CARLISLE SYNTEC SYSTEMS

Spectro-Weld™ TPO
Reinforced Membrane

Overview

Carlisle Spectro-Weld TPO is a premium heat-weldable single-ply thermoplastic polyolefin (TPO) membrane engineered to provide outstanding reflectance of solar radiation in new roof construction and re-roofing applications. Spectro-Weld TPO is primarily designed for appropriate photovoltaic (PV) applications where its solar reflectance of 0.88 will maximize sunlight-to-energy conversion efficiencies. Spectro-Weld TPO has the highest CRRC reflectance rating of any single-ply product, which helps minimize heat gain from sunlight into the building envelope from the roof surface.

Spectro-Weld TPO with OctaGuard XT™ weathering package technology withstands extreme durability testing intended to simulate exposure to severe climates. (Refer to Extreme Testing section on page 3 for specific information.) Spectro-Weld TPO membrane is based on advanced polymerization technology that combines the flexibility of ethylene-propylene (EP) rubber with the heat weldability of polypropylene.

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 Spectro-Weld TPO reinforced membranes with high breaking strength, tearing strength and puncture resistance. The smooth surface of Spectro-Weld TPO membrane produces a total-surface fusion weld that creates a consistent, watertight, monolithic roof assembly. The membrane is environmentally friendly and easy to install.

Spectro-Weld TPO reinforced membrane products are available in white 60- and 80-mil nominal thicknesses. Available widths are 6' perimeter sheets and 10' field sheets.

Features and Benefits

- Solar reflectance of 0.88 (ASTM C1549), higher than any competitive TPO
- Improves efficiency of certain PV systems
- Wide window of weldability
- Outstanding puncture resistance
- Chlorine-free with no halogenated flame retardants
- Plasticizer free, does not contain liquid or polymeric plasticizers
- Excellent low-temperature impact resistance
- Superior chemical resistance to acids, bases, and restaurant exhaust emissions
- UL 2218 Class 4 hail rating
- Exceptional resistance to UV, ozone, and oxidation
- 100% recyclable (refer to Carlisle's recyclability statement)
- Enhanced with OctaGuard XT Weathering Package

OCTAGUARD XT™ WEATHERING PACKAGE

Installation

Spectro-Weld TPO roofing systems are fast to install, as minimal labor and few components are required. The systems may be installed utilizing laborsaving devices that make sheet welding fast, clean, consistent and easy to learn, while reducing strain on the roofing technician.

Review Carlisle specifications and details for complete installation information.

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Precautions

(Spectro-Weld has extremely high sunlight reflectance.)

- Sunglasses that filter out ultraviolet light are strongly recommended as white surfaces are highly reflective to sunlight. Roofing technicians should dress appropriately and wear sunscreen to protect skin from the sun.
- Surfaces may become slippery due to frost and ice buildup. Exercise caution during cold weather conditions to prevent falls.
- Care must be exercised when working close to a roof edge when the surrounding area is snow-covered. 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 Spectro-Weld TPO membrane in the original undisturbed plastic wrap in a cool, shaded area and cover with light-colored, breathable, waterproof tarpaulins. Spectro-Weld TPO membrane that has been exposed to the weather must be prepared with Weathered Membrane Cleaner prior to hot-air welding.

Typical Properties and Characteristics

Physical Property	ASTM D6878 Requirement	60-MIL	80-MIL
Tolerance on nominal thickness, % ASTM D751 test method	+15, -10	± 10	± 10
Thickness over scrim, in. (mm) ASTM D7635 optical method, average of 3 areas	0.015 min (0.380)	0.024 typ (0.610)	0.034 typ (0.864)
Breaking strength, lbf (kN) ASTM D751 grab method	220 (976 N) min	250 (1.1) min 360 (1.6) typ	350 (1.6) min 425 (1.9) typ
Elongation break of reinforcement, % ASTM D751 grab method	15 min	15 min 25 typ	15 min 25 typ
Tearing strength, lbf (N) ASTM D751 proc. B 8 by 8 in.	55 (245) min	55 (245) min 130 (578) typ	55 (245) min 130 (578) typ
Brittleness point, °F (°C) ASTM D2137	-40 (-40) max.	-40 (-40) max. -50 (-46) typ	-40 (-40) max. -50 (-46) typ
Linear dimensional change, % ASTM D1204, 6 hours at 158°F	± 1 max.	± 1 max. -0.2 typ	± 1 max. -0.2 typ
Ozone resistance, no cracks 7x ASTM D1149, 100 pphm, 168 hrs	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 typ	3.0 max. 0.90 typ
Factory seam strength, lbf/in. (kN/m) ASTM D751 grab method	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 60 (10.5) typ	40 (7.0) min 70 (12.3) typ
Water vapor permeance, Perms ASTM E96 proc. B	No Requirement	0.10 max. 0.05 typ	0.10 max. 0.05 typ
Puncture resistance, lbf (kN) FTM 101C, method 2031 (see supplemental section)	No Requirement	300 (1.3) min 350 (1.6) typ	400 (1.8) min 450 (2.0) typ
Properties after heat aging - ASTM D573, 5376 hrs at 240°F - Breaking strength - Elongation reinf. - Tearing strength - Weight change, %	 198 (881) 90% min 13.5 (90% min) 33.0 (60% min) ± 1.0 max.	 225 (1000) min 13.5 min 33 min ± 1.0 max.	 315 (1400) min 13.5 min 33 min ± 1.0 max.
Typical Weights lb/ft^2 (kg/m^2)	0.23 (1.1)	0.29 (1.4)	0.40 (2.0)
Air Permeance, ASTM E2178	No Requirement	Pass	Pass

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.

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 delivers maximum performance for the intended purpose of roofing membranes. Maximum performance requires the membrane to far exceed the requirements of ASTM D6878.

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

Carlisle Testing – Heat Aging

	ASTM Requirement	Sure-Weld Requirement
ASTM TEST 240°F	32 weeks**	52 weeks

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

- Test specimen is a 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 UV, 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^2) at 340 nm machine UV wavelength. The irradiance power of the xenon-arc lamp is measured in watts per square meter (W/m^2).

Carlisle Testing - Xenon-Arc

		SPECTRO-WELD TPO Results	
ASTM Test	**ASTM D6878 Requirement**	**60-MIL**	**80-MIL**
kJ/m^2 at 340 nm	10,080	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"-mandrel.

Environmental Cycling subjects the membrane to repeated cycles of heat aging, hot-water immersion followed by xenon-arc exposure.

- 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)
  - 5040 kJ/m^2 (2000 hrs at 0.70 W/m^2 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. Spectro-Weld TPO meets or exceeds the requirements of **ASTM D6878**[1] Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing.
2. **Radiative Properties** for ENERGY STAR®*, Cool Roof Rating Council (CRRC) and LEED®.

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.

	TEST METHOD	WHITE TPO
ENERGY STAR initial solar reflectance	Solar Spectrum Reflectometer	0.88
ENERGY STAR solar reflectance after 3 years	Solar Spectrum Reflectometer (uncleaned)	0.75
CRRC initial solar reflectance	ASTM C1549	0.88
CRRC solar reflectance after 3 years	ASTM C1549 (uncleaned)	0.75
CRRC initial thermal emittance	ASTM C1371	0.89
CRRC thermal emittance after 3 years	ASTM C1371 (uncleaned)	0.90
LEED thermal emittance	ASTM C1371	0.89
Solar Reflectance Index (SRI)	ASTM E1980	111
SRI – 3 year aged		93

LEED Information

Pre-consumer Recycled Content	10%
Post-consumer Recycled Content	0%
Manufacturing Location	Senatobia, MS Tooele, UT Carlisle, PA
Solar Reflectance Index	111