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Raychem

Specification	**RT-510**
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RAYCHEM NT TUBING
Modified Chlorinated Polyolefin, Elastomeric, Flexible, Flame Retardant, Heat Shrinkable

1.0 Scope

This specification covers the requirements for one type of highly flexible, electrically insulating, extruded tubing whose diameter will reduce to a predetermined size upon the application of heat in excess of 135°C *(275°F)*.

2.0 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

SAE-AMS-1424	Anti-Icing and Deicing - Defrosting Fluid
MIL-DTL-83133	Turbine Fuels, Aviation, Kerosene Types, NATO F-34 (JP-8), NATO F-35 and JP-8 + 100
MIL-PRF-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
MIL-PRF-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number 0-148

2.2 Other Publications

American Society for Testing and Materials (ASTM)

ASTM D412	Standard Test Methods for Rubber Properties in Tension
ASTM D2240	Standard Method of Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer
ASTM D2671	Standard Methods of Testing Heat-Shrinkable Tubing for Electrical Use
ASTM G21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

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 at http://www.iso.org/iso/home.html

3.0 Requirements

3.1 Material

The tubing shall be fabricated from a stabilized, flame resistant, modified Chlorinated Polyolefin and shall be radiation crosslinked. It shall be homogeneous and essentially free from flaws, defects, pinholes, bubbles, seams, cracks and inclusions.

3.2 Color

The tubing shall be black.

3.3 Properties

The tubing shall meet the requirements of Table 3.

4.0 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 Acceptance Tests

Acceptance tests are those performed on tubing submitted for acceptance under contract. Acceptance tests shall consist of the following:

Dimensions
Longitudinal Change
Tensile Strength
Tensile Stress
Ultimate Elongation
Heat Shock
Flammability
Low Temperature Flexibility

Physical property tests performed at this time qualify subsequent sleeving lots produced from the same batch of compound. 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 tubing of each size. Qualification of any size within each size range specified below will qualify all sizes in the same range.

Size Range
1/8 through 7/8
1 through 4

4.2.2 Acceptance Test Samples

Acceptance test samples shall consist of not less than 16 feet *(5 m)* of tubing selected at random from each lot. A lot shall consist of all tubing of the same size, from the same production run and offered for inspection at the same time.

4.3 Test Procedures

Unless otherwise specified, tests shall be performed on specimens which have been fully recovered by conditioning for 10 minutes in a 175 ± 5°C *(347 ± 9°F)* oven. All ovens shall be of the mechanical convection type in which air passes over the specimens at a velocity of 100 to 200 feet *(30 to 61 m)* per minute. Tubing shall be allowed to cool to room temperature prior to testing. The Heat Shrinkable Sleeving and Measurement Gages shall be at room temperature with ambient relative humidity prior to testing before or after heat shrinking.

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4.3.1 Dimensions and Longitudinal Change

Three 6 inch *(150 mm)* specimens of tubing, as supplied, shall be measured for length ± 1/32 inch *(± 1 mm)* and inside diameter in accordance with ASTM D2671, conditioned for 10 minutes in a 175 ± 5°C *(347 ± 9°F)* oven, cooled to 23 ± 3°C *(73 ± 5°F)* and then re-measured. 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. Longitudinal change shall be calculated as follows:

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

Where: C = Longitudinal Change [Percent]
L_0 = Length Before Conditioning [inches (mm)]
L_1 = Length After Conditioning [inches (mm)]

4.3.2 Tensile Strength, Tensile Stress and Ultimate Elongation

Test three specimens of tubing for tensile strength and ultimate elongation in accordance with ASTM D2671 and for tensile stress in accordance with ASTM D412.
The rate of jaw separation shall be 20 ± 2 inches *(500 ± 50 mm)* per minute.

4.3.3 Copper Stability

Three 6 inch *(150 mm)* specimens of tubing shall be slid over snug fitting, straight, clean, bare copper mandrels, either solid or tubular. The specimens on the mandrels shall be conditioned for 24 hours in a desiccator or similar humidity chamber at 90 to 95 percent relative humidity and 25 ± 3°C *(77 ± 5°F)*. The specimens on the mandrels then shall be conditioned for 168 hours in a 121 ± 2°C *(250 ± 4°F)* oven. After conditioning, the specimens shall be removed from the oven, cooled to 23 ± 3°C *(73 ± 5°F)*. The copper mandrels shall then be removed from the tubing, then the tubing and copper mandrels shall be examined. Darkening of the copper due to normal air oxidation shall not be cause for rejection. The tubing shall be tested for Ultimate Elongation in accordance with 4.3.2.

4.4 Rejection And Retest

Failure of any sample of tubing to comply with 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 defect and then resubmitted for acceptance. Before resubmitting, full particulars concerning the rejection and the action taken to correct the defect shall be furnished to the inspector.

5.0 Preparation for Delivery

5.1 Packaging

Packaging shall be in accordance with good commercial practice. The shipping container shall be not be less than 125 pound-test fiberboard.

5.2 Marking

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

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TABLE 1
Tubing Dimensions

Size	AS SUPPLIED		RECOVERED							
	Inside Diameter Minimum		Inside Diameter Maximum		Wall Thickness					
					Minimum		Maximum		Nominal	
	in.	*mm.*	in.	*mm.*	in.	*mm.*	in.	*mm.*	in.	*mm.*
1/8	.125	*3.18*	.061	*1.55*	.019	*0.48*	.035	*0.91*	.027	*0.69*
3/16	.187	*4.75*	.100	*2.54*	.023	*0.58*	.043	*1.09*	.033	*0.83*
1/4	.250	*6.35*	.143	*3.63*	.025	*0.63*	.045	*1.14*	.035	*0.89*
3/8	.375	*9.52*	.214	*5.45*	.030	*0.76*	.050	*1.27*	.040	*1.01*
1/2	.500	*12.70*	.286	*7.25*	.033	*0.83*	.063	*1.60*	.048	*1.21*
5/8	.625	*15.87*	.357	*9.06*	.037	*0.93*	.067	*1.70*	.052	*1.32*
3/4	.750	*19.05*	.428	*10.88*	.042	*1.06*	.072	*1.82*	.057	*1.44*
7/8	.875	*22.22*	.500	*12.70*	.050	*1.27*	.080	*2.03*	.065	*1.65*
1	1.000	*25.40*	.570	*14.48*	.050	*1.27*	.090	*2.28*	.070	*1.77*
1-1/4	1.250	*31.75*	.714	*18.13*	.067	*1.70*	.107	*2.71*	.087	*2.20*
1-1/2	1.500	*38.10*	.857	*21.76*	.075	*1.90*	.115	*2.92*	.095	*2.41*
1-3/4	1.750	*44.45*	1.000	*25.40*	.087	*2.20*	.127	*3.22*	.107	*2.71*
2	2.000	*50.80*	1.140	*28.96*	.090	*2.28*	.130	*3.30*	.110	*2.79*
3	3.000	*76.20*	1.710	*43.43*	.105	*2.65*	.145	*3.67*	.125	*3.17*
4	4.000	*101.60*	2.280	*58.90*	.120	*3.04*	.160	*4.05*	.140	*3.55*

TABLE 2
Mandrel Dimensions for Bend Testing

Tubing Size in.	Mandrel Diameter	
	in.	*mm.*
1/8 through 3/16	5/16	*7.9*
1/4 through 3/8	3/8	*9.5*
1/2 through 1-3/4	7/16	*11.1*
2 through 3	7/8	*22.2*
4	1.0	*25.4*

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TABLE 3
Requirements

PROPERTY	UNIT	REQUIREMENT	TEST METHOD
PHYSICAL			
Dimensions	inches *(mm))*	In accordance with table 1	ASTM D 2671
Longitudinal Change	percent	+1, -5	Section 4.3.1
Tensile Strength	psi *(MPa)*	1500 *(10.3)* minimum	Section 4.3.2 ASTM D 2671
Ultimate Elongation	percent	225 minimum	ASTM D2671
Tensile Stress at 100% elongation	psi *(MPa)*	1500 *(10.3)* maximum	ASTM D 412
Specific Gravity	---	1.5 maximum	ASTM D 2671
Low Temperature Flexibility 4 hours at -70°C ± 2°C *(-94°± 4° F)*	---	No cracks	ASTM D 2671 Procedure C Table 2
Heat Shock 4 hours at 200°C± 3°C *(392°± 5° F)*	---	No cracks, flowing or dripping	ASTM D 2671 Table 2
Heat Resistance 168 hours at 121°C ± 2°C *(250 ± 4°F)* Followed by tests for: Tensile strength Ultimate elongation	--- psi *(MPa)* percent	--- 1200 *(8.3)* 175 minimum	ASTM D 2671 Section 4.3.2 ASTM D 2671 ASTM D 2671
ELECTRICAL			
Dielectric Strength	volts/mil (*kV/mm*)	300 minimum *(11.8)*	ASTM D 2671
Volume Resistivity	ohm-cm	10^{11} minimum	ASTM D 2671
CHEMICAL			
Copper Mirror Corrosion 16 hours at 150°± 2°C *(302°± 4° F)*	---	Noncorrosive	ASTM D 2671 Procedure A
Copper Contact Corrosion 16 hours at 150 ± 2°C *(302°± 4° F)*		No pitting or blackening of copper	ASTM D 2671 Procedure B
Copper Stability 168 hours at 121°± 2°C *(250°± 4° F)* Followed by test for: Ultimate Elongation	--- percent	No brittleness, glazing, cracking, or severe discoloration of tubing 175 minimum	Section 4.3.3 ASTM D 2671
Flammability	Seconds	Self-extinguishing within 15 seconds;	ASTM D 2671 Procedure A
Fungus Resistance Followed by tests for: Tensile Strength Ultimate Elongation Dielectric Strength Fungus Resistance	--- psi *(MPa)* percent volts/mil (*kV/mm*) ---	--- 1500 *(10.3)* minimum 225 minimum 300 *(11.8)* minimum Or Rating of 1 or less	ISO 846 Method B Section 4.3.2 ASTM D 2671 ASTM D 2671 ASTM G21
Water Absorption 24 hours at 23°± 2°C *(73° ± 4°F)*	Percent	1.0 maximum	ASTM D 2671

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TABLE 3
Requirements
(continued)

PROPERTY	UNIT	REQUIREMENTS	TEST METHOD
CHEMICAL (continued) Fluid Resistance 24 hours at 23°± 2°C (73° ± 4° *F)* JP-8 Fuel (MIL-DTL-83133) Hydraulic Fluid (MIL-PRF-5606) Lubricating Oil (MIL-PRF-7808) De-Icing Fluid (SAE-AMS-1424) Water Followed by tests for: Tensile Strength Dielectric Strength	--- psi *(MPa)* volts/mil *(kV/mm)*	--- 1000 *(6.9)* minimum 250 *(9.8)* minimum	 ASTM D 2671 Section 4.3.2 ASTM D 2671 ASTM D 2671

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