

Technical Guide

"The name trusted in roofing since 1906"



Equipment Needed to Install Mule-Hide Heat-Weld Membranes

Introduction - This section is intended to serve as a general guideline of the equipment that the contractor may need to successfully install a Mule-Hide Heat-Weld Membrane Roofing System.

General - The following list of hand tools should be included for an average crew of 4 to 6 men:

- One automatic welder
- Asphalt-free extension cord (#10/3 wire, 220 volt) with 220/30 amp male-female twist lock plugs for use with the automatic welder, not to exceed 100 feet in length
- 2 or 3 hand welders with nozzles
- Asphalt-free extension cords (#14/3 wire, 110 volts)
- 3 or 4 rubber hand rollers
- 1 pair of scissors per man
- 3 standard screw guns with disengaging clutch (RPM range of 1800-2500 with adjustable nose piece)
- Tape measures and one 100-foot tape
- 2 or 3 cotter pin extractors for probing seams
- Non-permanent ink pens (water soluble)
- Chalk lines with non permanent chalk (blue chalk)
- 4-inch wide paint brushes
- One-half inch nap paint rollers with solvent-resistant cores and handles
- Clean cotton rags
- Caulking guns
- Push Brooms
- Asphalt free waterproof canvas or other type of waterproof tarp for covering Mule-Hide products and equipment

Specialized Equipment - The Mule-Hide Roofing System requires 4 types of specialized equipment:

- Mule-Hide-approved automatic hot air seaming machine
- Mule-Hide-approved hand-held seaming machine
- Generator large enough to provide power to automatic welder and hand gun(s)
- Cotter pin puller or other type of pointed instrument to probe seams

WARNING: Never touch the metal portion of the fan housing, blower tube or blower nozzle of the automatic welder or hand held heat guns. They become extremely hot and can cause severe burns.

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The Mule-Hide Heat-Weld Membranes can be permanently fused to itself by the application of super-heated air and pressure. To provide the required heat and pressure, Mule-Hide Heat-Weld Membrane Roofing Systems specifies an automatic welder for making field seams. A hand welder is specified when an automatic welder cannot be used (see next Section).

Automatic Welder

General Description: An automatic welder is an electrically powered, self-propelled device that utilizes electrical resistance heating and fan-forced hot air in combination with its own weight (including additional weight mounted on the exterior housing) to fuse the Mule-Hide Heat-Weld Membranes to themselves.

Technical Specifications

The following specifications are for general information. Consult the manual accompanying the equipment for additional details.

- **Electrical requirements:** 220V, 30A (minimum fused), 7500 W (minimum recommended available power), single-phase current. If using a generator, ensure generator is of sufficient size to power all welding tools (hand gun(s), automatic welder) run from generator.
- **Power cord and extensions:** #10, 3-conductor type may be used for distances up to 100 ft.; for longer lengths, consult an electrical contractor. We suggest the use of the highest quality electrical cords to extend the life of your equipment and improve overall performance.
- **Supplemental weight:** When welding Mule-Hide field membrane, an additional weight is to be fixed on the exterior housing over the wheels of the automatic welder. Most automatic welders have removable external weights.
- **Adjustments:** Tracking alignment, nozzle alignment, forward speed, temperature of heating element and airflow louver (and therefore hot air output).
- **Welding speed:** The speed of the welder must be no faster than necessary to reproduce good hot air weld and will vary according to environmental conditions. As a general rule, 10 to 12 feet per minute (fpm) is a typical speed in warm summer temperatures; 8 fpm or less is typical in cold weather temperatures.
- **Metal track (if required by welder manufacturer):** Several lengths, 8 foot each of 24-26 gauge galvanized metal for use as a track for the automatic welder. The metal tracks may be necessary to minimize wrinkles during welding.

NOTE: Conditions seldom justify running at maximums speed, which usually result in inconsistent seam quality. As ambient temperatures change throughout the day, the operator must rely on his judgment to determine the optimum operating speed and temperature of the automatic welder. It is good roofing practice to conduct test seaming before welding the field seams. See page 4 for test welding instructions.

Procedure - Before Connecting to Power

Use the automatic hot-air welder to make all field seams as general practice; the nozzle can be adjusted to weld near-horizontal seams (typical field seams).

Be sure to take the following preliminary steps when using an automatic unit.

1. Supplemental weight. Fix the supplemental weight to the exterior housing over the wheels. This weight will ensure that the proper pressure is applied to the seam being welded.
2. Check hot-air nozzle alignment and adjust if required.

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3. Welding and non-welding positions. The hot-air nozzle can be locked into an UPWARD non-welding position, or into its DOWNWARD welding positions. The nozzle and blower assembly can be freely raised from the welding position after the release trigger on the blower housing is pulled and the entire assembly is slid OUTWARD from the machine. In this OUTWARD position, the nozzle and blower assembly escapes the detent that locks it into the DOWN position, and can be rotated to the UP position, where it will lock when the trigger is released. Position the hot-air nozzle so that it is in its DOWNWARD welding position and visually check to ensure that the nozzle will not direct the hot air into the silicone drive wheel or belt. Such misdirected super-heated air can quickly ruin the expensive wheel or belt drive. Any misalignment of the nozzle should be corrected at this time. After ensuring that the nozzle is properly aligned, return the hot-air nozzle to its UPWARD, non-welding position.

Be sure that the blower and transmission power switches are OFF and that the blower temperature control and speed control are set to ZERO.

CHECKPOINT: At this point, it is assumed that you are ready to hot-air weld a field seam, and the following requirements have been met:

- A roll of Mule-Hide Heat-Weld Membrane has been attached to the roof deck, and a second roll has been unrolled to provide a 5-1/2-inch overlap for mechanically attached and a 3" overlap for fully adhered over the previously attached edge, per Standard Mule-Hide Specifications.
- The surfaces to be hot-air welded are clean. If these surfaces are dirty, they must be rag-wiped clean with Fantastik® (or similar cleaner), then wiped with a clean rinse rag and thoroughly dried. The seam area should then be wiped with a clean rag dampened with either Mule-Hide Membrane Cleaner for TPO, or Mule-Hide PVC Membrane Cleaner for PVC. This will ensure removal of any remaining dirt or soap film.
- With the nozzle and blower assembly in the UP position, the automatic welder is positioned so that the silicone pressure wheel or belt is placed at the edge of overlapping sheet and the beveled guide wheel in front is at the edge of the top Mule-Hide sheet.
- Transmission and blower switches are OFF and speed and heat controls are set to ZERO.

WARNING: Never touch the metal portion of the fan housing blower tube, or blower nozzle. They become extremely hot and can cause severe burns.

Procedure - Connecting to Power

With the preliminaries done, you are ready to hot-air weld.

4. Connect the machine to power.
5. Turn the heater/blower power switch ON.
6. Set the temperature switch to the desired setting (1004° F is a good starting point).
7. Allow the machine to warm up (generally around 5 minutes).

NOTE: Test seams should be made at least at the start of work each morning and afternoon or any other time there is a noticeable change in temperature. Test seams should be made on use scrap material. After scrap material has cooled, attempt to physically tear them apart and examine them for consistent 1-1/2 to 2 inch wide fully laminated seam.

8. Prepare to set the machine in motion.
 - If ambient temperature is higher than 60 degrees F, adjust the transmission speed control switch so that the machine will move at about 12 fpm; further adjustment may be required once you are underway, depending on the quality of the seam produced.

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- If ambient temperature is 40-60 degrees F, adjust the machine to move at about 10 fpm; further adjustment may be required, depending on the quality of the seam produced.
- If ambient temperature is less than 40 degrees F, adjust the machine to move at less than 8 fpm; the best rate will have to be determined based on the quality of the seam produced. As a general rule, the colder the ambient temperature - and, hence, the membrane - the more slowly the automatic welder will have to proceed in order to produce good seams.

NOTE: As there are no ideal working conditions and ambient temperatures change throughout the day, the operator must rely solely on his own judgment to determine the operating speed of the automatic welder.

CAUTION: the operator of the welding equipment should be absolutely sure that the machine is positioned properly to begin welding before proceeding to the next step. Remember that the guide handle points IN THE DIRECTION THAT THE MACHINE WILL MOVE.

9. Separate the overlapping sheets. Place one hand palm-down on the blower housing, and put your index finger on the release trigger. With your other hand, use a seam probe (or similar tool) to separate the two overlapping Mule-Hide Heat-Weld Membranes so that the nozzle can be slid between them.
10. Insert the blower nozzle between the sheets. Pull the trigger, and position the nozzle between the membrane sheets, locking it in its DOWN welding position. Immediately proceed to the next step to prevent burning the membrane!
11. Start the machine moving. Quickly turn the transmission switch ON. **NOTE:** Some machines start automatically. The machine will start moving and welding the seam. Mark the start of the seam with a water-soluble marker.
12. Stay on course. As the automatic welder proceeds, keep the small guide wheel at the front of the machine at the edge of the top sheet. Steer the machine from the front to minimize zigzagging, which is likely to result from steering from the rear. If you go off-course, simply get back on course quickly. Seam deficiencies will be repaired later, with the hand welder.

IMPORTANT: Keep plenty of slack in the power cord. Any drag can pull the machine off-course.

13. Adjust to the speed that produces the best weld. The guidelines set in Step 8 provide good starting points. As welding proceeds, some trial-and-error adjustments will be required. Generally, adjusting the speed will be the most effective means of "dialing in" the best seam production. When the ambient temperature is very high, it may be necessary to turn the temperature down.

Rules-of-Thumb for Judging Seam Quality

- The seamed membrane is not discolored: Increase speed if membrane discolors (yellow/brown). If ambient temperature is very high and membrane discolors even when speed is at maximum, turn down the temperature control.
- Bubbling. If welder setup is marginally too hot, the seam surface may exhibit a slight bubbling appearance.
- Voids and wrinkles. A good seam has no voids or wrinkles and is 2 inches wide with the exposed edge tight. If not, see "Repairing Voids and Wrinkles," and "Repairing Holes in Membranes."
- Seam strength may be tested when cool. For best results, testing seams 8 hours after hot-air welding is recommended.

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14. Completing a welding run. At the end of a run, lock the nozzle in its UP, non-welding position and turn the transmission switch OFF to stop the machine's movement. NOTE: some machines stop automatically when the nozzle is taken out of the seam. Mark the end of the seam with a water-soluble marker.
15. Clean the nozzle frequently. The nozzle should be wire-brushed frequently to remove hot particles of the Mule-Hide Heat-Weld compound. (Some applicators wire-brush after each welding run.) If not removed, such particles are likely to be deposited by the nozzle, forming brown streaks at the edge of the lap; more than aesthetics is at stake - the presence of such particles in the seam can affect seam integrity.
16. Cool the welder down. At the completion of a period of welding - for example, at lunchtime or quitting time - with the nozzle locked in its UPWARD position, turn the temperature adjustment dial to its lowest setting. The heating element will shut off, but the blower will continue to operate, cooling the heating element. After about five minutes, turn the power switch OFF. NOTE: some machines will shut down automatically after pushing only one button.

Precautions

As with any high power electrical equipment used outdoors, use accepted practice and common sense to avoid injury. Some suggestions:

- Do not operate any heat welder during storms.
- Use extreme caution to avoid burns. The temperature of the super-heated air in this machine can reach approximately 1200 degrees F (645 degrees C).
- Guard against snagging the power cord.
- If the power cord should become disconnected while the machine is operating, it is desirable to reconnect as quickly as possible, with careful attention to safety, to avoid possible damage from overheating. Switch the machine OFF to avoid arcing when reconnecting to power. Reconnect to power. Turn the power switch ON to resume normal operation.
- Inspect the power cord and connections before each welding session. Repair or replace worn or frayed cords and connectors promptly.
- Although the unit may be a double-insulated design, a ground fault interrupter (G.F.I.) at the power source is still recommended.

NOTICE: This equipment is for industrial use only. These instructions are for general information only. Prior to actual operation of the hot-air welding equipment, refer to the operating instructions that are provided by the manufacturer. Because the handling and use of this equipment is beyond Mule-Hide's control, we will not accept any liability for the results obtained.

All statements herein are expressions of opinion, which by performance and testing are believed to be accurate and reliable, and are presented without any knowledge that such recommended uses may infringe any patent. No warranty of any kind whatsoever, expressed or implied, is made or intended.

Hand Welder

General Description: The hand-held hot-air welder is an electrical powered, hand-held device that utilizes electrical resistance heating and fan-forced super-heated air to heat Mule-Hide Heat-Weld Membranes. A hand-held rubber roller is used in conjunction with the welder to apply the pressure that fuses the heated Mule-Hide Heat-Weld Membrane surfaces to each other.

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The hand-held welder is used as general practice to touch up imperfect seams. It is also used when the self-propelled automatic model is inappropriate, such as in roofing details and on highly sloped surfaces.

Technical Specifications:

- **Electrical requirements:** 115V, 15A (minimum fused), 2,500 W (minimum recommended available power), single-phase current. If using a generator, ensure generator is capable of providing adequate wattage for using the automatic welder and hand gun(s) at the same time.
- **Power cord and extensions:** #12, 3-conductor type may be used for distances up to 100 ft.
- **Adjustments:** Temperature of heating element and air flow louvers (and therefore hot air output).
- **Accessories:** 3/4-in. (20-mm) nozzle (for welding details), 1-1/2-in. (40-mm) nozzle (for straight welding, as when repairing field seams), hand-held silicone rubber roller.
- **Welding speed:** Speed will vary according to ambient weather conditions, element control settings, and user proficiency.

Procedure - Before Connecting to Power

Use the hand-held hot-air welder to repair and/or make all seams that cannot be made by the automatic welders. Be sure to take the following preliminary steps before plugging in the equipment:

1. Fit the appropriate nozzle. In general, the 1-1/2-in. (40 mm) nozzle should be fitted to the welder when making or repairing straight welds; the 3/4-in. (20 mm) nozzle should be fitted when welding flashing details.
2. Be sure the power is OFF and the heat adjustment switch is set to ZERO.

CHECKPOINT: At this point, it is assumed that you are ready to hot-air weld a seam, and the following requirements have been met:

- All fasteners are in place and the two surfaces to be welded are in position.
- The surfaces to be hot-air welded are clean, free of adhesive (a potential problem with flashing details) and other contaminants. If these surfaces are dirty or contaminated, they must be rag-wiped clean with Fantastik® or similar general cleaner, then wiped with a clean rinse rag and dried thoroughly. The seam area should then be wiped with a clean rag dampened with either Mule-Hide Membrane Cleaner for TPO or Mule-Hide PVC Membrane Cleaner for PVC. This will ensure removal of any remaining dirt or soap film.
- During its warm-up period, hot air from the welder should be directed in a safe direction.
- A rubber hand roller is available.

WARNING: Never touch the metal portion of the fan housing, blower tube, or blower nozzle. They become extremely hot and can cause severe burns.

Procedure - Connecting to Power

With the preliminaries done, you are ready to hot-air weld.

1. Connect the machine to power. Ensure that the welder is pointed in a safe, unobstructed direction.

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2. Switch the power on. Turn the power switch ON and turn the heat adjustment switch to its highest position.
3. Warm-up the welder for 5 minutes.

NOTE: When first starting out or when welding confined work areas such as corners and pipe penetrations, it is advisable to turn the heat setting down a few notches to avoid applying heat faster than you can work effectively.

4. Insert the nozzle into the lap approximately 2" back from the edge of the membrane to create an air dam. Position the nozzle between the surfaces to be welded and quickly position the hand roller on the outer membrane about 1/8 to 1/4 in. from the end of the nozzle.

NOTE: More heat is needed when beginning a weld than after a weld is underway, because the membrane is cool. In addition, the super-heated air has an easy escape before a seam is formed. As welding proceeds, the membrane warms up and the hot air from the welder is partially trapped by the seam. Be prepared to pick up the pace as you proceed.

5. Roll the seam. When the membrane becomes softened, apply a firm pressure to the roller and roll it across the seam in strokes about 3 in. long.
6. After finishing the first pass down the seam to create the air dam, repeat the process to complete the seam. When making the final pass down the seam, keep a small (1/8") portion of the tip exposed beyond the edge of the membrane to ensure a complete weld all the way across the seam.
7. Adjust seaming speed to produce the best weld. As the seaming continues, some trial-and-error adjustment of seaming speed will be required. The membrane surfaces must be heated sufficiently to permit the roller pressure to fuse them together, yet the membrane must not be overheated.

Rules-of-Thumb for Judging Seam Quality

- The seamed membrane is not discolored: Increase seaming speed if membrane discolors (yellow-brown).
 - Bubbles and thinning: Overheating the membrane causes small bubbles and overstretching to the point of leaving too little sheet thickness, especially when working with unreinforced material. Another sign of overheating is a darkened "smeared" appearance on the seam.
 - Voids and wrinkles. A good seam has no voids or wrinkles. If voids or wrinkles are present, see "Repairing Voids and Wrinkles."
8. Clean the nozzle frequently. As with the automatic welding machine, the nozzle of the hand welder should be wire-brushed frequently to remove hot particles of the Mule-Hide Heat-Weld compound that may adhere to it. If not removed, such particles are likely to be deposited by the nozzle; the presence of such burned particles in the seam can affect seam integrity.
 9. Cool the welder down. When the welder is to be shut down at the completion of a period of welding - turn the temperature adjustment dial to its lowest setting. The heating element will shut off, but the blower will continue to operate, cooling the heating element. Set the welder down so that hot air from the welder is pointed in a safe direction. After about five minutes, turn the power switch OFF.

Precautions

As with any high power electrical equipment used outdoors, use accepted practice and common sense to avoid injury. Some suggestions:

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- Do not operate any heat welding equipment during storms.
- Use extreme caution to avoid burns. The temperature of the super-heated air in this machine can reach approximately 800 degrees F (427 degrees C).
- Guard against snagging the power cord.
- If the power cord should become disconnected while the machine is operating, it is desirable to reconnect as quickly as possible, with careful attention to safety, to avoid possible damage from overheating. Switch the machine OFF to avoid arcing when reconnecting to power. Reconnect to power. Turn the power switch ON to resume normal operation.
- Inspect the power cord and connections before each welding session. Repair or replace worn or frayed cords and connectors promptly.
- Use of a ground fault interrupter (G.F.I.) at the power source is recommended.

NOTICE: This equipment is for industrial use only. These instructions are for general information only. Prior to actual operation of the hand-held welding equipment, refer to the operating instructions that are provided by the manufacturer. Because the handling and use of this equipment is beyond Mule-Hide's control, we will not accept any liability for the results obtained.

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Seam Probing

General Description: the probing of hot-air welded seams is an important step in the application of a Mule-Hide roof, and is your best insurance for successful inspection. **SEAMS WITH VOIDS AND WRINKLES HAVE BEEN THE MOST COMMON DEFECTS CITED BY MULE-HIDE INSPECTORS OVER THE YEARS.**

To ensure consistently high-quality seaming on your job, be sure that ALL seams are probed with an appropriate seam probing tool each work day, and all deficiencies noted/marked with a water-soluble marker and repaired as promptly as possible with a hand-held hot-air welder. Mule-Hide recommends that you probe seams with a cotter pin puller.

Procedure for Probing the Seams

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 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 each void.
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.

End of Section