

MULE-HIDE TPO-c MEMBRANE (Standard and FR)

PRODUCT DESCRIPTION

Mule-Hide's TPO-c Membrane is a polyester reinforced, .045" or .060 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. Mule-Hide TPO-c FR membrane is formulated with additional flame retardant (compared to Standard) for higher slope fire code approvals. The Mule-Hide TPO-c membrane is also available in a 0.80" thickness (see Product Data Sheet for TPO-c EXTRA). The membrane is environmentally friendly and safe to install.

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.

SPECIFICATIONS

- Colors: White top/Black bottom (Standard)
 (Special Order Top Colors) Tan and Gray.
- Material: .045-inch and .060-inch (nominal) thick polyester reinforced thermoplastic
- Sizes: Field Sheet – 8', 10' and 12' by 100'
 Perimeter Sheet – 4' and 6' by 100'
- Weights: 45 Mil - 0.23 lb/ft² (1.1 kg/m²) typical
 60 Mil - 0.29 lb/ft² (1.4 kg/m²) typical

Physical Properties	Test Method	45-mil	60-mil
Thickness Tolerance on nominal, %	ASTM D-751	±10	±10
Thickness over scrim, in. (mm) (avg. of 3 areas)	ASTM D-6878 Optical Method	0.018 (0.457) ±10%	0.024 (0.610) ±10%
Breaking Strength, lbf (kN)	ASTM D-751 (Grab Method)	225 (1.0) min. 320 (1.4) typical	250 (1.1) min. 360 (1.6) typical
Elongation at break of fabric	ASTM D-751	15 minimum 25 typical	15 minimum 25 typical
Tear Strength, lbf (N) 8 by 8 in. specimen	ASTM D-751 (B Tongue Tear)	55 (245) min. 130 (578) typical	55 (245) min. 130 (578) typical
Brittleness point, F° (C°)	ASTM D-2137	-40 (-40) max. -50 (-46) typical	-40 (-40) max. -50 (-46) typical
Linear Dimensional Change (shrinkage) % change	ASTM D-1204 6 hours @ 158° F (70° C)	+/-1 max - 0.2 typical	+/-1 max - 0.2 typical
Ozone resistance, 100 pphm, 168 hrs.	ASTM D-1149	No cracks	No cracks
Factory seam strength, lbf/in (kN/m)	ASTM D-751	66 (290) minimum	66 (290) minimum
Field seam strength, lbf/in. (kN/m) Seams tested in peel	ASTM D-1876	25 (4.4) min. 50 (8.8) typical	25 (4.4) min. 60 (10.5) typical
Water vapor permeance, Perms	ASTM E-96 proc. B	0.10 max. 0.05 typical	0.10 max. 0.05 typical
Water Absorption	ASTM D-471 @ 158°F, 166 hours	3.0 max. 2.0 typical	3.0 max. 2.0 typical
Puncture resistance, lbf (N)	FTM 101C Method 2031	250 (1.1) min. 325 (1.4) typical	300 (1.3) min. 350 (1.6) typical
Properties after heat aging ASTM D573 670 hrs at 240°F (116° C)	Breaking Strength, % retained Elongation reinf., % retained Tearing Strength, % retained Weight change, %	90% min 90% min 60% min ± 1.0% max.	90% min 90% min 60% min ± 1.0% max.

MULE-HIDE TPO-c MEMBRANE (Standard and FR)

BENEFITS & SUPPLEMENTAL STATEMENTS

- Wide window of weldability
- Outstanding puncture resistance
- Chlorine-free with no halogenated flame retardants
- 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

CODE APPROVALS/COMPLIANCE

A variety of Factory Mutual Ratings and Underwriters Laboratories Classifications are available. Contact Mule-Hide Warranty Department for additional information.

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 deck.
- 3) Fully Adhered Roofing System
 - a) Perimeter sheets are not required.
 - 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 Standard or Premium 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 Mule-Hide Products for additional information.

PRECAUTIONS

- 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. Roof 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 elements for approximately 7 days or longer must be prepared with Weathered Membrane Cleaner prior to hot air welding.

MULE-HIDE TPO-c MEMBRANE (Standard and FR)

PROTECTION & SAFETY

Mule-Hide maintains Material Safety Data Sheets on all of its products. Material 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 Material Safety Data Sheets should be read and understood by all of your supervisory personnel and employees before using Mule-Hide products in your facilities.

SUPPLEMENTAL APPROVALS, STATEMENTS AND CHARACTERISTICS

- 1) TPO-c meets and exceeds the requirements of **ASTM D6878¹** Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing
- 2) **Radiative Properties** for ENERGY STAR®, Cool Roof Rating Council (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	0.68	N/A
ENERGY STAR® solar reflectance after 3 years	Solar Spectrum Reflectometer (uncleaned)	0.70	0.64	N/A
ENERGY STAR® initial emissivity		0.90	0.95	
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
CRRC SRI (Solar Reflectance Index)	ASTM E1980	99	86	53
CRRC SRI (Solar Reflectance Index after 3 yrs)	ASTM E1980	85	77	48
CRRC Product ID	N/A	0670-0009	0670-0016	0670-0017
LEED™ thermal emittance	ASTM E408	0.95	0.95	0.95

- 3) Mule-Hide tan and white TPO membranes are LEED compliant and are ENERGY STAR® and California Title 24 rated roof products.

An ENERGY STAR qualified low slope roof product must have an initial solar reflectance of at least 0.65 and a 3-year aged solar reflectance of at least 0.50. Cleaning the aged roof surface is not permitted by the ENERGY STAR test protocol. Energy Star is only valid in the United States for Roofing Products.

The Cool Roof Rating Council (CRRC) does not specify minimums for reflectance or emittance but they do require specific protocols for testing and reporting. Cleaning of the aged roof surface is not permitted for determination of radiative properties after 3 years.

A LEED "point" may be earned if a roof material is ENERGY STAR qualified and has a thermal emittance of at least 0.90 as determined by ASTM E408.

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.

California Title 24 requires an initial minimum reflectance of 0.70 and emittance of 0.75 as determined by CRRC.

- 4) 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.

MULE-HIDE TPO-c MEMBRANE (Standard and FR)

SUPPLEMENTAL APPROVALS, STATEMENTS AND CHARACTERISTICS - CONTINUED

- 5) 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)

¹Copyright © ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA

EXTREME TESTING – HEAT AGING		
Test Method	ASTM Requirement	Typical Results
ASTM Test - 240° F (116° C), No Visible Cracks	670 Hours (4 weeks)	5,376 Hours (32 weeks*)
Extreme Test - 275° F (135° C), No Visible Cracks	N/A	1,322 Hours (8 weeks)
*Comparable to 1,024 weeks (20 years) at 185° F for 6 hours per day		
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.		

EXTREME TESTING – ENVIRONMENTAL CYCLING	
Extreme Test	10 days heat aging at 240° F (116° C)
One cycle consists of 4 series of tests	5 days of water immersion at 158° F (70° C) or with another specimen set 5 eight-hours cycles in Kesternich sulfur dioxide chamber (sulfurous acid fog) 5040 kJ/m ² (2000 hours @ 0.70 W/ m ² irradiance) xenon-arc exposure
Test Criteria	After three complete cycles, test specimens shall remain flexible and not have any cracking under 10X magnification while wrapped around a 3" mandrel.
Environmental Cycling subjects the membrane to repeated cycles of heat aging, hot-water immersion or acid fog 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.	

XENON-ARC TESTING				
	ASTM D6878 Requirement	Typical Results 45-mil	Typical Results 60-mil	Typical Results 80-mil
kJ/ m ² at 340 nm	10,080	17,640	20,160	27,720
Hours at 0.35 W/m ²	8,000	14,000	16,000	22,000
Hours at 0.70 W/m ²	4,000	7,000	8,000	11,000
Total UV in MJ/ m ² (300 to 400 nm)	1,210	2,118	2,420	3,328
Xenon-Arc exposes the membrane samples to the combined effect of ultraviolet, visible and infrared radiation, 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). Test specimen is 2.75 by 5.5 in. piece of membrane, unbacked, weathering side facing lamp. Criteria – no visible cracks viewed under 10X magnification while wrapped around a 3 in. mandrel.				

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.

DISCLAIMER

The statements provided concerning the material shown are intended as a guide for material usage and are believed to be true and accurate at the time of printing. No statement made by anyone may supersede this information, except when done in writing by Mule-Hide Products Co., Inc. Since the manner of use is beyond our control, Mule-Hide does not authorize anyone to make any warranty of merchantability or fitness for any particular purpose or any other warranty, guarantee or representation, expressed or implied, concerning this material. This product may be eligible for a Mule-Hide warranty, please check the Mule-Hide website at www.mulehide.com or contact Mule-Hide directly at 800-786-1492 for details. Buyer and user accept the product under these conditions and assume the risk of any failure, any injury person or property (including that of the user), loss or liability resulting from the handling, storage or use of the product whether or not it is handled, stored or used in accordance with the directions or specifications. Mule-Hide must be notified in writing of any claims and be given the opportunity to inspect the alleged failure before repairs are made.