



# Product Data Sheet

## MULE-HIDE TPO-c FLEECE BACK PLUS MEMBRANE

### PRODUCT DESCRIPTION

Mule-Hide's TPO-c Fleece Back Plus FBP-045, FBP-060 and FBP-80 Membranes are polyester reinforced, 45-mil, 60-mil, or 80-mil thick, polyolefin based thermoplastic, heat-weldable membranes with a special 10 oz / yd<sup>2</sup> stain resistant, polyester fleece backing designed for attachment with hot asphalt. All Mule-Hide TPO membranes include OctaGuard XT™, 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 Plus membrane is used in fully adhered roofing systems in new construction, reroofing and recover (retrofit) applications, where the roof membrane is adhered with hot asphalt. The system must be installed over an acceptable roof insulation or other suitable substrate. See the Mule-Hide TPO Fleece Back PLUS Specifications Manual for complete specifications and details.

### SPECIFICATIONS

Colors: White top/White bottom Standard - Special Order Top Colors Tan and Gray

Material: 45-mil (FBP-45), 60-mil (FBP-60) and 80-mil (FBP-80) (nominal) thick polyester reinforced thermoplastic  
 FBP-045 = 120 mils total thickness, FBP-60 = 135 mils total thickness, FBP-80 = 155 mils total thickness

| Physical Properties   | Test Method   | Specification (min.)   | Mule-Hide TPO   |
|---|---|--|---|
| Tolerance on Nominal Thickness, %   | ASTM D751   | ± -10  | ± -10   |
| Thickness over fleece<br>FBP-45 (120 mils total)<br>FBP-60 (135 mils total)<br>FBP-80 (155 mils total)  | ASTM D4637  | 0.030 inch (.762 mm)<br>0.045 inch (1.14 mm)<br>0.080 inch (2.03 mm) | 0.045 inch (1.14 mm)<br>0.060 inch (1.52 mm)<br>0.080 inch (2.03 mm)  |
| Weight<br>FBP-45 (120 mils total)<br>FBP-60 (135 mils total)<br>FBP-80 (155 mils total)   | ---   | ---  | 0.31 lbm/ft <sup>2</sup><br>0.40 lbm/ft <sup>2</sup><br>0.50 lbm/ft <sup>2</sup>  |
| Breaking Strength<br>FBP-45 (120 mils total)<br>FBP-60 (135 mils total)<br>FBP-80 (155 mils total)  | ASTM D-751<br>(Grab Method)                             | 90 lb (0.4 kN)   | 300 lb (1.3 kN)<br>400 lb (1.8 kN)<br>425 lb (1.9 kN)   |
| Elongation at break of internal fabric  | ASTM D-751  | ---  | 25% typical   |
| Tearing Strength, B Tongue Tear   | ASTM D-751  | 10 lb (45 kN)  | 55 lb (245 kN)  |
| Brittleness point   | ASTM D-2137   | -40 F° (-40 C°) max.   | -50 F° (-46 C°)   |
| 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<br>After 7 days immersion 158°F (70°C)<br>Change in mass, %  | ASTM D-471<br>(fleece removed,<br>edges sealed)         | + 4.0%   | +2.0%   |
| Resistance to microbial surface growth,<br>rating (1 is very poor, 10 is no growth)   | ASTM D-3274   | ---  | 9-10 typical  |
| Field seam strength, seam tested in peel<br>FBP-45 (120 mils total)<br>FBP-60 (135 mils total)<br>FBP-80 (155 mils total)   | ASTM D-1876   | 25 lbf/in (4.4 kN/m)<br>25 lbf/in (4.4 kN/m)<br>40 lbf/in (7.0 kN/m) | 40 lbf/in (7.4 kN/m)<br>60 lbf/in (10.5 kN/m)<br>70 lbf/in (12.3 kN/m)  |
| Water vapor permeance, Proc B   | ASTM E-96   | ---  | 0.10 perms max<br>0.05 perms typical  |
| Puncture resistance<br>FBP-45 (120 mils total)<br>FBP-60 (135 mils total)<br>FBP-80 (155 mils total)  | FTM 101C<br>Method 2031 (lbf)<br>ASTM D5635<br>(Joules) | 350 lbf (--- Joules)<br>400 lbf (--- Joules)<br>425 lbf (--- Joules) | 525 lbf (17.5 Joules)<br>575 lb (22.5 Joules)<br>600 lb (30.0 Joules)   |
| Resistance to Outdoor (UV) Weathering<br>Xenon-Arc, 0.70 W/m <sup>2</sup> irradiance<br>exposure<br>FBP-45 (120 mils total)<br>FBP-60 (135 mils total)<br>FBP-80 (155 mils total) | ASTM G155<br>0.70 W/m <sup>2</sup><br>80°C B.P.T.       | No cracks<br>No loss of breaking<br>or tearing strength              | No cracks<br>No loss of breaking<br>or tearing strength<br>17,640 kg/m <sup>2</sup><br>20,160 kg/m <sup>2</sup><br>27,720 kg/m <sup>2</sup> |
| Properties after heat aging<br>Breaking Strength - % retained<br>Elongation Reinforced - % retained<br>Tearing Strength - % retained<br>Weight Change -%                          | ASTM D573<br>670 hrs @ 240 °F                           | ---  | 90% min<br>90% min<br>60% min<br>± 1.0 min  |

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.

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MULE-HIDE TPO-c Fleece Back Plus Membrane

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## **BENEFITS & SUPPLEMENTAL STATEMENTS**

- Wide window of weldability
- Thick 10 oz / yd<sup>2</sup> stain resistance fleece specifically designed for use with hot asphalt
- 75% fewer seams than modified - bitumen systems
- 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
- TPO-c Fleece Back 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) A proper substrate shall be provided to receive the Mule-Hide TPO-c Fleece Back Membrane Roofing System.
- 2) The Mule-Hide TPO-c Fleece Back membrane shall be fully adhered to the properly installed and prepared substrate using the techniques stated in Mule-Hide's specifications
- 3) The membrane side laps shall be overlapped before being hot air welded. All seams are to be hot air welded and probed.
- 4) The membrane is required to be mechanically attached only at the base of all vertical surfaces, roof edges, and angle changes.
- 5) The field of the roof is fully adhered to the substrate with hot asphalt applied at EVT.
- 6) All details will be done in accordance with Mule-Hide details use standard TPO-c membrane.
- 7) 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 TPO-c Fleece Back Plus Specifications, Details, Technical Bulletins, associated documents should be thoroughly reviewed prior to starting any project.

## **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.
- Maximum sustained temperature not to exceed 160°F (71°C) for TPO membrane.
- Use proper stacking procedures to ensure roll stability. Avoid creasing the membrane.
- Once installed, membrane must be sealed daily to prevent wicking of moisture into fleece.

## **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.

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MULE-HIDE TPO-c Fleece Back Plus Membrane

## SUPPLEMENTAL APPROVALS, STATEMENTS AND CHARACTERISTICS

- 1) The fabric reinforced membrane component of Mule-Hide TPO-c Fleece Back Plus meets and exceeds the requirements of **ASTM D6878<sup>1</sup>** Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing
- 2) 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
- 3) 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)

| <b>RADIATIVE PROPERTIES for ENERGY STAR<sup>®</sup>, CRRC and LEED</b> |                              |                    |                  |                   |
|--|------------------------------|--------------------|------------------|-------------------|
| <b>DESCRIPTION</b>   | <b>TEST METHOD</b>           | <b>WHITE TPO-c</b> | <b>TAN TPO-c</b> | <b>GRAY TPO-c</b> |
| <b>ENERGY STAR<sup>®</sup></b> initial solar reflectance               | Solar Spectrum Reflectometer | 0.79               | 0.71             | N/A               |
| <b>ENERGY STAR<sup>®</sup></b> initial emissivity                      |                              | 0.90               | 0.87             | N/A               |
| <b>CRRC</b> initial solar reflectance                                  | ASTM C1549                   | 0.79               | 0.71             | 0.46              |
| <b>CRRC</b> solar reflectance after 3 years                            | ASTM C1549 (uncleaned)       | 0.70               | 0.64             | 0.43              |
| <b>CRRC</b> initial thermal emittance                                  | ASTM C1371                   | 0.90               | 0.86             | 0.89              |
| <b>CRRC</b> thermal emittance after 3 years                            | ASTM C1371 (uncleaned)       | 0.86               | 0.87             | 0.88              |
| <b>CRRC</b> SRI (Solar Reflectance Index)                              | ASTM E1980                   | 99                 | 86               | 53                |
| <b>CRRC</b> SRI (Solar Reflectance Index after 3 yrs)                  | ASTM E1980                   | 85                 | 77               | 48                |
| <b>CRRC</b> Product ID   | N/A                          | 0670-0009          | 0670-0016        | 0670-0017         |
| <b>LEED<sup>™</sup></b> thermal emittance                              | ASTM E408                    | 0.95               | 0.86             | 0.53              |

Mule-Hide Tan and White TPO membranes are ENERGY STAR<sup>®</sup> and California Title 24 rated roof products. Mule-Hide White TPO membranes are Energy Star compliant

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 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.

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 membranes that exceed the requirements of ASTM Standard D6878.

| <b>EXTREME TESTING – HEAT AGING</b>  |                         |                        |
|--|-------------------------|------------------------|
| <b>Test Method</b>   | <b>ASTM Requirement</b> | <b>Typical Results</b> |
| ASTM Test - 240° F (116° C), No Visible Cracks   | 32 Weeks                | 52 Weeks               |
| Test specimen is 1" by 4" piece of 45-mil membrane unbacked, placed in circulating hot-air oven<br>Criterion-no visible cracks after bending aged test sample around 0.25" diameter mandrel.   |                         |                        |
| Heat Aging accelerates the oxidation rate that roughly doubles for each 10° C (18° F) increase in roof membrane temperature.<br>Oxidation (reaction with oxygen) is one of the primary chemical degradation mechanisms of roofing materials. |                         |                        |

# Product Data Sheet

MULE-HIDE TPO-c Fleece Back Plus Membrane

## SUPPLEMENTAL APPROVALS, STATEMENTS AND CHARACTERISTICS - CONTINUED

| <b>XENON-ARC TESTING</b>  |                               |                               |                               |                               |
|---|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
|   | <b>ASTM D6878 Requirement</b> | <b>Typical Results 45-mil</b> | <b>Typical Results 60-mil</b> | <b>Typical Results 80-mil</b> |
| <b>kJ/ m<sup>2</sup> at 340 nm</b>  | 10,080                        | 17,640                        | 20,160                        | 27,720                        |
| Test sample 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" diameter mandrel.   |                               |                               |                               |                               |
| 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 <sup>2</sup> ) at 340 nm machine UV wavelength. The irradiance "power" of the xenon-arc lamp is measured in Watts per square meter (W/m <sup>2</sup> ). 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. |                               |                               |                               |                               |

| <b>ENVIRONMENTAL CYCLING</b>   |                         |                                     |
|--|-------------------------|-------------------------------------|
| <b>Test Method</b>   | <b>ASTM Requirement</b> | <b>Typical Results</b>              |
| <b>EXTREME Test</b>  | NONE                    | No cracking under 10x magnification |
| Test specimen is 2.75" by 5.5" piece of membrane with edges sealed. <ul style="list-style-type: none"><li>- 10 days heat aging at 240° F (116° C) followed by</li><li>- 5 days water immersion at 158° F (70° C) followed by</li><li>- 5,040 kJ/m<sup>2</sup> (2000 hours at 0.70 W/m<sup>2</sup> irradiance) xenon-arc exposure</li></ul> |                         |                                     |
| 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.  |                         |                                     |

### ADDITIONAL INFORMATION

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

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