Single Wedge Welder Operation With Firestone Thermoplastic Geomembranes: an Overview
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Wedge Welding Firestone Thermoplastic Geomembranes: an Overview
Section 1 - Safety:

**General Safety Precautions for Wedge Welder Operating Personnel:**
Only qualified service personnel familiar with electrical shock hazards and the mechanical hazards present with electrical wedge welding equipment should perform disassembly or corrective maintenance of the welding equipment. To avoid shock hazards, the welding equipment must be grounded with an adequate earth ground in accordance with all applicable electrical codes.
The locations of potentially dangerous voltages and other hazards are to be identified and labeled on the original equipment labeling. Maintain or replace all original labels and observe all warnings when installing, operating, maintaining or servicing the welding equipment.
Disconnect the electrical power source from the welding equipment and remove the ~ (ac) line cord from the power outlet before attempting to service the welding equipment. Do not perform any electrical welding equipment service unless you are qualified to do so.
Observe all labeling and the precautions on the welding equipment to prevent damage to the equipment and to avoid injury to the operator.
Before connecting the equipment to an electrical power source, check to be certain that the ~ (ac) voltage, frequency and current to be supplied to the equipment are correct and match the requirements on the serial plate affixed to the welding equipment.
Use proper handling and packaging procedures for Electro-Static Discharge (ESD) sensitive circuit boards when adjusting, handling or replacing these items. Assume that all circuit boards are sensitive to potential damage from ESD.
Only persons familiar with industrial electrical equipment should remove the equipment’s panels or inspection covers that are provided for the operator’s protection.

A wedge welder is a high voltage piece of industrial equipment. Always disconnect the electrical power source before performing service and maintenance on the unit. Never pull, lift or carry the welder by its power cord or electrical connection. Always allow slack in the extension cord while the welder is in operation to avoid damaging the power connection. Keep hands and body away from the hot wedge and heating elements when they are heated. Always use the wedge welder in a well-ventilated area when welding materials that they may produce toxic fumes and do not inhale toxic fumes if they become present. Do not introduce or permit the use of flammable liquids or materials into the seam area while welding. Allow the wedge welder to cool down for at least 5-10 minutes before putting it back into a shipping/storage case or placing the welder in other secure equipment storage. Protect the welder from exposure to rain, water or moisture of any kind. Never attempt to weld while in bodily contact with water or other electrically conductive materials.

**Welder Operator’s Manual**
Always have the welder manufacturer’s operator’s manual in a location where the welder operator can use it for a quick reference as needed. The welder operator assigned to operate this welder must have read, completely understood and must retain the contents of welder manufacturer’s operator’s manual before starting any work. Repeated periodic review of the manual’s section(s) regarding all facets of safety is recommended.
Make no changes or modifications to the welder relative to safety without contacting the manufacturer for their advice and approval.

**Welder Maintenance**
Maintenance, inspection and adjustment of the welder may only be carried out by qualified personnel. Before removing or installing spare parts or performing other repair operations on the welder, consult the manufacturer as to the proper procedures. Tighten all screw connections before attempting to operate the unit after maintenance or repair. Also make sure all covers, guards, and other safety devices have been re-installed before use.

**Section 2 - Welder Set-up for Use:**

**Unpacking the Welder after Shipment**
The wedge welder should be delivered to the jobsite in a sturdy, reusable shipping/storage case. The custom foam inserts protect the welding unit from damage during shipping and remain in place at all times. When the welding unit is out of the case, make sure the lid is closed to avoid dirt, dust and rain from getting into the case.

**Electrical Connections**
The welder should be supplied with an appropriate U.S. plug-end according to the specified operating voltage of the welder. The supplied plug-end can be replaced with one that is rated at a minimum of 20 amps.

**Electrical Power Requirements for Welding**
Consult your welder’s operator’s manual for the specific voltage requirements of your welder. Contact the welder manufacturer for power requirements outside the U.S.

**Note:**
The above operating voltage ranges refer to actual voltage at point of welder’s plug, this is the voltage under load at the welder’s end of an extension cord.

*This procedure below should be performed by a qualified electrician.*
To measure voltage under load, connect the welder to the extension cord and the generator or other power source that will be used. Start the generator and turn the welder on. When the temperature controller is power up and the wedge is heating, separate the plug at the end of the welder’s power cord just enough to expose the prongs. When you have doubt about the power source’s adequacy, use a digital voltmeter to measure the voltage under load between the hot and neutral prongs of the male plug end before undertaking any welding.

**Field Generator Recommendations**
If using power supplied by a building’s circuitry, contact the welder manufacturer for advice on the best plug and cord configuration. Field generators generally should be rated for at least 3500 watts, however a rating of 5000 watts or more is recommended in order to obtain the best welder performance and temperature control. As a general rule, the higher the wattage of the generator, the better the welder will
perform. The length and wire gauge of the extension cord being used combined with the capacity of the generator will ultimately determine the operating voltage at the welder itself.

**Extension Cord Recommendation**

Extension cords should have a minimum wire thickness of 12 gauge wire and regardless of the cord’s overall length, it should have a minimum of 20 amps rated male and female plug-end connections. Keep slack in cords while welding and keep them away from the welding to avoid operator injury or damage to the cords.

Typical maximum recommended extension cord length:

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<td>10 gauge, 3 wire</td>
<td>152 meters (500 Feet)</td>
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<tr>
<td>12 gauge, 3 wire</td>
<td>76 meters (250 Feet)</td>
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**Welding Accessories**

Wedge welders are designed to weld a wide range of thermoplastic materials on most sub grades. For the best results at each job site, there may be a variety of welder accessories available to facilitate the welding process. Please contact the welder’s manufacturer or their authorized welding equipment supplier for more information.

**Section 3 - Material Set-up:**

Most wedge welders are designed to weld a wide variety of materials and geomembranes including Firestone fPP, fPP-R and TPO. These geomembranes are typically welded with a single 50 mm (2 inch) wide wedge. Non-woven geotextiles can be welded at very high speeds and with a split wedge arrangement. For best results on all materials, follow the manufacturer’s directions for the specific welder and material set-up. Most manufacturers’ material set-up procedures for geomembranes are similar to the following general set-up procedure:

**Notes:** before you begin, cut a piece of sample material for the welder’s adjustment according to welder’s manufacturer’s suggestions. The welding unit must be cool to avoid injury before attempting adjustments.

**Welding Parameters**

To determine optimum welding parameters, start welding Firestone materials together with the welder set at 370 °C (700°F) and about 4.5 meters per minute (15 feet per minute) welding speed. Adjust the temperature downward in 25°F increments until you no longer produce acceptable welds and are outside the “welding window.” Repeat the process at higher temperatures until you no longer produce acceptable welds and are outside the “welding window.” Find the midpoint between the highest and lowest welding temperatures that produce acceptable welds at an acceptable speed to make welds are comfortably within the “welding window.”

Management of three variables is critical to a consistently proper weld – temperature, pressure and speed. Trial welds to set welding parameters inside the welding window should be 1.82 meters (6 feet) in length and should be produced on the ground and under the same conditions as exist at the jobsite.
Welding Parameters – the “welding window”

The Welding Window

**Speed >**

\[ \Delta \text{Temperature} \]

**Nip Pressure Set-up Adjustments:**
Consult your welder’s operator’s manual on how to adjust the nip rollers for the proper pressure with the material you intend to weld. The correct amount of nip pressure is necessary for proper welding. It is important that the nip rollers are providing just enough traction to keep the welder from “burning out”. This can happen when the nip rollers lose traction on the material and spin without the welder moving, often causing the hot wedge to burn a hole in the material.

**Notes:** Relatively thin geomembranes and geotextiles generally require relatively less nip pressure. Too much pressure can cause these materials to perforate along the edge of the seam causing a “zipper” effect. When the nip pressure adjustment is correct, engaging the nip pressure should take moderate effort but it should feel like one smooth motion. Keep in mind that the thicker the material being welded, the greater the nip roller pressure that is required for a proper weld.

**Upper Contour Roller Set-up Adjustments:**
Consult your welder’s operator’s manual on any available adjustment for the upper contour rollers for the correct amount of pressure with the material you intend to weld.

**Lower Contour Roller Set-up Adjustments:**
Consult your welder’s operator’s manual on any available adjustment for the lower contour rollers for the correct amount of pressure with the material you intend to weld.

**Section 4 – Safe, Standard Welding Procedure:**
Refer to the welder manufacturers’ directions for welding procedural instructions. Use all safety information and procedures to avoid burns. Most manufactures’ directions include similar information to the following general instructions:

**Powering up the Welder**
Connect the welder power cord to power source making sure that the voltage is correct for your welder. Flip or turn the main power switch to the “on” position. Turn on the drive motor if it does engage automatically with the main power switch. It is generally recommended that the drive motor remain on at all times.
while the welder is plugged in. This helps eliminate hot spots on the nip rollers and makes beginning a weld faster and easier.

**Wedge Temperature Set-up**
Refer to the welder manufacturer’s welding speed and/or temperature setting chart(s) for recommended wedge temperature setting.

**Setting the Weld Speed**
To set weld speed, use the speed setting controls as directed by the welder manufacturer. If necessary, refer to the speed setting vs. actual travel rate chart, for understanding the setting verses the meters per minute (feet per minute) the welder is traveling.

**Starting a Weld**
To start a weld, first make sure that the material to be welded is set at the proper sheet overlap. The optimum overlap is typically 12.7-15.2 cm (5-6 inches) for field welding. For a recommendation on in-house fabrication overlap settings, please contact the welder manufacturer.

Start the material sheet insertion process with the nip lever in the disengaged position, the wedge disengaged and the nip rollers turning.
First, peel back the top sheet to expose the bottom sheet. Load bottom sheet of the material into welder, between the top of both lower contour rollers and the bottom of heating wedge, then between the nip rollers.
Second, insert the top sheet into the welder, between the bottom of upper contour roller(s) and the top of the heating wedge, and then between the nip rollers. You may need to roll the welder back and forth for both sheets to settle into position.
Third, engage the wedge if necessary toward nip rollers and lock it into place.
Fourth, engage the nip rollers by pushing the nip pressure lever down until it locks in position. At this time the welder should be moving forward and welding. If the nip rollers are spinning and overheating or burning through material, quickly disengage the nip rollers, roll the welder forward down the seam a few more inches, past the problem area, and engage again. Any burned through or un-welded area should be marked for repair and repaired as soon as possible or before the end of the day.

**Ending a Weld**
Just as the welder is about to run out of the end of the sheets being seamed, disengage the nip rollers, slide the welder out of the seam, and disengage the wedge. Place welder in such a position as to prevent a hole from being melted in the material from heat radiating from the hot wedge on the welder.

**Welder Shut-Down**
To shut down the welder simply flip or turn main power switch to the “off” position and unplug the unit. After 10 minutes of cool down time, place the welder in a shipping/storage case or in a secure storage location.
Firestone has no preference over the welding equipment used with its geomembrane. Firestone bears no liability or responsibility for any welding equipment whatsoever, regardless of its performance or use. The information in this document is not intended to supersede or replace any information or recommendation supplied by a welding equipment manufacturer concerning their equipment, its maintenance or its use. This document is for informational purposes only and it does not constitute a warranty or guarantee of materials or processes. Firestone Specialty Products Company assumes no responsibility for the use of this information. Application of this information for any project is to be at the recommendation of the project engineer and/or the welding equipment manufacturer.

Contact the Firestone Building Products Company (888-264-1735) for further information or geomembrane selection criteria.

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