

Technical Guide

"The name trusted in roofing since 1906"



HOW TO INSTALL MULE-HIDE REINFORCED TPO MEMBRANES

BASIC CONSIDERATIONS

The installation of a Mule-Hide roof involves procedures and techniques that have been carefully conceived and engineered to help you provide your customers with the most reliable, lowest maintenance roofing system available.

Successful roof installations do not just happen; they must be carefully planned and implemented. An understanding of the basic properties of the Mule-Hide system can help the contractor exploit its unique strengths and to avoid unnecessary problems. Keep the following in mind as you go through this section: Mule-Hide TPO Heat-Weld Membranes are polyester scrim-reinforced, single-ply roofing systems designed for mechanical, fully adhered, and ballasted attachment with hot-air welded seams. Mule-Hide TPO membrane is formulated with polymers that are highly resistant to sunlight and weather as well as many chemicals.

The remainder of this section covers the proper methods of performing each step of the installation. This material was written to provide the contractor with practical, detailed information that can help ensure the proper performance of each step of the Mule-Hide installation.

THE ADVANTAGE OF HOT-AIR WELDABILITY

The unique hot-air weldability of both the scrim-reinforced TPO field sheet membrane and non-reinforced TPO flashing membrane gives the contractor a special advantage when completing roof details. When used in connection with roofing details, hot-air welding provides the same assurance of watertightness as in field seaming - assurance that comes from permanently fused seams that can be as strong as the Mule-Hide TPO Membrane itself.

GENERAL APPROACH

The general approach to complete common roofing features involves hot-air welding, Mule-Hide Bonding Adhesive, Mule-Hide TPO Cut Edge Sealant, and terminating flashings. Common roofing features include such details as wall flashings, vertical and flat edge terminations, inside corners, outside corners, round shapes, drains, curbs and pitch pockets. Mule-Hide recommends that you rely on pitch pockets only as a last-ditch measure, although from time to time they can provide efficient means of dealing with particular problems concerning irregularly shaped projections.

As a general approach, the Bonding Adhesive is used to adhere, as appropriate, field sheet membrane to features such as curbs, vents, and parapets. Then hot-air welding is used to seam membrane overlaps and Mule-Hide TPO Cut Edge Sealant is applied to cut edges of reinforced membrane.

IMPORTANT: All roofing work must follow Mule-Hide TPO Standard Details. Any failure to complete details to Mule-Hide specifications can stand between you and a favorable inspection - and therefore, a Warranty. If no TPO Standard Detail applies to a particular requirement of your job, sketch the way you think it should be handled and submit the sketch with your Pre-Job Survey for approval. Consult Mule-Hide's Technical Department if you have any questions about the Mule-Hide TPO Standard Details.

NOTE: No deviation from Mule-Hide TPO Standard Details is authorized until: (1) it is submitted by the contractor in writing or sketch form for review and the job file, and (2) is approved by Mule-Hide's Technical Department.

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PREPARING THE SUBSTRATE

The substrate under the Mule-Hide TPO Membranes must be properly prepared. The general goal of this preparation is to provide a smooth compatible surface for the insulation (when required) and the membrane.

The contractor should follow good roofing practice when evaluating and preparing the surface. For example, as general practice, especially on reroofing jobs, prepare the entire roof before starting the Mule-Hide installation in order to minimize contamination and ensure the integrity of the seams. By keeping in mind the general properties of the Mule-Hide TPO Membrane you can help evaluate unusual situations when they arise; but if you are in doubt as to the resolution of problems not addressed on the Mule-Hide TPO Standard Details or Specifications, contact the Mule-Hide Technical Service Department for advice.

New Roofing Installations

On new roofing installations, keep the deck and insulation surface free of debris and trash. Note precisely the location of structural members, electrical conduits, and gas and water lines under the deck, as well as general deck characteristics that will affect the placement of mechanical fasteners - such as the direction and spacing of steel deck flutes.

Follow good roofing practice in the loading of the roof with Mule-Hide Heat-Weld Membrane rolls. Stack carefully and store in a cool, clean, dry location.

CAUTION: Keep the packaging protecting the Mule-Hide Heat-Weld Membrane intact until used.

Reroofing Installations

To ensure a successful reroofing job, you must be aware of the conditions that led to the need for the reroof. It may be that leakage has occurred from sources other than the roof. If so, be sure that the Building Owner or Operator is aware of any such sources as early as possible and understands that the application of a new roof may not solve all of the leakage problems. Some useful points to cover in your evaluation follow.

Investigate existing leakage conditions thoroughly. Before the installation begins, be sure that a thorough investigation of existing roof conditions has been performed and that a review of "as-built" plans and specifications for the building, as well as the assessment of current conditions, has determined that the building is structurally sound and otherwise suitable for reroofing.

It is helpful to know such details as the nature, extent, and duration of leaks that may have occurred through the old roofing. Because leaks often occur from sources such as building parapets, walls, and windows, a new roof may not solve all leakage problems. Check the building walls for dampness, spalling brick, large stress cracks, and efflorescence (salty, powdery deterioration) - signs of problems that extend beyond the roof itself. Look for stains inside the building and be sure that all sources of such stains are known.

Evaluate existing roof conditions: The cause(s) of poor drainage conditions should be thoroughly understood and solved as part of the reroofing process. For example, check for signs of ponding, a sure sign of poor drainage. If ponding occurs, determine the extent and duration of ponding. If needed, are overflow scuppers or other means of supplemental drainage present? Determine if a provision should be made for their installation.

Are there noticeable splits in the existing roofing? Splits may indicate a change in substrate or metal deck direction; they could be indications that an expansion joint is required.

Be sure that you know ALL types and conditions of substrate that are present, the spacing of structural members under the deck, the direction and gauge of a steel deck, the thickness of concrete, thickness of insulating fill (if present), drain placement, slope, and the location of expansion joints.

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Make a roof drawing: Once on the roof, work up a detailed roof drawing on the Mule-Hide Pre-Job Survey showing all dimensions, drains, mechanical equipment, penetrations, skylights, monitors, parapet walls, and other features. You will have to submit your drawing(s) as part of the Warranty Application.

Removal (tear-off) of existing roofing: Your crews should remove no more roofing and insulation from a given area of the roof than what can be completely covered with new insulation and Mule-Hide TPO membrane that day. On tear-offs, ALL gravel and debris will have to be broomed from the deck.

Reroofing over existing roofing: When reroofing over old roofing, broom ALL gravel and debris from the old roofing surface, cut out blisters and fishmouths, and seal. When reroofing over existing single ply membranes, cut the existing membrane in 10' x 10' grids. Remove and replace wet insulation as required. Tear off all existing flashings or cover with a suitable material (plywood, OSB, metal, etc.).

LAYING INSULATION

If old insulation is present and is to be retained, you should determine if it is wet. The surest diagnostic technique is by taking and evaluating a series of roof cuts. Alternatively, three techniques currently available to make this determination by indirect means are: nuclear moisture detection, infrared thermography, and electrical capacitance.

These techniques provide measurements of factors that can be associated with the presence of moisture. As such, they can help point out certain inconsistencies in the existing roof system but do not necessarily provide valid measures of moisture. Limited direct verification is always advisable.

Whatever your method of investigation, wet insulation must be removed and replaced. The presence of wet insulation must be noted on the Pre-Job Survey. These areas must be designated on the roof diagram.

Insulation must be laid and fastened according to its manufacturer's specifications and at a minimum must follow Factory Mutual's suggested guidelines.

The longest dimension of the insulation should run PARALLEL to the flutes of a steel deck and PERPENDICULAR to the direction in which the Mule-Hide field sheet will be unrolled. Regardless of the approved lay of the insulation board, the membrane field sheet direction must be proper with respect to the deck construction, as explained in "Installing Membrane - Field Sheet Membrane."

Lay no more new insulation than will be covered by the roofing membrane on the same day. Work on any given area of the roof must be made completely watertight at the end of each workday.

Good roofing practice dictates that care should be taken to achieve smooth transitions between insulation boards and roof areas. Always consider proper drainage and adjust thicknesses accordingly to achieve proper drainage. The membrane should never have to bridge an area and transitions should never cause ponding.

INSULATION ATTACHMENT

Mechanically Attached Systems

For a Mechanically Attached System, the roof insulation is attached to the substrate in order to keep the insulation in place. The individual boards are typically attached as follows:

- 4' x 8' Insulation Boards, less than 2" thick – 6 fasteners/plates per board over entire roof area.
- 4' x 8' Insulation Boards, 2" or more thick – 5 fasteners/plates per board over entire roof area.
- 4' x 4' Insulation Boards – 4 insulation fasteners/plates per board over entire roof area, regardless of thickness.

The 3" Galvalume Stress Plate must be used with a minimum #12 Drill Point Fastener to fasten roof insulation. See page 3 of the Fastener Guidelines portion of this manual for basic fastener patterns. Consult the Mule-Hide Technical Department for additional questions.

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Fully Adhered Systems

In a Fully Adhered System, the membrane is bonded directly to the insulation or substrate. Therefore, the strength, or wind uplift resistance of a Fully Adhered System is dependent upon the type and thickness of the *top most layer* of insulation and the method/density of insulation attachment (fasteners and/or foam adhesive). This requires increased insulation attachment for a Fully Adhered System over a Mechanically Attached one.

The density of insulation attachment used varies across the roof area. In the center of the roof, called the Field, the uplift pressures are calculated and the appropriate density of insulation attachment is specified to meet the design uplift pressures. Uplift pressures are greater in the Perimeter and Corner areas of the roof, resulting in the need to increase insulation attachment in those areas. It is the Field attachment requirements that set the requirements for the Perimeters and Corners. The Perimeter attachment requirements are generally 50% more than what is required in the Field and the attachment requirements in the Corners are generally 100% more than what is required in the Field.

The 3" Galvalume Stress Plate must be used with a minimum #12 Drill Point Fastener to fasten roof insulation. Basic insulation attachment patterns can be found in the Fastener Guidelines portion of this manual, beginning on page 3. More specific information is available in our Design Summary's located in Section 2 of this manual. Contact Mule-Hide Technical Department for addition information.

Low rise foam adhesives can be used in lieu of mechanical fasteners to attach insulation to the roof deck. Roof decks that are non-conductive to mechanical attachment, such as concrete, gypsum, lightweight concrete, or cementitious wood fiber, are prime candidates for the use of low rise foam adhesives to attach roof insulation. The Mule-Hide Technical Department must be contacted prior to bidding any project where low rise foam adhesives are being considered.

MEMBRANE ATTACHMENT

Mechanically Attached Systems

Perimeter Enhancements

To ensure that your installation meets the Mule-Hide specifications, refer to TPO Standard Details as you read this section.

CAUTION: Keep the protective packaging of the Mule-Hide Heat-Weld Membrane intact until ready to use.

NOTE: Half-sheet dimensions are 50% to 60% of the width of the field sheet. The field sheets must always be installed perpendicular to steel deck flutes, plywood deck joints, or deck plank direction, as appropriate. All field seams shall be shingled with the flow of water. Mule-Hide requires a minimum perimeter enhancement of 1 perimeter half sheet on all TPO Mechanically Attached systems. Consult TPO Tech Bulletin MA02-2006 for TPO half sheet requirements.

There are three methods for perimeter enhancements. Perimeter Enhancements can be formed by using individual 4' to 6' wide sheets, by subdividing 8' or 10' wide field sheets using 10" wide Pressure-Sensitive RUSS strip, or by installing rows of seam fastening plates through the top of the membrane and patching with appropriate materials.

1. Individual Perimeter Sheets Method

Position the half-sheets (either 4' or 6' wide) along the perimeter of the roof over the acceptable insulation/underlayment. Mechanically attach the half-sheets using Seam Plates and appropriate HD fasteners at the designated spacing dictated by the building height and roof deck type. TPO membrane is always fastened with 2.4" Seam Plates and minimum #14 HDP fasteners.

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a. Over steel roof decks

All seams and fastener rows must run perpendicular to the ribs of the deck. This requirement will necessitate that perimeter sheets on two sides of the roof (where the seams would be running parallel with the ribs of the deck) be turned so that the seams in the perimeter sheets run perpendicular to the deck ribs. See Details MHT-FM-308B, MHT-FM-310B, or MHT-FM-312B.

2. 10" RUSS Method

When **field sheets are positioned parallel to a roof perimeter, 10" wide TPO Pressure-Sensitive RUSS** (with 3" wide tape each side) shall be placed approximately down the center of the 8', 10', or 12' wide TPO field membrane sheets. When a 10" RUSS divides a field sheet in half, two perimeter sheets are created.

Unroll and position the 10" wide TPO Pressure-Sensitive RUSS over the insulation/substrate where membrane securement is desired. Locate the RUSS with the fastener markings and tape facing upwards.

Position Mule-Hide Seam Plates at the same spacing as the field sheets and secure with an appropriate fastener. Do not fasten plates over top of the release liner as this will cause the liner to tear when removed. 10" RUSS is always fastened with 2.4" Seam Plates and minimum #14 HDP fasteners.

Position the field sheet membrane and **thoroughly clean the underside of the TPO membrane using Weathered Membrane Cleaner if necessary.** (The entire membrane surface where the tape is to contact must be clean. The adhesive on the TPO Pressure Sensitive RUSS will not adhere to dusted / dirty surfaces). Apply Tape Primer to the underside of the membrane and let dry until tacky, remove the plastic release liners, and mate the field sheet to the 10" RUSS.

a. Over steel roof decks

Position "fingers" of 10" TPO RUSS below the membrane along the center of each field sheet where the field membrane sheets **extend perpendicular to the edge of the roof.** The 10" TPO RUSS should extend a distance equal to the perimeter enhancement dimension required by the specifications. Refer to Details MHT-FM-308A, MHT-FM-310A, or MHT-FM-312A.

CAUTION: 6" wide TPO RUSS is only available with 3" wide tape on one side and therefore cannot be used for perimeter enhancements.

3. Fastening Plates Method

In lieu of the 10" TPO RUSS securement method, position a row of seam fastening plates on top of the membrane down the center of the 8', 10', or 12' wide field sheets. Secure plates with appropriate fastener through the membrane and overlay plates with 6" wide Pressure-Sensitive TPO Cover Strip or 6" Reinforced TPO Cover Strip hot air welded to the field membrane. TPO membrane is always fastened with 2.4" Seam Plates and minimum #14 HDP fasteners.

On projects requesting warranties of 20 years or more, the plates and fasteners must be overlaid with 6" Reinforced TPO Cover Strip and hot air welded to the field membrane. Cut Edge Sealant must be applied to all cut edges of the Reinforced TPO Cover Strip.

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a. Over steel roof decks

Position “fingers” of Seam Plates and appropriate fasteners on top of the membrane along the center of each field sheet where the field membrane sheets **extend perpendicular to the edge of the roof**. The rows of Seam Plates and appropriate fasteners should extend a distance equal to the perimeter enhancement dimension required by the specifications. Refer to Details MHT-FM-308A, MHT-FM-310A, or MHT-FM-312A

NOTE: Consult Fastener Guidelines (Section 5) for determination of “perimeter” and fastener spacing.

Buildings with special conditions

Air pressurized buildings, canopies and buildings with large openings where the total wall openings exceed 10% of the total wall area on which the openings are located (such as airport hangars, warehouses and large maintenance facilities) will typically require additional perimeter enhancement. Refer to Details MHT-MA-103A or MHT-MA-103B

Field Sheet Membrane

1. Unroll the first full-width sheet membrane. Roll out the full-width Mule-Hide field sheet membrane so that it laps UNDER the perimeter half sheet by 5-1/2 inches. This will produce a 2 to 2-1/2 inch clear lap area for seam welding. Position the butt end of the membrane so that it will be overlapped 5-1/2 in. by the half-sheet that will be installed perpendicular to the field sheets.

- a. On Steel Roof Decks – run the first full width sheet so that the seam is perpendicular to the ribs of the deck. If perimeter half sheets are used, roll out the first full-width sheet so that it laps under the perimeter sheet by 5-1/2 inches on the roof edge that is perpendicular to the ribs of the deck. Run the full-width sheet all the way to the roof edge on the sides that are parallel to the ribs of the deck.

NOTE: All field seams shall be shingled with the flow of water.

2. Allow the membrane to relax at least 15 minutes prior to fastening, 30 minutes when the temperature is below 60° F.
3. Fasten the field sheet. TPO membrane is always attached with 2.4” Seam Plates and minimum #14 HDP fasteners. Mechanically fasten both edges and the butt end of the first field sheet (that overlaps a half sheet) into the deck. Take care to avoid making wrinkles. Fasteners must be installed so that the plates are 1/2 in. from the edges and end of field sheet. Space fasteners apart as required for the specific deck type and wind uplift requirements (see Section 4).
4. Install two more field sheets. These and subsequent rolls of field sheet membrane must OVERLAP by 5-1/2 inches (to the scribed lap line) the previous runs of field sheet membrane. Align ends so that they will be overlapped 5-1/2 inches by the perpendicular half-sheet, if used. Mechanically fasten field sheet into the deck along the edge that does not overlap the previous sheet. Space fasteners apart as indicated for the specific deck type and wind uplift requirements.
5. See Hot Air Welding section on Page 9.

NOTE: Wherever there is a change in plane greater than 2” per foot, base attachment must be installed. Base attachment can be accomplished by the use of 6” TPO Pressure Sensitive RUSS with Seam Plates and appropriate HD fasteners, Seam Plates and appropriate HD fasteners through the top of the membrane, or A/P Bar and appropriate fasteners. Refer to TPO Standard Details for approved base attachment construction.

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NOTE: Pay special attention to the “T” lap seams formed where the perpendicular half-sheet overlaps the butt ends of the field sheets and at the end laps of the field sheets. To ensure proper seaming of the “T” joints for 45 mil membrane with warranty lengths not exceeding 15 years, 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. On all 60 mil and 80 mil membranes and on projects requesting warranties exceeding 15 years, a separate “T” patch constructed of non-reinforced membrane is heat welded directly over the “T” joint.

Fully Adhered Systems

Perimeter Half Sheets are NOT required in a Fully Adhered System. However, increased insulation fastening densities are required in the perimeters and the corners to compensate for the increased wind forces in these areas. Mule-Hide requires the following additional insulation attachment provisions:

Perimeters – insulation attachment to be increased 50% over the field attachment requirements with a maximum of one (1) fastener every one (1) square feet.

Corners – insulation attachment to be increased 50% over the field attachment requirements with a maximum of one (1) fastener every one (1) square feet.

Mule-Hide defines the perimeter and corner width as a minimum of eight (8) feet. See Details MHT-UN-108A and MHT-UN-108B

To ensure that your installation meets the Mule-Hide specifications, refer to TPO Standard Details as you read this section.

CAUTION: Keep the protective packaging of the Mule-Hide Heat-Weld Membrane intact until ready to use.

Position membrane over substrate with a minimum 3” overlap at lap seams, and positioned so that laps will shed water. Allow the membrane to relax at least 15 minutes prior to adhering, 30 minutes when temperatures are below 60° F. After membrane has relaxed, fold membrane in half lengthwise exposing the underside of the sheet. Pails of adhesive are often used to weight the back edge of the membrane to hold it in position.

Using a medium nap roller, apply a smooth even coat of bonding adhesive to back side of membrane and substrate. Coverage rate should be 120 square feet per gallon per side for an installed coverage rate of 60 square feet per gallon. **Do not apply adhesive in area of seam laps.** 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 does not string when knuckle is lifted.

Roll coated membrane onto substrate being careful to not wrinkle the sheet or trap air bubbles. Once the membrane is mated to the substrate, thoroughly broom into place with a stiff bristled push broom to ensure proper contact and 100% adhesion. Repeat this procedure for remaining sheets.

See Hot Air Welding section on Page 9.

NOTE: Wherever there is a change in plane greater than 2” per foot, base attachment must be installed. Base attachment can be accomplished by the use of 6” TPO Pressure Sensitive RUSS with Seam Plates and appropriate HD fasteners, Seam Plates and appropriate HD fasteners through the top of the membrane, or A/P Bar and appropriate fasteners. Refer to TPO Standard Details for approved base attachment construction.

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NOTE: Pay special attention to the “T” lap seams at the butt ends of the field sheets. To ensure proper seaming of the “T” joints for 45 mil membrane with warranty lengths not exceeding 15 years, 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. On all 60 mil and 80 mil membranes and on projects requesting warranties exceeding 15 years, a separate “T” patch constructed of non-reinforced membrane is heat welded directly over the “T” joint.

FLASHING DETAILS

While many roofing jobs are likely to have their own special problems, the contractor is just as likely to face certain rooftop features over and over again. This section explains how to accommodate these common roof features quickly and effectively, time after time with the Mule-Hide TPO Membrane Roofing Systems.

In general, when dealing with common roof features (curbs, vents, etc.) complete the pertinent details per Mule-Hide TPO Standard Details. When approaching such features, cut and fit the membrane around each obstacle you encounter. All membrane flashings shall be installed concurrently with the roofing membrane as the job progresses. Install night seals as necessary at the end of each workday. Should any water penetrate the new roofing because of incomplete flashings, the affected areas shall be removed and replaced. In reroofing, maintain the ability of the existing roof to drain - don't block off drains or scuppers.

Base Attachment

Wherever there is a change in plane greater than 2” per foot, base attachment must be installed. Base attachment can be accomplished by the use of 6” TPO Pressure Sensitive RUSS with Seam Plates and appropriate HD fasteners, Seam Plates and appropriate HD fasteners through the top of the membrane, or A/P Bar and appropriate fasteners. 6” RUSS is always fastened with 2.4” Seam Plates a minimum #14 HDP fasteners. Refer to TPO Standard Details for approved base attachment construction.

Standard Details

IMPORTANT: All roofing detail work must follow Mule-Hide TPO Standard Details. Any failure to complete details to Mule-Hide specifications can stand between you and a favorable inspection - and therefore, a Warranty. Consult Mule-Hide Technical Service department if you have any questions about how to solve special roofing problems using the Mule-Hide system, or about the Mule-Hide TPO Standard Details.

Curbs, Vents, and Roof-to-Wall Flashings

Install approved base attachment required around these penetrations. Cut flashing membrane using the Mule-Hide Reinforced TPO Membrane as required. All TPO Membrane flashings shall be fully adhered using an approved Mule-Hide bonding adhesive. The following conditions must be met:

1. All existing flashing materials must be removed down to the substrate or covered with a suitable material. All surfaces to be fully adhered should be compatible, dry and smooth with no excessive surface roughness.
2. After the proper surface has been prepared, the approved Mule-Hide bonding adhesive shall be applied to both the back of the membrane and the substrate using a minimum 1/2 inch nap paint roller at a rate of approximately 1 gallon per 120 square feet of surface area depending on the type of substrate. Installed coverage rate will be 60 square feet per gallon. Apply adhesive in smooth even coat, avoiding globs, puddles, or other types of irregularities.

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Let adhesive dry sufficiently to produce strings when touched with a dry, clean finger. Mule-Hide TPO Membranes used as flashing shall be cut to a workable length and shall have an even coating of bonding adhesive applied to it at a rate of approximately 1 gallon per 120 square feet. Installed coverage rate will be 60 square feet per gallon. Carefully roll onto the previously coated substrate after the adhesive coating on 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 roll the membrane 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. The TPO Membrane Flashings shall extend a minimum of 6 inches onto the field sheet to allow the use of the automatic welder on the flashing seams. There shall be a minimum 2 inches hot-air weld in front of any fastener plates used on top of the membrane.

Areas of the flashings and membrane to be welded are not to have bonding adhesive applied to them.

All flashings shall extend a minimum of 8 inches above roof membrane level unless previously accepted by 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 reinforced flashings. All flashings shall be properly terminated according to Mule-Hide's published TPO Standard Details.

Roof Drains

Install roof drains according to the TPO Standard Details. Field seams must not run through drains. If seams are located within 24 inches of a roof drain, a minimum 36" x 36" target patch must be installed. In reroofing, old drains must be "**thoroughly cleaned**" or replaced. Existing sealing materials must be completely removed to avoid contamination and interference with the new membrane seal and with consistent clamping pressure. Insure that drain bolts and clamping ring are in good condition. Replace missing or broken parts as required, including screens. Missing drain bolts will not be allowed.

Metal Work

Install metalwork in a manner that prevents damage from expansion or contraction and from the wind. Seal and waterproof all metalwork in an acceptable manner. Note that metalwork other than Mule-Hide Coated Metal and Mule-Hide Metal Accessories supplied by Mule-Hide are not covered by Mule-Hide Warranty.

HOT AIR WELDING OF SEAMS

To qualify for a labor and material warranty, Mule-Hide requires that all seams be welded using an automatic welder, when it is practical for the automatic welder to be used. Some examples where using an automatic welder is impractical would be:

- Highly sloped surfaces
- Severely congested roof areas where there are limited open runs down the seams
- Small roofing details

The use of an automatic welder provides a consistent 1-½" to 2" wide solid weld at the seams. Take care to avoid wrinkles. Refer to the next section of TPO System Guidelines entitled Equipment Needed to Install Mule-Hide Heat-Weld Membranes for detailed information on heat welding.

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Probing Seams

Probe all seams and repair all deficient seams no later than the following workday. **FAULTY SEAMS HAVE BEEN THE SINGLE MOST COMMON DEFICIENCY NOTED BY MULE-HIDE INSPECTORS.**

Make it a routine to probe seams each workday, and to repair all seam deficiencies with the hand welder before leaving the work site.

The probing of seams should not be done until the hot-air welds have thoroughly cooled. As a general procedure, seam probing and repair of deficiencies should be done for all seams approximately 8 hours after they are initially welded.

WARNING: Premature probing can open or damage warm seams that would have been perfectly acceptable once they had cooled.

1. Draw probing tool tip along seams. Gripping the probing tool by its handle, draw its tip along the edge of the hot-air welded seam. Apply firm pressure into the seam junction - not into the bottom sheet. The tool should not penetrate into the lap area.
2. Mark deficiencies. Using a water-soluble marker, mark off the beginning and end of voids.
3. Repair deficiencies promptly. Using a hand-held welder, repair all seam deficiencies as quickly as possible. It is required by Mule-Hide that repairs be made the same day that they are discovered.
4. Check repairs. After the repaired seams have cooled completely, probe them again. If the repair is successful, wipe off the water-soluble marker line; if not, do the repair over.

Voids and Wrinkles in Seams - General

Unprobed, defective seams are the most common problem found by Mule-Hide inspectors. If defective seams are found by the Inspector on your job, they are likely to delay the issuance of a Mule-Hide Warranty. Therefore, it is in your best interest and good roofing practice to thoroughly check your seams to ensure they are acceptable to Mule-Hide BEFORE the final inspection occurs.

Probe all seams daily. Be sure to probe ALL new seams approximately 8 hours after completion or at the beginning of the next workday. Mark all voids and other defects for repair with a water-soluble marker. All seam welds must be at least 1-½ to 2" inches wide and free of voids. Seams that do not meet these specifications are not acceptable to Mule-Hide.

Defective seams must be repaired the same day as found. All voids and otherwise defective seams must be repaired by hot-air welding with a Mule-Hide approved hand-held hot-air welder the same day as probed.

NOTE: Seams do not deteriorate over a few days' or weeks' time when properly welded. When an inspector finds voids, the contractor could have found the problem with effective probing during the installation.

Repairing Voids and Wrinkles

Voids. The presence of voids generally indicates that not enough heat is being applied to the membrane, and therefore the movement of the welding machine should be slowed down. It may also be possible that you are trying to weld membrane that is dirty or wet. Follow this procedure to clean dirty TPO:

Clean the surface to be welded. Clean the surfaces of both sheets to be welded thoroughly with Fantastik® or other similar general cleaner. Rinse clear and let dry. Surfaces must be cleaned until they are white. Make a final pass over the cleaned area with a clean rag dampened with Mule-Hide Weathered Membrane Cleaner.

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Wrinkles. The presence of wrinkles in seams indicates the possibility of voids and a weak seam. Wrinkles may form if the hot-air welding machine drags the membrane at an angle to the seam. Such dragging can be caused by a machine that is out of alignment, by the welding of seams along, up, or down too great a slope, or by the improper unrolling of the membrane so that it does not lie flat and/or parallel to the seam direction.

Wrinkles and other distortions may also occur in hand welding operations because of inconsistent hand-rolling and welder movement. The operator should strive for smooth, consistent progress. Use a low enough heat setting to permit smooth work, especially with non-reinforced sheet.

Hand welding for field seams may be necessary on steep slopes, although some contractors find that the hot-air welder machine can be “held back” by the operator (possible with a helper) when welding DOWN slopes. This practice increases the difficulty of “staying on course,” and is not recommended for the novice operator.

SPECIAL PROBLEMS

Many roofing jobs are likely to have some special problems. This section explains how to accommodate some of these problems quickly and effectively with the Mule-Hide Roofing System.

Repairing Punctures and Holes in Membranes

Occasionally, punctures and holes may occur in the Mule-Hide TPO Membrane. Punctures and holes are frequently the result of other trades working on the roof, which should be kept to a minimum by the building owner/manager or project general contractor.

To repair punctures and holes in the TPO Membrane, follow this procedure for hand welding a patch:

1. Clean the surface to be patched. Clean an area a minimum of 4 inches in all directions around the puncture or hole thoroughly with Fantastik® or other similar general cleaner. Rinse thoroughly. Wipe with clean, damp rags and dry well. Surface must be cleaned until it is white.
2. Wipe the cleaned area of the field sheet membrane with Mule-Hide Weathered Membrane Cleaner, following all directions and precautions on the label. Final cleaning with the Mule-Hide Weathered Membrane Cleaner will help ensure the removal of any remaining dirt or soap film.
3. Cut out patch. Cut a round or rectangular patch with rounded corners from reinforced field sheet membrane. The patch must be 3 inches larger in all directions than the puncture or hole.

NOTE: All patches must be cut from scrim-reinforced membrane.

4. Position patch over the puncture or hole. Take care to allow for even laps on all sides.
5. Hot-air weld the patch. Using the hand-held hot-air welder and hand roller, hot-air weld the patch over the puncture or hole.
6. Probe the edges of the patch after it has cooled sufficiently.
7. Seal all edges of the patch with Mule-Hide Cut Edge Sealant.

Making a Temporary Tie-In

While the roofing job is underway, it is vital to keep insulation, roofing board, and/or other substrates and the deck dry. Moisture that is present under the Mule-Hide TPO Membrane will have a difficult time escaping once the membrane is hot-air welded.

Therefore, a “night seal,” or temporary waterstop, should be applied whenever storms threaten and at the end of every workday. The time needed to apply a night seal is well invested. The resulting protection can prevent the need for costly and time-consuming tear-off of wet substrate materials!

Technical Guide

HOW TO INSTALL MULE-HIDE REINFORCED TPO MEMBRANES

IMPORTANT! The membrane used to make a night seal must be trimmed back prior to work.

Temporary Sealing of a Penetration

From time to time, at the end of a workday or before a storm breaks, it may be necessary to seal penetrations temporarily. Follow this procedure:

1. DO NOT make finished cuts at this time. A surplus of membrane will ensure that the next steps do not compromise the eventual, final completion of the penetration detail.
2. Turn membrane up on curb or equipment a minimum of 2 inches.
3. Install duct tape. Tape should be a minimum of 4 inches wide. Make sure you have a good bond between the tape and the curb. Tape should always be used in a manner that does not rely strictly on the tape adhesive to stay in place; e.g. ballast, wrap, or tack in place.
4. Before permanent seaming and adhesive bonding, trim membrane that is contaminated with tape adhesive. Remember, adhesive from the duct tape will prevent successful hot-air welding and good bonding with Mule-Hide bonding adhesive.

WARNING: Duct tape is not a suitable means for permanent sealing of seams in the Mule-Hide TPO Membrane System. Only hot-air welding is an acceptable means of seaming.

ROOF WALKWAYS

A walkway must be provided to accommodate regular traffic to service rooftop units. You can use smooth surface paver blocks over a slip sheet, or use our Mule-Hide TPO Walkway Rolls.

End of Section