MULE-HIDE PRODUCTS CO., INC.
BALLASTED TPO SYSTEM SPECIFICATION

07540/MUL

PART 1 – GENERAL

1.01 Description

A. Scope:

1. Furnish and install a Ballasted 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 Ballasted 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 loose laid over an acceptable substrate and ballasted. Adjoining sheets are overlapped a minimum of 3 inches and welded with a robotic welder. A minimum of 10 lbs. per square foot (sf) of smooth river bottom stone is required as ballast. 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. Walkway

1.02 Quality Assurance

A. The Mule-Hide Ballasted TPO Membrane Roofing System shall be installed by an independent roofing contractor eligible to apply for Mule-Hide warranties when Standard System or Premium System Warranties are requested.

B. There shall be no deviations from this specification or Mule-Hide's 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 may perform an on-site inspection of the roof to verify that all installation and material requirements have been met.

D. Mule-Hide reserves the right to reject any roof system and refuse to issue any warranty on roofs which 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:

    a. Factory Mutual Research Laboratories
    Norwood, MA

    b. Underwriters Laboratories
    Northbrook, IL

B. Prior to starting the project, the roofing contractor shall submit to Mule-Hide's Warranty Department the following items:

1. All project specifications and details including deviations to the Mule-Hide standard specification, extension of wind coverage if requested and information to determine compliance with UL or FM.

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. Materials damaged in handling or storage shall not be used.

C. Store all materials in a dry, clean area protected from the elements. All adhesive and caulking shall be stored at temperatures between 60^{o}F and 80^{o}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.

D. 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.

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 Zone 3 (Section 8) as classified by Factory Mutual Loss Prevention Tables, Bulletin 1-28.

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. 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.

C. Only as much new roofing as can be made watertight each day shall be installed each day. This includes all flashing work.

D. 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.

E. Prior to and during application, all dirt, debris and dust shall be removed from surfaces to be roofed for both new and reroofing substrates.

F. On all projects where the ballasted 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. A ballast waiver, signed by the building owner or owner's representative, or a copy of the project specification shall be submitted to Mule-Hide's Warranty Department with the warranty application.

G. 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.

H. 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.

I. 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 disposed of properly. Waterstops shall be compatible with all materials.

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. 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 Customer Service Department for recommendations if such conditions exist.

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 or polyester felt protection to prevent damage.

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. Follow all laws, regulations and procedures to identify and properly dispose of asbestos materials that are to be torn off.

O. Any unusual or concealed condition discovered during the course of the work is 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.

P. All local building 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.

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

1. Roof heights greater than 60 feet.

2. Geographical location in wind zone 3, per Factory Mutual's current edition of Loss Prevention Data Sheet 1-28.

3. Geographical location in a 100 mph or greater wind zone, per the ANSI 100 year mean recurrence interval wind isotach.

4. Location with a D exposure as determined in ANSI A58.1

S. Consideration should be given in the project design to problems that can precipitate from the smooth surface characteristic of the Mule-Hide TPO membrane. The Ballasted TPO Roofing System shall not be installed where the slope of the roof exceeds an incline of 2 inches per foot. Pavers should be installed in areas that are subject to routine foot traffic.

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 (.060 inch) thick TPO membrane and shall incorporate additional design enhancements as outlined in the 20-year Design Enhancements for TPO Ballasted 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 Ballasted 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 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 Ballasted 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 Ballasted Mule-Hide TPO Membrane Roofing 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 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. 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, 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 – 25-gauge, galvanized steel to which is laminated 20 mils (.020" thick) of Mule-Hide TPO Membrane 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 Pourable Sealant - 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.

N. Mule-Hide Insulation - The Mule-Hide 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.

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 codes and insurance requirements.

2. Vapor retarders shall be compatible with insulation and other accessories.

3. The use and placement of a vapor retarder should be determined by an architect or engineer. Mule-Hide does not require the use of vapor retarders. 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% or greater.

4. Mule-Hide must be contacted for buildings that are refrigerated (freezers or cold storage) or have a high interior humidity such as, but not limited to, swimming pools, produce storage or locker rooms.

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, Mule-Hide Adhesives, Mule-Hide TPO Flashings and other Mule-Hide Accessories.

3. The following generic insulations are acceptable for use in a Mule-Hide Ballasted TPO Roofing System when a standard warranty is requested:

   a. Polyisocyanurate insulations having nonasphaltic facers meeting or exceeding the physical property requirements of Fed. Spec. HH-I-1972 and having a minimum compressive resistance of 18 psi. Thickness minimum is 1 inch or greater as required by the insulation manufacturer to span the flutes of a metal deck.

   b. High density wood fiberboard may be used as an overlay over an existing roof system (recover application). The minimum thickness is ½ inch. Refer to the Insulation Guidelines section of this manual for specific applications.

   c. Expanded Polystyrene insulation must be a minimum of 1" thick and certified by the manufacturer to have a minimum density of 1.00 lb. Refer to the insulation manufacture's minimum requirements for installation over a fluted steel deck. Review the Insulation Guidelines section of this manual for specific applications and restrictions.

   d. Extruded Polystyrene must be a minimum of 3/4" thick (1/2" min. over smooth surfaced BUR). Refer to the Insulation Guidelines section of this manual for specific applications and restrictions.

   e. State and local building codes should be reviewed regarding the installation of expanded or extruded polystyrene insulation directly over a steel deck.

4. Mule-Hide Premium Warranties require the use of the Mule-Hide Poly ISO 2 insulation. Use of other insulations shall disqualify the project for consideration of

the issuance of a Premium warranty. Contact the Mule-Hide Customer Service Department for specific requirements. Premium warranties are not available for recover applications.

D. Sheet Metal

1. TPO Coated Metal and non-coated metal components such as gravel stops, drip aprons, counterflashings, copings, etc., should be fabricated and installed in accordance with the SMACNA recommendations and requirements.

2. Sheet metal components supplied by others are not covered by the Mule-Hide warranties. Contact Mule-Hide's Warranty Department for specific requirements.

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 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 TPO Coated Metal or membrane. Contact Mule-Hide's Customer Service Department for recommendations for compatible color coatings.

E. Do not allow muriatic acid (masonry cleaner) to come in direct contact with the Mule-Hide TPO membranes, flashings or accessories.

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 180°F (82°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 loose 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 over heat. 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

When installing a Mule-Hide Ballasted TPO Roofing System in cooler weather, it is recommended that liquids such as solvents, sealants, etc., be stored at temperatures of 60^{o} F. or more 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 Mule-Hide Ballasted TPO Membrane Roofing System for recover, reroof and new construction:

A. The roof deck must be structurally sound and free of defects 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. The roofing contractor shall make an inspection of the deck prior to starting the roof installation, and if there is no general contractor, the roofing contractor shall be responsible for correcting any defects.

B. It is imperative that the roofing contractor performs test cuts at each roof area prior to recover applications. The condition of the substrate must be suitable to receive a Mule-Hide Ballasted TPO Membrane Roofing System. Wet insulation must be removed and replaced.

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, low temperature or a corrosive environment. Special fasteners (i.e. stainless steel), vapor retarders or details may be required.

E. It is acceptable to install a Ballasted Mule-Hide TPO Membrane Roofing System over the following deck substrates provided that an acceptable insulation is installed over the substrate as required and the building owner/owner’s representative has confirmed the additional weight of the ballasted roof system shall not exceed the design load limits of the roof deck:

1. Structural Metal Deck (22 gauge minimum) shall conform to recommendations outlined in Factory Mutual's Loss Prevention Data Sheet 1-28. Steel decks require the installation of the Mule-Hide Poly-ISO-2 insulation or other approved insulation.

2. Structural Concrete, pre-cast and pre-stressed concrete (3,000 p.s.i. minimum) shall be cured and dry to industry standards and surface shall be smooth, clean and free of moisture or frost.

3. Wood plank (1" minimum) shall conform to Factory Mutual's requirements for Class I impregnated decks.

4. Plywood (15/32" minimum).

5. Oriented Strand Board (7/16" min.)

6. Cementitious Fiber Substrates (Tectum, etc), Lightweight Concrete and Gypsum Decks may be acceptable upon confirmation that the new roof system shall not exceed the design load limits of the roof deck and support structure.

3.03 Preparation Of Existing Substrate

A. 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. Specifier or roofing contractor shall determine the condition of the existing roof deck and roofing system. Areas with deteriorated decking or 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.

B. 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.

C. Ponded water, snow or ice shall be removed before installing the Mule-Hide Ballasted TPO Roofing System. Do not roof over moisture in any form.

D. Recover Projects

1. When installing a new roof system over existing gravel surfaced built-up roof, all loose gravel must be removed. Insulation must always be used as a protection course for the TPO membrane.

2. When installing a new roof system over an existing single-ply roof system, the existing roof membrane must be cut up into maximum 10' x 10' sections to prevent entrapment of water between the two roof systems.

3. Sprayed in place urethane foam roof systems are not acceptable substrates for Mule-Hide Single-Ply roofing systems and **must be removed**.

4. Existing smooth surfaced built-up roof systems and mineral surfaced modified or built-up roof systems must have an acceptable insulation prior to installing the Mule-Hide Ballasted TPO Roofing System.

5. If a Mule-Hide Premium 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 must be taken, all wet areas removed and a copy of the survey submitted to Mule-Hide with the warranty application.

3.04 Vapor Retarder

A. Specific climate 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, its type and location in the roofing system.

B. The roofing contractor must follow the recommended installation procedures of the respective vapor retarder manufacturer and the project specifier's instructions for the type of vapor retarder specified for the project.

3.05 Wood Nailers

A. 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. Spacing and fastener embedment shall conform to Factory Mutual Loss Prevention Data Sheet 1-49.

B. Wood nailers shall be installed as specified by the project specifier and shall be in compliance with the Mule-Hide Standard Details.

C. The thickness of the wood nailer shall be determined so that the top of the nailer is flush with the top of the surface of the insulation.

D. Wood nailers installed along the perimeter of a roof surface, where a drip apron or gravel stop shall be installed, shall have a width that is wider than the metal flange to be installed.

E. Where pitch pans or scuppers are to be installed over wood nailers, the wood nailers must be wider than the metal flanges.

3.06 Insulation Installation

A. When installing insulation, each row of insulation shall be offset against the previous row by a minimum of 8 inches. 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.

B. 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.

C. Insulation other than Mule-Hide's Poly ISO 2 must be an FM approved insulation and acceptable to Mule-Hide for use under the Mule-Hide Ballasted Roofing System.

D. Mule-Hide does not require the insulation to be attached to the roof deck. Should mechanical attachment of the insulation be required by the specifier, an additional layer of insulation must be installed over the plates and fasteners. Contact Mule-Hide Customer Service Department for recommendations.

E. Refer to the insulation manufacturers guidelines for the appropriate type, size and thickness of the insulation needed for use over the respective substrate and under the Mule-Hide Ballasted Roofing System.

F. Insulation shall be cut to fit snugly around or against all protrusions, nailers, drains, pipes and walls. All gaps greater than 1/4" wide shall be filled with the same material.

G. Do not install any more insulation than can be covered by the membrane by the end of the working day and made watertight.

H. 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.

I. Factory Mutual does not test ballasted single-ply roofing systems. FM 1-60 and FM 1-90 ratings are not available. Mule-Hide recommends following the "Wind Design Guide For Ballasted Single-Ply Roofing Systems" as jointly published by the RMA and SPRI.

J. Mule-Hide does not permit mechanical attachment of the top layer of insulation when installing a ballasted system. Contact Mule-Hide for alternative methods of attachment when insulation attachment is required by the specifier. When a Mule-Hide Premium Warranty is requested, only Mule-Hide Poly ISO 2 insulation may be used unless written approval is obtained, prior to job bid, for an alternative insulation.

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.

B. Membrane should run perpendicular to the direction of steel deck flutes and orientation of wood decks where possible.

C. 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.

D. All membrane sheets are to be overlapped a minimum of 3" to provide space for a continuous, minimum 1-1/2" (40mm) wide weld.

E. 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 Membrane Securement (Mechanical)

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 angle changes that exceed inclines of 2" or greater per foot 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. 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. The 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 of the 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.

2. 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 inch Barbed Seam Plates are used to attach the RUSS either horizontally or vertically with appropriate fasteners. Refer to Mule-Hide Details # 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.

b. Follow the standard procedures for cleaning, applying primer and adhering the RUSS and field sheet. Only the Mule-Hide Tape 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 vertical attachment, the RUSS attachment strip must extend a minimum of 3 inches onto the horizontal surface (roof substrate). Installation of the plates must be on the vertical surface and a minimum of 6 inches to a maximum of 9 inches from the inside and outside corners.

e. For horizontal attachment, the RUSS attachment strip must be placed a maximum of ½ inch from the base of the angle change extending out onto the horizontal surface (roof substrate). The 2 inch Barbed Seam Plate must be placed a minimum of ½ 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.

3. 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 ½" 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 Tape 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 Tape Primer. Refer to Mule-Hide detail # MHT-UN-106B.

c. When drip aprons are used, proper ballast retainers must be installed.

3.10 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. 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.**

Note: When using Mule-Hide All-Purpose Bar under Counterflashing to terminate wall flashing or when coping is used, TPO Bonding Adhesive may be eliminated when flashing height is 18” (500 mm) or less. Refer to detail # MHT-UN-303 and # MHT-UN-310.

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" (40 mm) wide.

5. All flashings shall be properly terminated according to Mule-Hide's published Standard Details.

3.11 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.

3.12 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.

3.13 Waterstops

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. 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.