

System Specifications

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FULLY ADHERED TPO SYSTEM 07 54 00/MUL TABLE OF CONTENTS

Revision Date: June 4, 2019

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FULLY ADHERED TPO SYSTEM SPECIFICATION

PART 1 – GENERAL

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1.01 Description

A. Scope:

1. Furnish and install a Fully Adhered TPO Roofing Membrane with flashings and accessories necessary to comprise a roofing system. The Mule-Hide TPO products and accessories shall be installed in strict compliance with current specifications and drawings as published by Mule-Hide Products Co., Inc. ("Mule-Hide").
2. The Mule-Hide Fully Adhered TPO (Thermoplastic Polyolefin) Membrane Roof System utilizes a 45-mil (.045 inch), 60-mil (.060 inch) or 80-mil (.080 inch) thick reinforced TPO sheet. The TPO membrane is fully adhered to the substrate with bonding adhesive. Adjoining sheets and end laps are overlapped a minimum of 3 inches and welded with a robotic welder. The field membrane is secured at all changes in plane greater than 2" per foot. Note: All membrane thicknesses listed in this specification are nominal thicknesses.

B. Related Work:

The work includes, but is not necessarily limited to the installation of:

1. Vapor Retarder (where specified)
2. Wood Blocking (Nailers)
3. Insulation
4. Slip Sheet (where required)
5. Fasteners
6. Roof Membrane
7. Roof Membrane Flashings
8. Metal Flashings
9. Adhesives
10. Sealants
11. Walkways

Note: Mule-Hide recommends adherence to industry standards (SMACNA) for the installation of any metalwork.

C. General Design Considerations

1. It is the responsibility of the specifier to review local, state and regional codes to determine their impact on the specified Mule-Hide Roofing System.
2. It is the responsibility of the building owner or his/her designated representative to verify structural load limitations. In addition, a core cut may be taken to verify weight of existing components when the roofing system is to be specified on an existing facility.
3. On new construction projects, especially in cold climate regions, moisture generated due to the construction process could adversely impact various components within the roofing assembly if not addressed. Refer to SPRI Advisory Bulletin included in the Design Reference DR-03-11 "Construction Generated Moisture".
4. Drainage must be evaluated by the specifier in accordance with all applicable codes. Slopes may be provided by tapering the structure or through the use of tapered insulation; a sufficient number of roof drains should also be specified and properly located to allow for positive drainage. Significant ponding that could remain 48 hours after the termination of the most recent rain event should be eliminated with the addition of auxiliary drains in low areas where ponding is anticipated.
5. Mule-Hide specifically disclaims responsibility for the design and selection of an adequate drainage

system and drain accessories. Selection must be made by the building owner or the owner's design professional.

6. Small incidental areas of ponded water will not impact the performance of this roofing system; however, in accordance with industry standards, the roofing assembly should be designed to prevent ponding of water on the roof for prolonged periods (longer than 48 hours). Good roofing practice dictates proper drainage to prevent possible excessive live load and, in the event of a roof leak, to minimize potential interior damage to the roofing assembly and to the interior of the building.
7. The removal of existing wet insulation and membrane must be specified. The specifier shall select an appropriate and compatible material as filler for voids created by removal of old insulation or membrane.
8. Regardless of the type of membrane or assembly selected, any loose flashings at the perimeter, roof drains and roof penetrations must be removed.

1.02 Quality Assurance

- A. When a project requires a Standard or Premium System Warranty (NDL), the Mule-Hide Roofing System must be installed in compliance with Mule-Hide published Specifications and Details by an independent Mule-Hide Warranty Eligible Contractor.
- B. There shall be no deviations from this specification or the Mule-Hide Products Co., Inc. ("Mule-Hide") standard details without prior written approval from Mule-Hide's Technical Department.
- C. Upon completion of the installation according to the terms and conditions stated in this specification and in accordance to the information given in the Warranty Application, Pre-Job survey form and any additional approvals which might have been given by Mule-Hide, an authorized representative of Mule-Hide shall perform an on-site inspection of the roof (commercial projects only) to verify that all installation and material requirements have been met.

Note: Inspections are only conducted on projects where a "System Warranty" is requested. Inspections are not conducted on projects not requiring a Mule-Hide Warranty or when only a "Roofing Membrane Limited Warranty" is requested. The sole purpose of an inspection by a Mule-Hide Representative is not to be a final inspection for the benefit of the Building Owner/Owner's Representative. It is for the benefit of Mule-Hide to determine if a System Warranty may be offered for the project.

- D. Mule-Hide reserves the right to reject any roof system and refuse to issue any warranty on roofs that do not comply with Mule-Hide's specifications or current policies.

1.03 Submittals

- A. Prior to the time of bidding, the roofing contractor shall submit to the Owner or Owner's representative the following items:
 1. Copies of Mule-Hide specifications and published product data.
 2. Samples of each material to be used in the roof system.
 3. Specimen copy of Mule-Hide Products Co. warranty
 4. Dimensioned shop drawings to include an outline of the roof and appropriate details for flashings and terminations.
 5. Certification from insulation, roofing and accessory components manufacturers that all materials supplied comply with identified ASTM and industry standards.
 6. Verification that system specifications meet all identified code and insurance requirements including but not limited to the following if required:
 - a. Factory Mutual Research Laboratories
Norwood, MA

- b. Underwriters Laboratories
Northbrook, IL

Note: It is the Building Owner/Owner's Representative's responsibility to determine what submittals are required for the project.

- B. Submit to Mule-Hide, prior to the job start, a Heat-Weld System Warranty Application to be reviewed by the Mule-Hide Technical Department to determine the acceptability of the project based on the information provided.
 - 1. The Heat-Weld System Warranty Application ("Warranty Application") must be completely filled out and should be accompanied with a copy of the written roof specification provided by the building owner/designer (if available). Also included should be any requests for deviations to Mule-Hide's standard published specification and details.
 - 2. A roof drawing shall be submitted with the Warranty Application indicating all dimensions and locations of all penetrations.

1.04 Product Delivery, Storage and Handling

- A. All products delivered to the job site shall be in their original unopened containers or wrappings and clearly labeled with the manufacturer's name, product identification and date of manufacture.
- B. Protect all materials from damage during transit, storage and delivery to the job site. Place all materials on pallets and protect from moisture.
- C. Store all materials in a dry, clean area protected from the elements. All rolls of membrane shall be stored flat on pallets.
- D. All adhesive and caulking shall be stored at temperatures between 60°F and 80°F. Materials exposed to lower temperatures affect the workability and performance of the product. Products shall be restored to the above temperature prior to use.
- E. All flammable materials shall be stored in a cool, dry area away from open flames and sparks. Follow precautions outlined on containers or supplied by the material manufacturer/supplier.
- F. All materials determined as being damaged (confirmed by Mule-Hide) due to improper storage on the job site are to be replaced with new materials.

1.05 Job Conditions

- A. This specification shall not be considered applicable without the appropriate additional specifications approved by Mule-Hide if it should be determined that any of the following conditions exist:
 - 1. The installation of any Mule-Hide Roof System is in a coastal area or high wind zone.
 - 2. If the Mule-Hide Roof System should exceed the structural load conditions as determined by an architect or Engineer.
 - 3. When chemical or hazardous materials are discharged onto the Mule-Hide Roof System.
- B. Mule-Hide TPO roofing materials may be installed in temperatures below 40° F but only after consultation with the Mule-Hide Technical Department as special precautions or procedures may be necessary. The performance of the materials, installation costs and production rates may be affected.

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- C. The General Contractor or the building owner shall be responsible for providing adequate surfaces and structures to receive the insulation, Mule-Hide Roof System and related sheet metal necessary for the successful completion of the project.
- D. Only as much new roofing as can be made watertight each day shall be installed each day. This includes all flashing work.
- E. All substrates to receive new insulation, membrane or flashing shall be thoroughly dry. Should surface moisture occur, the contractor shall provide adequate equipment to dry the substrate prior to application of new material.
- F. Prior to and during application, all dirt, debris and dust shall be removed from surfaces to be roofed for both new and reroofing substrates.
- G. On all projects where the Fully Adhered TPO system is specified, it is the responsibility of the independent roofing contractor to have the owner or owner's representative verify the condition of the deck or substrate and to confirm the roof deck can withstand the additional load.
- H. Precautions shall be taken to prevent wind blow-off or wind damage during the course of the roofing application. This may necessitate additional securing of temporary construction, materials and equipment.
- I. The contractor shall verify and ensure that all roof drain lines are unblocked before starting work. Any blockages found shall be reported to the owner's representative and Mule-Hide's Technical Department in writing.
- J. Temporary water stops shall be installed at the end of each day's work. Temporary water stops shall be removed at the start of the next day's work and disposed of properly. Water stops shall be compatible with all materials.
- K. Do not install the Mule-Hide TPO Roofing Membrane in direct contact with any product containing coal tar pitch, creosote or penta-based materials. Consult the Mule-Hide Technical Department for special installation requirements.
- L. Do not allow contaminants such as petroleum, grease, acid, solvents, vegetable or mineral oil, animal oil, animal fat, etc. or direct steam venting to come into direct contact with the Mule-Hide TPO Roofing Membrane. Contact the Mule-Hide Technical Department for recommendations if such conditions exist.
- M. The contractor shall follow and comply with all safety regulations as recommended by OSHA.
- N. All work shall be scheduled and executed without exposing interior building areas to the effects of inclement weather. The existing building and its contents shall be protected against all risks.
- O. Arrange work sequence to avoid use of newly constructed roofing for storage, walking surfaces and equipment movement. Contractor shall provide all necessary protection and barriers to segregate the work areas and prevent damage to adjacent areas. If excessive traffic over newly installed membrane is necessary, contractor shall provide plywood or polyester felt protection to prevent damage. All damaged materials shall be replaced with new materials.
- P. All existing roofing materials to be removed for construction shall be immediately removed from the construction site to a dumping area authorized to receive such debris. Any hazardous materials such as asbestos or materials containing asbestos fibers shall be removed and disposed of in accordance with applicable City, State and Federal requirements.
- Q. Any unusual or concealed condition discovered during the course of the work is to be reported

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immediately in writing to the owner and Mule-Hide's Technical Department. Work is to be halted until the owner has responded with a solution to the problems.

R. Vapor Retarders

1. Mule-Hide does not require a vapor retarder for the protection of the membrane; however, it should be considered by the specifier for the protection of the roofing assembly (i.e. primarily insulation, underlayment and adhesives). The following criteria should be considered by the specifier:
 - a. Use of a vapor retarder to protect insulation and reduce moisture accumulation within an insulated roofing assembly, should be investigated by the specifier. Consult latest publications by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.), NRCA (National Roofing Contractors Association), and local building and energy codes for specific information.
 - b. In the generally temperate climate of the United States, during the winter months, water vapor flows upward from a heated, more humid interior toward a colder, drier exterior. Vapor retarders are more commonly required in northern climates than in southern regions, where downward vapor pressure may be expected and the roofing membrane itself becomes the vapor retarder.
 - c. On cold storage/freezer facilities, the perimeter and penetration details must be selected to provide an air seal and prevent outside air from infiltrating and condensing within the roofing assembly.
2. When a vapor retarder is specified, Mule-Hide F5 Air & Vapor Barrier may be used. Refer to F5 Air & Vapor Barrier Product Data Sheet for product installation.

S. On structural concrete decks, when a vapor retarder is not used, gaps in the deck along the perimeter and around penetrations must be sealed. If tilt-up panels are present, vertical joints between panels must be sealed as well. Sealing these areas will help prevent infiltration of hot humid air and possible moisture contamination resulting from condensation. This is specifically important when adhesive is used to attach the roof insulation.

T. All local building codes, energy codes and requirements should be followed where applicable. It is the roofing contractor's sole responsibility to determine and ensure that the roofing system selected complies with all local codes and requirements.

U. Both interior and exterior building areas affected by construction shall be cleaned up and any damaged areas shall be repaired to the owner's satisfaction.

V. Certain project conditions may require modifications to this specification. Contact the Mule-Hide Technical Department if any of the following conditions exist:

1. Roof heights greater than 100 feet.
2. Geographical location in a 100 mph or greater wind zone, per the ANSI 100 year mean recurrence interval wind isotach.
3. Location with a D exposure as determined in ANSI A58.1

W. When using heat-welding equipment, always review the equipment manufacturer's instructions, precautions and warnings.

X. Consideration should be given in the project design to problems that can precipitate from the smooth surface characteristic of the Mule-Hide TPO membrane.

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1.06 Warranties

All Mule-Hide warranties are available for commercial projects, term limits range from 10 to 30-years, and subject to enhancements as required such as membrane thicknesses. A Roofing Membrane Limited Warranty for a maximum of 20 years is available for residential projects

A. Mule-Hide's Roofing Membrane Limited Warranty For Commercial Projects

The Roofing Membrane Limited Warranty ("Warranty") covers only the Mule-Hide EPDM membrane (or portion thereof) determined by Mule-Hide to be defective and resulting in roof leaks. This Warranty does not cover workmanship or other components not supplied by Mule-Hide. Mule-Hide does not perform inspections of the installation before issuing the Roofing Membrane Limited Warranty. A Mule-Hide Warranty Application and the appropriate fee must be submitted to Mule-Hide to obtain this warranty. Proof of purchase may be required.

B. Mule-Hide's Standard System Warranty

The Standard warranty is an NDL ("No Dollar Limit"), labor and material warranty that covers only the Mule-Hide labeled membrane and accessories that comprise the Mule-Hide Roof System, other components supplied or approved in writing by Mule-Hide and exclusively installed by an independent Mule-Hide Warranty Eligible Contractor. Applicator must submit a Warranty Application and the appropriate fee to Mule-Hide. Standard warranties require inspections by a Mule-Hide representative.

C. Mule-Hide Premium System Warranty

The Premium warranty is an NDL ("No Dollar Limit"), labor and material warranty that covers only the Mule-Hide labeled membrane, insulation and accessories or components supplied or approved in writing by Mule-Hide and exclusively installed by an independent Mule-Hide Warranty Eligible Contractor. Applicator must submit a Warranty Application and the appropriate fee to Mule-Hide. Premium warranties require inspections by a Mule-Hide representative.

Warranty Table I

Warranty Term	Adhered Membrane Systems Warranty Options ¹						
	Extended Wind Speed Coverages Available				Mule-Hide Reinforced TPO-c Minimum Thickness	Additional Membrane Coverage	
	Standard 55 mph	72, 80, 90 mph	100 mph	110 to 120 mph		Additional Puncture	Hail
10, or 15 year	√ ⁴	√	√	√	45-mil	See Table II Below	See Table II Below
20 year ³	√ ⁴	√ ⁴	√	√	60-mil ²	See Table II Below	See Table II Below
25 year ³	√	√	√	N/A	80-mil ²	See Table II Below	See Table II Below
30 year ³	√	√	√	N/A	80-mil ²	See Table II Below	See Table II Below

Notes: N/A = Not Acceptable √= Acceptable

1. Contact Mule-Hide Technical Department for specific requirements.
2. All "T-Joints" must be overlaid with appropriate flashing material when using 60 or 80-mil membrane.
3. Enhancements may be required for certain flashing details. Published details must be referenced for applicable requirements.
4. Aqua Base 120 adhesive may be used for projects with 20 year maximum warranty and wind speed coverage up to 72 mph.

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Warranty Table II

Hail Coverage options	1" Diameter Hail Coverage requires min 60-mil adhered to cover board ¹
	2" Diameter Hail Coverage requires min 80-mil adhered to cover board ¹
Puncture Coverage	Minimum 80-mil membrane, Contact Mule-Hide Technical Department for specific requirements

1. Cover board options: Poly ISO 1-HD, DensDeck Prime, or Securock – Adhered in place only

Warranty Table III

Insulation/Cover Board & Required Attachment for Assemblies Up to 20 YR Warranty Term					
Peak Gust Wind Speed Warranty ⁹	Minimum Membrane Underlayment (Mule- Hide Supplied Only) ⁹	Insulation/Underlayment Attachment ⁹			Metal Edging
		# of Fasteners per 4' x 8' board size ¹	Adhesive Ribbon Spacing for 4' x 4' size board		
			Field	Perimeter /Corner	
55 MPH	1" (min. 20 psi) Poly ISO 1 or 2	16, 24, 32	12" ^{4,5}	6" ⁴	Mule-Hide Gravel Stop, Skirted Drip Edge, 2-Piece Snap-On Compression, 1-3/4" Fascia Cover ³ EclipsEdge ³
	1-1/2" (min. 20-psi) Poly ISO 1 or 2	12, 18, 24	12" ^{4,5}	6" ⁴	
	2" (min. 20 -psi) Poly ISO 1 or 2	8, 12, 16	12" ^{4,5}	6" ⁴	
72 OR 80 MPH	1/4" Dens-Deck ²	12, 18, 24	12" ^{4,6}	6" ^{4,6}	Mule-Hide Gravel Stop ³ , Skirted Drip Edge ³ , 2-Piece Snap-On Compression ³ , 1-3/4" Fascia Cover ³ EclipsEdge ³
	1/4" Securock ²				
	1/2" STRUCTODEK ²	16, 24, 32	6" ^{4,6}	6" ^{4,6}	
	1/2" Poly ISO 1 or 2-HD ²				
	1-1/2" (min. 20-psi) Poly ISO 1 or 2				
2" (min. 20 -psi) Poly ISO 1 or 2	8, 12, 16	6" ^{4,5,6}	6" ^{4,5,6}		
90 MPH (10)	1/2" Dens-Deck (2)	12, 18, 24	6" ^{6,7,8}	6" ^{6,7,8}	Mule-Hide Gravel Stop ³ , Skirted Drip Edge ³ , 2-Piece Snap-On Compression ³ , 1-3/4" Fascia Cover ³ EclipsEdge ³
	1/2" Securock (2)				
	1/2" Poly ISO 1 or 2-HD (2)	24, 32, 32	6" ^{6,7,8}	6" ^{6,7,8}	
	1-1/2" Hunter CGF Poly ISO (min. 20 psi)	16, 24, 32	6" ^{5,6,7,8}	6" ^{5,6,7,8}	
	2" Hunter CGF Poly ISO (Min.20 psi)	8, 12, 16	6" ^{5,6,7,8}	6" ^{5,6,7,8}	
100 MPH (10)	5/8" Dens Deck (2)	16, 24, 32	4"	4"	Skirted Drip Edge ³ , 2-Piece Snap-On Compression ³ , 1-3/4" Fascia Cover ³ EclipsEdge ³
	5/8" Securock (2)				
	2" Hunter CGF Poly ISO (min. 20 psi)				
110 MPH (10)	5/8" Dens Deck (2)	16, 24, 32	4"	4"	Skirted Drip Edge ³ , 2-Piece Snap-On Compression ³ , 1-3/4" Fascia Cover ³ EclipsEdge ³
	5/8" Securock (2)				
120 MPH (10)	5/8" Dens Deck (2)	24, 32, 32	4"	4"	Skirted Drip Edge ³ , 2-Piece Snap-On Compression ³ , 1-3/4" Fascia Cover ³ EclipsEdge ³
	5/8" Securock (2)				

- Order of fasteners required are field, perimeter and corners.
- Cover boards must be installed over a min. 1" thick approved Mule-Hide Insulation.
- Mule-Hide HDP (#14) or EHD (#15) fasteners are required for attachment to perimeter wood nailers.
- Gravel Surface BUR - Field @ 6" OC / Perimeter @ 4" OC
- Steel Decks - Field & Perimeter @ 6" OC Must adhere to top of deck flutes
- Cementitious Wood Fiber - Field @ 6" OC / Perimeter @ 4" OC
- Smooth BUR - Field @ 6" OC / Perimeter @ 4" OC
- Gravel Surface BUR – 4" OC

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9. See Design Enhancements for term specific requirements.
10. Requires use of HDP (#14) or EHD (#15) as insulation fasteners

Warranty Table IV

Insulation/Cover Board & Required Attachment for Assemblies with 25 or 30-Year Warranty Term					
Peak Gust Wind Speed Warranty	Minimum Membrane Underlayment	Insulation Attachment			Metal Edging
		# of Fasteners per 4' x 8' board size (6, 7)	Adhesive Ribbon Spacing for 4' x 4' size board		
			Field	Perimeter/ Corner	
55 MPH	1-1/2" to 2-1/2" (min. 25-psi) Poly ISO 1 or 2	16, 24, 32	6" ^{2.4}	6" ^{2.4}	Mule-Hide Gravel Stop, Skirted Drip Edge, 2-Piece Snap-On Compression, 1-3/4" Fascia Cover ³
	1/2" STRUCTODEK ¹				
	1/4" Dens-Deck ¹				
	1/4" Securock ¹				
72 or 80 MPH	1-1/2" to 2-1/2" Hunter CGF Poly ISO (min. 25 psi)	16,24, 32	6" ^{2.4,5}	6" ^{4.5}	Mule-Hide Gravel Stop ³ , Skirted Drip Edge ³ , 2-Piece Snap-On Compression ³ , 1-3/4" Fascia Cover ³ , EclipsEdge ³
	1/2" Dens-Deck ¹				
	1/2" Securock ¹				
90 or 100 MPH	1/2" Poly ISO (1 or 2)-HD ¹	16, 24, 32	4"	4"	Skirted Drip Edge ³ , 2-Piece Snap-On Compression ³ , 1-3/4" Fascia Cover ³ , EclipsEdge ³
	5/8" Dens Deck ¹				
	5/8" Securock ¹				

1. Hail coverage offered with substrate.
2. Structural Concrete - Field @ 12" / Perimeter @ 6" OC
3. Mule-Hide #14HD or #15EHD fasteners are required for attachment to perimeter wood nailers.
4. Cementitious Wood Fiber & Wood – 4" OC
5. 80-mph over Gypsum Decks – 4" OC
6. Order of fasteners required are field, perimeter and corners.
7. Requires use of HDP (#14) or EDH (#15) as insulation fasteners

- A. Mule-Hide is under no obligation to issue warranties on projects completed prior to submittal to the Mule-Hide Technical Department of a properly completed Warranty Application.
- E. Metal flashing products supplied by Mule-Hide (Mule-Hide Metal Accessories) and installed by a Mule-Hide Warranty Eligible Applicator will be covered under a Standard or Premium System warranty. The finish on the Mule-Hide labeled metal components are covered for a maximum warranty period for up to 25 years independent of the terms of the issued warranty (see the Mule-Hide 25 years Limited Metal Warranty for specific warranty coverage).
- F. Standard and Premium System warranties are not available for residential projects.
- G. TPO tie-ins to built-up (BUR) or any other type of roof system are not covered by Mule-Hide warranties.
- H. Contact Mule-Hide Technical Department for other extended warranties that may be available.
- I. Terms and Conditions of Warranties.

Mule-Hide's obligations under the Roofing Membrane Limited Warranty, the Standard System Warranty, and the Premium System Warranty are limited to the specific terms and conditions of the respective Warranties. Sample copies of the Mule-Hide Warranties are available from Mule-Hide upon request.

PART 2 - PRODUCTS

2.01 General

- A. The components of the Fully Adhered Mule-Hide TPO Membrane Roof System are to be products manufactured or supplied by Mule-Hide Products Co., Inc.
- B. Components other than those supplied or manufactured by Mule-Hide may be submitted for review and acceptance by Mule-Hide's Technical Department. Mule-Hide's acceptance of any other product is based solely on chemical compatibility and published performance data provided by the component manufacturer. Other components may be considered on a job-by-job basis and must be approved in writing by Mule-Hide's Technical Department. Mule-Hide offers no warranty or guarantee for the performance or suitability of any component not supplied or manufactured by Mule-Hide.

2.02 Roofing Membrane

The Mule-Hide Reinforced TPO-c Membrane is available in 45 mils (.045 inch), 60 mils (.060 inch), or 80 mils (.080 inch) thick. The Mule-Hide TPO-c membrane is a polyester scrim reinforced thermoplastic polyolefin roofing membrane that meets and exceeds the requirements of ASTM D6878 Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing. Refer to the Product Data Sheets for physical properties and additional information.

2.03 Accessory Materials

The following Mule-Hide materials must be used to install Mule-Hide Roof Systems. Mule-Hide will not warrant any application where another manufacturer's product is substituted for a Mule-Hide product. **All products listed below are physically and chemically compatible with each other.**

- A. Helix® Max Low-Rise Adhesive, Helix® Max Low-Rise Adhesive 5-Gallon Jug, Helix® Max Low-Rise Adhesive Dual Tank, and Helix® Max Low-Rise Adhesive Dual Cartridge (Helix Max Low-Rise Adhesive) are a two-component, low-rise, construction grade, polyurethane foam adhesive designed to adhere approved roof insulations, thermal barriers, cover boards and fleece backed single-ply membranes to acceptable substrates. This VOC, CFC, HCFC and solvent free adhesive is quickly and easily applied.
 - 1. Depending on the packaging and delivery option selected, these products can be installed in continuous beads, full spray, or splatter applications. Not all products have the same options so review of the product data sheets is required to ensure proper use.
- B. Helix® Low-Rise Adhesive is a two-component, low-rise, construction grade, polyurethane foam adhesive designed to adhere approved roof insulations, thermal barriers, or cover boards to acceptable substrates, and is available in multiple packaging options; 15 and 50 gallon drums, Dual Tanks, and Dual Cartridges.
- C. Mule-Hide TPO Bonding Adhesive - A solvent-based rubberized adhesive used for bonding Mule-Hide TPO-c Membrane to various vertical substrates and insulation boards. Mule-Hide TPO Bonding Adhesive is a two-surface contact adhesive that is applied to both the underside of the membrane and substrate surface. This product may be used with TPO field membrane and flashing membrane. Adhesive is compatible with polyisocyanurate, wood fiberboard insulations, fiberglass-faced gypsum panels, concrete, masonry, metal and wood surfaces.
- D. Mule-Hide Low VOC Bonding Adhesive - A high strength solvent-based contact adhesive that allows bonding of TPO membrane to various porous and non-porous substrates. It is specially formulated using a blend of VOC exempt and non-exempt solvents to meet the < 250 g/l VOC content requirements of the OTC Model Rule for Single Ply Roofing Adhesives.

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- E. AeroWeb – A low VOC contact adhesive used to adhere membranes to various substrates, and prime surfaces prior to the application of F5 Air & Vapor Retarder. It features a quick dry time and ease of application from the self-contained pressurized cylinder.
- F. Mule-Hide Low VOC Bonding Adhesive - 1168 – A high strength solvent-based contact adhesive that allows bonding of TPO membrane to various porous and non-porous substrates. It is specially formulated using a blend of VOC exempt and non-exempt solvents to meet the < 250 g/l VOC content requirements of the OTC Model Rule for Single Ply Roofing Adhesives. **This product COMPLIES with the following California counties' VOC regulations:** Alameda, Contra Costa, El Dorado, Los Angeles, Marin, Napa, Orange, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, San Mateo, Santa Clara, Solano, Sonoma, and Tehama.
- G. Aqua Base 120 Bonding Adhesive – A water base adhesive used to bond Mule-Hide TPO-c membrane to various vertical substrates and insulation boards. Aqua Base 120 is applied as a two-sided contact adhesive when used with standard (non-fleece back) TPO membranes, or as a single-side, wet lay-in adhesive when used with Mule-Hide Fleece Back TPO membrane.
- H. Mule-Hide TPO Primer - A high-solids-content, clear (translucent color), polymer-based splice primer used to prepare TPO membrane for improved adhesion to pressure-sensitive TPO accessories such as: RUSS Strips, TPO Pressure Sensitive Cover Strips, Uncured Flashing Tapes and Cured Cover Tapes. Mule-Hide TPO Primer is required to prepare TPO membrane surfaces prior to the application of any pressure sensitive Mule-Hide accessories.
- I. Mule-Hide Low VOC Primer - a solvent-based product designed to prepare TPO membrane for improved adhesion to pressure-sensitive TPO accessories such as: RUSS Strips, TPO Pressure Sensitive Cover Strips, Uncured Flashing Tapes and Cured Cover Tapes. This Low-VOC product is ideal for use in states where VOC content is a concern.
- J. Mule-Hide TPO Flashing - a non-reinforced, .060-inch thick material primarily used to seal details where field fabrication is necessary, such as drain details, pipe flashings, pitch pocket flashings, seaming joints of the Mule-Hide TPO Coated Metal, and any place where reinforced membrane is not practical.
- K. Mule-Hide TPO Universal Corners - .060-inch thick pre-molded, non-reinforced TPO material. They are uniform in shape and size and provide water tightness at corners formed by TPO coated metal and flashing membrane. They provide a neat, finished look to building corners, curbs and parapet flashings with no cutting or stretching required. Universal Corners are available in white only.
- L. Mule-Hide TPO Outside Corners – are pre-molded and are used for flashing outside corners on a variety of details. Installation is fast and easy with no cutting or stretching required. TPO Outside Corners are available in white, gray, and tan.
- M. Mule-Hide TPO Inside Corners – are pre-molded and are used for flashing inside corners on a variety of details. Installation is fast and easy with no cutting or stretching required. TPO Inside Corners are available in white, gray, and tan.
- N. Mule-Hide Weathered Membrane Cleaner - Used to clean in-service TPO-c membrane prior to the welding process. This cleaner helps to loosen and remove dirt and other contaminants from the surface of the TPO-c membranes and leaves a suitable surface for welding or the subsequent application of TPO Primer.
- O. Mule-Hide TPO Pipe Seal - An injection molded, pre-formed flashing for pipes made of Mule-Hide non-reinforced TPO material. They are designed to add ease to the installation process while offering increased watertight security and improved aesthetics. TPO Pipe Seals are designed as an economical flashing for single pipe penetrations on Mule-Hide TPO-c Membrane roof systems. The TPO Pipe Seals can be used wherever the TPO Pipe Seals may be slipped over the top of the pipe.

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- P. Mule-Hide TPO T-Joint Cover - 60-mil non-reinforced flashing cut into a 4.5" diameter circle used to seal step-offs at splice intersections. Installation is mandatory on all 60-mil and 80-mil TPO systems and on all jobs warranted longer than 15 years.
- Q. Mule-Hide TPO Coated Metal – 24-gauge, galvanized steel to which is laminated 35 mils (.035" thick) of Mule-Hide non-reinforced TPO Membrane used for flashing and edge metal detailing.
- R. Mule-Hide All-Purpose Bar ("A-P Bar") - an extruded aluminum bar, 50 mils (.050") thick, used to terminate adhered reinforced membrane vertical flashings in certain constructions. Mule-Hide A-P Bar may also be used to anchor the field sheet at the base of vertical angle changes.
- S. Membrane Fasteners and Discs - Mule-Hide offers a variety of membrane fasteners and discs to meet specific job conditions and substrates.
- T. Mule-Hide Thermoplastic Pourable Sealant - a one-component thermoplastic sealant for use in pitch pockets.
- U. Mule-Hide TPO .045 Reinforced 6" X 100' – used for stripping-in TPO Coated Metal and as cover strips over TPO Coated Metal joints.
- V. Mule-Hide TPO Cut Edge Sealant – A solvent-based liquid sealant used to seal the cut edge of the Mule-Hide TPO Membrane.
- W. Mule-Hide TPO Walkway Rolls – a 1/8-inch thick embossed TPO membrane available in rolls (34" x 50') having a herringbone traction surface. Walkway Rolls are trimmed in safety yellow along the length of the sheet to better define the walkway area. Walkway Rolls may be welded directly to the TPO roofing membrane. The yellow edges are smooth without safety lugs to allow for easier welding. Walkway Rolls are available in White and Gray colors.
- X. Mule-Hide Insulation - Mule-Hide Poly ISO 1 and Poly ISO 2 polyisocyanurate insulation (flat or tapered) is a closed-cell polyisocyanurate foam core laminated to heavy, black (non-asphaltic) glass fiber reinforced felt facers.
- Y. Mule-Hide HP Protective Mat - A nominal 6.0-ounce per square yard (140 grams per square meter) UV resistant polypropylene needle punched fabric. It can be used above the membrane as a slipsheet for protection from damage by materials placed on top of the membrane.
- X. F5 Air & Vapor Retarder - A 40-mil thick composite consisting of 35-mil self-adhering rubberized asphalt membrane laminated to a 5-mil UV resistant poly film with an anti-skid surface which is fully compatible with Helix Max Adhesive. A white poly film is available for summer time exposure and a black poly film is available for winter time exposure. F5 Air & Vapor Retarder can also function as a temporary roof for up to 120 days. Available in rolls 39" wide by 75' long (244 square feet).

2.04 Related Materials by Others

A. Wood Nailers

1. Nailers shall be #2 or better lumber. Creosote and asphaltic preservatives are not acceptable. Pressure treated lumber is not required on new construction unless specified by the architect.
2. Wood nailers shall conform to Factory Mutual's Loss Prevention Data Sheet 1-49.
3. Wood nailers shall be installed as specified on the project drawings and shall be of a height sufficient to match the thickness of the insulation being used.

B. Insulation

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1. Insulation shall be installed as a protection layer over the existing substrate or to obtain a desired thermal value.
2. Insulation shall be compatible with the Mule-Hide TPO Membranes, Mule-Hide Adhesives, Mule-Hide TPO Flashings and other Mule-Hide Accessories.
3. The following insulation boards are acceptable for use with a fully adhered roofing system when a standard warranty is requested:
 - a. Polyisocyanurate insulations having non-asphaltic facers (foil facers are not acceptable) meeting the physical property requirements of Fed. Spec HH-I-1972 and having a minimum compressive resistance of 20 psi. Thickness minimum is 1.0" or greater as required by insulation manufacturer to span steel deck flutes.
 - b. Poly ISO 1-HD is ½" thick, 109 psi high density polyisocyanurate insulation board that was specifically designed for use as a cover board. This product consists of a closed-cell polyisocyanurate foam core laminated to premium performance coated glass fiber felt facers.
 - c. High Density Wood Fiberboard - may be used as an overlay over other insulations. 1/2-inch thick is the minimum requirement when used as an overlay. Mule-Hide requires a minimum 1-inch thick board when installing directly over steel decks. Wood and concrete decks require a minimum 1/2-inch thick board. Minimum thicknesses and attachment rates will vary with wind requirements and deck types.
 - d. Expanded Polystyrene. Density of boards must be 1.0 PCF certified minimum and meeting ASTM C578, Type II physical properties. Minimum thickness shall be 1.0 inch. When installing directly over a steel deck the minimum thickness shall be as required by insulation manufacturer to span flutes. An overlay of a minimum 1/2" thick HD Wood Fiberboard, minimum 1" polyisocyanurate insulation, minimum ¼" DensDeck, or minimum ¼" Securock is required. Check local building codes as a layer of gypsum board may be required under the EPS insulation (on steel decks).
 - e. Extruded polystyrene meeting ASTM C578, Types IV, VI or VII physical properties. Minimum thickness shall be 1.0 inch. When installing directly over a steel deck the minimum thickness shall be as required by insulation manufacturer to span flutes. An overlay of a minimum 1/2" thick HD Wood Fiberboard, minimum 1" polyisocyanurate insulation, minimum ¼" DensDeck, or minimum ¼" Securock is required. Check local building codes as a layer of gypsum board may be required under the extruded insulation (on steel decks).
 - f. Perlite Insulation – Perlite is **not** an acceptable top layer insulation. Perlite may only be used as a fill insulation under an approved insulation. The TPO membrane cannot be adhered directly to perlite insulation.
 - g. Dens Deck Prime or Securock - A minimum 1/4" thick layer of Dens Deck Prime or Securock may be used as an overlay over an approved insulation or as a thermal barrier over a combustible deck.
 - h. State and local building codes should be reviewed regarding the installation of expanded or extruded polystyrene insulation directly over a steel deck.
4. Insulation manufacturer shall provide its recommendations for use and attachment to the owner with a copy sent to Mule-Hide's Warranty Department. In addition, the insulation manufacturer shall provide a copy of their specific warranty conditions.
5. Mule-Hide Premium Warranties require the use of the Mule-Hide labeled insulation or insulation by an

approved Mule-Hide manufacturer. Use of other insulations may disqualify the project for consideration of the issuance of a Premium warranty. Contact the Mule-Hide Technical Department for specific requirements.

C. UL and FM Approved Assemblies

Contact Mule-Hide Technical Department for proper insulated assemblies when projects require compliance with UL or FM requirements. The components may change with the slope, deck type and classification requested.

D. Sheet Metal

1. Metal flashing products supplied by Mule-Hide (Mule-Hide Metal Accessories) and installed by a Mule-Hide Warranty Eligible Contractor will be covered under a Standard or Premium System warranty.
2. TPO Coated Metal and non-coated metal components such as gravel stops, drip aprons, counterflashings, copings, etc., should be fabricated and installed in accordance ES-1 recommendations and requirements.
3. Sheet metal components supplied by others are not covered by the Mule-Hide warranties. Contact Mule-Hide's Technical Department for specific requirements.

2.05 Precautions

- A. Consult Safety Data Sheets and container labels for specific safety instructions prior to use.
- B. Avoid breathing vapors of solvents, cleaners, primers, sealants and adhesives. Use with adequate ventilation. Avoid prolonged contact of solvents, sealants, cleaners, primers and adhesives with skin. Solvent resistant rubber gloves should always be worn during use.
- C. Do not use Mule-Hide TPO roofing products near fire or flame. Do not use open flames for drying of surfaces, sealants or adhesives. **Do not smoke near flammable products.**
- D. Do not use oil-based paint on Mule-Hide TPO Coated Metal or membrane. Contact Mule-Hide's Technical Department for recommendations.
- E. Do not allow muriatic acid (masonry cleaner) to come in direct contact with the Mule-Hide TPO Membrane or accessory products.
- F. Do not allow Mule-Hide TPO membranes or accessories to come into direct contact with steam or vents that produce temperatures in excess of 160°F (71°C).
- G. The Mule-Hide TPO Roof System may be installed in cold weather provided the adhesives are stored at room temperature until just prior to use and used within 2 hours. Adhesives left in the cold must be returned to room temperature prior to use.
- H. Cover Tapes may lose tack when exposed to temperatures below 40° F. for extended periods of time. A heat gun may be used to warm the product. Only apply heat to the TPO side. Be careful not to overheat. Hot boxes are the preferred method to warm tapes.
- I. In colder temperatures when the ambient temperature is near the dew point, condensation may form on the tape primer and adhesive as the solvents flash off. If condensation occurs, discontinue the application and allow the surface to dry. **Do not attempt to dry the surface with heat guns or torches.** When weather permits apply a new coat of product.

PART 3 - EXECUTION

3.01 General

- A. When installing a Fully Adhered Mule-Hide Reinforced TPO Membrane Roofing System in cooler weather, it is recommended that liquids such as solvents, sealants, etc. be stored at warmer temperatures (60°F or more but not exceeding 80°F) until just prior to use in order to facilitate the installation.
- B. When using Aqua Base 120, the adhesive must be installed in temperatures of 40°F and rising for 48 consecutive hours to prevent the Aqua Base 120 from freezing before it fully cures.
- C. Application of the Helix Max Low-Rise Adhesive shall not proceed during periods of inclement weather. Follow Mule-Hide requirements for application temperatures and humidity levels.
- D. Do not apply Helix Max Low-Rise Adhesive when surface and/or ambient temperatures are below 25°F.

3.02 Substrate Conditions

The following general conditions apply to the substrate that will receive a Fully Adhered Mule-Hide TPO Membrane Roofing System for both new construction and reroof applications:

- A. The roof deck must be structurally sound to provide proper securement for mechanical fasteners. Areas showing a loss of integrity due to corrosion, rotting, warping, concrete spalling, etc., must be repaired or replaced prior to installing the roofing system.
- B. It is the responsibility of the roofing contractor to perform test cuts at each roof area prior to reroofing. The condition of the substrate must be suitable to receive a Fully Adhered Mule-Hide TPO Roofing System. Wet insulation must be removed and replaced. See Single-Ply Roofing Institute's guidelines for determining wet insulation.
- C. Contact the material manufacturer when the substrate is exposed to excessively high humidity and/or a corrosive environment. Special fasteners (i.e. - stainless steel) or details may be required.
- D. A determination must be made regarding the presence or absence of coal tar pitch within the existing roof assembly when considering a recover of the old roof system. The presence of coal tar pitch requires the use of a 6-mil poly slipsheet under the new insulation unless the coal tar pitch is 10 years or older and is separated from the Mule-Hide TPO membrane by a layer of insulation a minimum of 1-1/2" thick having a minimum "R" value of 5.0. All joints must be butted tightly together or have joints completely taped to prevent volatiles from damaging roof membrane.
- E. It is acceptable to install a Fully Adhered Mule-Hide TPO Membrane Roofing System over the following deck substrates provided that an acceptable insulation is installed over the substrate as needed:
 - 1. Structural Metal Deck (22 gauge minimum) shall conform to recommendations outlined in Factory Mutual's Loss Prevention Data Sheet 1-28 (requires insulation). Contact Mule-Hide's Warranty Department for attachment requirements for decks less than 22-gauge in thickness. All FM testing is based on attachment to a 22-gauge steel deck.
 - 2. Structural concrete and pre-cast, pre-stressed concrete (2,500 psi. minimum) shall be cured and dry to industry standards and surface shall be smooth and free of moisture or frost. All sharp ridges or other projections above the surface shall be removed before roofing. An approved insulation board is recommended. Minimum deck thickness shall be 2 inches with 3 inches preferred due to possible spalling damage that may occur to the underside of the deck when using fasteners for insulation and membrane attachment. Insulation may be attached with Type III or IV hot asphalt, approved adhesive or approved fasteners. The membrane may be adhered directly to structural concrete

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decks that have been trowel finished and are completely cured (28 day minimum). Gaps in the deck along the perimeter and around penetrations must be sealed along with vertical joints between tilt-up panels, if present, to prevent infiltration of hot humid air and possible moisture contamination resulting from condensation.

3. Lightweight Insulating Concrete Fill and Metal Form work (minimum 24 gauge metal form work) - the roof deck shall be cured and dry to the deck manufacturer's and/or industry standards and shall be smooth and free of ridges and depressions. All necessary venting as recommended by the roof deck manufacturer shall be accomplished. These decks may be acceptable to receive a Fully Adhered Mule-Hide TPO Membrane Roofing System after pullout tests have been completed and appropriate fasteners have been selected. Attachment must be through the insulating concrete into the steel or concrete deck. Insulation board is required. Vapor barriers may be required when installing insulation over new decks.
4. Wood Plank (1" minimum) shall conform to Factory Mutual's requirements for Class 1 impregnated decks (insulation is required). FM approved wood decks are a minimum, nominal 2-inch thick, tongue and groove planks.
5. Plywood (15/32" minimum) shall be exterior grade (minimum CDX grade). A layer of an approved insulation is required for reroof applications. On new construction, while insulation board is recommended, adhering directly to the plywood or Oriented Strand Board ("OSB") deck is acceptable if the decking is secured with screws or back-out resistant fasteners. Decks attached with common or cement coated nails or staples shall be covered with an approved insulation. Check with local building code requirements as adhering a TPO membrane direct to a wood deck may not meet local fire codes.
6. Cementitious Wood Fiber Decks - Certain cementitious wood fiber decks may be acceptable to receive a Fully Adhered Mule-Hide TPO Membrane Roofing System after pullout tests have been completed and appropriate fasteners have been selected. This deck type requires an acceptable insulation.
7. Gypsum Deck - shall be cured and dry to manufacturers' and/or industry standards. The surface of the deck shall be smooth and free from ridges and depressions. Certain gypsum concrete decks may be acceptable to receive a Fully Adhered Mule-Hide TPO Membrane Roofing System after pullout tests have been completed and appropriate attachment methods have been selected. This deck type typically requires an acceptable insulation.
8. Oriented Strand Board (OSB) shall be a minimum 7/16" thick. Contact Mule-Hide for acceptable sheet sizes, fastener types and spacing when using OSB as requirements will change with thickness used. Minimum thickness or usage restrictions may change depending on local code requirements. Pullout tests must be performed and submitted to Mule-Hide Technical Department prior to bidding the project.

Helix Max Substrate Compatibility					
Insulation/Underlayments		Roof Decks		Existing Roofing Materials	
Poly ISO 1 & 2	Yes	Concrete	Yes	Smooth BUR	Yes
StructoDek® High Density	Yes	Cellular Lt.Wt. Concrete	Yes ¹¹	Gravel BUR	Yes ⁵
Expanded Polystyrene (EPS)	Yes ¹	NVS Lt.Wt. Concrete	Yes ¹¹	Mineral Cap Sheet	Yes
Extruded Polystyrene (XPS)	Yes ²	Gypsum	Yes	Granular Modified-Bitumen	Yes
New Sprayed Foam	No ⁹	Cementitious Wood Fiber	Yes	Smooth Modified-Bitumen	Yes
Scarified SPF	No ⁹	Plywood/OSB	Yes	Coal Tar Pitch	Yes ⁶
DensDeck®	Yes	Painted Steel	Yes	Aluminum-Coated BUR	No ⁷
Securock®	Yes	Galvanized Steel	Yes ³	Acrylic-Coated SPF	No ⁸

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Oriented Strand Board	Yes	Acoustical Steel	Yes ⁴	Silicone-Coated SPF	No ⁸
Poly ISO 1HD	Yes	Wood Plank	Yes	Unoxidized (Shiny) Asphalt	Yes ¹⁰

1. Standard TPO (Non Fleece Back) membrane cannot be installed directly over EPS and requires a suitable overlayment or cover board.
 2. For insulation attachment only, contact Mule-Hide Technical Department for options.
 3. For new galvanized steel decks, power-washing is necessary to remove finishing oil residue if present.
 4. For acoustical steel decks, fill the flutes with fiberglass or other suitable fill insulation and tack in place with strips of duct tape 3' OC, or other adhesive, prior to spraying the deck with Helix Max Adhesive.
 5. A minimum of an approved cover board or insulation is required over properly prepared gravel BUR.
 6. An insulation providing the necessary R-value must be specified to prevent the coal tar pitch from softening.
 7. Aluminum coatings must be removed by power-washing or by physical abrasion prior to the application of Helix Max Adhesive. Adhesion tests are required to confirm sufficient preparation of the substrate.
 8. SPF roofing assemblies may be considered on a job by job basis, contact Mule Hide Technical Department prior to bidding.
 9. Contact Mule-Hide for specific requirements on recover applications over Aged Hypalon, or Aged (min 5-years) TPO membrane.
 10. Requires AeroWeb for all applications.
 11. Cellular or air-entrained lightweight substrates are acceptable. Lightweight concrete containing expanded aggregate such as perlite or vermiculite is not acceptable. New lightweight concrete must be confirmed by the contractor to be thoroughly dry. Existing substrates will require adhesion tests.
- F. For reroofing projects having plywood decks, a minimum of one layer of an approved insulation is required after the tear-off has been completed.
- G. Mule-Hide recommends that all roof surfaces have a positive slope to provide adequate drainage. There should not be any ponding water 48 hours after a rainfall.

3.03 Preparation of Existing Substrate

A. General

1. To prevent delays or interruptions, coordinate work with other trades or suppliers to ensure that components to be incorporated into the Fully Adhered Mule-Hide TPO Membrane Roofing System are available as the work progresses. Examine substrates to which the roofing materials are to be applied to ensure that their condition is satisfactory for the Mule-Hide TPO Membrane Roofing System application.
2. Do not permit voids greater than 1/4" wide in the substrate. Concrete substrates shall be cured and free of laitance and curing compounds. Substrates for roofing materials shall be dry and free of oil, dirt, grease, sharp edges and debris. Inspect substrates and correct defects before application of roofing membrane.
3. Specifier or roofing contractor shall determine the condition of the existing roof deck and roofing system. Areas with deteriorated decking, wet insulation or other failed materials shall have those affected materials removed and replaced. Make sure all decking is securely fastened. The roofing contractor has the final responsibility to ensure an acceptable deck is provided to receive the new roof system.
4. Large blisters shall be cut and patched to provide a reasonably level surface.
5. On recover projects, tear off all existing base flashings, cant strips and projection flashings down to the substrate. The flashing substrate shall be dry and free of oil, dirt, grease, sharp edges and debris.
6. Gravel over existing nailers must be totally removed prior to installing new nailers and flashings. Verify that the existing nailers are in good condition and securely anchored to the roof decks.
7. When an additional thickness of insulation is being added, new nailers must be added over existing nailers to match the height of the new insulation. Nailers must be securely anchored to the roof deck per Section 3.05 of this specification.

8. All roof surfaces shall be free of ponded water, ice, or snow. Significant ponding that remains after a period of 48 hours should be eliminated by either installing tapered insulation to create positive drainage of the roof surface or by installing new drains in the low areas where the ponding remains. Positive drainage shall also eliminate the possibility of excessive live loads caused by ponding water that could cause structural damage or failure.
9. When removing an existing roof during reroofing, remove only that amount of roofing and flashing that can be made watertight with new Mule-Hide TPO materials in a one-day period or prior to the onset of inclement weather.
10. Recovering over a gravel surfaced BUR system requires the installation of an acceptable insulation. Loose gravel must be removed prior to mechanically attaching a new layer of insulation. All lead pipe and drain flashings shall be removed.
11. Recovering over a smooth surfaced BUR and smooth Modified Bitumen roofing systems shall require the installation of an acceptable insulation. All lead pipe and drain flashings shall be removed. Single-ply membranes such as EPDM, Hypalon, PVC or CPA must have all existing flashings removed, the field sheet must be cut up into sections no larger than 10' by 10' and an acceptable layer of insulation shall be mechanically attached over the existing field membrane.
12. Polyurethane Foam roofing systems ("PUF") are not acceptable for recover applications. The PUF system must be completely removed and new insulation installed prior to the installation of the new TPO Roofing System.
13. If a Mule-Hide Premium System Warranty is requested, the existing roof system **must be removed to the deck** prior to the installation of the new roofing system or a moisture survey by an independent third party must be taken, all wet areas removed and a copy of the survey submitted to Mule-Hide with the warranty application. In no event shall the Mule-Hide Premium System warranty cover the existing roof system or problems created by the existing roof system.

3.04 Vapor Retarder Installation (where specified)

- A. Specific climatic and job conditions may require the use of a vapor retarder. It is the sole responsibility of the design professional to determine the need for a vapor retarder (which may be required by local building or energy codes) and its type and location in the roofing system. A vapor retarder may often act as an "air barrier" which may have a positive effect in reducing internal air pressure. Vapor retarders should be strongly considered for buildings subject to high internal air pressures such as airplane hangars and buildings with many loading bays such as warehouse facilities.
- B. The National Roofing Contractors Association recommends the installation of vapor retarders when interior relative humidity is 45% or greater and the outside mean average January temperature is below 40° F.
- C. Install a vapor retarder over a suitable substrate with all side and end laps and all penetrations sealed in accordance with the manufacturer's instructions. The vapor retarder may be loosely laid or adhered with the manufacturer's recommended adhesive.
- D. In reroofing where the existing built-up roof is to remain, the built-up roof may be an adequate vapor retarder as long as all splits or tears are repaired in order to provide a total barrier to vapor penetration.
- E. Projects utilizing Mule-Hide's F5 Air & Vapor Retarder must follow Mule-Hide's installation instructions and details for the F5 Air & Vapor Retarder.

3.05 Wood Nailers

- A. Wood nailers are required at all roof perimeter edges where metal edging and gutter systems are specified or where indicated in Mule-Hide's published Standard TPO Details.
- B. Nailers shall be firmly anchored to the decks at a maximum 2'-0" OC and shall resist a pullout force of 200 lbs./linear foot in any direction. A 1/2" vent space shall be provided between adjacent lengths of nailers. Fasteners shall be installed within 6 inches of each end. Spacing and fastener embedment shall conform to Factory Mutual Loss Prevention Data Sheet 1-49.
- C. Height of nailers shall match the surface level of the insulation and roof membrane. The width of the wood nailer shall extend beyond the metal flange to prevent damage to the membrane.
- D. All woodwork to be reused shall resist a minimum force of 200 lbs./linear foot in any direction and shall be free of rot.
- E. Wood nailers with creosote and asphaltic preservatives are not acceptable. Pressure treated lumber is not required on new construction unless specified by the architect.

3.06 Insulation Installation

- A. General
 - 1. Mule-Hide accepted roof insulations shall be installed in accordance with Mule-Hide specifications.
 - 2. Mule-Hide accepted roof insulations shall be secured to the roof deck in accordance with Mule-Hide's requirements.
 - 3. All roof insulation shall be neatly cut to fit around all penetrations and projections with a maximum allowable gap of 1/4-inch.
 - 4. Open joints shall be repaired with like insulation material.
 - 5. Insulation shall be feathered or tapered to provide a minimum sump area of 36" x 36" where possible at all drains. Crickets and saddles may be installed beneath the specified insulation where possible. Crickets and saddles made from non-compatible insulations materials must be overlaid with an acceptable insulation or underlayment.
 - 6. Install no more roof insulation in one day than can be covered with the Mule-Hide TPO Membrane or when the onset of inclement weather is anticipated.
 - 7. Insulation installed over steel decks shall be checked so that no edges are left unsupported along the flutes. All insulations shall be of sufficient thickness and density to prevent breakage under normal roof construction traffic.
 - 8. When installing insulation, the end joints of each row of insulation shall be offset against the previous row. When more than one layer of insulation is to be used, succeeding layers are to be laid staggered in relation to the previous layer of insulation and all joints shall be offset.
 - 9. When a Mule-Hide Premium System Warranty is requested, only Mule-Hide labeled insulation may be used unless written approval is obtained, prior to job bid, for an alternative insulation.
 - 10. Insulation other than Mule-Hide labeled insulation must be an FM approved insulation and approved by Mule-Hide for use under the Mule-Hide Fully Adhered TPO Roofing System. Refer to the insulation manufacturers guidelines for the appropriate type, size and thickness of the insulation

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needed for use over the respective substrate and under the Mule-Hide TPO Roofing System. Contact Mule-Hide Technical Department prior to bidding the project to determine approved insulations and assemblies.

B. Mechanical Attachment

1. Insulation fastening density will vary based on insulation type, thickness, and required warranty.
2. For code compliance, increased fastening density may be required depending upon project wind speed and wind uplift requirement.
3. Mule-Hide's minimum attachment rates shall be as follows:

Insulation Type or Overlay	Fasteners per 4' x 8' board		
	Field	Perimeter	Corner
Approved Polyisocyanurate - Min 2" thick (top layer)	8	12	16
Approved Polyisocyanurate - Min 1.5" up to 2" thick	12	18	24
Approved Polyisocyanurate - Min 1.0" up to 1.5" thick	16	24	32
½" HD Poly-Iso - Installed over Approved Insulation	16	24	32
HD Fiberboard - Min 1/2" thick- Installed over Approved Insulation	16	24	32
Dens Deck Prime or Securock - Min 1/4" thick - Installed over Approved Insulation	12	18	24
OSB - Min 7/16" thick - Installed over Approved Insulation	17	25	32
Approved OSB/Polyisocyanurate Composite - Min 2" thick	17	25	32

Contact Mule-Hide's Technical Department for FM approvals and required attachment rates that are determined by deck type, insulation brand, type and thickness. When using multiple layers of insulation or more than one type of insulation, the number of fasteners required per board is determined by the top layer of insulation.

4. Perimeter enhancements

To meet increased uplift requirements in the perimeters and corners of each roof area, additional insulation attachment provisions must be installed as follows:

- a. The minimum width of the perimeter and corner areas shall not be less than eight (8) feet.
- b. See Details MHT-UN-108A and MHT-UN-108B
- c. **Perimeters** – insulation attachment to be increased 50% over the field attachment requirements with a maximum of one (1) fastener every one (1) square feet.
- d. **Corners** – insulation attachment to be increased 100% over the field attachment requirements with a maximum of one (1) fastener every one (1) square feet.
- e. For Factory Mutual projects, the width of the roof perimeter and corner areas is defined as the smaller of 0.1 times the building lesser plan dimension or 0.4 times the eave height (mean roof height for slopes greater than 2"/12" slope), except for heights greater than 60 ft. The minimum width of the perimeter and corner areas shall not be less than three (3) feet. Contact Mule-Hide Technical Department for Factory Mutual projects exceeding 60 ft. heights.

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C. Adhesive Attachment

Adhesive attachment substrate preparation

1. The surface to which adhesive is to be applied shall be dry, clean and free of fins, protrusions, sharp edges, loose and foreign materials, oil and grease. Depressions greater than 1/4" (6 mm) shall be filled with Helix Max Adhesive or other approved patching material. All sharp projections shall be removed. Previously unoxidized (shiny) asphalt must be primed with AeroWeb.
2. Seal gaps between the wall/penetration and concrete deck with Mule-Hide F5 Air & Vapor Barrier, FROTH-PAK, or other suitable material, to avoid condensation issues and positive pressure from air infiltration.
3. Apply Helix Max Adhesive when the substrate and ambient temperatures are 25°F (-4°C) or above when spraying or extruding with heated or non-heated equipment. Dispense the adhesive between 300-800 psi depending on the equipment used. Consult Mule-Hide Technical Department for more details.

Adhesive installation

1. Apply Helix Max Adhesive to the substrate.
 - a. For fully adhered applications, spray adhesive to obtain full coverage (approx. 1/8" to 1/4" thick after foaming).
 - b. For bead applications, apply adhesive at 4", 6", or 12" on center with a **minimum 1/2" wide wet bead**. For steel decks, bead attachment of Helix Max Adhesive must run parallel with and be on top of the steel deck flutes.

Bead Spacing Requirements*				
Building Height	Perimeter Width	Bead Spacing		
		Field	Perimeter	Corner
0-25'	4 Feet	12" OC	6" OC	6" OC
26'-49'	8 Feet	12" OC	6" OC	6" OC
50'-74'	12 Feet	12" OC	6" OC	6" OC
75'-100'	16 Feet	12" OC	6" OC	6" OC
101' or greater	Contact Mule-Hide Technical Department			

*Spacing parameters are for 10, or 15-year 55-mph warranties: (Contact the Mule-Hide Technical Department for bead spacing on higher mph warranties or 20 and 30-year warranty projects).

2. Factory Mutual bead spacing guidelines in the perimeter and corner may differ from the table above. Beads at 12" OC are not acceptable at perimeters and corners.
3. Allow adhesive to rise and develop "string/body" (approx. 1-1/2 - 2 min.). String time will vary based on environmental conditions like temperature and humidity. Do not allow the adhesive to over-cure (lose tack) prior to setting insulation boards.
4. Place insulation boards (maximum 4' x 4'. Cover boards such as DensDeck Prime or Securock may be 4' x 8') into adhesive after allowing it to rise and develop "string/body".
5. Designate one person to walk boards into place and then roll the boards between 5-7 minutes from the initial adhesive application. Boards may be temporarily weighted or relief-cut where necessary to keep the boards in constant contact with the adhesive until the adhesive cures.
6. At the beginning of the insulation attachment process and periodically throughout the day, check the adhesion of boards to ensure a tight bond is created and maximum contact is achieved.

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CAUTION: Gaps between horizontal and vertical surfaces of the roof area as well as gaps around penetrations must be sealed to prevent interior warm air from infiltrating and condensing within the roofing assembly. Condensing moisture could weaken bottom insulation facer and eventually result in dislodgement or loose boards when adhesive is used.

NOTE: Projects utilizing Mule-Hide's F5 Air & Vapor Barrier must comply with Mule-Hide's installation requirements and published details.

3.07 Membrane Installation

General – Unroll the Mule-Hide TPO Membrane and position without stretching. Allow the membrane to relax at least 15 minutes when the temperature is above 60°F, or 30 minutes when the temperature is below 60°F, prior to installation. Inspect and remove any damaged membrane.

- A. Membrane should run perpendicular to the direction of steel deck flutes and orientation of wood decks where possible.
- B. All membrane overlaps shall be installed to facilitate the flow of water. Seams shall be shingled or run parallel to the flow of water. Backwater seams are not permitted.
- C. Lap sheets a minimum of 3 inches to provide space for a continuous, minimum 1-1/2" weld. Membrane overlaps shall be shingled with the flow of water or parallel to the flow of water. All welded field seams shall be a minimum of 2 inches wide. End laps shall be overlapped a minimum of 3 inches.
- D. The roofing contractor shall check all welded seams for continuity and integrity using a cotter pin puller or other suitable blunt object. The contractor shall make sample test seams each day prior to welding field seams. The contractor shall, using scrap material, run at least two test seams, each a minimum of 2' long. Each test seam shall be used to determine adequate seam strength and to ensure the equipment has warmed up, is operating properly and proper settings have been determined. This should be done each time the equipment is turned on after a cool down period.
- E. Perimeter - When installing the Mule-Hide Fully Adhered TPO Roofing membrane system, it is not necessary to install Half Sheets parallel with the perimeter. Full size sheets should be used everywhere practical to minimize the number of field seams. In place of Half Sheets, additional fasteners are installed in the insulation in the perimeter areas as defined in 3.06.B Perimeter Enhancements. Weld all laps (seams and end laps) continuously with a minimum weld width of 2 inches. All field welds shall be completed with an automatic welder. Perimeter areas shall be determined by one of the following methods:
 1. Mule-Hide Technical Bulletin TPO-FA01-2006, Standard Fastening Patterns and Guidelines. Mule-Hide defines the minimum perimeter area as 8' in from the roof edge along all exterior roof edges.
 2. For Factory Mutual insured buildings, follow guidelines in FM's Loss Prevention Data Sheet 1-29. Contact Mule-Hide Warranty Department for fastener spacing for compliance with FM 1-60 and 1-90 requirements.

3.08 Field Sheet Attachment

Adhesive Options for TPO Adhered Systems

Adhesive*	Single Sided (Wet Lay)	Double Sided (Contact)
TPO Bonding Adhesive	No	Yes
Low-VOC Bonding Adhesive	No	Yes
Low-VOC 1168 Bonding Adhesive	No	Yes
Aqua Base 120	No	Yes

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AeroWeb Low-VOC Aerosol Contact Adhesive	No	Yes
*Refer to Product Data Sheets for specific installation instructions related to each adhesive option.		

A. General

1. Position membrane over substrate with minimum 3" overlap at lap seams, and positioned so that laps will shed water. Allow the membrane to relax at least 15 minutes prior to fastening when temperatures are 60° F and above or 30 minutes when temperatures are below 60° F. After membrane has relaxed, fold membrane in half lengthwise exposing the underside of the sheet. Pails of adhesive are often used to weight the back edge of the membrane to hold it in position.
CAUTION: Keep the protective packaging of the Mule-Hide Heat-Weld Membrane intact until ready to use.

B. TPO Bonding Adhesive, Low VOC Bonding Adhesive, Low VOC Bonding Adhesive - 1168 (solvent base), and Aqua Base 120 Bonding Adhesive

1. Mix adhesive scraping the sides and bottom of the can (minimum of 5 minutes is required) until adhesive is uniform in color. Consult Product Data Sheet for adhesive instructions.
 - a. Low VOC Bonding Adhesive and Low VOC Bonding Adhesive – 1168 require mechanical stirring (electric drill), both initially and periodically during application.
2. Using a plastic core, medium nap roller, apply a smooth even coat of TPO Bonding Adhesive to back side of membrane and substrate (no globs or puddles). A nine inch roller will easily fit into a 5-gallon adhesive container. **Do not apply adhesive in area of seam laps.**
3. Coverage rates for TPO Bonding Adhesive, Low VOC Bonding Adhesive, and 1168 are approximately:

120 square feet per gallon for one surface (membrane or substrate only) or
60 square feet per gallon per finished surface (membrane & substrate)
4. Coverage rate for Aqua Base 120 is approximately:

100-120 square feet per gallon per finished surface (membrane & substrate)
5. Allow adhesive to dry to a 'tacky' state. Test adhesive by placing a knuckle into it and turning your wrist a one-quarter turn. Adhesive is ready to mate when it is tacky but does not string when knuckle is lifted (Aqua base 120 will take a longer time to dry).
6. Care must be taken to ensure proper drying. Avoid thin areas of adhesive which can result in over drying and improper adhesion.
7. Roll coated membrane onto substrate being careful to not wrinkle the sheet or trap air bubbles. Once membrane is mated to the substrate, thoroughly broom into place with a stiff bristled push broom to ensure proper contact and 100% adhesion. Repeat this procedure for remaining sheets.

C. AeroWeb

1. Connect spray gun to hose and connect hose to cylinder. Use lithium grease or petroleum jelly on all fittings and be careful to avoid cross-threading. Open valve on cylinder to check fittings for leaks. Keep cylinder valve open to maintain pressure in the hose/spray gun when not in use.
2. AeroWeb can be applied at ambient temperature of 25°F and above. Propellant in cylinders must be kept above 70°F for the product to spray properly. Utilize power-heated blanket, and hot boxes when

- necessary. Substrate shall be clean, dry, and free of debris and contaminants.
3. Application shall be continuous and uniform, avoiding globs or puddles.
 4. Spray substrate and back of the membrane with enough overlap to ensure 100% coverage (2"-3" of overlap).
 5. Do not apply adhesive to splice areas.
 6. Roll coated membrane onto substrate being careful to not wrinkle the sheet or trap air bubbles. Once membrane is mated to the substrate, thoroughly broom into place with a stiff bristled push broom to ensure proper contact and 100% adhesion. Repeat this procedure for remaining sheets.
- D. Extended drying times can be expected during cool, overcast, humid, shaded, or late day applications. The adhesive must be dry (but still tacky) before mating surfaces to avoid permanent blisters due to trapped moisture. Repeat this procedure for the second half of the sheet and each successive sheet of membrane on the roof, remembering to shingle all laps.
- E. Do not run any seams through field drains or sumps. Any seams running through drains shall be cut out and target patches (36" x 36") shall be installed.

3.09 Welding of Lap Areas

A. General

1. Roofing membrane is to be hot air welded only. Seaming of "membrane to membrane" and "flashing/detail membrane to membrane" shall be by hot air welding only.
2. All surfaces to be welded shall be clean and dry.

B. Hot Air Welding

1. Machines for hot air welding are available from several different sources. Each manufacturer's instructions for use shall be followed, as well as all local codes regarding electric grounding, supply and other related functions. Since most automatic welding machines require 218 to 230 volts, the use of a portable generator on the roof is recommended for greater flexibility. **Mule-Hide requires the use of automatic welding machines for all field sheet seaming. Hand welding is only acceptable for flashings and those seams where the automatic welder cannot be used.**
2. Hand-held welding equipment is also available to weld membrane. After the preheated nozzle tip is applied in the overlap area and the material starts to soften, immediately follow with a silicone hand roller to press the heated membrane surfaces together with slow, even movements. Keep the roller within 1 inch of the nozzle tip. Angle the hot air tool so that the flowing air faces the roller. Seam strength may be tested when cool. For best results, testing seams 8 hours after hot air welding is recommended.

C. "T" Joint Covers

1. **For 45-mil membrane and maximum warranty length of 15-years.** Pay special attention to the "T" lap seams formed where three layers of membrane overlap at a seam. To ensure proper seaming of the "T" joints, the top layer of the Heat-Weld Membrane is creased a minimum of one inch into the lower layer of membrane by using a heat gun with a narrow or pencil tip nozzle and a rubber hand roller. By inserting a heat gun nozzle between the layers of the membrane, the membrane will soften and begin to flow allowing it to crease and seal completely after applying pressure with a hand roller to ensure adequate bonding of the softened material. After heat-sealing the "T" joint, Edge Sealant must be applied on all cut edges of reinforced membrane. See detail MHT-UN-105A.

2. **For membrane thickness greater than 45-mil or warranty length greater than 15-years.** Separate "T" joint patches are required over all "T" joints. See detail MHT-UN-105B

D. Seam Patches at Roof/Wall Transitions

1. Mule-Hide requires the installation of Non-Reinforced TPO Flashing Membrane patches over any seam that transitions from the horizontal to the vertical. These patches are to be constructed with Non-Reinforced TPO Flashing Membrane only and hot air welded. Refer to Mule-Hide Detail MHT-UN-105C

E. Daily Welding Equipment Setup

1. The roofing contractor shall make sample test seams each day prior to welding field seams. The contractor shall, using scrap material, run at least two test seams, each a minimum of 2 feet long. Each test seam shall be used to determine adequate seam strength and to ensure the equipment has warmed up, is operating properly and proper settings have been determined. This should be done each time the equipment is turned on after a cool down period.

F. Quality Control of Seams

1. After seaming, the seams are checked for integrity with a probe. Any openings or "fishmouths" are to be repaired with a hand-held hot air tool fitted with a narrow nozzle tip and with a roller. Each day the contractor shall attempt to pull apart several sections of welded seams to test the quality of the welds. Should the welds be deficient, a more thorough examination of the work performed must be carried out and necessary repairs made.

3.10 Additional Membrane Securement (Base Attachment)

- A. Additional securement of the TPO membrane by mechanical attachment must be provided at the perimeter of each roof level, base of walls, curbs, skylights, expansion joints, tie-ins, interior walls, bottom of valleys and any angle changes that exceed inclines of 2:12 (2" rise in 12") and various penetrations as shown in the Mule-Hide Standard Details. All securement must be either horizontally to the roof deck or vertically to the base of the various penetrations as shown in the Mule-Hide Standard Details.
- B. The mechanical attachment of the membrane may be achieved by the following methods:
 1. 2.4" Seam Plate and appropriate fasteners through the membrane
 - a. The 2.4" Seam Plate and appropriate fasteners are placed with the edge of the Seam Plate approximately ½" away from the angle change. Seam Plates may be placed either horizontally or vertically depending on the conditions encountered. Refer to the Mule-Hide TPO Standard Details for proper placement.
 2. Mule-Hide All Purpose Bar
 - a. The Mule-Hide All Purpose Bar is a specially extruded aluminum bar that has pre-punched holes 6 inches on center. Bar may be placed either horizontally or vertically depending on the detail followed. Refer to the Mule-Hide TPO Standard Details for the proper placement. Refer to Mule-Hide Detail # MHT-UN-330 for appropriate placement of the All Purpose Bar.
 - b. The maximum spacing of the fasteners shall not exceed 12 inches on center. Adjoining bars should be spaced approximately ½ inch to 1 inch apart. All bars must be attached at the ends a maximum of 1 inch from the end of each bar. This may require pre-drilling additional holes. All cut bars shall be deburred.
 - c. Under no circumstances shall the All Purpose Bar be stripped-in with TPO PS Cover Strip. TPO

- .045 Reinforced 6" X 100' product may be used to strip-in the All Purpose Bar with a continuous, minimum of 1-1/2" (40 mm) wide weld.
- d. The All Purpose Bar must be installed a minimum of 3 inches to a maximum of 6 inches from inside and outside corners.
3. TPO PS RUSS attachment strip
 - a. The RUSS is a 6" wide reinforced strip of TPO membrane that may be installed at the base of walls and curbs. Mule-Hide 2.4 inch Seam Plates are used to attach the RUSS horizontally with appropriate fasteners. Refer to Mule-Hide Detail # MHT-UN-305B for appropriate placement of the RUSS, plates and fasteners. The RUSS attachment strip is installed prior to the placement of the field sheet. The RUSS attachment strip is to be placed on horizontal surfaces only and not turned up the vertical.
 - b. Follow the standard procedures for cleaning, applying primer and adhering the RUSS and field sheet. Only Mule-Hide TPO Primer or Low VOC Primer may be used to adhere the RUSS to the field sheet. Bonding Adhesive is **not permitted** for use with the RUSS attachment strips.
 - c. Spacing of the fasteners shall not exceed 12 inches on center. Adjoining RUSS attachment strips shall be spaced a maximum of 1 inch apart. It is not required to overlap the RUSS.
 - d. For horizontal attachment, the RUSS attachment strip must be placed a maximum of 1/2 inch from the base of the angle change extending out onto the horizontal surface (roof substrate). The 2.4 inch Seam Plate must be placed a minimum of 1/2 inch to a maximum of 1 inch from the exterior edge of the strip. Refer to Mule-Hide Detail # MHT-UN-305B. Installation of the plates must be a minimum of 6 inches to a maximum of 9 inches from the inside and outside corners.
 4. Drip Apron and Gravel Stop
 - a. For drip aprons and gravel stops, the metal flange shall extend a minimum of 3 inches onto the wood nailer. The wood nailer must be wider than the metal flange. Approved screw fasteners shall be installed a maximum of 6 inches on center and 1/2" to 3/4" from the inside edge of the metal flange. Ring shank nails spaced a maximum of 4" on center may also be used.
 - b. Drip aprons and gravel stops not made out of TPO Coated Metal shall be primed with Mule-Hide's TPO Primer or Low VOC Primer and stripped with Mule-Hide's TPO PS Cover Strip. Cleaning the metal with a solvent such as toluene or xylene to remove oil film may be required prior to installing and priming with the TPO Primer. Refer to Mule-Hide detail # MHT-UN-106B.

3.11 Flashing Installation

A. TPO Membrane Flashings

1. All membrane flashings are to be installed concurrently with the roof membrane as the project progresses. Temporary flashings are not allowed without prior written approval from the Mule-Hide Technical Department. Should any water penetrate the new roofing because of incomplete flashings, the affected areas shall be removed and replaced at the contractor's expense.
2. All surfaces to be fully adhered should be compatible, dry and smooth with no excessive surface roughness.
3. On recover projects, tear off all existing base flashings, cant strips and projection flashings down to the substrate. If deteriorated areas of substrate are uncovered, repairs must be made to provide a suitable substrate for the new TPO flashings.

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B. Adhesive options for wall flashings (Standard TPO only)

Adhesive*	Single Sided (Wet Lay)	Double Sided (Contact)
TPO Bonding Adhesive	No	Yes
Low-VOC Bonding Adhesive	No	Yes
Low-VOC 1168 Bonding Adhesive	No	Yes
Aqua Base 120	No	Yes
AeroWeb Low-VOC Aerosol Contact Adhesive	No	Yes
*Refer to Product Data Sheets for specific installation instructions related to each adhesive option.		

C. Double Sided Contact Application

- a. Refer to Section 3.08 C for AeroWeb application instructions.
- b. Mix adhesive scraping the sides and bottom of the can (minimum 5 minutes is required) until adhesive is uniform in color. Consult product data sheet for adhesive instructions.
- c. Low VOC Bonding Adhesive and Low VOC Bonding Adhesive – 1168 require mechanical stirring (electric drill), both initially and periodically during application.
- d. Porous surfaces and substrates may require the application of a prime coat and second coat of Low VOC Bonding Adhesive and Low VOC Bonding Adhesive – 1168 to accomplish proper adhesion.
- e. Using a plastic core, medium nap roller, apply a smooth even coat of TPO Bonding Adhesive to back side of membrane and substrate (no globs or puddles). A nine inch roller will easily fit into a 5-gallon adhesive container. **Do not apply adhesive in area of seam laps.**
- f. Allow adhesive to dry to a 'tacky' state. Test adhesive by placing a knuckle into it and turning your wrist a one-quarter turn. Adhesive is ready to mate when it is tacky but does not string when knuckle is lifted.
- g. Care must be taken to ensure proper drying. Avoid thin layers of adhesive which can result in over drying and improper adhesion.
- h. Roll coated membrane onto substrate being careful to not wrinkle the sheet or trap air bubbles. Once membrane is mated to the substrate, carefully roll the membrane with a 2-inch wide rubber hand roller to promote maximum positive contact between the membrane and the substrate.
- i. **Areas of the flashings and membrane to be welded are not to have TPO Bonding Adhesive applied to them.**
- j. Extended drying times can be expected during cool, overcast, humid, shaded, or late day applications. The adhesive must be dry (but still tacky) before mating surfaces to avoid permanent blisters due to trapped solvents.
- k. All flashings shall be extended a minimum of 8 inches above roof membrane level and be terminated unless previously accepted by the owner or his representative and the Mule-Hide Technical Department. All flashings shall be hot air welded at their connections with the roofing membrane. Apply Cut Edge Sealant at all welded edges of cut membrane flashings. Refer to Mule-Hide TPO Standard Details for more information.
 1. All flashings shall be hot air welded at their connections with the roofing membrane. All hand welds shall be a minimum of 1-1/2" wide.
 2. All flashings shall be properly terminated according to Mule-Hide's published Standard Details.

NOTE: When using Mule-Hide All-Purpose Bar under Counterflashing to terminate wall flashing or when coping is used, TPO Bonding Adhesive, Low VOC Bonding Adhesive, Low VOC Bonding Adhesive – 1168, Aqua Base 120 Bonding Adhesive, or AeroWeb may be eliminated when flashing height is 12" - 18" or less, depending on the type of termination. Refer to Mule-Hide's published Standard TPO Details for additional information.

3.12 Drains, Expansion Joints, Pitch Pans

A. Roof Drains

1. Prepare the surface around each drain to prevent any distortion, tenting, or bridging of the membrane. A smooth transition shall be provided from the roof surface to the surface of the drain bowl/clamping ring.
2. All existing roofing materials and metal flashings shall be removed.
3. Mule-Hide requires the application of one full tube of Water Cut-Off Mastic per drain applied to the drain bowl, under the membrane, where the clamping ring will be seated. This will provide a continuous seal between the membrane and the drain bowl.
4. Do not run field seams through drains or sumps. If sheet layout causes a seam to fall in line with a drain, a target patch (minimum 36" x 36") shall be required.

B. Expansion Joints

1. Refer to Mule-Hide's published Standard TPO Details for application methods for flashing expansion joints.

C. Pitch Pans

1. Install and flash pitch pans as indicated in Mule-Hide's published Standard TPO Details. All pitch pans shall be filled with Thermoplastic Pourable Sealant.

3.13 Walkway Installation

Walkways should be provided in areas where routine rooftop maintenance occurs and in areas where regular rooftop traffic is expected.

A. TPO Walkway Roll Installation

1. Install TPO Walkway Rolls over clean, dry surfaces.
2. Layout areas where TPO Walkway Rolls are to be installed with most of the material being oriented so that it is placed between field seams with each adjacent and abutting section gapped a minimum of 6". Do not install walkway pads over seams.
3. Heat weld the perimeter of the properly positioned TPO Walkway Roll. Check seams for any voids or inconsistencies that might prevent watertightness.

B. Precast Pavers

1. Install precast paver systems acceptable to Mule-Hide over one layer of 6 oz. HP Protection Mat. Contact Mule-Hide for other acceptable slipsheets.

3.14 Temporary Tie-ins

- A. Install temporary cutoffs around incomplete edges of roofing assembly at the end of each day's work and when work must be postponed due to inclement weather. Temporary tie-ins shall be positioned so any sealed membrane edge will not buck or pond water. Ensure drainage is not restricted.
- B. Remove all gravel, dirt, debris or other contaminants from the tie-in area and make sure all surfaces are clean and dry.
- C. All loose membrane edges should be sealed downslope with products compatible with the existing substrate and membrane type being installed. Provide continuous pressure along the sealed edge to prevent water migration under the finished roof sections.
- D. When work resumes, remove the temporary seals completely including contaminated membrane, sealants, insulation fillers, etc. from the work area and properly dispose.

Note: Mule-Hide does not warrant or guarantee the water tightness of any nightly tie-in. Temporary night seals and their performance are the sole responsibility of the roofing contractor.

End of Section

This specification represents the applicable information available at the time of its publication. Mule-Hide reserves the right to change this information at any time. Contact Mule-Hide Technical Department or check the Mule-Hide website (www.mulehide.com) for the latest updates regarding changes or modifications to this specification.