

Raychem

Specification RT-350
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THERMOFIT® RNF-100 TUBING Polyolefin, Flexible, Heat-Shrinkable

1. SCOPE

This specification covers the requirements for two types of flexible electrical insulating, extruded tubing whose diameter will reduce to a predetermined size upon the application of heat in excess of 121°C (250°F).

1.1 TYPE 1

Type 1 tubing shall be flame-retardant and shall be black, white, red, yellow, or blue unless otherwise specified.

1.2 TYPE 2

Type 2 tubing shall not be flame-retardant and shall be clear.

2. APPLICABLE DOCUMENTS

This specification takes precedence over documents referenced herein. Unless otherwise specified, the latest issue of referenced documents applies. The following documents form a part of this specification to the extent specified herein.

2.1 GOVERNMENT-FURNISHED DOCUMENTS

Military

ASTM D 910 Gasoline, Aviation, Grades 80/87, 100, and 115/145 MIL-PRF-5606 Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance MIL-T-83133 Turbine Fuel, Aviation, Grade JP-8

MIL-STD-104 Limits for Electrical Insulation Color

2.2 OTHER PUBLICATIONS

American Society for Testing and Materials (ASTM) D 910 Standard Spec. for Aviation Gasolines

D 2671 Standard Methods of Testing Heat-Shrinkable Tubing for Electrical Use

(Copies of ASTM publications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

International Organization for Standardization (ISO)

ISO 846 Plastics – Evaluation of the action of Microorganisms

(Copies of ISO publications may be obtained from the International Organization for Standardization, 1, rue de Varembé, CH-1211 Geneva 20, Switzerland or via the ISO website at http://www.iso.ch/iso/en/ISOOnline.frontpage)

3. REQUIREMENTS

3.1 MATERIALS

The tubing shall be fabricated from thermally stabilized, modified polyolefin and shall be crosslinked by irradiation. It shall be homogeneous and essentially free from flaws, defects, pinholes, bubbles, seams, cracks, and inclusions.

3.2 PROPERTIES

The tubing shall meet the requirements of Table 3.

4. QUALITY ASSURANCE PROVISIONS

4.1 CLASSIFICATION OF TESTS

4.1.1 Qualification Tests

Qualification tests are those performed on tubing submitted for qualification as a satisfactory product and shall consist of all tests listed in this specification.

4.1.2 <u>Acceptance Tests</u>

Acceptance tests are those performed on tubing submitted for acceptance under contract. Acceptance tests shall be: dimensions, longitudinal change, tensile strength, ultimate elongation, secant modulus, flammability (Type 1 only), and heat shock. Statistical process control data may be used to demonstrate conformance for dimensions.

4.2 SAMPLING INSTRUCTIONS

4.2.1 Qualification Test Samples

Qualification test samples shall consist of 50 feet (15 m) of black, white and clear tubing. Qualification of black and white shall qualify all colors. Clear shall be qualified separately. Qualification of any size within each size range specified below shall qualify all sizes within that size range.

Range of Sizes

3/64 through 1/4 3/8 through 1 1-1/4 through 5

4.2.2 <u>Acceptance Test Sample</u>

Acceptance test samples shall consist of not less than 16 feet (5 m) of tubing selected at random from each compound batch or the first sleeving production lot of the batch compound. Physical property tests performed at this time qualify subsequent sleeving lots produced from the same compound batch.

4.3 TEST PROCEDURES

Condition test specimens and measurement gauges at $23 \pm 3^{\circ}$ C $(73 \pm 5^{\circ}F)$ and ambient relative humidity prior to all testing, whether before or after heat shrinking. Unless otherwise specified, perform tests on specimens which have been fully recovered by conditioning for 3 minutes in a $200 \pm 5^{\circ}$ C $(392 \pm 9^{\circ}F)$ oven. Use mechanical convection type ovens in which air passes the specimens at a velocity of 100 to 200 feet (30 to 60 m) per minute.

4.3.1 Dimensions and Longitudinal Change

Measure three 6-inch (150 mm) specimens of tubing, as supplied, for length \pm 1/32 inch (\pm 1 mm), and inside diameter in accordance with ASTM D 2671. Condition the specimens for 3 minutes in a 200 \pm 5°C (392 \pm 9°F) oven, cool to 23 \pm 3°C (73 \pm 5°F) and then remeasure. Prior to and after conditioning, the dimensions of the tubing shall be in accordance with Table 1 and the longitudinal change shall be in accordance with Table 3. Calculate the longitudinal change as follows:

$$C = \frac{L_1 - L_0}{L_0} \times 100$$

Where: C = Longitudinal Change [Percent]

L₀ = Length Before Conditioning [Inches (mm)] L₁ = Length After Conditioning [Inches (mm)]

4.3.2 <u>Tensile Strength and Ultimate Elongation</u>

Determine the tensile strength and ultimate elongation of the tubing in accordance with ASTM D 2671 using 1-inch (25-mm) bench marks, a 1-inch (25-mm) initial jaw separation, and jaw separation speed of 20 ± 2 inches (500 \pm 50 mm) per minute.

4.4 REJECTION AND RETEST

Failure of any sample of tubing to conform to any one of the requirements of this specification shall be cause for rejection of the lot represented. Tubing which has been rejected may be replaced or reworked to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and action taken to correct the defects shall be furnished to the inspector.

5. PREPARATION FOR DELIVERY

5.1 FORM

The tubing shall be supplied on spools or in lengths of 48 + 1, -0 inches (1220 + 25.4, -0 mm) unless otherwise specified.

5.2 PACKAGING

Packaging shall be in accordance with good commercial practice.

5.3 MARKING

Each container of tubing shall be permanently and legibly marked with the size, quantity, manufacturer's identification, specification number, and lot number.

TABLE 1
Tubing Dimensions

	As Supplied Inside Diameter Minimum		As Recovered							
Size			Inside Diameter Maximum		Wall Thickness					
					Minimum		Maximum		Nominal	
	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.
3/64	.046	1.17	.023	0.58	.013	0.33	.019	0.48	.016	0.40
1/16	.063	1.60	.031	0.79	.014	0.35	.020	0.50	.017	0.43
3/32	.093	2.36	.046	1.17	.017	0.43	.023	0.58	.020	0.50
1/8	.125	3.17	.062	1.57	.017	0.43	.023	0.58	.020	0.50
3/16	.187	4.74	.093	2.36	.017	0.43	.023	0.58	.020	0.50
1/4	.250	6.35	.125	3.17	.022	0.56	.028	0.71	.025	0.64
3/8	.375	9.50	.187	4.74	.022	0.56	.028	0.71	.025	0.64
1/2	.500	12.70	.250	6.35	.022	0.56	.028	0.71	.025	0.64
3/4	.750	19.05	.375	9.50	.027	0.69	.033	0.84	.030	0.76
1	1.000	25.40	.500	12.70	.030	0.76	.040	1.01	.035	0.88
1-1/4	1.250	31.75	.625	14.30	.034	0.86	.046	1.17	.040	1.01
1-1/2	1.500	38.10	.750	19.05	.034	0.86	.046	1.17	.040	1.01
2	2.000	50.80	1.000	25.40	.038	0.96	.052	1.32	.045	1.14
3	3.000	76.20	1.500	38.10	.042	1.06	.058	1.47	.050	1.27
4	4.000	101.60	2.000	50.80	.046	1.16	.064	1.63	.055	1.39
5	5.000	127.00	2.500	63.50	.051	1.30	.069	1.75	.060	1.52

TABLE 2 Mandrel Dimensions for Bend Testing

Tubing Size	Mandrel Diameter			
	in.	mm.		
3/64 to 1/4 inclusive	5/16	7.9		
3/8 to 5 inclusive	3/8	9.5		

TABLE 3 Requirements

			REQUIREMENT		
PROPERTY	UNIT	TYPE 1	TEST METHOD		
PHYSICAL				Section 4.3.1	
Dimensions	Inches (mm)	In accordance	In accordance	ASTM D 2671	
		with Table 1	with Table 1		
Longitudinal Change	Percent	+0, -5	+0, -5		
Tensile Strength	psi (MPa)	1500 minimum	1500 minimum	Section 4.3.2	
		(10.3)	(10.3)	ASTM D 2671	
Ultimate Elongation	Percent	200 minimum	200 minimum		
Secant Modulus (Expanded)	psi (MPa)	2.5×10^4	2.5×10^4	ASTM D 2671	
		maximum	maximum		
		(172)	(172)		
Specific Gravity		1.35 maximum	1.0 maximum	ASTM D 2671	
Low Temperature Flexibility		No cracking	No cracking	Table 2	
4 hours at -55 ± 1°C (-67 ± 2°F)		3 10 23	3 10 23	ASTM D 2671	
()				Procedure C	
Heat Shock		No dripping,	No dripping,	Table 2	
4 hours at $250 \pm 3^{\circ}\text{C} (482 \pm 5^{\circ}F)$		flowing or	flowing or	ASTM D 2671	
, ,		cracking	cracking		
Heat Resistance				ASTM D 2671	
168 hours at $175 \pm 2^{\circ}\text{C} \ (347 \pm 4^{\circ}\text{F})$					
Followed by test for:					
Ultimate Elongation	Percent	150 minimum	150 minimum		
Color		MIL-STD-104		MIL-STD-104	
Color Stability		MIL-STD-104		ASTM D 2671	
48 hours at $175 \pm 2^{\circ}$ C $(347 \pm 4^{\circ}F)$					
ELECTRICAL					
Dielectric Strength	Volts/mil	500 minimum	500 minimum	NOTE 1	
	(volts/mm)	(19,680)	(19,680)	ASTM D 2671	
Volume Resistivity	ohm-cm	10 ¹⁴ minimum	10 ¹⁶ minimum	ASTM D 2671	
CHEMICAL	-				
Copper Mirror Corrosion 16 hours at 175 ±		No removal of	No removal of	ASTM D 2671	
$2^{\circ}C(347 \pm 4^{\circ}F)$		copper	copper	Procedure A	
Copper Contact Corrosion		No pitting or	No pitting or	ASTM D 2671	
168 hours at $160 \pm 2^{\circ}\text{C}$ (320 ± 4°F)		blackening of	blackening of	Procedure B	
,		copper	copper		
Copper Stability		No brittleness,	No brittleness,		
168 hours at $160 \pm 2^{\circ}\text{C}$ (320 ± 4°F)		glazing,	glazing,		
, ,		cracking, or	cracking, or		
		severe	severe		
		discoloration of	discoloration of		
		tubing	tubing		
Followed by test for:					
Ultimate Elongation	Percent	200 minimum	200 minimum		

TABLE 3 Requirements (continued)

PROPERTY	UNIT	TYPE 1	TYPE 2	TEST METHOD
CHEMICAL (continued)				
Flammability		Self-		ASTM D 2671
		extinguishing		Procedure B
		within		
		1 minute, 25%		
		maximum flag		
		burn		
Water Absorption	Percent	0.5 maximum	0.2 maximum	ASTM D 2671
24 hours at 23°C (73°F)				
Fluid Resistance				ASTM D 2671
24 hours at 23°C (73°F) in:				
JP-8 Fuel (MIL-T-83133)				
Skydrol* 500				
Hydraulic Fluid (MIL-PRF-5606)				
Aviation Gasoline (100)				
(ASTM D 910)				
Water				
Followed by tests for:				
Dielectric Strength	Volts/mil	400 minimum	400 minimum	
	(volts/mm)	(15,760)	(15, 760)	
Tensile Strength	psi (MPa)	1000 minimum	1000 minimum	
		(6.9)	(6.9)	
Fungus Resistance				ISO 846
				Method B
Followed by tests for:				
Tensile Strength	psi (Mpa)	1500 minimum	1500 minimum	Section 4.3.2
	,	(10.3)	(10.3)	ASTM D 2671
Ultimate Elongation	percent	200 minimum	200 minimum	ASTM D 2671
Dielectric Strength	Volts per mil	500 minimum	500 minimum	
	(volts per mm)	(19,680)	(19,680)	

^{*}Trademark of the Monsanto Company

NOTE 1: Recover the specimens on the metal mandrels for 10 minutes, minimum, at 175 ± 3 °C $(347 \pm 5$ °F) or until the tubing is completely shrunk on the mandrels.

ПОСТАВКА ЭЛЕКТРОННЫХ КОМПОНЕНТОВ

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Общество с ограниченной ответственностью «МосЧип» ИНН 7719860671 / КПП 771901001 Адрес: 105318, г.Москва, ул.Щербаковская д.3, офис 1107

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