SECTION 3

MULE-HIDE PRODUCTS CO., INC.

TPO Ballasted Specification

TPO Ballasted Summary Specification

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

07 54 00/MUL

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BALLASTED TPO SYSTEM SPECIFICATION

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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. The field membrane is secured at all changes in plane greater than 2" per foot. 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. 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 Ballasted TPO Membrane Roofing System shall be installed by an independent roofing contractor eligible (Warranty 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., Inc. ("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 may perform an on-site inspection of the roof to verify that all installation and material requirements have been met.

Note: Inspections are only conducted on projects where a "System Warranty" is

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

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

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. Materials exposed to lower temperatures affect the workability and performance of the

product. Products shall be restored to the above temperature prior to use.

E. All flammable materials shall be stored in a cool, dry area away from open flames and sparks. Follow precautions outlined on containers or supplied by the material manufacturer/supplier.

F. All materials determined as being damaged (confirmed by Mule-Hide) due to improper storage on the job site are to be replaced with new materials.

1.05 Job Conditions

A. This specification shall not be considered applicable without the appropriate additional specifications approved by Mule-Hide if it should be determined that any of the following conditions exist:

1. The installation of any Mule-Hide Roof System is in a coastal area or high wind zone.

2. If the Mule-Hide Roof System should exceed the structural load conditions as determined by an architect or Engineer.

3. When chemical or hazardous materials are discharged onto the Mule-Hide Roof System.

B. Mule-Hide TPO roofing materials may be installed in temperatures below 40° F but only after consultation with the Mule-Hide Technical Department as special precautions or procedures may be necessary. The performance of the materials, installation costs and production rates may be affected.

C. The General Contractor or the building owner shall be responsible for providing adequate surfaces and structures to receive the insulation, Mule-Hide Roof System and related sheet metal necessary for the successful completion of the project.

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

E. All substrates to receive new insulation, membrane or flashing shall be thoroughly dry. Should surface moisture occur, the contractor shall provide adequate equipment to dry the substrate prior to application of new materials.

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

G. On all projects where the 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.

H. 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.

I. The contractor shall verify and ensure that all roof drain lines are unblocked before starting work. Any blockages found shall be reported to the owner's representative and Mule-Hide's Warranty Department in writing.

J. 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.

K. Do not install the Mule-Hide TPO Roofing Membrane in direct contact with any product

containing coal tar pitch, creosote or penta-based materials. Consult the Mule-Hide Technical Service Department for special installation requirements.

L. Do not allow contaminants such as petroleum, grease, acid, solvents, vegetable or mineral oil, animal oil, animal fat, etc. or direct steam venting to come into direct contact with the Mule-Hide TPO Roofing Membrane. Contact the Mule-Hide Technical Service Department for recommendations if such conditions exist.

M. The contractor shall follow and comply with all safety regulations as recommended by OSHA.

N. All work shall be scheduled and executed without exposing interior building areas to the effects of inclement weather. The existing building and its contents shall be protected against all risks.

O. Arrange work sequence to avoid use of newly constructed roofing for storage, walking surfaces and equipment movement. Contractor shall provide all necessary protection and barriers to segregate the work areas and prevent damage to adjacent areas. If excessive traffic over newly installed membrane is necessary, contractor shall provide plywood or polyester felt protection to prevent damage. All damaged materials shall be replaced with new materials.

P. All existing roofing materials to be removed for construction shall be immediately removed from the construction site to a dumping area authorized to receive such debris. Any hazardous materials such as asbestos or materials containing asbestos fibers shall be removed and disposed of in accordance with applicable City, State and Federal requirements.

Q. Any unusual or concealed condition discovered during the course of the work is to be reported 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.

R. 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.

S. 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.

T. 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 a 100 mph or greater wind zone, per the ANSI 100 year mean recurrence interval wind isotach.

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

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

V. 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 or other type of membrane protection should be installed in areas that are subject to routine foot traffic.

W. 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.

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 not supplied by Mule-Hide 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 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. Metal flashing products supplied by Mule-Hide (Mule-Hide Metal Accessories) and installed by a Mule-Hide Warranty Eligible Applicator will be covered under a Standard or Premium System warranty.

E. Standard and Premium System warranties are not available for residential projects.

F. TPO tie-ins to built-up (BUR) or any other type of roof system are not covered by Mule-Hide warranties.

G. Contact Mule-Hide for other extended warranties that may be available.

H. 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., Inc.

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 used for bonding Mule-Hide TPO-c Membrane to various vertical substrates and insulation boards. Mule-Hide TPO Bonding Adhesive is a two-surface contact adhesive that is applied to both the underside of the membrane and substrate surface. This product may be used with TPO field membrane and flashing membrane. Adhesive is compatible with polyisocyanurate, wood fiberboard insulations, fiberglass-faced gypsum panels, concrete, masonry, metal and wood surfaces.

B. Mule-Hide Low VOC Bonding Adhesive - A high strength solvent-based contact adhesive that allows bonding of TPO membrane to various porous and non-porous substrates. It is specially formulated using a blend of VOC exempt and non-exempt solvents to meet the < 250 g/l VOC content requirements of the OTC Model Rule for Single Ply Roofing Adhesives.

C. Mule-Hide Low VOC Bonding Adhesive - 1168 – A high strength solvent-based contact adhesive that allows bonding of TPO membrane to various porous and non-porous substrates. It is specially formulated using a blend of VOC exempt and non-exempt solvents to meet the < 250 g/l VOC content requirements of the OTC Model Rule for Single Ply Roofing Adhesives. **This product COMPLIES with the following California counties' VOC regulations:** Alameda, Contra Costa, El Dorado, Los Angeles, Marin, Napa, Orange, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, San Mateo, Santa Clara, Solano, Sonoma, and Tehama.

D. Mule-Hide WBBA-2000 – A water base adhesive used to bond Mule-Hide TPO-c membrane to various vertical substrates and insulation boards. WBBA-2000 is applied as a two-sided contact adhesive when used with standard (non-fleece back) TPO membranes, or as a single-side, wet lay-in adhesive when used with Mule-Hide Fleece Back TPO membrane.

E. Mule-Hide TPO Primer - A high-solids-content, clear (translucent color), polymer-based splice primer used to prepare TPO membrane for improved adhesion to pressure-sensitive TPO accessories such as: RUSS Strips, TPO Pressure Sensitive Cover Strips, Uncured Flashing Tapes and Cured Cover Tapes. Mule-Hide TPO Primer is required to prepare TPO membrane surfaces prior to the application of any pressure sensitive Mule-Hide accessories.

F. Mule-Hide Low VOC Primer - a solvent-based product designed to prepare TPO membrane for improved adhesion to pressure-sensitive TPO accessories such as: RUSS Strips, TPO Pressure Sensitive Cover Strips, Uncured Flashing Tapes and Cured Cover Tapes. This Low-VOC product is ideal for use in states where VOC content is a concern.

G. Mule-Hide TPO Flashing - a non-reinforced, .060-inch thick material primarily used to seal details where field fabrication is necessary, such as drain details, pipe flashings, pitch pocket flashings, seaming joints of the Mule-Hide TPO Coated Metal, and any place where reinforced membrane is not practical.

H. Mule-Hide TPO Universal Corners - .060-inch thick pre-molded, non-reinforced TPO material. They are uniform in shape and size and provide water tightness at corners formed by TPO coated metal and flashing membrane. They provide a neat, finished look to building corners, curbs and parapet flashings with no cutting or stretching required. Universal Corners are available in white only.

I. Mule-Hide TPO Outside Corners – are pre-molded and are used for flashing outside corners on a variety of details. Installation is fast and easy with no cutting or stretching required. TPO Outside Corners are available in white, gray, and tan.

J. Mule-Hide TPO Inside Corners – are pre-molded and are used for flashing inside corners on a variety of details. Installation is fast and easy with no cutting or stretching required. TPO Inside Corners are available in white, gray, and tan.

K. Mule-Hide Weathered Membrane Cleaner - Used to clean in-service TPO-c membrane prior to the welding process. This cleaner helps to loosen and remove dirt and other contaminants from the surface of the TPO-c membranes and leaves a suitable surface for welding or the subsequent application of TPO Primer.

L. Mule-Hide TPO Pipe Seal - An injection molded, pre-formed flashing for pipes made of Mule-Hide non-reinforced TPO material. They are designed to add ease to the installation process while offering increased watertight security and improved aesthetics. TPO Pipe Seals are designed as an economical flashing for single pipe penetrations on Mule-Hide TPO-c Membrane roof systems. The TPO Pipe Seals can be used wherever the TPO Pipe Seals may be slipped over the top of the pipe.

M. Mule-Hide TPO T-Joint Cover - 60-mil non-reinforced flashing cut into a 4.5” diameter circle used to seal step-offs at splice intersections. Installation is mandatory on all 60-mil and 80-mil TPO systems and on all jobs warranted longer than 15 years.

N. Mule-Hide TPO Coated Metal – 24-gauge, galvanized steel to which is laminated 35 mils (.035" thick) of Mule-Hide non-reinforced TPO Membrane used for flashing and edge metal detailing.

O. 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.

P. Membrane Fasteners and Discs - Mule-Hide offers a variety of membrane fasteners and discs to meet specific job conditions and substrates.

Q. Mule-Hide Thermoplastic Pourable Sealant - a one-component thermoplastic sealant for use in pitch pockets.

R. Mule-Hide TPO .045 Reinforced 6” X 100’ – used for stripping-in TPO Coated Metal and as cover strips over TPO Coated Metal joints.

S. Mule-Hide TPO Cut Edge Sealant – A solvent-based liquid sealant used to seal the cut edge of the Mule-Hide TPO Membrane.

T. Mule-Hide TPO Walkway Rolls – a 1/8-inch thick embossed TPO membrane available in rolls (34" x 50’) having a herringbone traction surface. Walkway Rolls are trimmed in safety yellow along the length of the sheet to better define the walkway area. Walkway Rolls may be welded directly to the TPO roofing membrane. The yellow edges are smooth without safety lugs to allow for easier welding. Walkway Rolls are available in White and Gray colors.

U. Mule-Hide Insulation - Mule-Hide Poly ISO polyisocyanurate insulation (flat or tapered) is a closed-cell polyisocyanurate foam core laminated to heavy, black (non-asphaltic) glass fiber reinforced felt facers.

V. Mule-Hide HP Protective Mat - A nominal 6.0-ounce per square yard (140 grams per square meter) UV resistant polypropylene needle punched fabric. It can be used above the membrane as a slipsheet for crushed stone or pavers on ballasted system applications.

2.04 Related Materials By Others

A. Wood Nailers

1. Nailers shall be #2 or better lumber. Creosote and asphaltic preservatives are not acceptable. Pressure treated lumber is not required on new construction unless specified by the architect.

2. Wood nailers shall conform to Factory Mutual's Loss Prevention Data Sheet 1-49.

3. Wood nailers shall be installed as specified on the project drawings and shall be of a height sufficient to match the thickness of the insulation being used.

B. 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 insulation boards are acceptable for use with a ballasted roofing system when a standard warranty is requested:

   a. Polyisocyanurate insulations having non-asphaltic facers (foil facers are not acceptable) meeting the physical property requirements of Fed. Spec HH-I-1972 and having a minimum compressive resistance of 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 is the minimum requirement when used as an overlay. Mule-Hide requires a minimum 1-inch thick board when installing directly over steel decks. Wood and concrete decks require a minimum 1/2-inch thick board. Minimum thicknesses and attachment rates will vary with wind requirements and deck types.

   c. 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 local building codes as a layer of gypsum board may be required under the EPS insulation (on steel decks).

   d. Extruded polystyrene meeting ASTM C578, Types IV, VI or VII physical properties. Minimum thickness shall be as required by insulation manufacturer to span steel deck flutes.

   e. Perlite Insulation – Perlite is not an acceptable insulation. Perlite may only be used as fill insulation under an approved insulation. The TPO membrane cannot be adhered directly to perlite insulation.

   f. Dens Deck Prime or Securock - A minimum 1/4" thick layer of Dens Deck Prime or Securock may be used as an overlay over an approved insulation or as a thermal barrier over a combustible deck.

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

4. Insulation manufacturer shall provide its recommendations for use and attachment to the owner with a copy sent to Mule-Hide's Warranty Department. In addition, the insulation manufacturer shall provide a copy of their specific warranty conditions.

5. Mule-Hide Premium Warranties require the use of the Mule-Hide labeled insulation or insulation by an approved Mule-Hide manufacturer. Use of other insulations may disqualify the project for consideration of the issuance of a Premium warranty. Contact the Mule-Hide Technical Service Department for specific requirements.

D. UL and FM Approved Assemblies

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

E. Sheet Metal

1. Metal flashing products supplied by Mule-Hide (Mule-Hide Metal Accessories) and installed by a Mule-Hide Warranty Eligible Applicator will be covered under a Standard or Premium System warranty.

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

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

F. Ballast Types

1. **Rounded Water-Worn Gravel** may be placed directly on the TPO membrane without additional membrane protection.

a. Minimum acceptable gradation:

1. Nominal 1-1/2" rounded water worn gravel which conforms to the following gradation: 50% retained by a 3/4" screen, 95% retained by a 1/2" screen and 98% retained by a 1/4" screen. Use ASTM C136 method for sizing gravel.

2. Alternately, #4, #3 and #24 stone (sized in accordance with ASTM D448 method of sizing) may be used in lieu of the stone listed above.

3. Coverage rate shall be no less than 1000 pounds per 100 square feet and ballast must be evenly distributed to maintain an average of 10 pounds per square foot.

4. Nominal 2-1/2" rounded water worn gravel which conforms to gradation #1 or #2 when sized in accordance with ASTM D448 method of sizing. Coverage rate shall be no less than 1300 pounds per 100 square feet and gravel must be evenly distributed to maintain an average of 13 pounds per square foot.

b. **Standard sizes of coarse aggregate** - Based on ASTM D448

Size Number	1	2	24	3	4
Nominal Size Square Openings	3-½" – 1-½"	2-½" – 1-½"	2-½" – ¾"	2" – 1"	1-½" – ¾"
Amounts Passing Each Lab Sieve (Square Opening), Percent (%)					
4"	100				
3-½"	90 to 100				
3"		100	100		
2-½"	25 to 60	90 to 100	90 to 100	100	
2"		35 to 70		90 to 100	100
1-½"	0 to 15	0 to 15	25 to 60	35 to 70	90 to 100
1"				0 to 15	20 to 55
¾"	0 to 5	0 to 5	0 to 10		0 to 15
½"			0 to 5	0 to 5	
3/8"					0 to 5

2. **Crushed Stone,** when specified, shall conform to the gradations approved for rounded water-worn gravel and must be installed in conjunction with Mule-Hide HP Protective Mat.

   a. HP Protective Mat must extend a minimum of 2" above the crushed stone at the perimeter and penetrations, but must be discontinued at scuppers, Dutch gutters and at drain bases.

   b. A minimum 6" overlap between adjacent sheets of HP Protective Mat must be specified.

3. **Individual Concrete Pavers**

   a. Individual pavers with a minimum weight of 18 pounds per square foot may be substituted for nominal 1-1/2" stone. Individual pavers with a minimum weight of 22 pounds per square foot may be substituted for nominal 2-1/2" stone.

   b. Individual pavers must be a maximum of two feet square. Unless otherwise required by Mule-Hide, pavers must weigh no more than 80 pounds per unit to allow for easy removal and replacement.

   c. Individual pavers with a surface other than a steel troweled finish as approved by Mule-Hide, must be installed over Mule-Hide HP Protective Mat and must be accepted by Mule-Hide prior to installation.

   d. Elevating pavers should increase life expectancy, reduce freeze/thaw effects and promote more positive drainage. Acceptable pedestals can be specified under corners of pavers to elevate paver.

   e. Individual concrete pavers shall be loose laid and butted together with no gaps greater than 1/2".

4. **Lightweight Interlocking Concrete Pavers**

   a. Depending on the type of lightweight interlocking system, Mule-Hide HP Protective Mat or manufacturer's recommended matting may be required by Mule-Hide as a protection layer for the membrane. **Mule-Hide's Technical Department must be consulted prior to installation concerning protective matting requirements.**

b. Lightweight interlocking pavers (minimum 10 pounds per square foot) may be substituted for nominal 1-1/2" stone or nominal 2-1/2" stone.

c. When lightweight interlocking pavers are specified, the respective paver manufacturer must be consulted concerning installation criteria.

CAUTION: The securement method suggested by the respective interlocking paver manufacturer must be reviewed by Mule-Hide to determine membrane accessibility. If access to the membrane system is impaired by the paver interlocking mechanism (mechanical clips, strapping, adhesive, etc.), the building owner must assume the responsibility of providing access to the membrane for the purpose of investigation and warranty related repairs.

d. Lightweight Ballast Paver – 2" x 2" x 1.25" weighing 15 lbs/sq. ft.

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 Technical 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 membrane or accessory products.

F. Do not allow Mule-Hide TPO membranes or accessories to come into direct contact with steam or vents that produce temperatures in excess of 160°F (71°C).

G. The Mule-Hide TPO Roof System may be installed in cold weather provided the adhesives are stored at room temperature until just prior to use and used within 2 hours. Adhesives left in the cold must be returned to room temperature prior to use.

H. Cover Tapes may lose tack when exposed to temperatures below 40° F. for extended periods of time. A heat gun may be used to warm the product. Only apply heat to the TPO side. Be careful not to 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

A. When installing a Ballasted 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 Mule-Hide Ballasted TPO Membrane Roofing System for recover, reroof and new construction:

A. The roof deck must be structurally sound to provide proper securement for mechanical fasteners and strong enough to withstand the load of a ballasted roofing system. 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. 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.

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

C. Contact the material manufacturer when the substrate is exposed to excessively high humidity and/or a corrosive environment. Special fasteners (i.e.- stainless steel) or details may be required.

D. A determination must be made regarding the presence or absence of coal tar pitch within the existing roof assembly when considering a recover of the old roof system. The presence of coal tar pitch requires the use of a 6-mil poly slipsheet under the insulation unless the coal tar pitch is 10 years or older and is separated from the Mule-Hide TPO membrane by a layer of insulation a minimum of 1-1/2" thick having a minimum "R" value of 5.0. All joints must be butted tightly together or have joints completely taped to prevent volatiles from damaging roof membrane.

E. It is acceptable to install a 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 (requires insulation). Contact Mule-Hide's Warranty Department for attachment requirements for decks less than 22-gauge in thickness. All FM testing is based on attachment to a 22-gauge steel deck.

2. Structural Concrete, 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. All sharp ridges or other projections above the surface shall be removed before roofing. An approved insulation board is recommended. Minimum deck thickness shall be 2 inches with 3 inches preferred due to possible spalling damage that may occur to the underside of the deck when using fasteners for membrane attachment.

3. Lightweight Insulating Concrete Fill and Metal Form work (minimum 24 gauge metal form work) - the roof deck shall be cured and dry to the deck manufacturer's and/or industry standards and shall be smooth and free of ridges and depressions. All necessary venting as recommended by the roof deck manufacturer shall be accomplished. Any membrane attachment must be through the insulating concrete into the steel or concrete deck. Insulation board is required. Vapor barriers may be required when installing insulation over new decks.

4. Wood Plank (1" minimum) shall conform to Factory Mutual's requirements for Class 1 impregnated decks (insulation is required). FM approved wood decks are a minimum, nominal 2-inch thick, tongue and groove planks.

5. Plywood (15/32" minimum) shall be exterior grade (minimum CDX grade). A layer of an approved insulation is required for reroof applications. Decks attached with common or cement coated nails or staples shall be covered with an approved insulation.

6. Cementitious Wood Fiber Decks - Certain cementitious wood fiber 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.

7. Gypsum Concrete Deck - shall be cured and dry to manufacturers' and/or industry standards. The surface of the deck shall be smooth and free from ridges and depressions. Certain gypsum concrete decks may be acceptable upon confirmation that the new roof system shall not exceed the design load limits of the roof deck and support structure.

F. For reroofing projects having plywood decks, a minimum of one layer of an approved insulation is required after the tear-off has been completed.

G. Mule-Hide recommends that all roof surfaces have a positive slope to provide adequate drainage. There should not be any ponding water 48 hours after a rainfall.

3.03 Preparation Of Existing Substrate

A. General

1. To prevent delays or interruptions, coordinate work with other trades or suppliers to ensure that components to be incorporated into the Ballasted Mule-Hide TPO Membrane Roofing System are available as the work progresses. Examine substrates to which the roofing materials are to be applied to ensure that their condition is satisfactory for the Mule-Hide TPO Membrane Roofing System application.

2. Do not permit voids greater than 1/4" wide in the substrate. Concrete substrates shall be cured and free of laitance and curing compounds. Substrates for roofing materials shall be dry and free of oil, dirt, grease, sharp edges and debris. Inspect substrates and correct defects before application of roofing membrane.

3. Specifier or roofing contractor shall determine the condition of the existing roof deck and roofing system. Areas with deteriorated decking, wet insulation or other failed materials shall have those affected materials removed and replaced. Make sure all decking is securely fastened. The roofing contractor has the final responsibility to ensure an acceptable deck is provided to receive the new roof system.

4. Large blisters shall be cut and patched to provide a reasonably level substrate surface.

5. On recover projects, all existing base and projections flashings must be removed down to the substrate or covered with new suitable material. The flashing substrate shall be dry and free of oil, dirt, grease, sharp edges and debris.

6. Gravel over existing nailers must be totally removed prior to installing new nailers and flashings. Verify that the existing nailers are in good condition and securely anchored to the roof decks.

7. When an additional thickness of insulation is being added, new nailers must be

added to match the height of the new insulation. Nailers must be securely anchored to the roof deck per Section 3.05 of this specification.

8. All roof surfaces shall be free of ponded water, ice, or snow. Significant ponding that remains after a period of 48 hours should be eliminated by either installing tapered insulation to create positive drainage of the roof surface or by installing new drains in the low areas where the ponding remains. Positive drainage shall also eliminate the possibility of excessive live loads caused by ponding water that could cause structural damage or failure.

9. When removing an existing roof during reroofing, remove only that amount of roofing and flashing that can be made watertight with new Mule-Hide TPO materials in a one-day period or prior to the onset of inclement weather.

10. Recovering over a gravel surfaced BUR systems require the installation of an acceptable insulation. Loose gravel must be removed. All lead pipe and drain flashings shall be removed.

11. Recovering over a smooth surfaced BUR and smooth Modified Bitumen roofing systems shall require the installation of an acceptable insulation. All lead pipe and drain flashings shall be removed. Single-ply membranes such as EPDM, Hypalon, PVC or CPA must have all existing flashings removed, the field sheet must be cut up into sections no larger than 10' by 10' and an acceptable layer of insulation shall be installed over the existing field membrane.

12. Polyurethane Foam roofing systems ("PUF") are not acceptable for recover applications. The PUF system must be completely removed and new insulation installed prior to the installation of the new TPO Roofing System.

13. If a Mule-Hide Premium warranty is requested, the existing roof system **must be removed to the deck** prior to the installation of the new roofing system or a moisture survey by an independent third party must be taken, all wet areas removed and a copy of the survey submitted to Mule-Hide with the warranty application.

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. Wood nailers with creosote and asphaltic preservatives are not acceptable. Pressure treated lumber is not required on new construction unless specified by the architect.

3.06 Insulation Installation

A. Mule-Hide accepted roof insulations shall be installed in accordance with Mule-Hide specifications.

B. Mule-Hide accepted roof insulations shall be loose laid to the deck in accordance with Mule-Hide's requirements.

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 minimum sump area of 36" x 36" where possible at all drains. Crickets and saddles may be installed beneath the specified insulation where possible. Crickets and saddles made from non-compatible insulations materials must be overlaid with an acceptable insulation or underlayment.

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. When installing insulation, the end joints of each row of insulation shall be offset against the previous row. When more than one layer of insulation is to be used, succeeding layers are to be laid staggered in relation to the previous layer of insulation and all joints shall be offset.

I. When a Mule-Hide Premium Warranty is requested, only Mule-Hide labeled insulation may be used unless written approval is obtained, prior to job bid, for an alternative insulation.

J. Insulation other than Mule-Hide labeled insulation must be an FM approved insulation and acceptable to Mule-Hide for use under the Mule-Hide Ballasted Roofing System. 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.

K. Mule-Hide does not require the insulation to be attached to the roof deck.

L. 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. 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 Technical Department for recommendations.

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. Lap sheets a minimum of 3 inches to provide space for a continuous, minimum 2” weld. Membrane overlaps shall be shingled with the flow of water or parallel to the flow of water. All welded field seams shall be a minimum of 2 inches wide. End laps shall be overlapped a minimum of 3 inches.

E. The roofing contractor shall check all welded seams for continuity and integrity using a cotter pin puller or other suitable blunt object. The contractor shall make sample test seams each day prior to welding field seams. The contractor shall, using scrap material, run at least two test seams, each a minimum of 2' long. Each test seam shall be used to determine adequate seam strength and to ensure the equipment has warmed up, is operating properly and proper settings have been determined. This should be done each time the equipment is turned on after a cool down period.

F. Perimeter - When installing the Mule-Hide Ballasted TPO Roofing membrane system, it is not necessary to install Half Sheets parallel with the perimeter. Full size sheets should be used everywhere practical to minimize the number of field seams. In place of Half Sheets, additional ballast is installed as defined in 3.08.B.5 Ballast Criteria (perimeter enhancement). Weld all laps (seams and end laps) continuously with a minimum weld width of 2 inches. All field welds shall be completed with an automatic welder.

3.08 Field Sheet Attachment

A. Ballasting - General

1. Use of temporary ballast to prevent wind uplift is the responsibility of the Roofing Applicator. For immediate protection against wind uplift, Mule-Hide requires ballast to be installed as each section of the installation is completed.

2. Care must be exercised during application of gravel or pavers. Heavily traveled areas during ballast installation must be protected by placing temporary protection courses to prevent possible damage to the TPO deck membrane and insulation.

3. 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.

B. Field Sheet Attachment (Ballast Requirements)

The coverage rates listed in this section are considered minimum and are required by Mule-Hide for issuance of the standard Mule-Hide warranty. Depending on specific project conditions (building height, parapet height and project location), additional ballast

may be necessary to provide wind uplift protection. Comply with the specifier's requirements when an additional ballast coverage rate is specified.

1. **Rounded Water-Worn Gravel** must be applied over the TPO membrane at the minimum rate of 1000 pounds per square and must be evenly distributed to maintain an average of 10 pounds per square foot.

ASTM D 448 SIZE NUMBER	MINIMUM COVERAGE RATE (pounds per square)	AVERAGE COVER RATE (lbs/sq. ft. continuously distributed)
4 (1-½" nominal diameter)	1000	10
3 (2" nominal diameter)	1000	10
24 (2-½" nominal diameter)	1000	10
2 (2-½" nominal diameter)	1300	13
1 (3-½" nominal diameter)	1300	13

Notes: In the field of the roof, some bare spots resulting from installation are permitted; however, they must not exceed 64 square inches and must be limited to no more than 2 per square (100 square feet). No bare spots are permitted in the perimeter area of the roof that is 10' wide.

2. **Crushed Stone** must be applied in conjunction with Mule-Hide HP Protective Mat placed over the TPO membrane. The crushed stone must be applied at the minimum rate of 1000 pounds per square and must be evenly distributed to maintain an average of 10 pounds per square foot.

3. **Smooth Surfaced Individual Concrete Pavers** or **Lightweight Interlocking Concrete Pavers**

   a. Lightweight interlocking pavers and individual concrete pavers with a surface other than steel troweled finish must be installed over Mule-Hide HP Protective Mat. Contact Mule-Hide for verification of acceptable pavers.

   b. **Individual Concrete Pavers,** when specified, must be installed loose laid and butted with no gaps greater than 1/2".

   Note: Do not install pavers heavier than 80 pounds per unit unless approved in writing by Mule-Hide

   c. Lightweight Interlocking Concrete Pavers, when specified, must be installed in accordance with the respective manufacturer's specification and as approved by Mule-Hide prior to installation.

4. Placement of Mule-Hide HP Protective Mat

   a. When specified or required by Mule-Hide, position Mule-Hide HP Protective Mat loosely over the membrane with all edges overlapped a minimum of 6".

   b. Extend the mat a minimum of 2" above the anticipated ballast level at the perimeter and around penetrations except for roof drains and scuppers.

   c. The mat must extend to drain bases, scupper openings and the base of Dutch gutters but must not restrict drainage.

   d. Additional matting must be installed around penetrations to prevent direct contact between crushed stone or pavers and flashing.

   Note: Following the placement of the fabric, it is necessary to install the ballast or temporary ballast to prevent the movement or displacement of unballasted

fabric.

5. Ballast Criteria (perimeter enhancement)

a. Stone Ballast

Building Height	Ballast Requirements
Up to 25'	#2 Stone @ 13#/SF for 10' wide perimeter #4 Stone @ 10#/SF for field of roof
26' to 50'	#2 Stone @ 13#/SF for 20' corners #2 Stone @ 13#/SF for 10' wide perimeter #4 Stone @ 10#/SF for field of roof
Over 50'	Mule-Hide recommends the use of a interlocking ballast paver system

b. Concrete Pavers

1. Minimum Size: 2’ x 2’ x 2”
2. Minimum Weight: 22 pounds per square foot
3. Membrane Protection: Rubber or plastic pedestals, or 4” x 4” sections of Mule-Hide Walkway Pads.
4. Paver type must be submitted to Mule-Hide for approval prior to bid.

C. Do not run any seams through field drains or sumps. Any seams running through drains or shall be cut out and target patches (36” x 36”) shall be installed.

3.09 Welding of Lap Areas

A. General

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

2. All surfaces to be welded shall be clean and dry.

B. Hot Air Welding

1. Machines for hot air welding are available from several different sources. Each manufacturer's instructions for use shall be followed, as well as all local codes regarding electric grounding, supply and other related functions. Since most automatic welding machines require 218 to 230 volts, the use of a portable generator on the roof is recommended for greater flexibility. **Mule-Hide requires the use of automatic welding machines for all field sheet seaming. Hand welding is only acceptable for flashings and those seams where the automatic welder cannot be used.**

2. Hand-held welding equipment is also available to weld membrane. After the preheated nozzle tip is applied in the overlap area and the material starts to soften, immediately follow with a silicone hand roller to press the heated membrane surfaces together with slow, even movements. Keep the roller within 1 inch of the nozzle tip. Angle the hot air tool so that the flowing air faces the roller. Seam strength may be tested when cool. For best results, testing seams 8 hours after hot air welding is recommended.

C. “T” Joint Covers

1. **For 45-mil membrane and maximum warranty length of 15-years.** Pay special attention to the “T” lap seams formed where three layers of membrane

overlap at a seam. To ensure proper seaming of the “T” joints, the top layer of the Heat-Weld Membrane is creased a minimum of one inch into the lower layer of membrane by using a heat gun with a narrow or pencil tip nozzle and a rubber hand roller. By inserting a heat gun nozzle between the layers of the membrane, the membrane will soften and begin to flow allowing it to crease and seal completely after applying pressure with a hand roller to ensure adequate bonding of the softened material. After heat-sealing the “T” joint, Edge Sealant must be applied on all cut edges of reinforced membrane. See detail MHT-UN-105A

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

D. Seam Patches at Roof/Wall Transitions

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

E. Daily Welding Equipment Setup

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

F. Quality Control of Seams

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

3.10 Additional Membrane Securement (Base Attachment)

A. Additional securement of the TPO membrane by mechanical attachment must be provided at the perimeter of each roof level, base of walls, curbs, skylights, expansion joints, tie-ins, interior walls, bottom of valleys and any angle changes that exceed inclines of 2:12 (2” rise in 12”) and various penetrations as shown in the Mule-Hide Standard Details. All securement must be either horizontally to the roof deck or vertically to the base of the various penetrations as shown in the Mule-Hide Standard Details.

B. The mechanical attachment of the membrane may be achieved by the following methods:

1. 2.4” Seam Plate and appropriate fasteners through the membrane

a. The 2.4” Seam Plate and appropriate fasteners are placed with the edge of the Seam Plate approximately ½” away from the angle change. Seam Plates may be placed either horizontally or vertically depending on the conditions encountered. Refer to the Mule-Hide TPO Standard Details for proper placement.

2. Mule-Hide All Purpose Bar

a. The Mule-Hide All Purpose Bar is a specially extruded aluminum bar that

has pre-punched holes 6 inches on center. Bar may be placed either horizontally or vertically depending on the detail followed. Refer to the Mule-Hide TPO Standard Details for the proper placement. Refer to Mule-Hide Detail # MHT-UN-330 appropriate placement of the All Purpose Bar.

b. The maximum spacing of the fasteners shall not exceed 12 inches on center. Adjoining bars should be spaced approximately ½ inch to 1 inch apart. All bars must be attached at the ends a maximum of 1 inch from the end of each bar. This may require pre-drilling additional holes. All cut bars shall be deburred.

c. Under no circumstances shall the All Purpose Bar be stripped-in with TPO PS Cover Strip. TPO .045 Reinforced 6” X 100’ product may be used to strip-in the All Purpose Bar with a continuous, minimum of 1-1/2” (40 mm) wide weld.

d. The All Purpose Bar must be installed a minimum of 3 inches to a maximum of 6 inches from inside and outside corners.

3. TPO PS RUSS attachment strip

a. The RUSS is a 6" wide reinforced strip of TPO membrane that may be installed at the base of walls and curbs. Mule-Hide 2.4 inch Seam Plates are used to attach the RUSS horizontally with appropriate fasteners. Refer to Mule-Hide Detail # MHT-UN-305B for appropriate placement of the RUSS, plates and fasteners. The RUSS attachment strip is installed prior to the placement of the field sheet. The RUSS attachment strip is to be placed on horizontal surfaces only and not turned up the vertical.

b. Follow the standard procedures for cleaning, applying primer and adhering the RUSS and field sheet. Only Mule-Hide TPO Primer or Low VOC Primer may be used to adhere the RUSS to the field sheet. Bonding Adhesive is **not permitted** for use with the RUSS attachment strips.

c. Spacing of the fasteners shall not exceed 12 inches on center. Adjoining RUSS attachment strips shall be spaced a maximum of 1 inch apart. It is not required to overlap the RUSS.

d. For horizontal attachment, the RUSS attachment strip must be placed a maximum of ½ inch from the base of the angle change extending out onto the horizontal surface (roof substrate). The 2.4 inch Seam Plate must be placed a minimum of 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.

4. Drip Apron and Gravel Stop

a. For drip aprons and gravel stops, the metal flange shall extend a minimum of 3 inches onto the wood nailer. The wood nailer must be wider than the metal flange. Approved screw fasteners shall be installed a maximum of 6 inches on center and 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 TPO Primer or Low Voc Primer and stripped with Mule-Hide’s TPO PS Cover Strip. Cleaning the metal with a solvent such as toluene or xylene to remove oil film may be required prior to

installing and priming with the TPO Primer. Refer to Mule-Hide detail # MHT-UN-106B.

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

3.11 Flashing Installation

A. TPO Membrane Flashings

1. All membrane flashings are to be installed concurrently with the roof membrane as the project progresses. Temporary flashings are not allowed without prior written approval from the Mule-Hide 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 surfaces to be fully adhered should be compatible, dry and smooth with no excessive surface roughness.

3. On recover projects, all existing base flashings must be removed down to the substrate or covered with new suitable material. If deteriorated areas of substrate are uncovered, repairs must be made to provide a suitable substrate for the new TPO flashings.

B. **TPO Bonding Adhesive, Low VOC Bonding Adhesive, and Low VOC Bonding Adhesive - 1168 (solvent base)**

1. Mix adhesive scraping the sides and bottom of the can (minimum 5 minutes is required) until adhesive is uniform in color. Consult product data sheet for adhesive instructions.

   a. Low VOC Bonding Adhesive and Low VOC Bonding Adhesive – 1168 require mechanical stirring (electric drill), both initially and periodically during application.
   b. Porous surfaces and substrates may require the application of a prime coat and second coat of Low VOC Bonding Adhesive and Low VOC Bonding Adhesive – 1168 to accomplish proper adhesion.

2. Using a plastic core, medium nap roller, apply a smooth even coat of TPO Bonding Adhesive to back side of membrane and substrate (no globs or puddles). A nine inch roller will easily fit into a 5-gallon adhesive container. **Do not apply adhesive in area of seam laps.**

3. Coverage rate to be approximately:
   120 square feet per gallon for one surface (membrane or substrate only)
   or
   60 square feet per gallon per finished surface (membrane and substrate)

4. Allow adhesive to dry to a ‘tacky’ state. Test adhesive by placing a knuckle into it and turning your wrist a one-quarter turn. Adhesive is ready to mate when it is tacky but does not string when knuckle is lifted.

5. Care must be taken to ensure proper drying. Avoid thin layers of adhesive which can result in over drying and improper adhesion.

6. Roll coated membrane onto substrate being careful to not wrinkle the sheet or trap air bubbles. Once membrane is mated to the substrate, carefully roll the membrane with a 2-inch wide rubber hand roller to promote maximum positive contact between the membrane and the substrate.

7. TPO Membrane Flashings shall extend a minimum of 6 inches onto the field

sheet and be adhered securely. There shall be a minimum of 2 inches between the front of the fastener plates and the edge of the sheet to allow for heat welding. All side laps are to overlap a minimum of 2 inches.

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

9. Extended drying times can be expected during cool, overcast, humid, shaded, or late day applications. The adhesive must be dry (but still tacky) before mating surfaces to avoid permanent blisters due to trapped solvents.

10. All flashings shall be extended a minimum of 8 inches above roof membrane level and be terminated unless previously accepted by the owner or his representative and the Mule-Hide Technical Department. All flashings shall be hot air welded at their connections with the roofing membrane. Apply Cut Edge Sealant at all welded edges of cut membrane flashings. Refer to Mule-Hide TPO Standard Details for more information.

NOTE: After flashing is adhered in place, promote full contact adhesion by going back over entire area with a 2-inch rubber hand roller.

C. **WBBA-2000** (Water Base Bonding Adhesive)

1. Mix adhesive scraping the sides and bottom of the can (minimum 5 minutes is required) until adhesive is uniform in color. Consult product data sheet for adhesive instructions.

2. Using a 9” wide, ¼” or 3/8” nap roller, apply a smooth even coat of WBBA-2000 adhesive to back side of membrane and substrate (no globs or puddles). A nine inch roller will easily fit into a 5-gallon adhesive container. **Do not apply adhesive in area of seam laps.**

3. Coverage rate to be approximately:
120 square feet per gallon for one surface (membrane or substrate only)
or
60 square feet per gallon per finished surface (membrane and substrate)

4. Allow adhesive to dry until it turns translucent and does not transfer to a dry finger or pull away from the substrate. WBBA-2000 adhesive will take a longer time to dry. Adhesive must remain tacky.

5. Mate surfaces together avoiding wrinkles. Immediately roll the bonded area of the sheet with a 2-inch wide rubber hand roller to promote maximum positive contact between the membrane and the substrate. Overlap all adjacent flashing sheets a minimum of 2 inches.

6. **Do not apply adhesive in area to be heat-welded.**

7. Extended drying times can be expected during cool, overcast, humid, shaded, or late day applications. The adhesive must be dry (but still tacky) before mating surfaces to avoid permanent blisters due to trapped moisture.

8. Overlap all adjacent flashing sheets a minimum of 2 inches. TPO Membrane Flashings shall extend a minimum of 6 inches onto the field sheet and be adhered securely. There shall be a minimum of 2 inches between the front of the fastener plates and the edge of the sheet to allow for heat welding. All side laps are to overlap a minimum of 2 inches.

9. All flashings shall be extended a minimum of 8 inches above roof membrane level and be terminated unless previously accepted by the owner or his representative and the Mule-Hide Technical Department. All flashings shall be

hot air welded at their connections with the roofing membrane. Apply Cut Edge Sealant at all welded edges of cut membrane flashings. Refer to Mule-Hide TPO Standard Details for more information.

NOTE: After flashing is adhered in place, promote full contact adhesion by going back over entire area with a 2-inch rubber hand roller.

10. 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.

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

NOTE: When using Mule-Hide All-Purpose Bar under Counterflashing to terminate wall flashing or when coping is used, TPO Bonding Adhesive, Low VOC Bonding Adhesive, Low VOC Bonding Adhesive – 1168, or WBBA-2000 Bonding Adhesive may be eliminated when flashing height is 12” - 18” or less, depending on the type of termination. Refer to Mule-Hide’s published Standard TPO Details for additional information.

3.12 Drains, Expansion Joints, Pitch Pans

A. Roof Drains

1. Prepare the surface around each drain to prevent any distortion, tenting, or bridging of the membrane. A smooth transition shall be provided from the roof surface to the surface of the drain bowl/clamping ring.

2. All existing roofing materials and metal flashings shall be removed.

3. Mule-Hide requires the application of one full tube of Water Cut-Off Mastic per drain applied to the drain bowl, under the membrane, where the clamping ring will be seated. This will provide a continuous seal between the membrane and the drain bowl.

4. Do not run field seams through drains or sumps. If sheet layout causes a seam to fall in line with a drain or sump, a target patch (minimum 36” x 36”) shall be required.

B. Expansion Joints

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

C. Pitch Pans

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

3.13 Walkway Installation

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

A. TPO Walkway Roll Installation

1. Install TPO Walkway Rolls over clean, dry surfaces.

2. Layout areas where TPO Walkway Rolls are to be installed with most of the material being oriented so that it is placed between field seams with each adjacent and abutting section gapped a minimum of 6". Do not install walkway

pads over seams.

3. Heat weld the perimeter of the properly positioned TPO Walkway Roll. Check seams for any voids or inconsistencies that might prevent watertightness.

B. Precast Pavers

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

3.13 Temporary Tie-ins

A. Install temporary cutoffs around incomplete edges of roofing assembly at the end of each day's work and when work must be postponed due to inclement weather. 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 at least six inches in width overlaid with an embedded reinforcement on gravel surfaced roofs. Use polyurethane sealant, low rise foam adhesive, or pourable sealer to seal onto single plies, smooth BUR, or modified bitumen roofs. 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.

MULE-HIDE PRODUCTS CO., INC
Ballasted Roofing System
SUMMARY SPECIFICATION

TPO Systems

This Summary Specification is a brief overview of Mule-Hide Product's specification and requirements for a Ballasted Mule-Hide Reinforced TPO Roofing System and is intended for use as a submittal in a bid package. Specifier's and Mule-Hide Warranty Eligible Contractors must comply with Mule-Hide Product's specifications and requirements prior to design or bid.

Part 1 General

1.01 Description

The Mule-Hide Ballasted Reinforced TPO Roofing System utilizes a (maximum) 12' wide, scrim reinforced Mule-Hide TPO membrane in thickness of 45, 60, or 80 mil. Approved insulation is loosely laid to the substrate, and the TPO membrane is loosely laid over the insulation. The entire roof assembly is then covered with rock ballast, pavers, or a combination of both. The adjoining sheets are overlapped approximately 3" and seamed together with a min 2" wide heat weld.

1.02 Quality Assurance

A. The roofing system must be installed by a Mule-Hide Warranty Eligible Contractor in accordance with installation guidelines and detail drawings as approved by Mule-Hide. Prior written approval from the Mule-Hide Warranty Department is required for all deviations from Mule-Hide's published specifications and details.

B. Projects requesting a Labor and Material Warranty will be inspected by a Mule-Hide Representative to verify that Mule-Hide's installation and material requirements have been met.

C. Mule-Hide roofing systems offer a variety of Underwriters Laboratories (UL), Factory Mutual (FM) and other ratings. Consult the appropriate approval guides and Mule-Hide Products for specific code approvals.

1.03 Submittals

A. To ensure compliance with Mule-Hide's warranty requirements contact the Mule-Hide Warranty Department if any of the following conditions exist.
   1. Specified wind speed warranty greater than 55 MPH.
   2. Building height is greater than 60'
   3. Projects located in coastal or high wind zones.
   4. Pressurized buildings
   5. Cold Storage or Freezer Buildings
   6. Membrane exposed to chemicals

B. Submit a completed Warranty Application form to Mule-Hide prior to bidding. Also include fastener pullout testing results as required for non-standard substrates.

C. All projects must have a Mule-Hide warranty application number assigned prior to inspection.

1.04 Product Delivery, Storage, and Handling

A. Deliver materials to the job site in original, unopened containers, with the manufacturer's name, brand name and installation instructions.

B. Store all materials in a dry, clean area protected from the elements, as per manufacturer's recommendations.

1.05 Job Conditions

A. All existing wet or damaged roofing materials must be removed and replaced with new materials.

B. All existing phenolic insulation and sprayed-in-place urethane roofs must be removed.

C. The specifier must determine the use and placement of vapor retarders. Consult ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.) and NRCA (National Roofing Contractors Association) publications.

D. Coordinate work between all trades to avoid traffic over completed sections of roofing.

1.06 Warranty.

Fees are required for all Labor and Material (System) Warranties. System Warranties must be obtained through a Mule-Hide Warranty Eligible Applicator. All projects requesting a System Warranty must be inspected by a Mule-Hide Representative. Components of the roofing system must be supplied by Mule-Hide. Warranty covers only Mule-Hide supplied materials. Sample warranties are available upon request. Contact Mule-Hide Warranty Department for warranty requirements.

Part 2 Products

2.01 General

A. The components of this roofing system are to be manufactured, supplied, or approved in writing by Mule-Hide Products.

2.02 Membrane

Mule-Hide White, Gray, or Tan, reinforced 45, 60, or 80-mil thick Thermoplastic Polyolefin (TPO) membrane is used for this system. The membrane is available in a variety of widths up to 12' and in lengths of 100'. Refer to our Product Data Sheet for physical properties and other information.

2.03 Related Materials

Mule-Hide products include: Reinforced and Non-Reinforced Flashings, Bonding Adhesives, TPO Cut-Edge Sealant, TPO Coated Metal, Membrane fasteners and discs, Thermoplastic One-Part Pourable Sealer, All-Purpose Bar, TPO Walkway Roll, Universal Single Ply Sealant, and other components.

Part 3 Execution

3.01 General

A. Work should begin at the highest point of the roof level and proceed to the lowest point. Work should be completed on a daily bases including flashings, terminations, and daily seals.

B. Prepare the existing roof deck or substrate according to Mule-Hide design guides and full-system specifications prior to applying the new roofing system.

3.02 Roof Deck Criteria

A. A proper substrate shall be provided by the building owner. The structure shall be able to withstand normal construction loads and live loads.

B. Substrate must allow for drainage so that all water is removed within 48 hours after a rain.

C. Roof deck must be capable of supporting a ballasted roofing system.

3.03 Substrate Preparation

A. Re-cover projects - All wet or damaged materials must be removed and replaced with new materials.

B. Substrate must be clean, level, and smooth so that the insulation lays flat. Fresh applications of bitumen based roof cement must be removed or covered.

3.04 Installation

Refer to the applicable Product Data Sheets and Material Safety Data Sheets for cautions and warnings.

A. Insulation Attachment

Roof insulation is loosely laid in place over existing substrate.

B. Membrane Installation and Hot Air Welding

Place membrane over substrate with minimum 3" overlap at lap seams and positioned so that laps will shed water. Allow membrane to relax. Hot-air weld seams with automatic welder to achieve a minimum 2" wide heat weld. Hand welded field seams are not allowed. Ballast membrane with washed river rock at a minimum rate of 10 lbs per square foot or concrete pavers at a minimum rate of 22 lbs per square foot.

C. Additional Membrane Securement

The membrane must be secured at the perimeter of each individual roof area, projection, and any angle change that exceeds 2" per lineal foot. Consult Mule-Hide's published detail drawings.

D. Membrane Flashing

All existing base flashings are to be removed or covered with a suitable material. Install new membrane flashings as per manufacturer's details and guidelines. Flashings must be terminated along top edge as per appropriate Mule-Hide detail.

E. Other Related Work

1. Walkways should be provided in areas where regular rooftop traffic is expected. Walkways are considered a maintenance item and are excluded from the Mule-Hide warranty.

2. Mule-Hide TPO Walkway Rolls are to be installed over clean, dry surfaces, with a minimum 6" spacing over field seams. Hot air weld the perimeter of the Walkway Roll to the field membrane.

3. Concrete pavers may be used if installed over one layer of HP Protection Mat.

4. Copings, counter flashing and other metal work shall be fastened to resist wind uplift and prevent buckling. Metal should be sealed to prevent moisture infiltration.

This summary specification represents the applicable information available at time of publication. Mule-Hide reserves the right to change this information at any time. Contact Mule-Hide Products or visit our website at www.mulehide.com for the latest updates, changes, or modifications to this summary specification.