RAYCHEM HT-200 TUBING Specification

Formerly RW-1200

TEC-108-120028

Clear Fluoropolymer, Very Flexible, Flame-Resistant, Fluid–Resistant, Heat-Shrinkable

HT-200 heat-shrinkable tubing is a very flexible, highly flame-resistant (SAE AS23053, Test C, and ASTM D2671, Procedure C), high-clarity, high-temperature, chemical resistant tubing made from a fluoropolymer material. This Raychem tubing provides very-thin-wall insulation and strain relief of multipin connectors, solder joints and other delicate electrical connections and terminations. Not recommended for use as a primary insulator at temperatures exceeding 135°C *(275°F).*

It is well-suited for applications that require dense packing of components or visual inspection of covered components such as downhole sensors. It is especially suitable for applications requiring superior chemical and solvent resistance. Its high temperature performance meets or exceeds military and industrial standards. HT-200 meets NASA outgassing requirements making it suitable for use in space applications such as satellites.

HT-200 meets the requirements of SAE AS23053/18, Class 3.

Continuous operating range: –70°C to 200°C *(-94°F to 392°F)*

Table of Contents

| Indicates Change

1. SCOPE

This specification covers the requirements for one type of flexible, 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 the standard color 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

Federal

A-A-694	Sodium Chloride, Technical

Military

MIL-PRF-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordinance
MIL-T-83133	Turbine Fuel, Aviation, Grades JP-8
MIL-PRF-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-PRF-23699	Lubricating Oil, Aircraft Turbine Engines, Synthetic Base, NATO Code Number 0-156

2.2. OTHER PUBLICATIONS

American Society for Testing and Materials (ASTM)

D 2671	Standard Methods of Testing Heat-Shrinkable Tubing for Electrical Use
E 595	Standard Methods of Test for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
D 412	Standard Test Methods for Rubber Properties in Tension.
G 21	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 19103or via the ASTM website at http://www.astm.org.)

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SAE International

AMS 1424 De-icing/Anti-Icing Fluid, Aircraft, SAE Type 1

SAE AS23053 Insulating Sleeving, Electrical, Heat Shrinkable, General Specification for

(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)

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 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. COLOR

Unless otherwise specified, the tubing shall be clear.

3.3. PROPERTIES

The tubing shall meet the requirements of Table 2.

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.

| Indicates Change

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
Low Temperature Flexibility
Flammability
Heat Shock
Clarity Stability (Clear only)

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 15 m *(50 feet)* of tubing. Qualification of any size within each size range specified below shall qualify all sizes within that size range.

Range of Sizes
3/64 through 1/8
3/16 through 1-inch

4.2.2. Acceptance Test Samples

Acceptance test samples shall consist of not less than 5 m *(16 feet)* of tubing selected at random from each lot 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.

4.2.3. 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 30 to 60 m *(100 to 200 feet)* per minute.

| Indicates Change

4.3.1. Tensile Strength and Elongation

Test three specimens of tubing for tensile strength and elongation in accordance with ASTM D2671. For tubing sizes 3/8 and smaller, the specimens shall be full sections of tubing; for sizes 1/2 and larger, the specimens shall be cut with die D of ASTM D412. The specimens shall have 1 inch (25 mm) bench marks, centrally located. The testing machine shall have an initial jaw separation of 2 inches (51 mm) for full sections of tubing and 2 inches (51 mm) for die-cut specimens. The rate of jaw separation shall be 2 ± 0.22 inches (51 ± 5.1 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, 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, color, lot number and date of manufacturing

APPENDIX

TABLE 1

MANDREL DIMENSIONS FOR BEND TESTING

Tubing Size	Mandrel Diameter	
	mm.	*in.*
3/64 to 1/4 inclusive	7.9 ± 0.05	*5/16 ± 0.002*
3/8 to 1/2 inclusive	9.5 ± 0.08	*3/8 ± 0.003*
3/4 to 1 inclusive	11.1 ± 0.10	*7/16 ± 0.004*

TABLE 2

REQUIREMENTS

PROPERTY	UNIT	REQUIREMENT	TEST METHOD
PHYSICAL Dimensions	mm *(inches)*	In accordance HT-200 SCD	ASTM D2671
Longitudinal Change	Percent	+0, -10	Note 1
Tensile Strength	MPa *(psi)*	10.3 *(1500)* minimum	Section 4.3.1
Ultimate Elongation	Percent	250 minimum	ASTM D2671
Concentricity (Expanded)	Percent	70 minimum	ASTM D2671
Secant Modulus (Expanded)	MPa *(psi)*	172 *(2.5 x 10^4)* maximum	ASTM D2671
Specific Gravity	---	2.0 maximum	ASTM D2671
Low Temperature Flexibility 4 hours at -70 ± 2°C *(-94 ± 4°F)*	---	No cracking	SAE AS23053,
Heat Shock 4 hours at 300 ± 3°C *(572 ± 5°F)*	---	No dripping, flowing or cracking	Table 2 ASTM D2671
Heat Resistance 168 hours at 250 ± 3°C *(482 ± 5°F)* Followed by tests for: Tensile Strength Ultimate Elongation	 MPa *(psi)* Percent	 8.3 *(1200)* minimum 200 minimum	Section 4.3.1 ASTM D2671
Vacuum Outgassing TML (Total Mass Loss) VCM (Volatile Condensable Material)	 Percent Percent	 1.0 Maximum 0.1 Maximum	ASTM E 595
Clarity Stability 24 hours at 200 ± 3°C *(392 ± 5°F)*	---	Marking legible through tubing wall (Clear only)	SAE AS23053
ELECTRICAL Dielectric Strength	Volts/mm *(Volts/mil)*	19,700 *(500)* minimum	ASTM D2671 Note 2
Volume Resistivity	ohm-cm	1 x 10^{13} minimum	ASTM D2671

| Indicates Change

REQUIREMENTS (cont.)

PROPERTY	UNIT	REQUIREMENT	TEST METHOD
CHEMICAL Copper Mirror Corrosion 16 hours at 175 ± 2°C *(347 ± 4°F)*	---	Non-corrosive	ASTM D2671 Procedure A
Flammability	---	Self-extinguishing within 15 seconds, 25% maximum flag burn	ASTM D2671 Procedure C
Fungus Resistance (Note 3)	---	Rating of 0	ASTM G21 OR ISO 846 Method B
Followed by tests for:			
Tensile Strength	MPa *(psi)*	10.3 *(1500)* minimum	Section 4.3.1
Ultimate Elongation	Percent	250 minimum	ASTM D2671
Dielectric Strength	Volts/mm *(Volts/mil)*	19,700 *(500)* minimum	ASTM D2671 Note 2
Fluid Resistance 24 hours at 24 ± 3°C *(75 ± 5°F)* in: JP-8 Fuel (MIL-DTL-83133) Hydraulic Fluid (MIL-PRF-5606) Lubricating Oil, (MIL-PRF-23699) Lubricating Oil, (MIL-PRF-7808) Skydrol 500 5% NaCl, A-A-694 De-icing Fluid (AMS 1424) Water	---	---	ASTM D2671
Followed by tests for:			
Tensile Strength	psi *(MPa)*	1200 *(8.3)* minimum	
Ultimate Elongation	Percent	250	
Water Absorption 24 hours at 23 ± 3°C *(73 ± 5°F)*	Percent	0.1 maximum	ASTM D2671

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: 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 3: For Fungus Resistance use any expanded tube size in the range from 4.74 mm *(3/16 inch)* up to 19.05 mm *(3/4 inch)*.

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