

# Sure-Weld® TPO

## Reinforced Membrane



### Overview

Carlisle's Sure-Weld membrane is a premium heat-weldable single-ply thermoplastic polyolefin (TPO) sheet designed for new roof construction and re-roofing applications. Sure-Weld High Slope (HS) membrane is formulated with additional flame retardant (compared to standard TPO) for higher-slope fire code approvals. Sure-Weld EXTRA is 80-mils-thick for significantly higher strength and weatherability.

Carlisle Sure-Weld TPO membrane features advanced polymerization technology that combines the flexibility of ethylene-propylene (EP) rubber with the heat weldability of polypropylene. All Sure-Weld TPO membranes include OctaGuard XT™, an industry-leading, state-of-the-art weathering package. OctaGuard XT technology enables Sure-Weld TPO to withstand extreme weatherability testing intended to simulate exposure to severe climates.

Physical properties of the membrane are enhanced by a strong polyester fabric that is encapsulated between the TPO-based top and bottom plies. The combination of the fabric and TPO plies provides Sure-Weld reinforced membranes with high breaking strength, tearing strength and puncture resistance. The relatively smooth surface of Sure-Weld membrane produces a total surface fusion weld that creates a consistent, watertight, monolithic roof assembly. The membrane is environmentally friendly and safe to install.

Sure-Weld Standard and HS products are available in highly reflective white, tan and gray, in both 45-mil and 60-mil thicknesses. Sure-Weld EXTRA (including HS) is available in 80-mil thickness, in white, gray and tan. Sixteen special colors are also available (see Carlisle's TPO Color Palette brochure). Available widths are 4-, 5- and 6-ft perimeter sheets and 8-, 10- and 12-ft field sheets.

Carlisle's Sure-Weld tan and white TPO membrane can contribute toward LEED® (Leadership in Energy and Environmental Design) credits. Tan and white Sure-Weld are ENERGY STAR®\*-qualified and California Title 24 compliant.

### Features and Benefits

- » Outstanding puncture resistance
- » Chlorine-free with no halogenated flame retardants
- » Plasticizer-free; does not contain liquid or polymeric plasticizers
- » Excellent low temperature impact resistance
- » Excellent chemical resistance to acids, bases and restaurant exhaust emissions
- » UL 2218 Class 4 hail rating
- » Exceptional resistance to heat, solar UV, ozone and oxidation
- » Hot-melt extrusion processed for complete scrim encapsulation
- » Sure-Weld is 100% recyclable (refer to Carlisle's Recyclability Statement)
- » Enhanced with the OctaGuard XT™ weathering package



### Installation

1. Sure-Weld Roofing Systems are quick to install, as minimal labor and few components are required. The systems may be installed utilizing labor-saving devices that make sheet welding fast, clean, consistent and easy to learn, while reducing strain on the roofing technician.
2. **The Carlisle Mechanically Fastened Roof System** installation starts with the insulation fastened with a minimum of 5 fasteners per 4 by 8 ft. board. The Sure-Weld reinforced membrane is mechanically fastened to the deck using HP-X™ Fasteners and Piranha Plates™ or HP-XTRA Fasteners and Piranha XTRA Plates. Adjoining sheets of Sure-Weld membrane are overlapped over the fasteners and plates and joined together with a minimum 1½-inch-(4 cm) wide hot-air weld.
3. **The Carlisle Fully Adhered Roofing System** application begins with the insulation fastened at the required density (max. 1 every 2 sq ft) necessary to resist the appropriate wind load. The substrate and membrane are coated with an appropriate Sure-Weld Bonding Adhesive and the membrane is rolled into place.

*Review Carlisle specifications and details for complete installation information.*

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### Precautions

- » Sunglasses that filter out ultraviolet light are strongly recommended, as tan and white surfaces are highly reflective. Roofing technicians should dress appropriately and wear sunscreen to protect skin.
- » Surfaces may become slippery due to frost and ice buildup. Exercise caution during cold conditions to prevent falls.
- » Care must be exercised when working close to a roof edge when surrounding area is snow-covered as the roof edge may not be clearly visible.
- » Use proper stacking procedures to ensure sufficient stability of the rolls.
- » Exercise caution when walking on wet membrane. Membranes may be slippery when wet.
- » Store Sure-Weld membrane in the original undisturbed plastic wrap in a cool, shaded area and cover with light-colored, breathable, waterproof tarpaulins. Sure-Weld membrane that has been exposed to the weather must be prepared with Weathered Membrane Cleaner prior to hot-air welding.
- » Take care not to stand or place heavy objects on the edge of folded over membrane, causing a hard crease in the membrane.

### Typical Properties and Characteristics

Physical Property	ASTM D6878 Requirement	45-mil	60-mil	80-mil EXTRA
Tolerance on nominal thickness, % ASTM D751 test method	+15, -10	± 10	± 10	± 10
Thickness over scrim, in. (mm) ASTM D7635 optical method, average of 3 areas	0.015 min (0.380)	0.018 typical (0.457)	0.024 typical (0.610)	0.034 typical (0.864)
Breaking strength, lbf (kN) ASTM D751 grab method	220 (976 N) min	225 (1.0) min 320 (1.4) typical	250 (1.1) min 360 (1.6) typical	350 (1.6) min 425 (1.9) typical
Elongation break of reinforcement, % ASTM D751 grab method	15 min	15 min 25 typical	15 min 25 typical	15 min 25 typical
Tearing strength, lbf (N) ASTM D751 proc. B 8 in. x 8 in.	55 (245) min	55 (245) min 130 (578) typical	55 (245) min 130 (578) typical	55 (245) min 130 (578) typical
Brittleness point, °F (°C) ASTM D2137	-40 (-40) max	-40 (-40) max -50 (-46) typical	-40 (-40) max -50 (-46) typical	-40 (-40) max -50 (-46) typical
Linear dimensional change, % ASTM D1204, 6 hours at 158°F	± 1 max	± 1 max -0.2 typical	± 1 max -0.2 typical	± 1 max -0.2 typical
Ozone Resistance, no cracks 7X ASTM D1149, 100 pphm, 168 hrs	PASS	PASS	PASS	PASS
Water absorption resistance, mass % ASTM D471 top surface only 166 hours at 158°F water	± 3.0 max	± 3.0 max 0.90 typical	± 3.0 max 0.90 typical	± 3.0 max 0.90 typical
Factory seam strength, lbf/in (kN/m) ASTM D751 grab method	66 (290) min	66 (290) min	66 (290) min	66 (290) min
Field seam strength, lbf/in (kN/m) ASTM D1876 tested in peel	No requirement	25 (4.4) min 50 (8.8) typical	25 (4.4) min 60 (10.5) typical	40 (7.0) min 70 (12.3) typical
Water vapor permeance, Perms ASTM E96 proc. B	No requirement	0.10 max 0.05 typical	0.10 max 0.05 typical	0.10 max 0.05 typical
Puncture resistance, lbf (kN) FTM 101C, method 2031 (see supplemental section)	No requirement	250 (1.1) min 325 (1.4) typical	300 (1.3) min 350 (1.6) typical	400 (1.8) min 450 (2.0) typical
Properties after heat aging ASTM D573, 5376 hours @ 240°F				
Breaking strength	198 (881) 90% min	205 (912) min	225 (1000) min	315 (1400) min
Elongation reinf.	13.5 (90%) min	13.5 min	13.5 min	13.5 min
Tearing Strength	33 (60%) min	33 min	33 min	33 min
Weight change, %	± 1.0 max	1.0 max	1.0 max	1.0 max
Typical Weights lb/ft <sup>2</sup> (kg/m <sup>2</sup> )	0.23 (1.1)		0.29 (1.4)	0.40 (2.0)

Typical properties and characteristics are based on samples tested and are not guaranteed for all samples of this product. This data and information is intended as a guide and does not reflect the specification range for any particular property of this product.

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### Extreme Testing For Severe Climates

ASTM Standard D6878 is the material specification for Thermoplastic Polyolefin-Based Sheet Roofing. It covers material property requirements for TPO roof sheeting and includes initial and aged properties after heat and xenon-arc exposure. As stated in the scope of the standard, “the tests and property limits used to characterize the sheet are values intended to ensure minimum quality for the intended purpose.” Carlisle’s goal is to produce TPO that ensures maximum performance for the intended purpose of roofing membranes. Maximum performance requires the membrane to far exceed the requirements of ASTM D6878. For severe climates like Miami, FL and Phoenix, AZ, EXTREME testing is required.

**Heat Aging** accelerates the oxidation rate that roughly doubles for each 10°C (18°F) increase in roof membrane temperature. Oxidation (reaction with oxygen) is one of the primary chemical degradation mechanisms of roofing materials.

#### Carlisle Extreme Testing – Heat Aging

	ASTM Requirement	Sure-Weld Requirement
<b>ASTM TEST</b> 240°F	32 weeks*	52 weeks
<b>Carlisle Extreme Test</b> 275°F	N/A	13 weeks

\*Comparable to 1,024 weeks (20 years) at 185°F for 6 hours/day.

- » Test specimen is 1" by 4" piece of 45-mil membrane unbacked, placed in circulating hot-air oven.
- » Criterion – no visible cracks after bending aged test specimen around 0.25"-diameter mandrel.

Xenon-Arc exposes the membrane samples to the combined effect of ultraviolet, visible and infrared radiation as well as ozone, heat and water spray, to greatly accelerate the effects of outdoor weathering. The radiation dose is measured in kilojoules per square meter (kJ/m<sup>2</sup>) at 340 nm machine UV wavelength. The irradiance power of the xenon-arc lamp is measured in Watts per square meter (W/m<sup>2</sup>).

#### Carlisle Extreme Testing – Xenon-Arc

ASTM TEST	Sure-Weld Results			
	ASTM D6878 Requirement	45-mil	60-mil	80-mil
kJ/m <sup>2</sup> at 340 nm	10,080	17,640	20,160	27,720

- » Test specimen is 2.75" by 5.5" piece of membrane, unbacked, weathering side facing arc lamp.
- » Criterion – no visible cracks viewed under 10x magnification while wrapped around 3"-diameter mandrel.

**Environmental Cycling** subjects the membrane to repeated cycles of heat aging, hot-water immersion followed by xenon-arc exposure. The acid fog accelerates acid etching that may occur from acid rain if the roof membrane is not resistant to acidic conditions.

- » ASTM requirement – none
- » Carlisle EXTREME test\*:
  - 10 days heat aging at 240°F (116°C) followed by
  - 5 days water immersion at 158°F (70°C) followed by
  - 5040 kJ/m<sup>2</sup> (2000 hours at 0.70 W/m<sup>2</sup> irradiance) xenon-arc exposure

\*Test specimen is 2.75" by 5.5" piece of membrane with edges sealed.

\*Criterion – after 3 complete cycles, test specimens shall remain flexible and not have any cracking under 10x magnification while wrapped around a 3"-diameter mandrel.

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### Supplemental Approvals, Statements and Characteristics:

1. Sure-Weld TPO meets or exceeds the requirements of ASTM D6878 Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing.
2. **Radiative Properties** for ENERGY STAR, Cool Roof Rating Council (CRRC) and LEED.
3. Sure-Weld TPO membranes conform to requirements of the U.S.E.P.A. Toxic Leachate Test (40 CFR part 136) performed by an independent analytical laboratory.
4. Sure-Weld reinforced TPO was tested for dynamic puncture resistance per ASTM D5635-04 using the most recently modified impact head. 45-mil was watertight after an impact energy of 12.5 J (9.2 ft-lbf) and 60-mil was watertight after 22.5 J (16.6 ft-lbf). 80-mil EXTRA was watertight after an impact energy of 30.0 J (22.1 ft-lbf).

### Radiative Properties for ENERGY STAR, Cool Roof Rating Council (CRRC) and LEED

	Test Method	White TPO	Tan TPO	Gray TPO
ENERGY STAR – initial solar reflectance	Solar Spectrum Reflectometer	0.79	0.71	N/A
ENERGY STAR –initial solar reflectance after 3 years	Solar Spectrum Reflectometer (uncleaned)	0.70	0.64	N/A
CRRC – initial solar reflectance	ASTM C1549	0.79	0.71	0.46
CRRC – solar reflectance after 3 years	ASTM C1549 (uncleaned)	0.70	0.64	0.43
CRRC – initial thermal emittance	ASTM C1371	0.90	0.86	0.89
CRRC – thermal emittance after 3 years	ASTM C1371 (uncleaned)	0.86	0.87	0.88
LEED – thermal emittance	PASS	0.90	0.86	0.86
*SRI (Solar Reflectance Index)		99	86	53

\*Solar Reflectance Index (SRI) is calculated per ASTM E1980. The SRI is a measure of the roof's ability to reject solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. Materials with the highest SRI values are the coolest choices for roofing. Due to the way SRI is defined, particularly hot materials can even take slightly negative values and particularly cool materials can even exceed 100.

### LEED Information

Pre-consumer Recycled Content	10%
Post-consumer Recycled Content	0%
Manufacturing Location	Senatobia, MS Tooele, UT
Solar Reflectance Index	99 (white) 86 (tan)