RW-125 Specification

108-120005

Raychem RW-125 Tubing
Fluoropolymer, High Clarity, Flexible, Flame Resistant, Heat-Shrinkable

RW-125 is a single wall 2:1 shrink ratio heat shrinkable tubing fabricated from cross linked fluoropolymer. Designed for use where high clarity, exposure to UV, and organic fluids (especially oils and diesel fuel) are required. In addition, RW-125 is highly flame resistant and recovers at a relativly low temperature of 130°C *(266°F)*.
Tubing is clear unless otherwise specified.

Continuous operating temperature -55°C to + 150°C.
Not recommended as a primary electrical insulator above 135°C.

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1. SCOPE

This specification covers the requirements for one type of flexible, flame resistant, electrical insulating, extruded tubing whose diameter will reduce to a predetermined size upon the application of heat in excess of 130°C *(266°F)*. The tubing shall be flame resistant and shall be clear. This quality assurance specification establishes the quality standard for a flame resistant heat-shrinkable clear tubing for use in applications where high performance during exposure to UV radiation, organic fluids, especially oils and diesel fuel is required. These special requirements are detailed in Table 2.

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.

American Society for Testing and Materials (ASTM)

D2671	Standard Methods of Testing Heat-Shrinkable Tubing for Electrical Use
D471	Standard Test Method for Rubber Property—Effect of Liquids
D975	Standard Specification for Diesel Fuel
D3032	Standard Test Methods for Hookup Wire Insulation
D3306	Standard Specification for Glycol Base Engine Coolant for Automobile and Light-Duty Service
D1746	Standard Test Method for Transparency of Plastic Sheeting

(Copies of ASTM publications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103 or via the ASTM website at http://www.astm.org).

International Organization for Standardization (ISO)

ISO 4892-1	Plastics -- Methods of exposure to laboratory light sources -- Part 1: General guidance
ISO 4892-2	Plastics -- Methods of exposure to laboratory light sources -- Part 2: Xenon-arc lamps
ISO 7724-1	Paints and Varnishes -- Colorimetry -- Part 1: Principles

(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)

SAE International

SAE J 1128	Low Tension Primary Cable, Standard
SAE J 1703	Motor Vehicle Brake Fluid
AS23053	Insulation Sleeving, Electrical, Heat Shrinkable, General Specification For

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(Copies of SAE publications may be obtained from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or via the SAE website at http://www.sae.org.)

TE project reference PRJ-17-000902102

3. REQUIREMENTS

3.1 MATERIALS

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

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 Acceptance Tests

Acceptance tests are those performed on tubing submitted for acceptance under contract. Acceptance tests shall be:

Dimensions
Longitudinal Change
Concentricity
Tensile Strength
Ultimate Elongation
Secant Modulus
Clarity

Statistical process control data may be used to demonstrate conformance for dimensions.

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4.2 SAMPLING INSTRUCTIONS

4.2.1 Qualification Test Samples

Qualification test samples shall consist of 150 feet *(45 m)* of tubing. One size will qualify the entire range of sizes. Weather-Ometer Resistance, is performed using compound formed into a plaque.

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 compound batch or the first tubing production lot of the batch compound. Physical property tests performed at this time qualify subsequent tubing lots produced from the same compound batch.

4.2.3 Lot Formation

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, perform tests on specimens which have been fully recovered by conditioning for 3 minutes in a 200 ± 5°C *(392 ± 9°F)* oven. Condition the test specimens (and measurement gauges, when applicable) for 3 hours at 23 ± 3°C *(73 ± 5°F)* and 50 ± 5 percent relative humidity prior to all testing. 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 Low Temperature Flexibility

For tubing of expanded diameter less than 1/4 inch *(6 mm)*, cut three tubular specimens, 12 inches *(300 mm)* long, from the expanded tubing. For tubing of expanded diameter 1/4 inch *(6 mm)* or greater, cut three strip specimens, 1/4 inch *(6 mm)* wide and 12 inches *(300 mm)* long, from the expanded tubing. Recover the specimens in accordance with Section 4.3.

Condition the recovered specimens with appropriate mandrels for 4 hours at -55 ± 2°C *(-67 ± 4°F)*. The mandrel diameter shall be 10 times the recovered specimen thickness, ± 10 percent. For tubular specimens, the specimen thickness shall be equivalent to the outside diameter. While at the specified temperature, and without removing the specimens from the cold chamber, wrap the specimens 360° around the mandrel in approximately 2 seconds. Disregard any side cracking, caused by flattening of the specimens on the mandrel.

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4.3.2 Weatherometer Sample Preperation

Melt blend the RW-125 compound using a 300 cc mixing bowl (360 grams total batch weight), at 180 ± 3°C *(355 ± 7°F)*. The resulting batch is pressed it into a “pancake” approx. 1/8 inch *(3mm)* thick in the cold press. Cut the pancake into ~3 inch *(75 mm)* strips.

Prepare 0.032 – 0.040 in *(0.81-1.00 mm)* thick plaques using ~ 36 grams of compound in a 6 x 6 x 0.035 inch *(152 x 152 x 0.89 mm)* mold sandwiched in between two 203 x 203 x 3 mm *(8 x 8 x 1/8 inch)* plates each lined with release paper. Insert the filled mold into a press set at 180 ± 3°C *(355 ± 7°F).* Gradually pump the press to 40,000 pounds *(18,160 kg)*. When the indicatied pressure is stable, hold for 1 minute, release the pressure and remove the mold from the press and place it immediately into a cold press. Gradually pump to 9,080 kg *(20,000 pounds)*, hold there of 5 minutes.

Remove the plaque from the cold press and separate if form the mold, release paper and plates. Irradiate the plaque to a dose of 10 Mrads.

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, 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 name, product name, and lot number.

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APPENDIX

TABLE 1
Mandrel Dimensions
For Heat Shock Bend Testing

Tubing Size	Mandrel Diameter	
	in.	mm.
3/64 to 1/4 inclusive	0.313 ± 0.002	7.90 ± 0.05
3/8 to 1/2 inclusive	0.375 ± 0.003	9.50 ± 0.08
3/4 to 1 inclusive	0.438 ± 0.004	11.10 ± 0.10

TABLE 2
Requirements

PROPERTY	UNIT	REQUIREMENT	TEST METHOD
PHYSICAL Dimensions	Inches *(mm)*	In accordance RW-125 Tubing SCD	ASTM D2671
Longitudinal Change	Percent	+0, -10	Note 1
Tensile Strength	psi *(MPa)*	3500 *(24.1)* minimum	ASTM D2671
Ultimate Elongation	Percent	300 minimum	Note 2
Concentricity (Expanded)	Percent	70 minimum	ASTM D2671
Secant Modulus (Expanded)	psi *(MPa)*	7.5 x 10^4 *(517)* maximum	ASTM D2671
Specific Gravity	---	1.90 maximum	ASTM D2671
Low Temperature Flexibility 4 hours at -55 ± 2°C *(-67 ± 4°F)*	---	No cracking	Section 4.3.1
Heat Shock 4 hours at 250 ± 3°C *(482 ± 5°F)*	---	No dripping, flowing or cracking	Table 2 ASTM D2671
Heat Resistance 336 hours at 225 ± 3°C *(437 ± 5°F)* Followed by test for:			ASTM D2671
Ultimate Elongation	Percent	100 minimum	
Clarity – Transmittance As Supplied (Expanded) Fully Recovered	Percent	 65 minimum 35 minimum	ASTM D1746 Note 5
ELECTRICAL Dielectric Strength	Volts/mil *(Volts/mm)*	400 *(15,760)* minimum	ASTM D2671 Note 3
Volume Resistivity	Ohm-cm	10^{11} minimum	ASTM D2671
CHEMICAL Copper Mirror Corrosion 16 hours at 160 ± 2°C *(320 ± 4°F)*	---	Noncorrosive	ASTM D2671 Procedure A
Copper Contact Corrosion 16 hours at 160 ± 2°C *(320 ± 4°F)*	---	No pitting or blackening of copper	ASTM D2671 Procedure B

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TABLE 2
Requirements (continued)

PROPERTY	UNIT	REQUIREMENT	TEST METHOD
Flammability	---	Self-extinguishing within 1 minute, 25% maximum flag burn	ASTM D2671 Procedure C
Water Absorption 24 hours at 23 ± 3°C *(73 ± 5°F)*	Percent	0.5 maximum	ASTM D2671
Fluid Resistance 24 hours at 23 ± 3°C *(73 ± 5°F)* in: Diesel Fuel No. 2 (ASTM D975) Fuel C (ASTM D471) Oil, IRM 903 (ASTM D471) Engine Coolant, Type III (ASTM D3306) 5% NaCl Solution Brake Fluid (SAE J 1703) Water Followed by tests for:	---	---	ASTM D2671 Note 4
Tensile Strength	psi *(MPa)*	2000 *(13.8)* minimum	
Ultimate Elongation	Percent	250	
Dielectric Strength	Volts/mil *(Volts/mm)*	400 *(15,760)* minimum	
Weatherometer Resistance ISO 4892-1, ISO 4892-2 Radiant Energy ≥ 3000 kJ/m^2 Inner and outer filter: Borosilicate Radiant exposure: 0.50 W/m^2 @ 340 Nm Test Program Cam No. 7 Light only: 102 ± 0.5 minutes Light and spray: 18 ± 0.5 minutes Black Standard Temp.: 80 ± 3 °C Followed by Test for:			
Color Change	---	Delta E* (ΔE*) ≤ 5.0	ISO 7724-1

NOTE 1: Condition the specimens for 3 minutes at 200 ± 3°C *(392 ± 5°F)* and cool to room temperature before final measurements.

NOTE 2: Use 1-inch *(25.4 mm)* bench marks, 1-inch *(25.4 mm)* initial jaw separation, and 2 ± 0.2 inch/min *(50 ± 5 mm/min)* jaw separation speed.

NOTE 3: Recover the specimens on the metal mandrels for 10 minutes, minimum, at 175 ± 2°C *(347 ± 4°F)* or until the tubing is completely shrunk on the mandrels.

NOTE 4: To measure the dielectric strength, immerse the recovered specimens in the fluids prior to inserting the mandrels into the wiped and dried specimens.

NOTE 5: Expanded size 1 inch *(25.4mm)* standard wall is used to test the clarity only.

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