Product Data Sheet

TPO-c EXTRA MEMBRANE

PRODUCT DESCRIPTION

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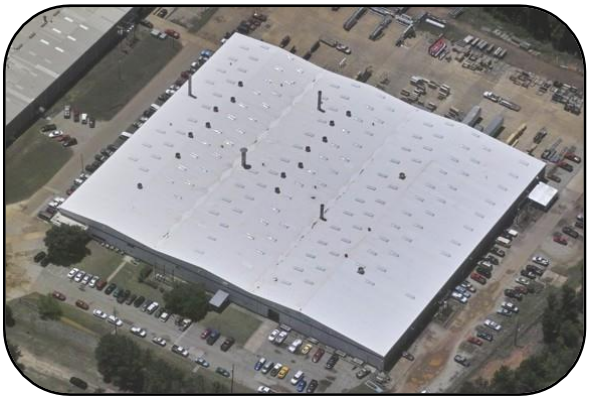

Mule-Hide TPO-c EXTRA Membrane is a polyester reinforced, .080 thick, polyolefin based, thermoplastic, heat-weldable membrane. High breaking strength, tearing strength, and puncture resistance is achieved by encapsulating a strong polyester fabric between the top and bottom plies. The .080" thickness affords higher strength and weatherability when compared to our .045" and .060" products. The membrane is environmentally friendly and safe to install. All Mule-Hide TPO membranes include MHP Weathering Package, an industry leading, state of the art weather package that enables Mule-Hide TPO membranes to withstand the extreme weatherability testing which simulates exposure to severe climates.

BASIC USES

The TPO-c membrane is used in mechanically attached and fully adhered roofing systems in new construction, reroofing and recover (retrofit) applications. It may also be used as flexible membrane flashings for walls, curbs, etc, when installing TPO-c membrane roofing systems. The system must be installed over acceptable roof insulation or other suitable substrate. See the Mule-Hide TPO Specifications Manual for complete specifications and details.

BENEFITS & SUPPLEMENTAL STATEMENTS

- Wide window of weldability
- Outstanding puncture resistance
- Chlorine-free with no halogenated flame retardants
- UL 2218 Class 4 hail rating available on select systems
- Excellent low temperature impact resistance
- Excellent chemical resistance to acids, bases, restaurant oils and greases
- Plasticizer-free, does not contain liquid or polymeric plasticizer
- Exceptional resistance to solar UV, ozone and oxidation
- Low water vapor permeance and water absorption
- Hot melt extrusion processed for complete scrim encapsulation
- Non woven reinforcement fabric for smooth surface and greater thickness-over-scrim
- Polyester reinforcing fabric which is resistant to degradation by bacteria, mildew and fungi
- TPO-c is 100% recyclable
- Meets and exceeds requirements of ASTM D6878 Standard Specification for Thermal Plastic Polyolefin Based Sheet Roofing
- CLEAN Film guards the TPO membrane surface from scuffs and dirt accumulation during installation, helping to improve the roof systems appearance and maintain long-term reflectivity.
- CLEAN Film can be left in place for up to 90 days due to its excellent heat and UV resistance.

CODE APPROVALS/COMPLIANCE

A variety of Factory Mutual Ratings and Underwriters Laboratories Classifications are available. Canadian Construction Materials Centre (CCMC) Evaluation Report 13580-R is also available. Contact the Mule-Hide Technical Department for additional information.

SPECIFICATIONS

Standard Colors:	White, Gray and Tan
Colorway Colors:	Medium Bronze, Patina Green, Rock Brown, Slate Gray & Terra Cotta.
Material:	.080-inch (nominal) thick polyester reinforced thermoplastic
Sizes:	Standard Colors as 4', 6', 8', 10' and 12' sheet widths by 100' Colorway Colors as 5' and 10' sheet widths by 100'
Weight:	80 Mil - 0.40 lb/ft^2 (2.0 kg/m^2) typical

SPECIFICATIONS (continued)

Physical Properties*	Test Method	Requirement	80-mil
Thickness Tolerance on nominal, %	ASTM D-751	+15, -10	±10
Thickness over scrim, in. (mm) (avg. of 3 areas)	ASTM D-6878 Optical Method	0.015 min. (0.380)	0.034 typical (0.864)
Breaking Strength, lbf (kN)	ASTM D-751 (Grab Method)	220 (976 N) minimum	350 (1.6) min. 425 (1.9) typical
Elongation at break of fabric, %	ASTM D-751 (Grab Method)	15 minimum	15 minimum 25 typical
Tear Strength, lbf (N) 8 by 8 in. specimen	ASTM D-751 (B Tongue Tear)	55 (245) minimum	55 (245) min. 130 (578) typical
Brittleness point, ºF (ºC)	ASTM D-2137	-40 (-40) maximum	-40 ºF (-40 ºC) max. -50 ºF (-46 ºC) typical
Linear Dimensional Change (shrinkage) % change	ASTM D-1204 6 hours @ 158º F (70º C)	±1 maximum	+/-1 max - 0.2 typical
Ozone resistance, 100 pphm, 168 hrs.	ASTM D-1149	PASS	PASS
Factory seam strength, lbf/in (kN/m)	ASTM D-751	66 (290) min	66 (290) minimum
Field seam strength, lbf/in. (kN/m) Seams tested in peel	ASTM D-1876	No requirement	40 (7.0) min. 70 (12.3) typical
Water vapor permeance, Perms	ASTM E-96 proc. B	No requirement	0.10 max. 0.05 typical
Water Absorption Resistance, mass % Top surface only	ASTM D-471 @ 158ºF, 166 hours	No requirement	3.0 max. 0.90 typical
Puncture resistance, lbf (N)	FTM 101C Method 2031	No requirement	400 (1.8) min. 450 (2.0) typical
Properties after heat aging - ASTM D573, 32 weeks at 240ºF or 8 weeks at 275 ºF No cracking when bent around 3" dia. mandrel Weight change, %	 PASS No Cracking ±1.5 max	 PASS No Cracking ±1.0 max	 PASS No Cracking ±1.0 max
*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.			

INSTALLATION INSTRUCTIONS

1) Approved insulation shall be attached to the roof deck with an approved insulation adhesive or approved fasteners and plates. Install insulation with its largest dimension perpendicular to the direction of the membrane seams where possible.
2) Mechanically Attached Roofing System
   a) Perimeter sheets to be installed in an approved pattern along all exterior roof edges.
   b) Mechanical fasteners and plates are installed in the seams of both the perimeter sheets and field sheets and into the roof deck. Use approved fasteners and maintain proper penetration for specific roof decks.
3) Fully Adhered Roofing System
   a) Perimeter sheets are not required, perimeter enhancements are completed by installing additional insulation fasteners at perimeters and corners.
   b) The membrane is required to be mechanically attached at the base of all vertical surfaces, roof edges, and angle changes.
   c) The field of the roof is fully adhered to the substrate with Mule-Hide TPO Bonding Adhesive.
4) All seams are hot air welded and checked by probing.
5) All details will be done in accordance with Mule-Hide details.
6) On projects where a Mule-Hide System Warranty is requested, an authorized Mule-Hide representative shall inspect all completed work. This is only a brief summary and not the complete specification. The Mule-Hide Specifications, Details, Technical Bulletins, and associated documents should be thoroughly reviewed prior to starting any project. Contact the Mule-Hide Technical Department for additional information.

PRECAUTIONS

- Maximum sustained temperature not to exceed 160ºF (71ºC) for TPO membrane.
- Use proper stacking procedures to ensure roll stability. Avoid creasing the membrane.
- Surfaces may be slippery when wet, or due to frost and ice build-up. Exercise caution to prevent falls.
- Mule-Hide TPO membranes are highly reflective to sunlight. Workers should dress appropriately, wear sunscreen, and wear sunglasses that filter out UV light.
- Exercise care when working near roof edge as edges may not be visible when surrounding area is covered with snow.
- Store Mule-Hide membrane in original wrappings in a cool, shaded area. Cover with light-colored, breathable, waterproof tarpaulins. Mule-Hide 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.
- Do not use razor blades or other sharp tools to cut the CLEAN 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 CLEAN Film by pulling towards the center of the roof. Do not remove the film by pulling towards the roof edge.
- A static electricity charge may develop when removing the CLEAN Film from the surface of the membrane sheet. To avoid the possibility of ignition, lids must be closed on any flammable products and fire extinguishers 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 standard, "the tests and property limits used to characterize the sheet are values intended to ensure minimum quality for the intended purpose." Mule-Hide's goal is to provide TPO that delivers maximum performance for the intended purpose of roofing membranes. Maximum performance requires the membrane to far exceed the requirements of ASTM Standard D6878.

Heat Aging accelerates the oxidation rate the 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.

HEAT AGING		
Test Method	**ASTM Requirement**	**Typical Results**
ASTM Test - 240º F (116º C), No Visible Cracks	32 Weeks**	>128 Weeks
**Heat exposure comparable to 3,120 weeks (60 years) at 185°F for 8 hours per day.		
Test specimen is 2" by 6" piece of 45-mil membrane un-backed, placed in circulating hot-air oven Criterion-no visible cracks after bending aged test sample around 3" diameter mandrel.		
Heat Aging accelerates the oxidation rate that roughly doubles for each 10º C (18º F) increase in roof membrane temperature. Oxidation (reaction with oxygen) is one of the primary chemical degradation mechanisms of roofing materials.		

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 affects 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).

XENON-ARC TESTING		
Test Method	**ASTM D6878 Requirement**	**Typical Results 80-mil**
kJ/ m^2 at 340 nm	10,080	>60,000
Test sample is 2.75" by 5.5" piece of membrane, un-backed, weathering side facing arc lamp. Criterion-no visible cracks viewed under 7x magnification while wrapped around 3" 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. Mule-Hide requires it's TPO membranes to pass the equivalent of 40 year exposure in the Q-Trac.

Q-Trac Testing		
Test Method	**ASTM Requirement**	**Mule-Hide Requirement**
ASTM Test N/A	N/A	Equivalent of 40 years exposure
Environmental Cycling subjects the membrane to repeated cycles of heat aging, hot-water immersion and xenon-arc exposure.		
Test specimen is 2.75" by 5.5" piece of membrane with edges sealed. - 10 days heat aging at 240º F (116º C) followed by - 5 days water immersion at 158º F (70º C) followed by - 5,040 kJ/m^2 (2000 hours at 0.70 W/m^2 irradiance) xenon-arc exposure		
Criterion – after 3 completed cycles, test specimens shall remain flexible and not have any cracking under 10x magnifications while wrapped around a 3" diameter mandrel.		

SUPPLEMENTAL APPROVALS, STATEMENTS AND CHARACTERISTICS

1) TPO-c meets and 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) Mule-Hide TPO-c 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) TPO-c 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 an impact energy of 22.5 J (16.6 ft-lbf)
5) NSF-P151 Certification for rainwater catchment systems components. (Plant 91/White Only)

RADIATIVE PROPERTIES for ENERGY STAR*, CRRC and LEED				
DESCRIPTION	**TEST METHOD**	**WHITE TPO-c**	**TAN TPO-c**	**GRAY TPO-c**
ENERGY STAR® initial solar reflectance	Solar Spectrum Reflectometer	0.79	0.71	N/A
ENERGY STAR® initial solar reflectance after 3 years (un-cleaned)		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 (un-cleaned)	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 (un-cleaned)	0.86	0.87	0.88
CRRC SRI (Solar Reflectance Index)	ASTM E1980	99	86	53
CRRC SRI (Solar Reflectance Index after 3 yrs)	ASTM E1980	85	77	48

RADIATIVE PROPERTIES (Initial) FOR COLORWAY COLORS			
Color	**Reflectance**	**Emittance**	**SRI**
Medium Bronze	0.28	0.86	29
Rock Brown	0.25	0.87	26
Slate Gray	0.38	0.87	42
Terra Cotta	0.25	0.86	25
Patina Green	0.25	0.88	25

Solar Reflectance Index (SRI) is calculated per ASTM E 1980. 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.

*ENERGY STAR recommends that using the Roof Savings Calculator (rsn.ornl.gov), which factors in both heating and cooling costs, to determine whether a cool roof will be an energy efficient choice for your geographical climate and building type.

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

PROTECTION & SAFETY

Mule-Hide maintains Safety Data Sheets on all of its non-exempt products. Safety Data Sheets contain health and safety information for your development of appropriate product handling procedures to protect your employees and customers. Mule-Hide's Safety Data Sheets should be read and understood by all of your supervisory personnel and employees before using Mule-Hide products in your facilities.

ADDITIONAL INFORMATION

The information given on this PDS is subject to change without notice. Always check the Mule-Hide website at www.mulehide.com for the latest information, changes and updates or contact Mule-Hide Products Company at 800-786-1492.

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