

MULE-HIDE PRODUCTS CO., INC.
MECHANICALLY ATTACHED TPO SYSTEM SPECIFICATION

07540/MUL

PART 1 - GENERAL

1.01 Description

A. Scope:

1. Furnish and install a Mechanically Attached Mule-Hide Reinforced TPO Roofing Membrane with flashings and accessories necessary to comprise a roofing system. This system utilizes a 45-mil (.045 inch), 60-mil (.060 inch) or 80-mil (.080 inch) thick scrim reinforced membrane. 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.

1.02 Quality Assurance

- A. The Mule-Hide Reinforced TPO Membrane Roofing System shall be installed by an independent roofing contractor eligible to apply for Mule-Hide "System Warranties" when Standard System or Premium System Warranties are requested.
- B. There shall be no deviations from this specification or the Mule-Hide Products Co. ("Mule-Hide") standard details without prior written approval from Mule-Hide's Warranty 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 and 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 to ascertain 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 "Membrane (Material) Warranty" is requested. The sole purpose of an inspection by a Mule-Hide Representative is not intended 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 warranty may be offered for the project.

1.03 Submittals

- A. Prior to the time of bidding, the roofing contractor shall submit to the Building Owner/Owner's representative the following items:
1. Copies of Mule-Hide's specification 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 (if requested by the Building Owner) but not limited to the following:
 - 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 Warranty 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 (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.
- 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. Mule-Hide TPO roofing materials may be installed in temperatures below 40° F but only

after consultation with the Mule-Hide Customer Service Department as special precautions or procedures may be necessary. The performance of the materials, installation costs and production rates may be affected.

- B. Only as much new roofing as can be made watertight each day shall be installed each day. This includes all flashing work.
- C. 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 materials.
- D. Prior to and during application, all dirt, debris and dust shall be removed from surfaces to be roofed for both new and reroofing substrates.
- E. On all reroofing projects and for all lightweight deck systems, pullout tests shall be performed by the independent roofing contractor, fastener manufacturer or owner's representative to verify the condition of the deck or substrate and to confirm system design pullout values. A minimum of 10 pullout tests for areas up to 500 squares, thereafter 2 tests per 100 squares is considered sufficient. Tests should be taken approximately 60% in perimeters and 40% from field areas. Additional tests shall be performed in areas where the integrity of the deck is questionable. A written report of pullout test results shall be submitted to Mule-Hide's Warranty Department for review.
- F. Precautions shall be taken to prevent wind blow-off or wind damage during the course of the roofing application. This may necessitate additional securement of temporary construction, materials and equipment.
- G. 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 Warranty Department in writing.
- H. Temporary waterstops shall be installed at the end of each day's work. Temporary waterstops shall be removed at the start of the next day's work and properly disposed. Waterstops shall be compatible with all materials.
- I. Do not allow contaminants such as petroleum, acid, solvents, etc. or direct steam venting to come into direct contact with the Mule-Hide TPO Roofing Membrane. Contact the Mule-Hide Customer Service Department for recommendations if such conditions exist.
- J. 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 Customer Service Department for special installation requirements.
- K. The contractor shall follow and comply with all safety regulations as recommended by OSHA.
- L. 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.
- M. 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, wood fiberboard or polyester felt protection to prevent damage. All damaged material shall be replaced with new materials.
- N. 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.

- O. Any unusual or concealed conditions discovered during the course of the work are to be reported to the owner and Mule-Hide immediately in writing. Work is to be halted until the owner has responded with a solution to the problems.
- P. All local building codes and requirements must 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.
- Q. 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.
- R. When using heat-welding equipment, always review the equipment manufacturer's instructions, precautions and warnings.

1.06 Warranties

All Mule-Hide warranties are available for commercial projects. A Roofing Membrane Limited Warranty for a maximum of 10 years is available for residential projects.

A. Mule-Hide's Roofing Membrane Limited Warranty

Mule-Hide offers a 10, 15 or 20-year Roofing Membrane Limited Warranty ("Warranty") for a charge. The Warranty covers only the Mule-Hide TPO 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.

Note: Projects requesting a 20-year Roofing Membrane Limited Warranty require the use of a minimum 60-mil thick TPO membrane and shall incorporate additional design enhancements as outlined in the 20-year Design Enhancements for TPO Mechanically Attached Roofing System Specification. Mule-Hide recommends that Warranty Applications be submitted for review prior to bidding the project.

B. Mule-Hide's Standard System Warranty

Mule-Hide offers a 10, 15 or 20-year Standard System Warranty ("Standard") for commercial projects for a charge. The Standard warranty is a "No Dollar Limit", labor and material warranty that covers the Mule-Hide labeled membrane and other components supplied by Mule-Hide installed by a Mule-Hide Warranty Eligible Applicator. The Standard warranty does not cover insulation or its attachment system. Metal flashing components are not covered under this warranty. A Mule-Hide Warranty Eligible Applicator must submit a Warranty Application and the appropriate fee to Mule-Hide. Standard warranties require inspections by a Mule-Hide representative.

Note: Projects requesting a 20-year Standard System Warranty require the use of a minimum 60-mil thick TPO membrane and shall incorporate additional design enhancements as outlined in the 20-year Design Enhancements for TPO Mechanically Attached Roofing System Specification. Mule-Hide recommends that Warranty Applications be submitted for review prior to bidding the project.

C. Mule-Hide Premium System Warranty

Mule-Hide offers a 10, 15 or 20-year Premium System Warranty ("Premium") for commercial projects for a charge. The Premium warranty is a "No Dollar Limit", labor and material warranty that covers the Mule-Hide labeled membrane, insulation, other components supplied by Mule-Hide and approved products (such as metal flashing, insulation adhesive or other pre-approved accessories) installed by a Mule-Hide Warranty Eligible Applicator. A Mule-Hide Warranty Eligible Applicator must submit a Warranty Application and the appropriate fee to Mule-Hide. Premium warranties require

inspections by a Mule-Hide representative.

Note: Projects requesting a 20-year Premium System Warranty require the use of a minimum 60-mil thick TPO membrane and shall incorporate additional design enhancements as outlined in the 20-year Design Enhancements for TPO Mechanically Attached Roofing System Specification. Mule-Hide recommends that Warranty Applications be submitted for review prior to bidding the project.

- D. Standard and Premium System warranties are not available for residential projects.
- E. TPO tie-ins to built-up (BUR) or any other type of roof system are not covered by Mule-Hide warranties.
- F. Contact Mule-Hide for other extended warranties that may be available.
- G. 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 Mechanically Attached Mule-Hide TPO Membrane Roof System are to be products manufactured or supplied by Mule-Hide Products Co. as specified in the contract documents.
- B. Components other than those supplied or manufactured by Mule-Hide may be submitted for review and acceptance by Mule-Hide's Warranty 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 Warranty 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

- A. Mule-Hide TPO Bonding Adhesive - a solvent-based rubberized adhesive for bonding the Mule-Hide TPO-c Membrane to various vertical substrates and insulation boards. The Mule-Hide TPO Bonding Adhesive is a two-surface contact adhesive applied to both the underside of the membrane and substrate surface. This product may be used with the TPO membrane, flashing membrane and the fleece-backed membrane. This product is compatible with polyisocyanurate and wood fiberboard insulations, fiberglass-faced gypsum panels, concrete, masonry, metal and wood surfaces.
- B. Non-Reinforced TPO Flashing - a non-reinforced, .060-inch thick material used where pre-molded accessories such as pipe boots and pre-molded corners cannot be used.
- C. TPO Universal Corners - .060-inch thick pre-molded, non-reinforced TPO material. Universal style accommodates both inside and outside corners of base and curb flashing.

Heat welds directly to the TPO membrane.

- D. Slipsheets - Mule-Hide offers a variety of slipsheets dependent upon the particulars of an application. Some of these are the following:
 - 1. Seekure Paper - a laminated kraft paper with fiberglass scrim reinforcement.
 - 2. Polyester Mat Protection Material 9 oz. - needle-punched polyester fabric.
- E. Weathered Membrane Cleaner - a clear liquid solvent available in 5 gallon cans, used for cleaning asphalt and dirt from membrane surface.
- F. TPO Pre-Molded Pipe Seal - .060-inch thick molded TPO material. One standard size accommodates most common pipe and conduit sizes from 1" to 6". Stainless steel clamping rings are supplied with each boot.
- G. TPO Coated Metal – 24-gauge, galvanized steel to which is laminated 35-mils (.035" thick) of Mule-Hide TPO Non-Reinforced Flashing used for flashing and edge metal detailing.
- H. 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.
- I. Membrane Fasteners and Discs - Mule-Hide offers a variety of membrane fasteners and discs to meet specific job conditions and substrates.
- J. Thermoplastic One-Part Pourable Sealer - a one-component thermoplastic sealant for use in pitch pockets.
- K. TPO .045 Reinforced 6" X 100' – are used for stripping-in TPO Coated Metal and as cover strips over TPO Coated Metal joints.
- L. TPO Cut-Edge Sealant – A solvent-based, liquid sealant used to seal the cut edge of the Mule-Hide TPO Membrane.
- M. TPO Walkway Rolls – a 1/8-inch thick extruded and embossed TPO membrane available in pads (30" x 50') having a herringbone traction surface. Walkway Rolls may be welded directly to the TPO roofing membrane. Walkway Rolls are available in White and Gray colors.

2.04 Related Materials By Others

- A. Wood Nailers
 - 1. Nailers shall be #2 or better lumber and shall be pressure-treated for rot resistance. Creosote and asphaltic preservatives are not acceptable.
 - 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. Vapor Retarders
 - 1. Vapor retarders shall meet specified code and/or insurance requirements.
 - 2. Vapor retarders shall be compatible with insulation and other accessories.
 - 3. The use and placement of a vapor retarder shall be determined by an architect or

engineer. However, Mule-Hide recommends that a vapor retarder be considered when both of two conditions are anticipated:

- a. The outside average January temperature is below 40° F, and
- b. The expected interior winter relative humidity is 45 percent or greater.

C. Insulation

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 or have an acceptable slipsheet placed between the insulation and the TPO roof membrane.
3. The following insulation boards are acceptable for use in a mechanically attached roofing system when a standard warranty is requested:
 - a. Polyisocyanurate insulations having non-asphaltic or foil facers meeting the physical property requirements of Fed. Spec HH-I-1972 and having a minimum compressive resistance of 18 psi. Thickness minimum is 1.0" or greater as required by insulation manufacturer to span steel deck flutes.
 - b. High Density Wood Fiberboard - may be used as an overlay over other insulations. 1/2-inch thick 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 FM and wind requirements.
 - c. Dens-Deck Board – 1/4", 1/2" or 5/8" thick moisture resistant treated gypsum core that incorporates glass-mat facings on the top and bottom side. The Dens-Deck may be used as a membrane underlayment in conjunction with other Mule-Hide approved insulations for roofing assemblies.
 - 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. Check with 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 insulation thickness shall be as required by insulation manufacturer to span steel deck flutes.
 - f. Perlite – Perlite is not a recommended insulation and may only be used as a filler under an approved insulation. Perlite is not approved for use when applying for a Mule-Hide "Premium System Warranty".
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. The Mule-Hide Products Co., Inc. "Premium System Warranty" requires Mule-Hide Poly ISO 2[®] insulation to be used with the specified roof system. Contact the Mule-Hide Warranty Department for specific requirements.

D. Insulation Adhesive

1. Insta-Stik™ - A single component polyurethane, construction grade, low-rise expanding foam adhesive used for attaching approved insulations to concrete, cellular lightweight insulating concrete, gypsum or cementitious wood fiber decks.
 2. PLIODECK® – A one part urethane low-rise adhesive. Used for attaching approved insulations to concrete, cellular lightweight insulating concrete, gypsum or cementitious wood fiber decks.
 3. OlyBond™ - A dual-component, low-rise, reaction-cure, polyurethane foam spray adhesive system. Used for attaching approved insulations to concrete, cellular lightweight insulating concrete, gypsum or cementitious wood fiber decks.
- E. UL and FM Approved Assemblies

Contact Mule-Hide Warranty 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.

2.05 Precautions

- A. Consult Material Safety Data Sheets and container labels for specific safety instructions prior to use.
- B. Avoid breathing vapors of solvent, sealant and adhesives. Use with adequate ventilation. Avoid prolonged contact of solvents, sealants and adhesives with skin.
- C. Do not use Mule-Hide TPO roofing products near fire or flame.
- D. Do not use open flames for drying of surfaces, sealants, or adhesives.
- E. Do not use oil-based paint on Mule-Hide TPO Coated Metal or membrane. Contact Mule-Hide's Customer Service Department for recommendations.
- F. Do not allow muriatic acid (masonry cleaner) to come in direct contact with the Mule-Hide TPO Membrane or accessory products.

Part 3 - EXECUTION

3.01 General

- A. When installing a Mechanically Attached 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.

3.02 Substrate Conditions

The following general conditions apply to the substrate that will receive a Mechanically Attached Mule-Hide TPO Membrane Roofing System:

- 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 Mechanically Attached Mule-Hide TPO Roofing System. Wet insulation must be removed and replaced. See Single Ply Roofing Institute's guidelines for determining wet insulation.
- C. 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 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.

- D. 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.
- E. It is acceptable to install a Mechanically Attached Mule-Hide TPO Membrane Roofing System over the following deck substrates in new construction, provided that an acceptable insulation or an appropriate slipsheet is installed over the substrate as needed:
 - 1. Structural Metal Deck (24 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. Plywood (15/32" minimum) shall be exterior grade (minimum CDX grade). A slipsheet or insulation board is required. Note: Standard FM approved plywood decking is a minimum 3/4-inch thick tongue and groove fire-rated panels.
 - 3. 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. This deck type requires a slipsheet or insulation board. Minimum 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.
 - 4. 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 Mechanically Attached 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. Slipsheet or insulation board is required. Vapor barriers may be required when installing insulation over new decks.
 - 5. Wood Plank (1" minimum) shall conform to Factory Mutual's requirements for Class 1 impregnated decks (insulation is required). FM approved wood decks are minimum, nominal 2-inch thick, tongue and groove planks.
 - 6. Cementitious Wood Fiber Decks - Certain cementitious wood fiber decks may be acceptable to receive a Mechanically Attached 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 Concrete Deck - shall be cured and dry to manufacturer's 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 Mechanically Attached 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.

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 Mechanically Attached 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. Do not permit voids greater than 1/4" width 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.
2. Large blisters shall be cut and patched to provide a reasonably level substrate surface.
3. 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.
4. When an additional thickness of insulation is being added, new nailers must be added to match the height of the new insulation. Nailers must be securely anchored to the roof deck per Section 3.05 of this specification.
5. All roof surfaces shall be free of ponded water, ice, or snow.
6. Specifier and/or roofing contractor shall determine the condition of the existing roof deck and roofing. Areas with deteriorated decking or wet insulation or other materials shall have those affected materials removed and replaced.
7. 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.
8. Gravel surfaced BUR and modified bitumen systems, mineral surfaced BUR or modified bitumen systems, and coal tar pitch systems require the installation of an acceptable insulation. Loose gravel must be removed.
9. Smooth Surfaced BUR and smooth Modified Bitumen roofing systems shall require the installation of an acceptable insulation or slipsheet. 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 installed over the existing field membrane.
10. 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.

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, 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 Contractor's 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. 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.

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" o.c. 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. For recover applications, treated wood nailers are recommended and shall be pressure treated. Creosote and asphaltic preservatives are not acceptable.

3.06 Insulation Installation

- A. Mule-Hide accepted roof insulations shall be installed in accordance with Mule-Hide specifications.
- B. Mule-Hide accepted roof insulations shall be secured to the roof deck in accordance with Mule-Hide's requirements utilizing Mule-Hide fasteners or approved compatible fasteners. 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 staggered. An approved low-rise foam adhesive may be substituted.
- C. All roof insulation shall be neatly cut to fit around all penetrations and projections with a maximum allowable gap of 1/4 inch.
- D. Open joints shall be repaired with like insulation material.
- E. Insulation shall be feathered or tapered to provide a sump area a minimum of 36" x 36" where possible at all drains.
- F. 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.
- G. 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.
- H. Mule-Hide's minimum attachment rates to attach insulation shall be as follows (refer to detail drawings for alternative attachment rates):

2' by 4' boards shall be 2 per board
4' by 4' boards shall be 4 per board

4' by 8' boards shall be 6 per board

Note: When using multiple layers of insulation or using more than one type of insulation, the number of fasteners required per board is determined by the top layer of insulation.

- I. If a slipsheet is to be installed, the roof membrane shall be installed immediately after the slipsheet to prevent any displacement. The slipsheet should be overlapped a minimum of 4 inches on each edge. Plates and fasteners may be necessary to anchor the slipsheet when installing in windy conditions. Sufficient fasteners should be used to ensure the slipsheets lay flat under the roof membrane.

3.07 Membrane Installation

- A. 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. Lap sheets a minimum of 5", for In-Lap Fastening, leaving space for mechanical fasteners and discs and space for a 1-1/2" wide weld. Membrane overlaps shall be shingled with the flow of water or parallel to the flow of water. End laps shall be a minimum of 3" wide.

- B. In-Lap Fastening

1. Perimeter - When installing Mule-Hide TPO Roofing, install Half Sheets (See Technical Bulletin TPO-MA02-2006 for number of sheets required) parallel with the perimeter and fastened with Mule-Hide approved fastening system at the predetermined spacing in the lap area in a line centered approximately 1-1/2" from the edge of the sheet leaving 1/2" of membrane outside the disc. Weld lap area continuously with a minimum weld width of 1-1/2" inches (40 mm).

Perimeter areas shall be determined by one of the following methods:

- a. Mule-Hide Technical Bulletin TPO-MA-02-2006
 - b. For Factory Mutual insured buildings, follow guidelines in FM's Loss Prevention Data Sheet 1-29. Perimeter area for all exterior roof edges/parapet walls is calculated by taking 40% of the roof height or 10% of the lesser plan dimension, whichever is less. The calculated distance is the area into the field of the roof, from the exterior edge/wall, which shall be covered with the Half Sheets, rounding off to the next full Half Sheet. Contact Mule-Hide Warranty Department for fastener spacing for compliance with FM 1-60 and 1-90 requirements.
 - c. Parapet walls of a height of 8 feet or greater do not require Half Sheets.
 - d. Parapets, walls and expansion joints separating adjoining roofs of the same elevation or roofs that are at a higher elevation than the roof being installed are considered interior walls and do not require Half Sheets.
 - e. Roof edges and parapet walls separating other roofs areas that are at a lower elevation than the roof being installed, are considered exterior edges/parapets and shall require the installation of Half Sheets.
 - f. For roofs of heights of 70 feet or greater and located in wind zones higher than 80 mph, Mule-Hide requires that FM guidelines be followed when determining the number of Half Sheets.
2. Field Areas
 - 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. All membrane sheets are to be overlapped a minimum of 5" to provide space for fastener and disc placement and for a continuous, minimum 1-1/2" (40mm) wide weld.
- C. The roofing contractor shall check all welded seams for continuity and integrity using a rounded screwdriver 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.

3.08 Welding of Lap Areas

- A. General
 - 1. Roofing membrane is to be hot air welded only. All surfaces to be welded shall be clean and dry. Seaming of "membrane to membrane" and "Flashing/Detail membrane to membrane" shall be by hot air welding only.
- 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.**
 - 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 nylon hand roller to press the heated membrane surfaces together with slow, even movements. Keep the roller within 1 inch (25mm) 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. 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.

3.09 Flashing Installation

- A. TPO Coated Metal Flashing
 - 1. TPO Coated Metal Flashing shall be installed in accordance with Mule-Hide TPO Roofing Systems' standard details.
 - 2. Complete all metalwork concurrently with roofing and flashings so that a watertight condition can be achieved each day.
 - 3. TPO Coated Metal may be used at all peaks, valleys and slope intersections where the net change in slope exceeds 1-1/2" in 12". In some cases, reinforced

membrane may be sufficient for ridges, but should be fastened securely at all transition areas. Contact the Mule-Hide Warranty Department for specific recommendations.

4. TPO Coated Metal shall be installed to provide adequate resistance to bending and to allow for normal thermal expansion and contraction.
5. All metal joints are to be watertight and staggered over nailer joints to prevent joints in nailers and joints in metal from lining up.
6. Base flashings shall extend a minimum of 8" up vertical surfaces where possible. Do not cover weep holes or thru-wall flashings.
7. All metal flashings and terminations shall be securely fastened in the plane of the roof deck with fasteners recommended by Mule-Hide.
8. Fasteners used to secure flashings to wood nailers shall be stainless steel, galvanized metal or other corrosion resistant material, with a head diameter of not less than 3/8", and with fastener penetration into the wood nailer of at least 3/4".
9. Scuppers and metal overflows are to be assembled using TPO Coated metal.
10. All TPO coated metal shall be fabricated to form hemmed edges to prevent sharp metal edges from cutting the membrane, except when used in conjunction with wood nailers.

B. 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 Warranty 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 TPO Membrane flashings shall be fully adhered to vertical surfaces/substrates using Mule-Hide's TPO Bonding Adhesive. The following conditions must be met:
 - a. All surfaces to be fully adhered should be compatible, dry and smooth with no excessive surface roughness.
 - b. All flashing membrane shall be cut from the standard field sheet/half sheet. .060 Non-Reinforced TPO Flashing material is used only to flash corners, field flash pipes and other details that require the product to be molded into place.
 - c. After the surface has been properly prepared, Mule-Hide's TPO Bonding Adhesive shall be applied using a minimum 1/2" (15mm) nap paint roller at a rate of approximately 1 gallon per 120 square feet of surface area. Coverage rates may vary due to the type of substrate. Once the membrane is mated to the substrate the "finished coverage rate" will be approximately 60 square feet per gallon. Apply adhesive in smooth even coats, avoiding globs, puddles or other types of irregularities.
 - d. Mule-Hide TPO membrane used as flashing membrane shall be cut to a workable length and shall have an even coat of TPO Bonding Adhesive applied at a rate of approximately 1 gallon per 120 square feet. Let adhesive dry sufficiently to produce strings when touched with a dry, clean finger. Carefully roll onto the previously coated substrate after the adhesive coating the membrane has dried sufficiently as indicated above.

Coverage rates will vary depending on substrate and environmental conditions.

Avoid wrinkling membrane when applying to substrate. The amount of adhesive that can be successfully applied to the membrane will vary depending on ambient temperatures, humidity and manpower. After mating membrane to the substrate, carefully broom the membrane with fine bristle push broom to promote maximum positive contact between the membrane and the substrate. Overlap all adjacent flashing sheets a minimum of 2". The TPO Membrane flashings shall extend a minimum of 6" onto the field sheet and be securely adhered. There shall be a minimum 1-1/2" wide weld in front of the fastener plates. All side laps are to overlap a minimum of 2" with a minimum of a 1-1/2" wide weld.

e. **Areas of the flashings and membrane to be welded are not to have TPO Bonding Adhesive applied to them.**

3. All flashings shall extend a minimum of 8 inches above roof membrane level where possible unless previously accepted by the owner or his representative and the Mule-Hide Warranty Department. Do not cover "thru-wall flashings" or weep holes.
4. 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.
5. All flashings shall be properly terminated according to Mule-Hide's published Standard Details.

3.10 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 Details. All pitch pans shall be filled with Thermoplastic Pourable Sealant.

3.11 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".
 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 the 9 oz. Polyester Mat Protection Material. Contact Mule-Hide for other acceptable slipsheets.

3.12 Temporary Tie-ins

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. Straighten the insulation line using pieces of insulation loosely laid, and seal the Mule-Hide TPO membrane to the deck or existing membrane. Use a heavy application of roof cement or hot asphalt at least six inches in width overlaid with an embedded reinforcement. Remove the temporary seals completely when work resumes, cutting out the contaminated membrane. Remove all sealant, contaminated membrane, insulation fillers, etc. from the work area and properly dispose off-site.

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 or check the Mule-Hide website (www.mulehide.com) for the latest updates regarding changes or modifications to this specification.