



SWFR

Single Wall, Heat Shrink Tubing Highly flame-retardant, UL VW-1 rated, Zerohal tubing

PRODUCT DESCRIPTION

SWFR tubing from TE Connectivity (TE) is a cost effective, highly flame-retardant, 2:1 shrink ratio tubing made irradiated, cross-linked polyolefin. It insulates and mechanically protects components, electrical connections, and terminations. SWFR is offered in two very flexible types. X2 is a thin wall tubing, and X4 is a very thin wall tubing. The thicker wall of the X2 offers better protection, while the space-saving thinner wall of the X4 permits denser packing of protected components and a faster shrink time to better protect against thermal damage of temperature-sensitive components. Both types are halogen free, permitting their use in enclosed spaces where toxic gasses from burning materials containing halogens is undesirable.

KEY FEATURES

- Highly flame-retardant with UL VW-1 and CSA OFT flammability rating
- Environmentally friendly formula is essentially free of halogens, permitting use in enclosed areas where emission of toxic gasses from burning materials containing halogens is undesirable.

APPLICATIONS

- Household appliances
- Automotive
- Commercial electronics & communications
- Consumer products
- Industrial equipment
- · Rail & Mass Transit

STANDARDS AND SPECIFICATIONS

- Customer drawings: SWFR X2 and SWFR X4
- UL 224 VW-1, CSA OFT
- UL file E35586
- CSA file LR31929

ELECTRICAL, MECHANICAL, & MATERIALS

- Provides excellent electrical insulation
- Provides mechanical protection from abrasion
- Highly flexible X2 thin wall & X4 very thin wall types
- Non-halogenated irradiated polyolefin
- RoHS & REACH compliant

TEMPERATURE RATING

- Minimum shrink temperature 70°C [158°F]
- Full recovery temperature 90°C [194°F]
- Operating temperature -30°C to 125°C [22°F to 257°F]

ORDERING INFORMATION

- Color: Black (-0)
- Packaging: (-SP) spool, varying lengths (consult TE for details) & (-FSP) flat on spool (only for sizes 8mm & larger)
- Ordering description: Specify product type, size, color, packaging & surface marking. For example, X2-2.0-0-SP-SM
- Product is now available surface marked (except 0.6 size X4)

DIMENSIONS



| Product Type | Size | Minimum Expanded I.D. (D) | Maximum Recovered I.D. (d) | Total Recovered Wall Thickness (W) |
|------------------|------|------------------------------|-------------------------------|------------------------------------|
| | 1.0 | 1.3 | 0.5 | 0.44 |
| | 1.5 | 1.9 | 0.75 | 0.44 |
| | 2.0 | 2.4 | 1.0 | 0.44 |
| | 2.5 | 2.9 | 1.25 | 0.44 |
| | 3.0 | 3.4 | 1.5 | 0.44 |
| | 3.5 | 3.8 | 1.75 | 0.46 |
| | 4.0 | 4.3 | 2.0 | 0.46 |
| | 5.0 | 5.3 | 2.5 | 0.56 |
| | 6.0 | 6.3 | 3.0 | 0.56 |
| X2 (Thin Wall) | 7.0 | 7.3 | 3.5 | 0.56 |
| AZ (TIIII VVaII) | 8.0 | 8.3 | 4.0 | 0.56 |
| | 9.0 | 9.3 | 4.5 | 0.56 |
| | 10.0 | 10.1 | 5.0 | 0.56 |
| | 11.0 | 11.1 | 5.5 | 0.56 |
| | 12.0 | 12.4 | 6.0 | 0.56 |
| | 16.0 | 16.5 | 8.0 | 0.69 |
| | 18.0 | 18.6 | 9.0 | 0.77 |
| | 20.0 | 21.0 | 10.0 | 0.77 |
| | 25.0 | 26.4 | 12.5 | 0.77 |
| | 30.0 | 31.6 | 15.0 | 0.89 |
| | 0.6 | 0.7 | 0.3 | 0.25 |
| | 0.8 | 0.95 | 0.4 | 0.25 |
| | 1.0 | 1.15 | 0.5 | 0.25 |
| | 1.5 | 1.65 | 0.75 | 0.25 |
| | 2.0 | 2.05 | 1.0 | 0.26 |
| | 2.5 | 2.55 | 1.25 | 0.28 |
| | 3.0 | 3.05 | 1.5 | 0.28 |
| | 3.5 | 3.55 | 1.75 | 0.28 |
| X4 (Very Thin | 4.0 | 4.15 | 2.0 | 0.28 |
| Wall) | 6.0 | 6.1 | 3.0 | 0.33 |
| | 8.0 | 8.1 | 4.0 | 0.33 |
| | 9.0 | 9.1 | 4.5 | 0.33 |
| | 10.0 | 10.0 | 5.0 | 0.33 |
| | 12.0 | 12.4 | 6.0 | 0.33 |
| | 18.0 | 18.6 | 9.0 | 0.46 |
| | 25.0 | 25.4 | 12.5 | 0.46 |

PRODUCT DESCRIPTION & ORDERING INFORMATION

| Product Type | Material Description | Material Number | |
|---------------------------------------|-------------------------|--------------------|--|
| | X2-1.0-0-SP-SM | EM7479-000 | |
| | X2-1.5-0-SP-SM | EM7480-000 | |
| | X2-2.0-0-SP-SM | EM7481-000 | |
| | X2-2.5-0-SP-SM | EM7482-000 | |
| | X2-3.0-0-SP-SM | EM7483-000 | |
| | X2-3.5-0-SP-SM | EM7484-000 | |
| | X2-4.0-0-SP-SM | EM7485-000 | |
| V2 (Th:- | X2-5.0-0-SP-SM | EM7486-000 | |
| X2 (Thin Wall) | X2-6.0-0-SP-SM | EM7487-000 | |
| · · · · · · · · · · · · · · · · · · · | X2-7.0-0-SP-SM | EM7488-000 | |
| | X2-8.0-0-FSP-SM | EM7489-000 | |
| | X2-9.0-0-FSP-SM | EM7490-000 | |
| | X2-10.0-0-FSP-SM | EM7491-000 | |
| | X2-11.0-0-FSP-SM | EM7492-000 | |
| | X2-12.0-0-FSP-SM | EM7493-000 | |
| | X2-16.0-0-FSP-SM | EM6974-000 | |
| | X2-18.0-0-FSP-SM | EM7496-000 | |
| | X2-20.0-0-FSP-SM | EM6975-000 | |
| | X2-25.0-0-FSP-SM | EM7494-000 | |
| | X2-30.0-0-FSP-SM | EM7497-000 | |

| Product Type | Material Description | Material Number |
|------------------------|----------------------|--------------------|
| | X4-0.6-0-SP | EM6977-000 |
| | X4-0.8-0-SP-SM | EM7499-000 |
| | X4-1.0-0-SP-SM | EM7500-000 |
| | X4-1.5-0-SP-SM | EM7501-000 |
| | X4-2.0-0-SP-SM | EM7502-000 |
| | X4-2.5-0-SP-SM | EM7503-000 |
| | X4-3.0-0-SP-SM | EM7504-000 |
| V4 01 | X4-3.5-0-SP-SM | EM7505-000 |
| X4 (Very Thin Wall) | X4-4.0-0-SP-SM | EM7506-000 |
| | X4-6.0-0-SP-SM | EM7507-000 |
| | X4-8.0-0-SP-SM | EM6978-000 |
| | X4-9.0-0-SP-SM | EM7508-000 |
| | X4-10-0-SP-SM | EM6979-000 |
| | X4-12.0-0-FSP-SM | EM7548-000 |
| | X4-18.0-0-FSP-SM | EM7549-000 |
| | X4-25.0-0-FSP-SM | EM7550-000 |

For additional part numbers visit www.te.com/SWFRtubing



X2 THIN WALL PROPERTY REQUIREMENTS

| Dimensions | Property | Unit | Requirement | Test Method |
|--|-------------------------------|--------------------|--------------------------------------|--------------------|
| Longitudinal change | Physical | | | |
| ASTM D 2671 UL 224 Dercent | Dimensions | mm | As shown in DIMENSIONS table | ASTM D 2671 |
| UL 224 | Longitudinal change | | | |
| Eccentricity (recovered) | ASTM D 2671 | percent | +1, -5 | ASTM D 2671 |
| Tensile strength MPa (psi) 10.3 (1500) minimum ASTM D 2671 Ultimate elongation percent 200 minimum ASTM D 2671 Secant modulus (as supplied) MPa (psi) 172 (2.5 x 10°) maximum ASTM D 2671 Low-temperature flexibility No cracking UL 224 (1 hour at -30°C/-22°F) No cracking UL 224 Heat shock No cracking UL 224 (4 hours at 250°C/482°F) No cracking UL 224 Heat aging UL 224 UL 224 (7 days at 158°C/316°F) 70% minimum of unaged specimens UL 224 Ultimate elongation percent 100 minimum UL 224 Ultimate elongation percent 100 minimum ASTM D 2671 Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Dielectric breakdown volts 50% minimum of unaged specimens UL 224 Dielectric breakdown volts 50% minimum of unaged specimens UL 224 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Restricted shrinkage< | UL 224 | percent | +3, -3 | UL 224 |
| Ultimate elongation percent 200 minimum ASTM D 2671 Secant modulus (as supplied) MPa (psi) 172 (2.5 x 10 ⁴) maximum ASTM D 2671 Low-temperature flexibility (1 hour at ~30°C/~22°F) No cracking UL 224 Heat shock (4 hours at 250°C/482°F) UL 224 Heat aging (7 days at 158°C/316°F) UL 224 Tensile strength MPa (psi) 70% minimum of unaged specimens UL 224 Ultimate elongation percent 100 minimum UL 224 Flexibility No cracking ASTM D 2671 Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Dielectric breakdown volts 50% minimum of unaged specimens UL 224 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Restricted shrinkage Pass UL 224 Electrical Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Restricted shrinkage Pass UL 224 Electrical Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Restricted shrinkage Pass UL 224 Electrical Corrosive effect No corrosion ASTM D 2671 Copper stability No corrosion ASTM D 2671 Copper stability No brittleness, glazing, cracking, or severe discoloration of tubing, No percent Ultimate elongation percent 100 minimum ASTM D 2671 Pollowed by tests for: Ultimate elongation percent 100 minimum ASTM D 2671 | Eccentricity (recovered) | percent | 30 maximum | ASTM D 2671 |
| Secant modulus (as supplied) MPa (psi) 172 (2.5 x 10 ⁴) maximum ASTM D 2671 Low-temperature flexibility (1 hour at -30°C/-22°F) Heat shock (2 hours at 250°C/-422°F) Heat aging (7 days at 158°C/316°F) Followed by tests for: Tensile strength MPa (psi) 70% minimum of unaged specimens UL 224 Ultimate elongation percent 100 minimum UL 224 Flexibility No cracking ASTM D 2671 Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Restricted shrinkage Pass UL 224 Electrical Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Copper stability ohm-cm 10 ¹⁴ minimum ASTM D 2671 Copper stability No corrosion ASTM D 2671 Copper stability No brittleness, glazing, cracking, or severe discoloration of tubing, No percent Ultimate elongation percent 100 minimum ASTM D 2671 Low by tests for: Ultimate elongation percent 100 minimum ASTM D 2671 | Tensile strength | MPa (<i>psi</i>) | 10.3 (1500) minimum | ASTM D 2671 |
| Low-temperature flexibility (I hour at -30°C/-22°F) Heat shock (A hours at 250°C/482°F) Heat aging (7 days at 158°C/316°F) Followed by tests for: Tensile strength MPa (psi) Ultimate elongation Dielectric withstand at 2500V Dielectric strength Restricted shrinkage Dielectric withstand at 2500V Restricted shrinkage Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Restricted shrinkage Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Restricted shrinkage Dielectric strength Restricted shrinkage Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Dielectric strength Restricted shrinkage Dielectric strength Restricted shrinkage Dielectric withstand at 2500V Seconds Ominimum ASTM D 2671 Restricted strength Restricted shrinkage Dielectric withstand at 2500V Seconds Ominimum ASTM D 2671 Restricted strength Restricted shrinkage Dielectric withstand at 2500V Seconds Ominimum ASTM D 2671 Volume resistivity Ohm-cm 10 ¹⁴ minimum ASTM D 2671 Chemical Corrosive effect No corrosion ASTM D 2671 Chemical Corrosive effect No corrosion ASTM D 2671 ASTM D 2671 Chemical Corpoper stability ASTM D 2671 Chemical Corpoper stability ASTM D 2671 Dielectric withing or blackening of copper. Followed by tests for: Ultimate elongation Percent 100 minimum ASTM D 2671 | Ultimate elongation | percent | 200 minimum | ASTM D 2671 |
| (I hour at ~30°C/~22°F) Heat shock (4 hours at 250°C/482°F) Heat aging (7 days at 158°C/316°F) Followed by tests for: Tensile strength MPa (psi) Dielectric withstand at 2500V Dielectric strength Electrical Dielectric withstand at 2500V Seconds Electrical No minimum ASTM D 2671 Chemical Chemical Corrosive effect No corrosion ASTM D 2671 Chemical Copper stability No brittleness, glazing, cracking, or severe discoloration of tubing, No pitting or blackening of copper. Followed by tests for: Ultimate elongation Percent 100 minimum ASTM D 2671 | Secant modulus (as supplied) | MPa (<i>psi</i>) | 172 (2.5 x 10 ⁴) maximum | ASTM D 2671 |
| (I hour at -30°C/-22°F) Heat shock (4 hours at 250°C/482°F) Heat aging (7 days at 158°C/316°F) Followed by tests for: Tensile strength MPa (psi) Dielectric withstand at 2500V Dielectric strength No cracking Dielectric withstand at 2500V Dielectric withstand at 2500V Dielectric strength Restricted shrinkage Dielectric withstand at 2500V Dielectric withstand by tests for: Electrical Dielectric withstand by tests for: Dielectric strength Restricted shrinkage Dielectric strength Restricted shrinkage Dielectric withstand at 2500V Seconds Dielectric withstand by tests for: UL 224 Dielectric strength Restricted shrinkage Dielectric strength Restricted shrinkage Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Seconds Dielectric strength Restricted Shrinkage Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Seconds Dielectric strength Restricted Shrinkage Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Seconds Dielectric strength Restricted Shrinkage Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Seconds Dielectric strength Restricted Shrinkage Restricted Shrinkage Restricted Shrinkage Restricted Shrinkage Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Dielectric withstand at 2500V Seconds Dielectric with | Low-temperature flexibility | | Nie aveelije v | 111.224 |
| No cracking No cracking UL 224 | (1 hour at -30°C/-22°F) | | No cracking | OL 224 |
| (4 hours at 250°C/482°F) Heat aging (7 days at 158°C/316°F) Followed by tests for: Tensile strength MPa (psi) Dielectric withstand at 2500V Dielectric strength Electrical Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Dielectric strength Electrical Dielectric strength MV/mm (volts/mil) Dielectric withstand at 2500V Seconds Dielectric withstand with a 2500V Dielectric strength Electrical Dielectric strength Electrical Dielectric withstand at 2500V Seconds Dielectric withstand with a 2500V Seconds Dielectric withstand with a 2500V Seconds Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Seconds Dielectric withstand at 2500V Seconds Dielectric withstand with a 2500V Seconds Dielectric with with | Heat shock | | No grading | LII 224 |
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| (7 days at 158°C/316°F) Followed by tests for: Tensile strength MPa (psi) 70% minimum of unaged specimens UL 224 Ultimate elongation percent 100 minimum UL 224 Flexibility No cracking ASTM D 2671 Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Dielectric breakdown volts 50% minimum of unaged specimens UL 224 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Restricted shrinkage Pass UL 224 Electrical Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Restricted shrinkage Pass UL 224 Electrical Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Volume resistivity ohm-cm 10 ¹⁴ minimum ASTM D 2671 Chemical Corrosive effect No corrosion ASTM D 2671 Copper stability No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation percent 100 minimum ASTM 2671 | Heat aging | | | |
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| Ultimate elongation percent 100 minimum UL 224 | Followed by tests for: | | | |
| Flexibility Dielectric withstand at 2500V Seconds 60 minimum ASTM D 2671 Dielectric breakdown Volts Dielectric breakdown Dielectric strength Restricted shrinkage Flexibility Dielectric withstand at 2500V Seconds Flexibility Dielectric strength Restricted shrinkage Flexibility Dielectric withstand at 2500V Seconds Flexibility Dielectric withstand at 2500V Seconds Flexibility Seconds Flexibility | Tensile strength | MPa (psi) | | UL 224 |
| Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Dielectric breakdown volts 50% minimum of unaged specimens UL 224 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Restricted shrinkage Pass UL 224 Electrical Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Volume resistivity ohm-cm 10 ¹⁴ minimum ASTM D 2671 Chemical Corrosive effect No corrosion ASTM D 2671 Copper stability No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation percent 100 minimum ASTM 2671 | Ultimate elongation | percent | 100 minimum | UL 224 |
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| Dielectric breakdown Dielectric strength Electrical Dielectric withstand at 2500V Dielectric strength Electrical Dielectric strength Electrical Dielectric strength Electrical Dielectric withstand at 2500V Dielectric strength Electric strength Elec | Dielectric withstand at 2500V | seconds | 60 minimum | ASTM D 2671 |
| Restricted shrinkage Flass UL 224 Electrical Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Volume resistivity ohm-cm 10 ¹⁴ minimum ASTM D 2671 Chemical Corrosive effect (7 days at 158°C/316°F) Copper stability (7 days at 158°C/316°F) No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation percent 100 minimum ASTM 2671 | Dielectric breakdown | volts | | UL 224 |
| Electrical Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Volume resistivity ohm-cm 10 ¹⁴ minimum ASTM D 2671 Chemical Corrosive effect (7 days at 158°C/316°F) Copper stability (7 days at 158°C/316°F) No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation percent 100 minimum ASTM 2671 | Dielectric strength | kV/mm (volts/mil) | 19.7 (500) minimum | ASTM D 2671 |
| Dielectric withstand at 2500V seconds 60 minimum ASTM D 2671 Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Volume resistivity ohm-cm 10 ¹⁴ minimum ASTM D 2671 Chemical Corrosive effect (7 days at 158°C/316°F) Copper stability (7 days at 158°C/316°F) No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation percent 100 minimum ASTM 2671 | Restricted shrinkage | | Pass | UL 224 |
| Dielectric strength kV/mm (volts/mil) 19.7 (500) minimum ASTM D 2671 Volume resistivity ohm-cm 10 ¹⁴ minimum ASTM D 2671 Chemical Corrosive effect No corrosion ASTM D 2671 Copper stability No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation percent 100 minimum ASTM D 2671 | Electrical | | | |
| Volume resistivity ohm-cm 10 ¹⁴ minimum ASTM D 2671 Chemical Corrosive effect (7 days at 158°C/316°F) Copper stability (7 days at 158°C/316°F) No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation percent 100 minimum ASTM 2671 | Dielectric withstand at 2500V | seconds | 60 minimum | ASTM D 2671 |
| Chemical Corrosive effect (7 days at 158°C/316°F) Copper stability (7 days at 158°C/316°F) No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation Description No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. ASTM D 2671 ASTM D 2671 | Dielectric strength | kV/mm (volts/mil) | 19.7 (500) minimum | ASTM D 2671 |
| Corrosive effect (7 days at 158°C/316°F) Copper stability (7 days at 158°C/316°F) No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation Dercent No corrosion ASTM D 2671 ASTM D 2671 ASTM D 2671 | Volume resistivity | ohm-cm | 10 ¹⁴ minimum | ASTM D 2671 |
| (7 days at 158°C/316°F) Copper stability (7 days at 158°C/316°F) No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation No corrosion ASTM D 2671 ASTM D 2671 | Chemical | | | |
| (7 days at 158°C/316°F) Copper stability (7 days at 158°C/316°F) No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation Dercent No brittleness, glazing, cracking, or severe discoloration of tubing.No pitting or blackening of copper. ASTM D 2671 ASTM 2671 | Corrosive effect | | No corrector | A STM D 2671 |
| severe discoloration of tubing.No pitting or blackening of copper. Followed by tests for: Ultimate elongation percent 100 minimum ASTM 2671 | (7 days at 158°C/316°F) | | NO CORPOSION | A31M D 20/1 |
| (7 days at 158°C/316°F) pitting or blackening of copper. Followed by tests for: Ultimate elongation percent 100 minimum ASTM 2671 | Copper stability | | | |
| Ultimate elongation percent 100 minimum ASTM 2671 | (7 days at 158°C/316°F) | | | ASTM D 2671 |
| | Followed by tests for: | I. | | |
| Flammability Pass UL 224, VW-1 | Ultimate elongation | percent | 100 minimum | ASTM 2671 |
| | Flammability | | Pass | UL 224, VW-1 |

X4 VERY THIN WALL PROPERTY REQUIREMENTS

| Property | Unit | Requirement | Test Method |
|-------------------------------|--------------------|---|--------------|
| Physical | | | |
| Dimensions | mm | As shown in DIMENSIONS table | ASTM D 2671 |
| Longitudinal change | | | |
| ASTM D 2671 | percent | +1, -15 | ASTM D 2671 |
| UL 224 | percent | +3, -3 | UL 224 |
| Eccentricity (recovered) | percent | 30 maximum | ASTM D 2671 |
| Tensile strength | MPa (<i>psi</i>) | 10.3 (1500) minimum | ASTM D 2671 |
| Ultimate elongation | percent | 200 minimum | ASTM D 2671 |
| Secant modulus (as supplied) | MPa (<i>psi</i>) | 103 (1.5 x 10 ⁴) maximum | ASTM D 2671 |
| Low-temperature flexibility | | No. and the | 111 004 |
| (1 hour at -30°C/-22°F) | | No cracking | UL 224 |
| Heat shock | | | |
| (4 hours at 250°C/482°F) | | No cracking | UL 224 |
| Heat aging | | | |
| (7 days at 158°C/316°F) | | | UL 224 |
| Followed by tests for: | | | |
| Tensile strength | MPa (psi) | 70% minimum of unaged specimens | UL 224 |
| Ultimate elongation | percent | 100 minimum | UL 224 |
| Flexibility | | No cracking | ASTM D 2671 |
| Dielectric withstand at 2500V | seconds | 60 minimum | ASTM D 2671 |
| Dielectric breakdown | volts | 50% minimum of unaged specimens | UL 224 |
| Dielectric strength | kV/mm (volts/mil) | 19.7 (500) minimum | ASTM D 2671 |
| Restricted shrinkage | | Pass | UL 224 |
| Electrical | | | |
| Dielectric withstand at 2500V | seconds | 60 minimum | ASTM D 2671 |
| Dielectric strength | kV/mm (volts/mil) | 19.7 (500) minimum | ASTM D 2671 |
| Volume resistivity | ohm-cm | 10 ¹⁴ minimum | ASTM D 2671 |
| Chemical | | | |
| Corrosive effect | | No corrector | A CTM D 2671 |
| (7 days at 158°C/316°F) | | No corrosion | ASTM D 2671 |
| Copper stability | | No brittleness, glazing, cracking, or severe discoloration of tubing.No | ASTM D 2671 |
| (7 days at 158°C/316°F) | | pitting or blackening of copper. | |
| Followed by tests for: | | | |
| Ultimate elongation | percent | 100 minimum | ASTM 2671 |
| Flammability | | Pass | UL 224, VW-1 |

FOR MORE INFORMATION

Visit www.te.com and enter search term "SWFR," or visit www.te.com/SWFRtubing.

TE TECHNICAL SUPPORT CENTER

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