SPECIFICATION
SUPPLEMENT

T-01

Heat Welding Equipment Use & Procedures Thermoplastic Membranes

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The information contained in this supplement serves as a criteria for Specifiers and Authorized Contractors regarding the design and installation of Versico Roofing Systems and related products. Additional information essential for the design and installation of the Roof Systems mentioned herein are also included in the respective Specification for each Roof System and in the Design Reference Section of the Versico Technical Manual. Specifiers and Authorized Contractors are advised to reference all applicable sections.

A. Automatic Heat Welder

An electrically powered, self- propelled device that utilizes an electrical resistance heating element or heater and fan-forced super heated air to weld membrane seams.

1. Temperature Settings

a. When making a VersiWeld TPO/VersiFlex PVC splice, no one temperature setting or speed can be used to describe the temperature setting or speed to set the robot. The splice must be tested to determine the quality of the splice.

b. Consult the respective heat welding machine manufacturer for recommendations concerning proper temperature setting and speed control of their equipment.

c. Typically, the colder the ambient temperature (and likewise the membrane temperature) the slower the Automatic Heat Welder speed control must be adjusted to produce proper seams.

d. As a general guide, depending on the length of the nozzle, **VersiWeld** membranes will weld at a lower temperature 1004° F (540° C) and faster speed (12 feet to 18 feet per minute) than most other heat welded membrane materials. **VersiFlex** membrane will weld at a temperature of 1094° F (590° C) and a speed of 8 feet to 12 feet per minute.

e. Using an Automatic Heat Welder, the suggested starting point for welder set up is 1004° F (540° C) at 12.5 feet per minute for VersiWeld OR 1094° F (590° C) at 10.4' per minute for VersiFlex. Refer to automatic heat welder manufacturer's recommended temperature and speed to obtain the correct splice results.

f. The following is a list of items to be checked to determine the temperature setting and the speed at which a splice should be completed:

1) When the membrane is in direct sunlight, the temperature or robot speed may have to be adjusted when moving into a shaded area, check the splice results. Remember the membrane surface in a shaded area will be cooler than a membrane surface that is in sunlight. Darker colored membrane (such as gray) will be warmer than white and may affect the welder speed.

2) Dampness on the membrane from dew, a passing rain shower or misting condition will reduce heat from the splice due to evaporating moisture from the membrane surface. The heat welding temperature (increased) or the robot speed (slower) will have to be adjusted to produce a good splice. Water must be wiped from the welding surface prior to welding the splice.

3) Wind has a cooling affect as it blows over the surface. It will also affect the airflow in the splice

reducing the effectiveness of the hot air gun. This will require the operator to increase heat from the hot air gun or reduce the welder speed.

4) Substrates make a substantial difference in the amount of heat required to produce a proper heat welded splice. The robot will have to be adjusted accordingly:

   a) Plywood and Concrete act as heat sinks and will take a higher temperature or slower speed setting than insulation.

   b) Cool damp substrates will take a higher temperature or slower speed setting than dry substrates.

5) Membrane “bleed-out” from sheets should occur with VersiFlex membrane if properly welded. If bleed-out is not occurring (the underside of the membrane begins to melt and flow), the welder speed should be decreased to increase welding temperature.

2. **Equipment Set-up**

a. Equipment set up is the responsibility of the Authorized Contractor. When poor welding is occurring check the following:

1) If the membrane is overheated on one side or the other, check the nozzle to be sure it is distributing the heat evenly between the two sheets.

2) If the heat is bypassing the edge of the sheet producing a cold weld along the edge of the splice, be sure the nozzle is completely under the sheet and the air dam is in place and functional.

3) If the probed splice is tight at the edge but a cold weld is present in center of the splice (the heat is melting the edges but does not melt the center of the splice), check to be sure the robot is not running too fast.

4) Ensure the silicone pressure wheel is intact with no voids in the silicone. If voids are present, incomplete welding will result.

5) Be sure all wheels on the air dam are not binding. Binding wheels will cause sheet movement and distortion during the welding process.

6) The automatic heat welder nozzle should be adjusted as close to the pressure wheel as possible. If the nozzle is too far away from the pressure wheel, distortion of the membrane may occur due to heat expansion.

NOTE: Adjust welder nozzle so the curved portion (heel) extending outside the seam area does not contact or drag on the exposed surface of the membrane. This portion of the nozzle should be 1/16" to 1/8" above membrane surface.

7) Overheating the membrane will cause poor welds. It is recommended the automatic welder be run not less than 8' a minute on average temperature days.

8) Only on very cold days the welder should be run below this speed. The temperature and welder speeds must be determined based on test welds prior to actual sheet welding.

9) Clean screen of dirt and debris on air inlet of heat gun every day. Accumulation of contaminants on screen will reduce air flow and heat output of welder.

3. **Membrane Welding**

a. Prepare the Automatic Heat Welder and allow it to warm for approximately 5 to 10 minutes to reach operating temperature.

b. Position the Automatic Heat Welder properly prior to seaming with the guide handle pointing in the same direction the machine will move along the seam.

c. Lift the overlapping membrane sheet and insert the blower nozzle of the Automatic Heat Welder between the overlap. Immediately begin moving the machine along the seam to prevent burning the membrane.

d. Weight plates provided on Automatic Welders must be utilized.

e. Proceed along the seam ensuring that the small guide wheel in front of the machine aligns with the edge of the top membrane sheet. Guide the machine from the front only.

CAUTION: Ensure the power cord has plenty of slack to prevent dragging the machine off course (which could result from a tightly stretched cord).

f. At all splice intersections, roll the seam with a silicone roller to ensure a continuous heat welded seam (the membrane should be creased into any membrane step-off with the edge of the silicone roller). A false weld may result due to surface irregularities created by multiple thicknesses of VersiWeld/VersiFlex membrane sheets..

When using **60-mil or 80-mil** VersiWeld TPO Membrane or VersiFlex PVC Membrane, a **TPO/PVC "T" Joint Cover** must be applied over all "T" joint splice intersections.

g. To remove the Automatic Heat Welder from the finished splice, stop the movement of the machine and immediately remove the nozzle from the seam area.

h. Mark the end of the heat welded seam with a water-soluble marker for easy identification. A Hand Held Welder will be necessary to complete the weld in the area between where the Automatic Heat Welder is stopped and restarted.

i. Perform a test weld, at least, at the start of work each morning and afternoon. Test welds should be made if any changes in substrate or weather conditions occur.

4. **Preventing Membrane Creeping During Welding**

a. The operator of the robot must apply foot pressure to the membrane, kicking and sliding the membrane under the robot to keep the membrane tight. Always have the operator stand on the unfastened sheet of membrane to prevent sheet movement.

b. Do not release foot pressure from the membrane until the pressure wheel rolls over the membrane in front of the foot that is holding the membrane in place.

5. **Use of Welding Tracks**

a. Set welding tracks lengthwise along the splice, close to the Automatic Heat Welder air dam to reduce membrane movement caused by the welding process. The operator must continue to apply foot pressure to the welding tracks to help hold the membrane splice in place. Welding tracks are moved as welder progresses along seam.

b. Welding tracks can be:

1) Sheet metal, 22 gauge – 12" wide by 10' long (with rounded corners).

2) Aluminum or steel plates – 1/4" x 3", 4' to 6' long (with rounded corners).

3) Wood planks – 2" x 12" X 4' to 6' long.

4) Heavy plywood – 3/4" x 24" x 8' long.

6. **Test Cuts**

a. Perform a test weld at least at the start of work each morning and afternoon.

b. The test sample should be approximately 1 inch wide and longer than the width of the seam (cut across the heat welded seam).

c. Peel the test sample apart after it has thoroughly cooled (approximately 10 minutes) and examine for a consistent 1-1/2 inch wide minimum weld. De-lamination of the membrane from the scrim-reinforcement is an indication of a properly welded seam.

d. Identify the following seam problems to assure seam quality:

1) Discolored or scorched membrane – Increase speed or decrease temperature setting if membrane discolors.

2) Voids and wrinkles - A proper heat welded seam has no voids or wrinkles and must be at least 1-1/2 inches wide. Refer to Seam Probing procedures outlined below for proper inspection of seam deficiencies.

7. **Seam Probing**

The use of a Versico Seam Probe, a blunt or dull cotter pin puller is recommended to probe all heat-welded seams. Probing seams must be done once heat welds have thoroughly cooled. Heat welded seams must be probed throughout the day to check seam quality and to make proper adjustments to heat welding equipment. **The repair of deficiencies must be done routinely throughout the day but no later than the end of each workday.**

a. Allow heat-welded seams to cool thoroughly for approximately 30 minutes. Premature probing can damage warm seams.

b. Draw probing tool tip along the edge of the heat welded seam. Apply firm pressure to probe the seam junction, but not into the bottom membrane sheet. The tool will not penetrate into the lap area of a properly welded seam.

c. If the seam-probing tool penetrates into the lap area, mark the seam using a water-soluble marker at the beginning and the end of voids or wrinkles in the seam edge.

d. Repair seam deficiencies as soon as possible using the hand held welder. Versico recommends that repairs be made the same day they are discovered.

e. Probe **repaired seams** after they have cooled completely. If the repair is acceptable, wipe off the water soluble marker lines; if not acceptable, repair the seam using standard heat welded overlay procedures.

Note: All laps must be probed each day soon after it has cooled to verify the welder set-up is effective. Particular attention must be given to all membrane intersections and heat-welded seams at insulation joints. In addition, there should be periodic checks (including at the start of each day) to verify good peel strength.

f. Considerations when probing TPO systems:

1) TPO does not "flow" like PVC. If you observe an area in which you see "flow" of the bottom black ply, scorched areas of detail/flashing membrane, or scorched field membrane welds, these areas should be probed. If these areas are overheated to the point of membrane damage, an overlay repair will be required even if the weld probes successfully.

2) A properly heated field membrane weld will typically have a visual "sheen" approximately 1/2" wide on the bottom sheet at the weld overlap. When walking seams look for the sheen. If it is not present probe to ensure weld quality.

3) TPO seams require a minimum 1.5" weld. Welds less than 1.5" must be overlaid following specification and detail, even if probing does not produce deficiencies.

g. Considerations when probing PVC Systems:

1) Welds on PVC systems should produce "bleed out". Bleed out refers to the flow of the bottom ply (of the top sheet) outside of the weld. If you do not see bleed out at seam areas, this increases the probability the seam did not receive enough heat when it was welded. Be sure to probe these areas to ensure weld quality.

2) PVC is a “softer” and more flexible membrane than TPO. As such, a different probe should be used than the one used on TPO roofing systems. The PVC probe should have a blunt/dull tip.

h. PVC seams require a minimum 1.5" weld. If you observe welds which are less than 1.5", these should be overlaid following specification and detail, even if probing does not produce deficiencies

i. **Apply Cut-Edge Sealant** on all cut edges of the reinforced VersiWeld TPO membrane (where the scrim reinforcement is exposed) **after seam probing** is completed. When a 1/8" diameter bead of Cut-Edge Sealant is applied, approximately 225 – 275 linear feet of coverage per squeeze bottle can be achieved.

1) Cut Edge Sealant is not required on cut edges of VersiFlex PVC membrane (Horizontal or Vertical).

2) Cut-Edge Sealant is not required on vertical VersiWeld splices.

B. **Hot Air Hand Welder**

1. General

a. An electrically powered, hand-held device that utilizes an electrical resistance heating element or heater and fan-forced super heated air to heat weld VersiWeld/VersiFlex membrane and flashing. A hand-held **silicone** rubber roller is used in conjunction with the welder to apply the pressure that fuses the heated membrane surfaces to each other.

b. The hand-held welder is typically used to repair seams, or when the use of the Automatic Heat Welder is inappropriate (such as flashing penetrations and on high sloped surfaces).

2. Hand Held Welder Settings

a. Temperature setting for hand held welders when used for flashing should be approximately “6” (on a scale from 1 to 10).

b. Temperature settings for hand held welders when used for membrane should be approximately “8 –10” (on a scale from 1 to 10).

c. Exact settings will vary based on heat welding membrane type, ambient temperatures, substrate and type of welder.

d. Silicone roller should be used to apply pressure to the membrane to be welded.

C. **Electrical Cords:** For generator requirements and maximum length of electrical cords, refer to Generator/Electrical Requirements below.

D. **Seam Probing:** The probing of heat welded seams is an important step in the application of a VersiWeld TPO/VersiFlex PVC Roofing System. Versico recommends the use of a Versico Seam Probe to probe all heat welded seams. All seams must be probed (**after the seam has thoroughly cooled**) with the appropriate seam probing tool and all deficiencies must be repaired accordingly with a hand held hot air welder no later than the end of each work day.

E. **Silicone Rubber Roller**: A 2" wide rubber roller used for rolling heat welded splices.

F. **Generator/Electrical Requirements**

Building power supplies do not typically provide the proper amount of power necessary for consistent heat welding. The use of a portable generator conforming to the following guidelines is strongly advised.

1. A **minimum 6500 watt generator** with a minimum output of 210 volts is required **for one Automatic Heat Welder**. Reduced power availability will result if additional equipment is connected to the generator and may result in faulty heat welded seams. GFI (Ground Fault Interrupter) protection is recommended. Additional generators will be required for operating other power tools and hand held heat welders.

Electrical cords (3 conductors) of the maximum length indicated must be used with the corresponding wire as listed below:

Maximum Length	Wire Size
50 foot	#12
100 foot	#10
300 foot	#8

2. **A minimum 3,000 watt generator** may be used to power a maximum of **two hand held heat welders** as long as no other equipment is connected. This generator should service a minimum of 110 volts and be GFI (Ground Fault Interrupter) protected.

   Electrical cords (3 conductors) of the maximum length indicated must be used with the corresponding wire as listed below:

Maximum Length	Wire Size
50 foot	#14
100 foot	#12

   For extension cords longer than 100', consult an electrician or electrical contractor to ensure proper size of generator and wire.

G. **Heat Welding Precautions**

1. Check the welding machine set-up to ensure proper alignment of the heating nozzle, air dam, pressure wheels, or moving parts to see they move properly or are free-spinning. Test run the welding machine to ensure it moves forward following a straight line. If the alignment is off, make necessary adjustments.

2. Make sure the air intake is open. Clean out the air intake screen for the blower unit at each start up.

3. Check the machine for worn or broken parts which need to be replaced. Exercise care to protect the pressure wheel from notches or cuts to prevent incomplete sealing of the welded seam.

4. Before the machine is connected to the power source, make sure it is switched off to prevent a power surge that could damage the unit. Turn the unit on and allow the blower/heater unit to warm up for approximately 5 to 10 minutes to reach operating temperature.

5. Clean the heat nozzle with a wire brush to remove any build-up of membrane, as needed.

6. To extend the life of the heating element of the Heat Welding Equipment, always turn the temperature adjustment down so the welder can cool prior to switching the machine off.

7. Follow all care and maintenance instructions recommended by the respective manufacturer.

8. It is recommended that two Automatic Heat Welders and two generators be available at the project site in the event of mechanical failure.

H. **Welding Problems/Repairs**

1. A Hand Held Hot Air Welder and a 2" wide silicone roller must be used when repairing the membrane. When the entire heat welded seam is to be overlaid, an Automatic Heat Welder may be used.

2. Prior to proceeding with any repair procedure, the area to be repaired must be cleaned and any material which has been exposed approximately 7 days must be prepared with Versico Weathered Membrane Cleaner (VersiWeld TPO) or PVC or KEE HP Membrane Cleaner (VersiFlex PVC). The membrane can typically be repaired up to 6 months to a year with a standard cleaning method. In cases where the standard cleaning method is not sufficient, the following procedures must be used:

   a. Scrub the area to be welded with a “Scotch Brite” Pad and appropriate Membrane Cleaner.

   b. Clean all residue from the area to be welded with a Splice Wipe or a clean natural fiber (cotton) rag.

   c. Weld the new membrane to the cleaned area using standard welding procedures.

3. Voids in welded seams can be repaired using a Hand Held Hot Air Welder and a silicone roller. Depending on conditions, a splice overlay may be required.

4. Position the hand held welder facing into void so hot air is forced between overlapping membranes. Roll the top membrane surface using positive pressure toward the outer edge until the heated membrane surfaces are fused.

5. Exposed scrim-reinforcement (resulting from scorching surface of membrane) and test weld areas must be

repaired by overlaying the damaged area with a separate piece of membrane with rounded corners. The overlay must extend a minimum of 2 inches past the area to be repaired.

6. Probe all edges of the overlay once cooled to ensure a proper weld has been achieved.
7. Seal all cut edges of VersiWeld TPO Membrane with Cut-Edge Sealant. Cut-Edge sealant not required on cut edges of VersiFlex PVC Membrane (horizontal or vertical).

Note: The same overlay repair procedures may be used for punctures in the heat weldable membrane.