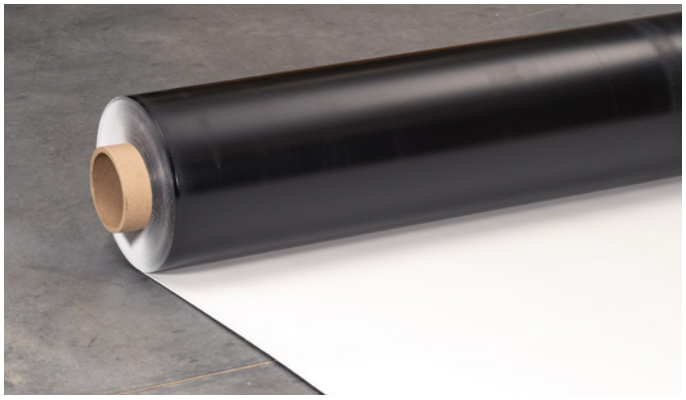
CARLISLE SYNTEC SYSTEMS

Sure-Weld® TPO
Reinforced Membrane



Overview

Carlisle's Sure-Weld TPO reinforced 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 for higher-slope fire code approvals. Sure-Weld Extra is 80 mils (2.03 mm) thick for significantly higher strength and weatherability.

Sure-Weld TPO membranes use 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 the extreme weatherability testing that is 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 high breaking and tearing strength, as well as excellent puncture resistance. The relatively smooth surface of the membrane produces a total surface fusion weld that results in a consistent, watertight, monolithic roof assembly. The membrane is environmentally friendly and safe to install.

Features and Benefits

- Living Building Challenge "Red List Free" – Declare Label
- Sure-Weld TPO is available in 4- and 6-ft (121.92 cm and 182.88 cm) perimeter sheets and 8-, 10-, 12-, and 16-ft (243.84 cm, 304.80 cm, 365.76 cm, and 487.68 cm) Sure-Weld field sheets*
- Outstanding puncture resistance and excellent fire resistant assemblies
- Environmentally friendly and stable formulation
- Excellent resistance to impact and low temperatures
- UL 2218 Class 4 hail rating
- Manufactured with non-halogenated flame retardants
- Excellent chemical resistance to acids, bases and restaurant exhaust emissions
- Exceptional resistance to heat, solar UV, ozone and oxidation
- Manufactured using a hot-melt extrusion process for complete scrim encapsulation
- Enhanced with the OctaGuard XT weathering package

OCTAGUARD XT WEATHERING PACKAGE

- Standard Colors:

White | Gray | Tan

- Special Colors:

Slate Gray | Med Bronze | Terra Cotta | Patina Green | Rock Brown

*Sure-Weld HS Special Color TPO membranes are available in limited sizes. Refer to Carlisle's Sure-Weld TPO Color Palette Sell Sheet for details. Sure-Weld 80-mil in special colors are limited to warranties up to 20 years.

Sustainable Attributes

Carlisle SynTec Systems' focus has always been innovation — Innovation to solve problems, improve performance, reduce labor, and above all, improve sustainability. Carlisle is committed to driving sustainable and efficient processes in the design and manufacturing of our products.

- Up to 10% pre-consumer recycled content
- Fully recyclable when used in mechanically attached systems
- 3rd-party verified Environmental Product Declaration available
- NSF P151 certification for rainwater catchment**
- California Title 24 compliant***
- Free of Living Building Challenge red list chemicals

**White only, produced in Tooele, UT and Carlisle, PA
***White and Tan only

Installation

Sure-Weld TPO roofing systems are quick to install, as minimal labor and few components are required. TPO systems are installed using an Automatic Heat Welder, making sheet welding fast, clean, consistent, and easy to learn, while reducing strain on the roofing technician.

Sure-Weld TPO
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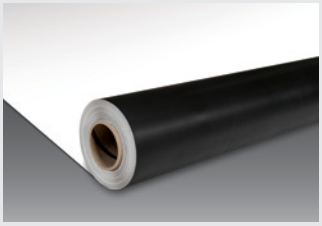
Wider is Better

Carlisle's 16-foot Sure-Weld TPO delivers a leap in productivity on adhered and induction welded roofs by cutting down on the number of rolls needed and dramatically reducing the number of seams on the roof.



With fewer rolls to load, stage, and kick out, and fewer seams to weld, contractors can save significant time on each project, moving on to the next one sooner.

16-Foot TPO Benefits

- Fewer rolls to load and stage on a job saves crane time and labor at the beginning of each project
- Fewer rolls to position, kick-out, and align during installation saves labor
- Up to 60% fewer seams vs. 10-foot TPO
- Fewer seams to weld, probe, and inspect, saving considerable time during installation
- Fewer T-joint patches to install on each roof
- Less waste and trash from packaging
- Less time spent on each project, allowing contractors to complete more roofs and grow their business

Fully-Adhered – membrane is adhered to a suitable substrate utilizing an appropriate bonding adhesive

Mechanically Fastened – membrane is attached to the roof deck over a suitable substrate utilizing plates and fasteners which are overlapped with membrane

Induction-Welded – membrane is attached over a suitable substrate via an induction welding tool being placed over the membrane where a fastened TPO induction welding plate is located to weld the two components together

Review Carlisle specifications and details for complete installation information.

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.
- Surfaces may become slippery due to frost and ice buildup. Exercise caution during cold conditions to prevent falls. Exercise caution when walking on wet membrane. Membranes may be slippery when wet.
- Care must be exercised when working close to a roof edge when the 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.
- Store membrane in the original undisturbed plastic wrap in a cool, shaded area and cover with light-colored, breathable, waterproof tarpaulins. 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, as this could cause a hard crease in the membrane.
- Maximum sustained temperature not to exceed 160°F (71°C) for TPO membrane.
- Do not use razor blades or other sharp tools to cut the APEEL Protective Film while it is still adhered to the TPO membrane as damage to the underlying membrane may occur. Pull the protective film away from the membrane prior to cutting.
- Remove APEEL Protective Film by pulling towards the center of the roof. Do not remove the film by pulling towards the roof edge.
- A static electric charge may develop when removing APEEL Protective Film from the surface of the membrane sheet. To avoid the possibility of ignition, lids must be closed on any flammable products and a fire extinguisher should be readily available.
- Color membranes will 'fade' over time mainly due to the ultraviolet portion of sunlight. Since most roof surfaces are exposed to variable sunlight, some areas will be more susceptible to color changes caused by UV fading. Warranties for color membranes do not cover fading of colors.

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**	>128 weeks

**Heat exposure comparable to 3,120 weeks (60 years) at 185°F for 8 hours/day.

- Test specimen is a 2" by 6" (50.8 mm by 152.4 mm) piece of 45-mil (1.14 mm) membrane unbacked, placed in circulating hot-air oven.
- Criterion – no visible cracks after bending aged test specimen around 3" (76.2 mm)-diameter mandrel.

Q-Trac testing combines accelerated weathering with real-world conditions using an array of ten mirrors to reflect and concentrate full spectrum sunlight onto membrane test specimens. The Q-Trac device automatically tracks the sun's path from morning to night. Also, it adjusts to compensate for seasonal changes in the sun's altitude. Eight years in Q-Trac testing is equal to 40 years of real-world exposure. Carlisle requires its Sure-Weld TPO membranes to pass the equivalent of 40 years of exposure in the Q-Trac.

Carlisle Testing – Q-Trac

	ASTM D6878 Requirement	Sure-Weld Requirement
ASTM TEST N/A	N/A	Equivalent of 40 years of exposure

Environmental Cycling subjects the membrane to repeated cycles of heat aging, hot-water immersion, and 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) followed by
  - 5,040 kJ/m² (2000 hours at 0.70 W/m² irradiance) xenon-arc exposure

*Test specimen is 2.75" (69.85 mm by 140 mm) 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" (76.2 mm)-diameter mandrel.

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. Sure-Weld TPO membranes conform to requirements of the US E.P.A. Toxic Leachate Test (40 CFR part 136) performed by an independent analytical laboratory.
3. Sure-Weld TPO was tested for dynamic puncture resistance per ASTM D5635-04 using the most recently modified impact head. 45-mil (1.14 mm) was watertight after an impact energy of 12.5 J (9.2 ft-lbf) and 60-mil (1.52 mm) was watertight after 22.5 J (16.6 ft-lbf). 80-mil (2.03 mm) Extra was watertight after an impact energy of 30.0 J (22.1 ft-lbf).
4. All FM approved assemblies have been tested to pass FM 4470 for foot traffic resistance.

Optional APEEL™ Protective Film

Shield Carlisle's Sure-Weld TPO membrane from dirt and scuffs during installation with APEEL Protective Film. Factory-applied and easy to remove, APEEL eliminates the need for rooftop cleaning upon project completion.

- Ideal for re-roofing, re-cover, and new construction projects
- Simple and easy to remove
- Saves time and money when compared to pressure washing
- Protecting from dirt maintains maximum membrane reflectivity and long-term performance

Installation

Simply order membrane with APEEL, install, and remove the film to reveal a clean, new roof.

- APEEL Protective Film should be removed from within areas that are to be heat-welded together. In areas that do not require heat-welding, the APEEL Protective Film can be left in place for up to 90 days without degrading due to its excellent heat- and UV-resistance.
- When the installation of the entire TPO roofing system is complete, remove and discard the APEEL Protective Film.

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Typical Properties and Characteristics

Physical Property	ASTM D6878 Requirement	45-mil (1.14 mm)	60-mil (1.52 mm)	80-mil Extra (2.03 mm)
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
UV Exposure (Xenon Arc), no cracks 7X ASTM G155, min. exposure 10,080 kJ/m² (4,000 hrs - 0.70 W/m²)	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 (N) 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, 32 weeks @ 240°F or 8 weeks @ 275°F No cracking when bent around 3" diameter mandrel Weight Change, %	PASS No cracking ± 1.5 max	PASS No cracking 1.0 max	PASS No cracking 1.0 max	PASS No cracking 1.0 max
Typical Weights lb/ft² (kg/m²)		0.25 (1.22)	.33 (1.61)	.45 (2.20)
Air Permeance, ASTM E2178	No Requirement	PASS	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.

Green Building Information

Pre-Consumer Recycled Content	10%
Post-Consumer Recycled Content	0%
Solar Reflectance Index (SRI)	White – 99 Tan – 86 Gray – 52
Global Warming Potential (GWP)	TPO 45 mils 2.90E+00 TPO 60 mils 3.77E+00 TPO 80 mils 5.28E+00
Volatile Organic Compounds (VOC) Content	N/A
Manufacturing Location(s)	Senatobia, MS Tooele, UT Carlisle, PA
Corporate Sustainability Report (CSR) Availability	Yes
Environmental Product Declaration (EPD) Availability	

Radiative Properties for Cool Roof Rating Council (CRRC) and LEED

	Test Method	White TPO	Tan TPO	Gray TPO
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	ASTM E408	0.90	0.86	0.85
SRI – Initial (Solar Reflectance Index)	ASTM E1980	99	86	52
SRI – 3 year aged (Solar Reflectance Index)		85	77	49

Radiative Properties (Initial) for Special Colors

	Reflectance	Emittance	SRI
Medium Bronze	0.12	0.89	8
Rock Brown	0.23	0.88	23
Slate Gray	0.20	0.89	18
Terra Cotta	0.25	0.88	24
Patina Green	0.25	0.88	25

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.

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