121006. Six sleeves shall be prepared as detailed in sections 3.1. Specimens shall be conditioned for 4 hours at -30±2°C (-22±4°F) in a cold chamber. Half the markers shall be removed and allowed to warm to room temperature for a minimum of 2 hours at 23±2°C (73±7°F).
After conditioning three samples shall be tested for Mark Adherence at 23±2°C (73±3°F) in accordance with section 4.1.1. The marking shall be examined for legibility using normal reading vision. Print contrast shall be evaluated in accordance with TE Document 411-121002.

The three remaining samples shall be tested for resistance to bending. The samples and mandrel shall be at low temperature when tested as in method TE 109-121006. Mandrel diameter for RPS-16-10 size tubing is 7.9mm.

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4.4 Electrical Testing

4.4.1 Dielectric Strength

The test method shall be as specified in TE method 109-121005. Five printed 150mm long specimens should be recovered onto mandrels 24 hours before testing. The mandrels shall be tight fitting. A 25mm piece of aluminium self-adhesive foil electrode shall be installed at the centre of each of the recovered samples. Mean average dielectric strength of five samples shall be recorded as the result.

4.5 Chemical Testing

4.5.1 Copper Mirror Corrosion

The test method shall be as specified in TE method 109-121009. Three glass test tubes should be used. Prepare one control test tube with copper mirror only, and two test tubes with mirrors and printed product. Prepare samples out of recovered specimens, using at least 150mm^2 surface area in each tube. Use a printed sample 10mm long. The test period shall be 168 hours at 158±2°C (316±4°F). After the test, mirrors should be assessed for corrosion.

4.5.2 Water Absorption

The test method shall be as specified in TE method 109-121016. Three 25mm long helical samples should be cut from recovered printed tubing specimens. Samples should be weighed after drying in the oven and after immersion in water. The mean average of three samples should be used.

4.6 Flammability

Sample preparation and testing shall comply with UL 224 All Tubing Flame Test. Samples shall be printed.

4.7 Environmental

4.7.1 Fungus resistance

Fungus resistance testing shall be conducted in accordance with accordance with ISO 846 B with an incubation time of 56 days. Samples shall be prepared for mark adherence, tensile strength, and dielectric strength prior to fungus exposure. After the 56-day exposure period, samples shall be washed and then tested to determine any effect of the fungus exposure on the functional properties.

5 RELATED DOCUMENTS

5.1 Table 4: Related Documents

Document	Description
MIL STD 202 Method 215	Test Methods for Electronic and Electrical Component Parts. Resistance of Solvents.
UL 224	Standard for Safety: Extruded Insulating Tubing
bs en ISO 846:2019	Plastics - Evaluation of the action of microorganisms
SAE J183	Engine Oil Performance and Egine Service Classification (other than Energy Conserving" or Resource Conserving")
SAE J300	Engine Oil Viscosity Classification
SAE J1703	Motor Vehicle Brake Fluid
SAE AMS 1424	Fluid De-icing/Anti-Icing, SAE Type I

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5.2 Table 5: TE Documents

TE Reference	Title	Complies with
411-121002	TE Connectivity Print contrast reference scale	---
411-121005	TE Identification Printer Product Ribbon Matrix	---
109-121002	Tensile Strength and Ultimate Elongation at 23°C	ASTM D882 Method A
109-121003	Dimensions	---
109-121005	Dielectric strength	ASTM D2671 (ASTM D149)
109-121006	Low Temperature Flexibility	IEC 60684-2
109-121008	Heat Ageing	AMS DTL 23053
109-121009	Copper Mirror Corrosion	AMS DTL 23053
109-121012	Print Permanence testing using the Mechanical Crockmeter	SAE AS5942
109-121014	Resistance to Solvents	MIL 202 Method 215
109-121016	Water Absorption	ASTM D570
109-121039	Fluid Immersion at Room Temperature	---

The current revision of the document shall be used.

6 SAMPLING

Tests shall be carried out on a sample taken at random from a batch. A batch is defined as that quantity of product extruded at any one time. Samples shall be of the form required to complete the test.
Testing frequency shall be Production Routine or Qualification.
Production routine tests consisting of visual examination, dimensions, and longitudinal change, print quality and adherence of marking shall be carried out on every batch of sleeving.

Qualification tests shall be carried out to the requirements of the Design Authority.

7 STORAGE CONDITIONS

Product should be stored in a clean dry location in its original packaging. Maximum storage temperature is 35°C (95°F).

8 PACKAGING

Packaging shall be in accordance with good commercial practice. Each package shall bear an identification label showing material quantity, description, size, color, and batch number. Additional information shall be supplied as specified in the contract or order.

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9 REVISION INFORMATION

Revision Number	Description of change	Date	Incorporated By
1	Replaces RT-1804 Issue 8	July 2004	
2	Format Update	Feb' 2014	Martyn Priddle
3	Addition of RPS-CT, format change and add solution D to MIL 202 method 215 test	Dec' 2023	Alan Kean
4	Addition of mark adherence test after fungus resistance, correction to dielectric strength units	Oct' 2024	Alan Kean

10 TABLE 6: REQUIREMENTS

PROPERTY	TEST METHOD	UNITS	REQUIREMENTS	RW-2510 SECTION
PRINT PERFORMANCE				
Mark Adherence	TE 109-121012 20 rubs, 1kg load, eraser	---	Legible, minimum print contrast 3	4.1.1.
Solvent Resistance Solution A Solution B Solution C Solution D	TE Document 109-121014 (MIL202 method 215) 30 strokes, toothbrush	---	Legible, minimum print contrast 3	4.1.2.
Fluid Resistance	24±2 hours immersion at 23±2°C, followed by: TE 109-121012, 20 rubs 1kg load	---	Legible, minimum print contrast 3	4.1.3.
HydroFlouroCarbon Solvent Vertrel XF				
Isopropyl Alcohol				
Gasoline (unleaded)				
Diesel Fuel, DF2				
Auto Engine Oil, SF 10W-40 (SAE J 183, SAE J 300)				
Motor Vehicle Brake Fluid, SAE J 1703				
Propylene Glycol de-icing fluid (SAE-AMS-1424)				
5% Sodium chloride solution				
Tap Water				
PHYSICAL				
Visual Inspection	In good lighting, using normal or corrected vision at a distance of 14 inches.	---	In accordance with section 3.2.	2.2
Dimensions	TE 109-121003	---	In accordance with tables 1 and 2	4.2.1.
Longitudinal Change	TE 109-121003	%	0 to -20	4.2.1.
Tensile Strength	TE 109-121002	MPa	8.27 Minimum	4.2.2.
Ultimate Elongation	TE 109-121002	%	150 Minimum	4.2.2.

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Table 6 continued

PROPERTY	TEST METHOD	UNITS	REQUIREMENTS	RW-2510 SECTION
THERMAL				
Heat Ageing 168 hours at 158°C (316°F), followed by: Mandrel Bend Mark Adherence	 360° bend around a mandrel TE 109-121012 20 rubs, 1kg load, eraser	 --- ---	 No damage to the marker and print Legible, minimum print contrast 3	4.3.1.
Heat Shock 4 hours at 250°C (482°F), followed by: Mandrel Bend Mark Adherence	TE 109-121007 360° bend around a mandrel TE 109-121012 20 rubs, 1kg load, eraser	 --- ---	 No damage to the marker and print Legible, minimum print contrast 3	4.3.2.
Low Temperature flexibility 4 hours at -30°C (-22°F), followed by: Mandrel Bend Mark Adherence	TE 109-121006 360° bend around a mandrel at -30°C TE 109-121012 20 rubs, 1kg load, eraser	 --- ---	 No damage to the marker and print Legible, minimum print contrast 3	4.3.3.
ELECTRICAL				
Dielectric strength	TE 109-121005	kV/mm	19.7 minimum	4.4.1.
CHEMICAL				
Copper Mirror Corrosion	TE 109-121009 16hrs at 158±2°C (316±4°F)	%	5% transparent area maximum	4.5.1.
Water Absorption	TE 109-121016 24 hours at 23±3°C (73±4°F)	%	0.5 maximum	4.5.2.
FLAMMABILITY				
Flammability	UL 224 - All Tubing Flame Test	---	No flaming or glowing longer than 60s following any flame application, and no more than 25% of damage to the indicator flag. No dripping or flowing.	4.6
ENVIRONMENTAL				
Fungus resistance 56-day incubation followed by: Tensile Strength Ultimate Elongation Dielectric Strength Mark Adherence	ISO 846 Method B TE 109-121002 TE 109-121002 TE 109-121005 TE 109-121012	 MPa % kV/mm ---	 8.27 minimum 150 minimum 19.7 minimum Legible, C3 minimum	4.7.1

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Table 7 Test Fluids Description

Fluid	Description
SF 10W-40 (SAE J 183, SAE J 300)	Auto Engine Oil
Fluid, SAE J 1703	Brake Fluid
Gasoline Diesel Fuel	General fuels used in transportation
Propylene Glycol de-icing fluid (SAE-AMS-1424)	Aerospace De-icing fluid, 50/50 % mixture with water (replaces ethylene glycol)
Tap Water	Universal solvent
5% Sodium chloride solution	Sodium chloride is a universal compound used in many chemicals and de-icing fluids
IPA – Isopropyl alcohol	Widely used as a solvent and cleaner
HydroFlouroCarbon Solvent Vertrel XF	Degreasing fluid with zero ozone depletion potential.

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