Product Data Sheet

TPO-c FLEECE BACK MEMBRANE

PRODUCT DESCRIPTION

Revision Date: May 2022

Mule-Hide's TPO-c Fleece Back FB-045, FB-060 and FB-080 Membranes are polyester reinforced, .045", .060" or .080" thick, polyolefin based thermoplastic, heat-weldable membranes with a 55-mil polyester fleece backing. 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 Fleece Back membrane is used in fully adhered and mechanically attached roofing systems in new construction, reroofing and recover (retrofit) applications. The system must be installed over an acceptable roof insulation or other suitable substrate. See the Mule-Hide TPO Fleece Back Specifications Manual for complete specifications and details.

SPECIFICATIONS

Physical Properties	Test Method	Specification (min.)	Mule-Hide TPO
Tolerance on Nominal Thickness, %	ASTM D751	± -10	± -10
Thickness over fleece FB-45 (100 mils total) FB-60 (115 mils total) FB-80 (135 mils total)	ASTM D4637	 --- --- ---	 0.045 inch (1.14 mm) 0.060 inch (1.52 mm) 0.080 inch (2.03 mm)
Weight FB-45 (100 mils total) FB-60 (115 mils total) FB-80 (135 mils total)	 --- --- ---	 --- --- ---	 0.27 lbm/ft^2 0.34 lbm/ft^2 0.44 lbm/ft^2
Breaking Strength FB-45 (100 mils total) FB-60 (115 mils total) FB-80 (135 mils total)	ASTM D-751 (Grab Method)	220 lb (1.0 kN)	 350 lb (1.6 kN) 450 lb (2.0 kN) 500 lb (2.2 kN)
Elongation at break of internal fabric	ASTM D-751	15%	25% typical
Tearing Strength, B Tongue Tear	ASTM D-751	55 lb (245 kN)	100 lb (445 kN)
Puncture resistance FB-45 (100 mils total) FB-60 (115 mils total) FB-80 (135 mils total)	FTM 101C Method 2031 (lbf) ASTM D5635 (Joules)	 350 lbf (--- Joules) 400 lbf (--- Joules) 425 lbf (--- Joules)	 450 lbf (17.5 Joules) 500 lb (22.5 Joules) 525 lb (30.0 Joules)
Brittleness point	ASTM D-2137	-40 Fº (-40 Cº) max.	-50 Fº (-46 Cº)
Linear Dimensional Change	ASTM D-1204	+/- 1.0% max	-0.2% typical
Ozone resistance, 100 pphm, 168 hours	ASTM D-1149	No cracks	No cracks
Resistance to water absorption After 7 days immersion 158ºF (70ºC) Change in mass, %	ASTM D-471 (fleece removed, edges sealed)	+ 3.0%	+0.9%
Resistance to microbial surface growth, rating (1 is very poor, 10 is no growth)	ASTM D-3274	---	9-10 typical
Field seam strength, seam tested in peel FB-45 (100 mils total) FB-60 (115 mils total) FB-80 (135 mils total)	ASTM D-1876	 25 lbf/in (4.4 kN/m) 25 lbf/in (4.4 kN/m) 40 lbf/in (7.0 kN/m)	 50 lbf/in (8.8 kN/m) 60 lbf/in (10.5 kN/m) 70 lbf/in (12.3 kN/m)
Water vapor permeance, Proc B	ASTM E-96	---	0.10 perms max 0.05 perms typical
Resistance to Outdoor (UV) Weathering Xenon-Arc, 0.70 W/m^2 irradiance exposure FB-45 (100 mils total) FB-60 (115 mils total) FB-80 (135 mils total)	ASTM G155 0.70 W/m^2 80ºC B.P.T.	No cracks No loss of breaking or tearing strength	No cracks No loss of breaking or tearing strength 17,640 kg/m^2 20,160 kg/m^2 27,720 kg/m^2
Properties after heat aging Breaking Strength - % retained Elongation Reinforced - % retained Tearing Strength - % retained Weight Change - %	ASTM D573 670 hrs @ 240 ºF	 --- --- --- ---	 90% min 90% min 60% min ± 1.0% max
Standard Colors	White, Gray and Tan – Available in 45, 60 and 80-mil		
Colorway Colors	Medium Bronze, Patina Green, Rock Brown, Slate Gray & Terra Cotta - *Available only as 60-mil*		
Material Total Thickness	45-mil (FB-45), 60-mil (FB-60) and 80-mil (FB-80) polyester reinforced thermoplastic FB-045 = 100 mils, FB-60 = 115 mils, FM-80 = 135 mils		
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.			

BENEFITS & SUPPLEMENTAL STATEMENTS

- Wide window of weldability
- Outstanding puncture resistance which is enhanced further by the fleece backing
- 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
- Hot melt extrusion processed for complete scrim encapsulation
- Warp knitted fabric (not woven) for smooth surface and greater thickness-over-scrim
- Low vapor permeance and water absorption
- Polyester reinforcing fabric and fleece backing which are resistant to degradation by bacteria, mildew and fungi
- Polyester fleece backing for fully adhered systems provided exceptional wind uplift resistance

CODE APPROVALS/COMPLIANCE

A variety of Factory Mutual Ratings and Underwriters Laboratories Classifications are available. Contact Mule-Hide Warranty Department for additional information. Mule-Hide TPO-c meets and exceeds the requirements of ASTM D6878 Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing

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 are to extend 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 either Aqua Base 120 (as a wet lay-in adhesive) or Mule-Hide Helix low-rise foam adhesive.
4) Non- Fleece Back TPO-c membrane is to be used for membrane flashings.
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.
- TPO Fleece Back membranes must be tarped and elevated to keep dry prior to application. If fleece gets wet, use a wet vac system to help remove moisture from the fleece. DO NOT INSTALL MEMBRANE IF FLEECE IS WET
- TPO Fleece Back membrane exposed to the weather must be prepared with Weathered Membrane Cleaner prior to hot-air welding.
- Maximum sustained temperature not to exceed 160ºF (71ºC) for TPO membrane.
- Use proper stacking procedures to ensure sufficient stability. Avoid creasing the membrane.
- Once installed, membrane must be sealed daily to prevent wicking of moisture into fleece.

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	52 Weeks
Test specimen is 2" by 6" piece of 45-mil membrane unbacked, 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 45-mil**	**Typical Results 60-mil**	**Typical Results 80-mil**
kJ/ m^2 at 340 nm	10,080	>40,000	>50,000	>60,000
Test sample is 2.75" by 5.5" piece of membrane, unbacked, 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 its 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 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)

TPO-c Fleece Back Membrane

SUPPLEMENTAL APPROVALS, STATEMENTS AND CHARACTERISTICS (continued)

RADIATIVE PROPERTIES for CRRC and LEED				
DESCRIPTION	**TEST METHOD**	**WHITE TPO-c**	**TAN TPO-c**	**GRAY TPO-c**
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 Number		0670-0009	0670-0016	0670-0017

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.

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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