Heliarc® 250 AC/DC
SQUARE WAVE POWER SOURCES

NOTE: This manual is also suitable for use with L-TEC Heliarc 250 HF plus.

Be sure this information reaches the operator. You can get extra copies through your supplier.
This equipment will perform in conformity with the description thereof contained in this manual and accompanying labels and/or inserts when installed, operated, maintained and repaired in accordance with the instructions provided. This equipment must be checked periodically. Defective equipment should not be used. Parts that are broken, missing, worn, distorted or contaminated should be replaced immediately. Should such repair or replacement become necessary, the manufacturer recommends that a telephone or written request for service advice be made to the Authorized Distributor from whom purchased.

This equipment or any of its parts should not be altered without the prior written approval of the manufacturer. The user of this equipment shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, damage, improper repair or alteration by anyone other than the manufacturer or a service facility designated by the manufacturer.
SAFETY PRECAUTIONS

WARNING: These Safety Precautions are for your protection. They summarize precautionary information from the references listed in Additional Safety Information section. Before performing any installation or operating procedures, be sure to read and follow the safety precautions listed below as well as all other manuals, material safety data sheets, labels, etc. Failure to observe Safety Precautions can result in injury or death.

PROTECT YOURSELF AND OTHERS -- Some welding, cutting, and gouging processes are noisy and require ear protection. The arc, like the sun, emits ultraviolet (UV) and other radiation and can injure skin and eyes. Hot metal can cause burns. Training in the proper use of the processes and equipment is essential to prevent accidents. Therefore:

1. Always wear safety glasses with side shields in any work area, even if welding helmets, face shields, and goggles are also required.
2. Use a face shield fitted with the correct filter and cover plates to protect your eyes, face, neck, and ears from sparks and rays of the arc when operating or observing operations. Warn bystanders not to watch the arc and not to expose themselves to the rays of the electric-arc or hot metal.
3. Wear flameproof gauntlet type gloves, heavy long-sleeve shirt, cuffless trousers, high-topped shoes, and a welding helmet or cap for protection against radiation, heat, and sparks.
4. Hot sparks or metal can lodge in rolled up sleeves, trouser cuffs, or pockets. Sleeves and collars should be kept buttoned, and open pockets eliminated from the front of clothing.
5. Protect other personnel from arc rays and hot sparks with a suitable non-flammable partition or curtains.
6. Use goggles over safety glasses when chipping slag or grinding. Chipped slag may be hot and can fly far. Bystanders should also wear goggles over safety glasses.

FIRES AND EXPLOSIONS -- Heat from flames and arcs can start fires. Hot slag or sparks can also cause fires and explosions. Therefore:

1. Remove all combustible materials well away from the work area or cover the materials with a protective non-flammable covering. Combustible materials include wood, cloth, sawdust, liquid and gas fuels, solvents, paints and coatings, paper, etc.
2. Hot sparks or hot metal can fall through cracks or crevices in floors or wall openings and cause a hidden smoldering fire or fires on the floor below. Make certain that such openings are protected from hot sparks and metal.
3. Do not weld, cut or perform other hot work until the workpiece has been completely cleaned so that there are no substances on the workpiece which might produce flammable or toxic vapors. Do not do hot work on closed containers. They may explode.
4. Have fire extinguishing equipment handy for instant use, such as a garden hose, water pail, sand bucket, or portable fire extinguisher. Be sure you are trained in its use.
5. Do not use equipment beyond its ratings. For example, overloaded welding cable can overheat and create a fire hazard.
6. After completing operations, inspect the work area to make certain there are no hot sparks or hot metal which could cause a later fire. Use fire watchers when necessary.
7. For additional information, refer to NFPA Standard 51B, "Fire Prevention in Use of Cutting and Welding Processes", available from the National Fire Protection Association, Battery March Park, Quincy, MA 02269.

ELECTRICAL SHOCK -- Contact with live electrical parts and ground can cause severe injury or death. DO NOT use AC welding current in damp areas, if movement is confined, or if there is danger of falling.

1. Be sure the power source frame (chassis) is connected to the ground system of the input power.
2. Connect the workpiece to a good electrical ground.
3. Connect the work cable to the workpiece. A poor or missing connection can expose you or others to a fatal shock.
4. Use well-maintained equipment. Replace worn or damaged cables.
5. Keep everything dry, including clothing, work area, cables, torch/electrode holder, and power source.
6. Make sure that all parts of your body are insulated from work and from ground.
7. Do not stand directly on metal or the earth while working in tight quarters or a damp area; stand on dry boards or an insulating platform and wear rubber-soled shoes.
8. Put on dry, hole-free gloves before turning on the power.
9. Turn off the power before removing your gloves.
10. Refer to ANSI/ASC Standard Z49.1 (listed on next page) for specific grounding recommendations. Do not mistake the work lead for a ground cable.

ELECTRIC AND MAGNETIC FIELDS — May be dangerous. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding and cutting current creates EMF around welding cables and welding machines. Therefore:

1. Welders having pacemakers should consult their physician before welding. EMF may interfere with some pacemakers.
2. Exposure to EMF may have other health effects which are unknown.
3. Welders should use the following procedures to minimize exposure to EMF:
   A. Route the electrode and work cables together. Secure them with tape when possible.
   B. Never coil the torch or work cable around your body.
   C. Do not place your body between the torch and work cables. Route cables on the same side of your body.
   D. Connect the work cable to the workpiece as close as possible to the area being welded.
   E. Keep welding power source and cables as far away from your body as possible.
1. Always provide adequate ventilation in the work area by natural or mechanical means. Do not weld, cut, or gouge on materials such as galvanized steel, stainless steel, copper, zinc, lead, beryllium, or cadmium unless positive mechanical ventilation is provided. Do not breathe fumes from these materials.

2. Do not operate near degreasing and spraying operations. The heat or arc rays can react with chlorinated hydrocarbon vapors to form phosgene, a highly toxic gas, and other irritant gases.

3. If you develop momentary eye, nose, or throat irritation while operating, this is an indication that ventilation is not adequate. Stop work and take necessary steps to improve ventilation in the work area. Do not continue to operate if physical discomfort persists.

4. Refer to ANSI/ASC Standard Z49.1 (see listing below) for specific ventilation recommendations.

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1. Use the proper gas for the process and use the proper pressure reducing regulator designed to operate from the compressed gas cylinder. Do not use adaptors. Maintain hoses and fittings in good condition. Follow manufacturer's operating instructions for mounting regulator to a compressed gas cylinder.

2. Always secure cylinders in an upright position by chain or strap to suitable hand trucks, undercarriages, benches, walls, post, or racks. Never secure cylinders to work tables or fixtures where they may become part of an electrical circuit.

3. When not in use, keep cylinder valves closed. Have valve protection cap in place if regulator is not connected. Secure and move cylinders by using suitable hand trucks. Avoid rough handling of cylinders.

4. Locate cylinders away from heat, sparks, and flames. Never strike an arc on a cylinder.

5. For additional information, refer to CGA Standard P-1, "Precautions for Safe Handling of Compressed Gases in Cylinders", which is available from Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.

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1. Always have qualified personnel perform the installation, troubleshooting, and maintenance work. Do not perform any electrical work unless you are qualified to perform such work.

2. Before performing any maintenance work inside a power source, disconnect the power source from the incoming electrical power.

3. Maintain cables, grounding wire, connections, power cord, and power supply in safe working order. Do not operate any equipment in faulty condition.

4. Do not abuse any equipment or accessories. Keep equipment away from heat sources such as furnaces, wet conditions such as water puddles, oil or grease, corrosive atmospheres and inclement weather.

5. Keep all safety devices and cabinet covers in position and in good repair.

6. Use equipment only for its intended purpose. Do not modify it in any manner.

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The following publications, which are available from the American Welding Society, 550 N.W. LeJuene Road, Miami, FL 33126, are recommended to you:

1. ANSI/ASC Z49.1 - "Safety in Welding and Cutting"
2. AWS C5.1 - "Recommended Practices for Plasma Arc Welding"
3. AWS C5.2 - "Recommended Practices for Plasma Arc Cutting"
4. AWS C5.3 - "Recommended Practices for Air Carbon Arc Gouging and Cutting"
5. AWS C5.5 - "Recommended Practices for Gas Tungsten Arc Welding"
6. AWS C5.6 - "Recommended Practices for Gas Metal Arc Welding"
8. ANSI/AWS F4.1, "Recommended Safe Practices for Welding and Cutting of Containers That Have Held Hazardous Substances."

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The following definitions apply to DANGER, WARNING, CAUTION found throughout this manual:

**DANGER**

Used to call attention to immediate hazards which, if not avoided, will result in immediate, serious personal injury or loss of life.

**WARNING**

Used to call attention to potential hazards which could result in personal injury or loss of life.

**CAUTION**

Used to call attention to hazards which could result in minor personal injury.
1.1 Introduction

The Heliarc 250 ac/dc welding power sources are constant current AC/DC welding power sources for high quality tig and stick welding in both the AC and DC mode. The unique characteristics of the magnetic and solid state circuits provide excellent arc conditions for all tig welding as well as high alloy stick electrodes. The non-saturating current limiting reactor and electronic feedback control prohibits high current surges inherent with saturable reactors or solid state SCR control alone, therefore reducing spatter on stick electrodes as well as tungsten spitting when tig welding. The electronic firing circuit utilizes a voltage compensating circuit which compensates for line voltage variations of +/- 10 percent.

Through its unique design, the Heliarc 250 ac/dc combines all of the latest state-of-the-art magnetic and solid state concepts to provide the wide range volt-ampere curve characteristics needed for a constant current AC/DC power source - see Figure 1-1. Refer to Table 1-1 for technical specifications.

<table>
<thead>
<tr>
<th>Table 1-1. Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated Output @ 40% Duty Cycle</strong></td>
</tr>
<tr>
<td><strong>Open Circuit Voltage</strong></td>
</tr>
<tr>
<td><strong>Output Current Range in Amperes</strong></td>
</tr>
<tr>
<td>Low Range</td>
</tr>
<tr>
<td>5 to 60 Amps</td>
</tr>
<tr>
<td>(20 to 320 Amps*)</td>
</tr>
<tr>
<td><strong>Input Voltage AC</strong></td>
</tr>
<tr>
<td><strong>Input Current @ Rated Load in Ampere</strong></td>
</tr>
<tr>
<td>With P.F.C.*</td>
</tr>
<tr>
<td><strong>Power Factor @ Rated Load</strong></td>
</tr>
<tr>
<td>With P.F.C.*</td>
</tr>
<tr>
<td><strong>Auxiliary Power Output</strong></td>
</tr>
<tr>
<td><strong>Dimensions:</strong></td>
</tr>
<tr>
<td><strong>Depth</strong></td>
</tr>
<tr>
<td><strong>Height</strong></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
</tr>
<tr>
<td><em><em>(205 lbs 179 kg</em>)</em>*</td>
</tr>
</tbody>
</table>

* P.F.C. indicates with or without power factor correction

¹ The input currents listed are for balance control in the "max. clean" (0) position. When balance control is set in the "max. penetration" (10) position, input current will increase approximately 40%.

1.2 Duty Cycle

Duty cycle is defined as the ratio of load time to the total time. Standard current ratings are based on a 10-minute cycle. This machine is rated at 40 percent duty cycle which means the rated load (250 amps.) is applied for a total of 4 minutes and shut off for a total of 6 minutes in a 10-minute period. However, if the welding current is decreased, the duty cycle can be increased. Conversely, if the welding current is increased, the duty cycle must be decreased. Figure 1-2 enables the operator to determine the safe output of the power source at various duty cycles. Note that the duty cycle of the unit without p.f. is approximately 50% less (25% less on unit with p.f.) when Balance Control is in the "max. penetration" position.
2.1 Installation

Proper installation can contribute materially to the satisfactory and trouble-free operation of the power source. It is suggested that each step in this section be studied carefully and followed as closely as possible.

A. UNPACKING AND PLACEMENT

1. Immediately upon receipt of the power source, it should be inspected for damage which may have occurred in transit. Notify the carrier of any defects or damage at once.

2. After removing the power source from the shipping container, check the container for any loose parts. Remove all packing materials.

3. Check air passages at front, bottom, and rear of cabinet for any packing materials that may obstruct air flow through the power source.

4. If the machine is not to be installed immediately, store it in a clean, dry, well-ventilated area.

5. The location of the welding machine should be carefully selected to ensure satisfactory and dependable service. Using the lifting eyebolt, or a fork-lift truck, place the power source in the desired location. Choose a location relatively close to a properly fused supply of electrical power.

6. The machine’s components are maintained at proper operating temperature by forced air which is drawn through the cabinet by the fan unit on the rear panel. The power source is designed to operate up to a 40 °C (104 °F) ambient temperature. For this reason, locate the machine in an open area where air can circulate freely at front, bottom, and rear openings. Leave at least 2 feet of clearance between the rear of the power source and wall or other obstruction.

IMPORTANT: Do not use filters on this unit. Output ratings are designed and based on an unobstructed supply of “clean” cooling air drawn over its internal components. If cooling air is dirty (e.g., laden with conductive dust), the interior should be cleaned using low pressure air (see Maintenance).

B. PRIMARY (INPUT) ELECTRICAL CONNECTIONS

This welding power source is a single-phase unit and must be connected to a single-phase power supply.

Although designed with line voltage compensation, it is suggested the unit be operated on a separate circuit to assure that the performance of the machine is not impaired due to an overloaded circuit.

ELECTRIC SHOCK CAN KILL! Do not touch electrically live parts. Be sure that all power is off by opening the line (wall) disconnect switch when primary electrical connections are made to the power source. To be doubly safe, check your input leads with a voltmeter to make sure that all power is OFF.

1. A line (wall) disconnect switch, with fuses or circuit breakers, should be provided at the main power panel (see Fig. 2-1). The primary power input must have three insulated copper conductors (two power leads and one ground wire). The wires may be heavy rubber-covered cable, or may be run in a solid or flexible conduit. Refer to the following table for recommended input conductors and line fuse sizes. Do not connect the input conductors until step 3.

Table 2-1. Recommended Sizes for Input Conductors and Line Fuses

<table>
<thead>
<tr>
<th>Input Requirements</th>
<th>Input &amp; Gnd. Conductor*</th>
<th>Time-Delay Fuse Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part No. 1341-0355/0356/0357/0358</td>
<td>CU/AWG</td>
<td></td>
</tr>
<tr>
<td>Volts</td>
<td>Amps.</td>
<td></td>
</tr>
<tr>
<td>208 (200)</td>
<td>107</td>
<td>No. 2</td>
</tr>
<tr>
<td>230</td>
<td>96</td>
<td>No. 2</td>
</tr>
<tr>
<td>460</td>
<td>48</td>
<td>No. 6</td>
</tr>
<tr>
<td>Part No. 1341-0366/0367</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volts</td>
<td>Amps.</td>
<td></td>
</tr>
<tr>
<td>230</td>
<td>96</td>
<td>No. 2</td>
</tr>
<tr>
<td>460</td>
<td>48</td>
<td>No. 6</td>
</tr>
<tr>
<td>575</td>
<td>38</td>
<td>No. 8</td>
</tr>
<tr>
<td>Part No. 1341-0368</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part No. 1341-0369</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volts</td>
<td>Amps.</td>
<td></td>
</tr>
<tr>
<td>220</td>
<td>78</td>
<td>3</td>
</tr>
<tr>
<td>380</td>
<td>45</td>
<td>6</td>
</tr>
<tr>
<td>415</td>
<td>41</td>
<td>8</td>
</tr>
<tr>
<td>440</td>
<td>39</td>
<td>8</td>
</tr>
</tbody>
</table>

* Sized per National Electric Code for 75°C rated conductors @ 30°C ambient. Not more than three conductors in raceway or cable. Local codes should be followed if they specify sizes other than those listed above.
2. For access to input terminal board, remove the screws which secure the right side access panel of the power source. The input terminal board, Figure 2-2, is clearly marked to show the available primary voltage connections which may be used. Set the voltage links, on this board, to match your actual incoming voltage. As shipped from the factory, the input terminal board voltage links are set up to match the highest available voltage.

3. Thread the input conductor cables from the wall disconnect switch through the (strain relief) hole in the rear panel (see Fig. 2-1). Secure the cables with the strain relief coupling provided and then connect conductors to terminals L1 and L2 (on the input terminal board) using UL listed pressure wire connectors. Connect the ground wire to the grounding stud provided on the chassis base near the input terminal board.

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**Figure 2-1. Interconnection Diagram**
It is of the utmost importance that the chassis be connected to an approved electrical ground to prevent accidental shocking. Take care not to connect the ground wire to any of the primary leads.

4. Recheck all connections to make sure they are tight, well insulated, and that the proper connection has been made.

C. EXTERNAL PRIMARY/SECONDARY CONNECTIONS

Verify that all electrical connections comply with local electrical codes and especially with requirements established in booklet ADI-5054 "High Frequency Stabilized Arc Welding Equipment", which is packed with this power source.

Refer to Interconnection Diagram, Figure 2-1, for typical primary input, secondary output, process gas and water, and torch connections that are required for this unit’s welding application.

Before making any connections to the power source's output receptacles, make sure that all primary input power to the machine is deenergized (off) at the customer's disconnect switch.

The proper operation of the welding machine depends to a great extent on the use of output cables that are insulated copper, adequately sized, in good condition, and properly connected to the machine using UL listed pressure wire connectors. It is recommended that the output cables be kept as short as possible (this is particularly important for tig applications using ACHF), and be of adequate current carrying capacity. The resistance of the output cables and connections causes a voltage drop which is added to the voltage of the arc. Excessive cable resistance may result in overloading as well as reducing the maximum current output of which the power source is capable. The welding output terminals are located on the front panel. The following table will prove useful for selecting the recommended output cable size.

<table>
<thead>
<tr>
<th>Welding Current</th>
<th>Total Length (Feet) of Cable in Weld Circuit*</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>1 1 1/0</td>
</tr>
<tr>
<td>250</td>
<td>1 1 1/0</td>
</tr>
</tbody>
</table>

* Total cable length includes work and electrode cables. Cable size is based on direct current, insulated copper conductors, 40% duty cycle, and a voltage drop of 4 or less volts. The welding cable insulation must have a voltage rating that is high enough to withstand the open circuit voltage of the machine.

D. ACCESSORIES

1. FC-4 Foot Current and Contactor Control, P/N 679662. This device provides the operator with remote control of current and contactor operation at the welding station. Interconnection of these functions to the main unit is provided by a mating 25-foot cable/plug assembly. By depressing the foot pedal, the weld-start sequence circuit will energize, and the welding current will increase or decrease within the range preset on the power source Current Control potentiometer.

2. TC-1A Torch Current and Contactor Control, P/N 34718 (25-ft lg). This remote fingertip control is designed to be taped to any Tig torch handle and to provide the operator with complete contactor control and variable control of the welding current. By simply rotating the knob clockwise (off of zero), the integral switch will energize the contactor. Further rotation (clockwise) will increase the output current up to the limit preset on the power source main control.

3. Torch Switch Assembly, P/N 674038. This device is designed to be attached to any Tig welding torch, and provides the operator with remote control.

Fig. 2.2 - Input Terminal Board
contactor operation at the welding station. Inter-
connection to the power source is provided by its
12-1/2-ft. cable/plug assembly.

4. Current Hand Control, P/N 674209. This acces-
sory operates in series with the power sources
"main current control" potentiometer to provide
remote (up to 25-ft.) current regulation. The hand
control potentiometer’s current adjustment is al-
ways controlled by and limited to the range that is
preset on the main current control.

5. TR-11 Truck, P/N 600437. Provides complete
mobility for power source or welding outfit and
includes handle and gas cylinder bracket.

6. AC/DC Analog Meter Kit, P/N 34722. This op-
tional meter kit provides direct accurate reading of
AC and DC open-circuit and welding voltages as
well as welding current. The kit mounts directly to
the top of the power source. A plugged hole in the
top panel of the unit provides access for the meter
kit wiring to connect to the P16 receptacle provided
inside the power source.

7. WC-5B Water Cooler, P/N 19947. A self con-
tained 3 gallon capacity water cooler suitable for
most water cooled torch applications. The unit
circulates 1.8 gallon per minute at 60 psi and
operates from 115 volt, 60 Hz., 1 phase (5.4 amp)
input (see F-14-422). **NOTE: We recommend
bypassing the Solenoid Valve (8. below) when
using the WC-5B.**

8. Water Solenoid Kit, P/N 30459. This kit comes
completely assembled and ready for mounting on
the front panel (adjacent to the Gas Solenoid) using
the hardware supplied (see Fig. 6). It is identical to
the gas assembly except that its hose adaptor
connections are left-hand fittings (11N16). For wir-
ing requirement, refer to diagrams at rear of book-
let. If a coolant circulator is used, the water solenoid
should be bypassed.
3.1 Control Functions

A. Power On-Off Switch (ROS). In the OFF position, the power source is electrically shut down; however, input voltage is still present in the unit (at the input terminal board and the Power On-Off switch) -- unless the customer's line switch is off. In the ON position, this switch provides power to the fan motor, the primary and secondary of the main transformer, and its 115-volt and 24-volt windings to energize the control circuitry by preparing the ready-to-weld status of the unit, as determined by the positioning of the Contactor Control switch TSS (see Item B, following).

B. Tig-Stick Mode Switch (TSS). This 2-position toggle switch sets the operational modes which can be used. In the STICK position (with the ROS toggle ON), the solid-state contactor circuits immediately energize, and welding power is continuously present at the output terminals. In the TIG position, the solid-state contactor and other tig sequencing circuits are controlled by a remote device (foot or torch switch) through the Remote Control receptacle P17 (see Item D, following).

C. Current Control (Panel-Remote) Switch (PRS). This 2-position toggle switch determines the location from which welding current will be operated; PANEL position from the power source Weld Current potentiometer, or REMOTE position from an optional foot or hand control that plugs into the Remote Control receptacle P17 (see Item D). When the REMOTE position is selected, the optional remote control will vary the welding current, but only within the range preset on the power source Weld Current potentiometer CCP (see Item G).

D. Remote Torch (contactor Receptacle - RTR). The cable connector from the remote Foot Control or Torch Switch accessories plugs into this low-voltage receptacle to control the conducting sequence of the bridge SCR’s to make or break the Tig welding output power.

E. Remote Control Receptacle (RCC). This receptacle allows you to plug-in a remote accessory (i.e., foot or hand control) to provide remote current and/or contactor control, depending on the Panel/Remote selection of panel switches described in Items B and C above.

F. Current Selector Switch (CSS). A 3-position switch offers a choice of AC, DCSP, or DCRP output current to suit your particular welding applications. Placing the switch in its DCSP mode causes the output terminals to assume the following polarities: work is positive, and torch/electrode is negative. Conversely, when the switch is in DCRP; work is negative and torch/electrode is positive. Do not change the position of this switch while welding or under load.

G. Current Range Selector Switch (SW1). This 2-position switch (an integral part of the SCR Control PC BD.) permits quick coarse selection of the output current ranges which can be used. The current ranges are marked (low) 5-60 Amps and (high) 15-320 Amps. The low range provides exceptional cleaning action for all low current Tig AC applications. For higher current Tig welding, always try to select the appropriate minimum current range that adequately covers your welding requirements. For Stick electrode welding, position the switch to the desired current output range. Do not change the position of this switch while welding or under load.

H. Current Control Potentiometer (CCP). This potentiometer (an integral part of SCR Control PC BD.) provides fine adjustment of welding current within the range selected on the Range Switch (SW1). The panel-faced dial provides an accurate reference for resetting and/or adjusting the potentiometer.

I. High Frequency (Solenoid) Selector Switch (HFS). A 3-position toggle switch (an integral part of the Logic PC BD.) controls high frequency and shielding gas in the welding operation.

The functional positions are: Off -- no high frequency and gas solenoid valve is deenergized (this is the normal position for all stick welding), Continuous -- high frequency and shielding gas are provided throughout the entire welding cycle (this is the normal position for all AC Tig welding), and Start -- high frequency initiates immediately and cuts off when the arc is established, and the gas solenoid energizes and remains on throughout the welding cycle (this last position is normal for most DC Tig welding applications).

J. Post Flow Control (PFP). This potentiometer (an integral part of the Logic PC BD.) provides a timed (from 5 to 45 seconds) post-flow of shielding gas after the welding arc is broken.

K. Auxiliary 115-Volt Receptacle (J3). This duplex receptacle can be utilized to source 115-volt power for auxiliary equipment (grinder, etc.) and is protected by a 15-amp circuit breaker.
L. Arc Force Potentiometer (AFP). This control is used in the STICK mode only. The lower settings provide less short circuit current and a softer, more stable arc. The higher settings provide more short circuit current and a forceful, more penetrating arc. For most Stick welding, set the knob at 3 or 4 and readjust up (forceful) or down (softer) as desired. Note that with the knob in the MIN. position, a longer arc length can be maintained; and at MAX., the arc will extinguish much easier when drawing the rod away from the work.

M. Balance Control Potentiometer (BP). This control changes the wave balance for Tig welding operations (see Fig. 3-1). It is not operative in Stick welding operations. With the potentiometer set in its extreme counterclockwise or “Max. Cleaning” position, the machine is set up for “balanced” wave operation (equal portions of reverse and straight polarity - 50/50) for use in DC and AC Tig with Maximum Cleaning (and minimum penetration). This will be the normal (counterclockwise) position for most applications. As the potentiometer is turned clockwise toward “Max. Penetration”, cleaning action will lessen and penetration will increase until you reach Maximum Penetration. This “unbalanced” wave output (straighter than reverse polarity) should only be used for AC Tig applications when needed.

3.2 Sequence of Operation

**WARNING**

ELECTRIC SHOCK CAN KILL! Do not use AC output in damp areas, if movement is confined, or if danger of falling exists.

Use AC output only if required for the welding process.

**CAUTION**

Never, under any circumstances, operate the power source without its panels in place. In addition to the safety hazard, improper cooling may cause overheating which will damage the internal components. Also, make sure you are adequately protected before you start welding -- welding helmet, gloves, and ear protection and safety glasses with side shields should always be worn.

A. STICK ELECTRODE/SHIELDED METAL ARC WELDING

1. Connect all welding cables to workpiece and electrode holder as shown on the Interconnection Diagram, Fig. 2-1.

2. Place the power source's Power ON-OFF and High Frequency Selector switches to the OFF position.

3. Close the main (wall) disconnect switch or circuit breaker to provide input voltage to the power source.

4. Place the Current Selector switch to AC, DCSP, or DCRP depending on your welding application.

**WARNING**

ELECTRIC SHOCK CAN KILL! Do not use AC output in damp areas, if movement is confined, or if danger of falling exists.

Use AC output only if required for the welding process.

**NOTE:** Square wave machines generally offer better cleaning in AC tig welding than conventional saturable reactor machines. The extra cleaning results from more reverse polarity which decreases the maximum current for a given electrode. The following may help to resolve this situation: (1) Adjust the balance control for less cleaning, (2) use a larger electrode, and (3) use 2% thoriated tungsten.
Do not change the position of this switch while welding.

5. Place the Tig/Stick toggle switch to its STICK position.

6. Leave the High Frequency Selector switch in its OFF position.

7. Place the Current Range Selector to one of the two Current Range positions to suit your welding applications.

Do not change the position of this switch while welding.

8. Adjust the Current Control potentiometer for the approximate desired welding current.

9. Set the Arc Force control at 3 or 4 on the dial and readjust as necessary to provide a softer or harder welding arc as described in Section 3.1-L

10. Place the Power ON-OFF switch to the ON position. This will immediately energize the power source up to the output terminals and the electrode holder. Commence welding by touch or scratch starting.

11. If necessary, readjust the Current Control potentiometer and/or Arc Force control to obtain the exact welding condition required.

B. TIG WELDING

1. Make the necessary welding power and service connections as shown on the Interconnection Diagram, Fig. 2-1.

2. Set the Power ON-OFF switch to the OFF position.

3. Set the Tig-Stick switch to the TIG position. Remember, this mode requires that a torch switch or foot control be plugged into the Remote Control receptacle (RCC) in order to make and break the welding sequence.

4. Close the main (wall) disconnect switch or circuit breaker to provide input voltage to the power source.

5. Place the Current Selector switch in AC, DCSP, or DCRP position. The AC position is primarily used for welding of aluminum and magnesium. The DCSP position will normally be used to cover all of the remaining metals (steel, copper, refractory, etc.) and alloys. The DCRP position produces a shallow weld, which makes it suitable for joining thin sheets of metal (e.g., magnesium, foil, etc.)

CAUTION
Do not change the position of this switch while welding.

6. Set the Balance control to the position which best suits your "AC-Tig" welding condition — Remember that when using "Maximum Penetration" mode, your duty cycle (AC welding arc time) must be reduced (see Fig. 1-2 - Duty Cycle chart). Also remember that for DC welding applications, this control should always be set for "Maximum Cleaning".

7. Place the current Range Selector to one of the two Current Range positions to suit your welding application.

CAUTION
Do not change the position of this switch while welding.

6. Set the Balance control to the position which best suits your "AC-Tig" welding condition — Remember that when using "Maximum Penetration" mode, your duty cycle (AC welding arc time) must be reduced (see Fig. 1-2 - Duty Cycle chart). Also remember that for DC welding applications, this control should always be set for "Maximum Cleaning".

8. Adjust the Current Control potentiometer for the approximate welding current desired (see Table 3-1). Remember, that the setting placed on this potentiometer will be the maximum current which can be regulated from a Remote Foot or Torch Control.

9. Depending on the type of current regulation desired, place the "PANEL-REMOTE" Current Control switch (PRS) as follows:

PANEL Position -- permits full range current regulation only from the power source Current Control potentiometer.

Table 3-1. Typical Current Ranges for
3. Operation

10. Depending on your welding application, place the High Frequency Selector switch in the START or CONTINUOUS position.

11. Set the POSTFLOW control to provide the desired interval of post-flow shielding gas (from 5 to 30 seconds) after the welding arc voltage is broken.

12. Place the Power ON-OFF switch to the ON position. This will immediately energize the power source up to its solid state contactor.

13. To establish the welding arc, position the torch electrode near the workpiece (i.e., 1/8" typical) and close the Remote Torch or Foot Control. This will energize the solid state contactor and provide high frequency and welding current to initiate the arc.

14. If necessary, readjust the panel or remote Current Control until you secure the exact condition desired.

---

### Tungsten Electrodes

<table>
<thead>
<tr>
<th>Electrode Diameter (Inches)</th>
<th>Welding Currents (Amps)</th>
<th>ACHF</th>
<th>DCSP</th>
<th>DCRP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Using pure Tungsten electrodes</td>
<td>Using thoriated electrodes</td>
<td>Using pure or thoriated tungsten electrodes</td>
<td></td>
</tr>
<tr>
<td>0.020</td>
<td>5-15</td>
<td>5-20</td>
<td>5-20</td>
<td>--</td>
</tr>
<tr>
<td>0.040</td>
<td>10-60</td>
<td>15-80</td>
<td>15-80</td>
<td>--</td>
</tr>
<tr>
<td>1/16</td>
<td>50-100</td>
<td>70-150</td>
<td>70-150</td>
<td>10-20</td>
</tr>
<tr>
<td>3/32</td>
<td>100-160</td>
<td>140-235</td>
<td>150-250</td>
<td>15-30</td>
</tr>
<tr>
<td>1/8</td>
<td>150-210</td>
<td>225-325</td>
<td>250-400</td>
<td>25-40</td>
</tr>
<tr>
<td>5/32</td>
<td>200-275</td>
<td>300-400</td>
<td>--</td>
<td>40-55</td>
</tr>
<tr>
<td>3/16</td>
<td>250-350</td>
<td>--</td>
<td>--</td>
<td>55-80</td>
</tr>
<tr>
<td>1/4</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>80-125</td>
</tr>
</tbody>
</table>

**REMOTE Position** -- permits current regulation from a remote location by connecting either the Foot or Torch control options to the Remote Control receptacle (RCC). Note that welding current regulation from the remote control option is "always" limited to the maximum current that you preset on the power source main Current Control potentiometer. For example: if the main potentiometer is dial-set at 50, the remote potentiometer will provide full range, finer tuned current values up to the equivalent dial setting of 50 on the main pot; however, if you want complete remote current control operation, the main potentiometer on the power source must be dial-set at 100 (or maximum) on the dial.
4.1 Maintenance

If this Equipment does not operate properly, stop work immediately and investigate the cause of the malfunction. Maintenance work must be performed by an experienced person, and electrical work by a trained electrician. Do not permit untrained persons to inspect, clean, or repair this Equipment. Use only recommended replacement parts.

WARNING

Be sure that the wall disconnect switch or circuit breaker is open before attempting any inspection or work inside of the power source. Always wear safety goggles with side shields when blowing out the unit with low pressure air.

A. CLEANING

Since there are no moving parts (other than the fan) in the power source, maintenance consists mainly of keeping the interior of the cabinet clean. Periodically, remove the cover from the cabinet and blow accumulated dust and dirt from the air passages and the interior components, using clean low pressure air. It is imperative that the air passages, to the interior of the unit, be kept free of dirt accumulation to ensure adequate circulation of cooling air, especially over the rectifier bridge plates and PC boards. The length of time between cleaning will depend on the location of the unit and the amount of dust in the atmosphere.

B. LUBRICATION

Fan motors with old tubes require lubrication after 1 year of service. Motors without oil tubes are permanently lubricated and do not require any attention.

C. SPARK GAP SERVICING

This component is part of the high frequency assembly. It will probably be necessary to readjust these gaps after extended operation, or if erratic high frequency operation is noted. It is important that the gaps be adjusted with a feeler gauge rather than by eye. Cleaning and dressing of spark gap points is not recommended since the points are tungsten and difficult to file. Points (P/N 673578) should be replaced as a set.

D. SPARK GAP ADJUSTMENT

Generally, the high frequency output of the unit increases as the gap setting is increased. Electronic instability in other equipment may occur if the gap is opened more than the factory-set .025 inches (+/- 002-in.). However, if the high frequency intensity is not sufficient for your application; open or close the spark gaps until the desired high frequency intensity is obtained. Remember that high frequency radiation increases as the gap increases, and this can cause interference in other electronic equipment.

1. Loosen retaining screw "A" only enough to free electrode point "C" for adjustment.

2. Place feeler gauge of proper thickness between gap "B".

3. Apply slight pressure against loosened electrode point "C" so the feeler gauge is held firmly in the gap. Tighten retaining screw "A".

Figure 4-1. Spark Gap Adjustment

E. TESTING AND REPLACING BRIDGE ASSY. COMPONENTS

SCRs and silicon diodes are devices which allow current to flow in only one direction and block current in the other direction. The SCRs and silicon diodes used in this power source are designed to provide long trouble-free operation; however, should a failure occur, they may require replacement. The testing procedures to determine defective components are as follows:

1. Silicon Diode Rectifier, D1-D2.
   Disconnect the power lead to the diode in order to provide an open-circuit across the component to be tested. Using an ohmmeter set to the R x 1 scale, check the resistance in the forward and reverse direction. A good diode will read high in reverse direction and low in the forward direction.
When replacing defective diodes, make sure mounting surfaces are clean. Coat mounting surfaces with Dow-Corning No. 340 silicon heat sink compound, or equivalent. Replacement diode (nuts) should be tightened only until firm, and then torqued (recommended range is 275 inch-lbs min. to 325 inch-lbs max.).

2. Silicon Controlled Rectifier - SCR.
Disconnect the SCR wiring (but do not unclamp) to break continuity and provide an open circuit across the component to be tested. Using an ohmmeter set to the R x 1 scale, check the resistance across the SCR in both directions. A good SCR will read high in both directions. If the reading is low or zero in either direction, the SCR is defective.

When replacing defective SCRs, make sure the mounting surfaces are clean. Coat the mounting surfaces with Alcoa No. 2 electrical joint compound, available in 8 oz. containers under P/N 73585002. Make certain the polarity on the replacement SCR is the same as on the unit being replaced. Place the top clamp piece over the bolts and tighten each nut **hard finger tight**. The clamp piece should be parallel to the top plate. Next, tighten each nut approximately 1/4 turn at a time (alternately) for two complete revolutions until the force indicator on the clamp assembly reads 1.0 kilo pounds (1000 lbs).
5.1 General

**WARNING**

Be sure that all primary power to the machine has been externally disconnected. Open wall disconnect switch or circuit breaker before attempting inspection or work inside of the power source.

If power source is operating improperly, the following troubleshooting information may be used to locate the source of the trouble.

Check the problem against the symptoms in the following Troubleshooting Guide. The remedy may be quite simple. If the cause cannot be quickly located, open up the unit and perform a simple visual inspection of all the components and wiring. Check for secure terminal connections, loose or burned wiring or components, bulged or leaking capacitors, or any other sign of damage or discoloration.

5.2 Troubleshooting Guide

**A. Unit completely inoperative. Fan does not run.**

1. Open line fuses -- check the line fuses for continuity and replace if necessary. If the fuses continue to open, the jumper links may not be in proper position. See Primary Electrical Connections.

2. No power input -- check position of line disconnect switch.

3. Improper jumper link placement on input terminal board. See Primary Electrical Connections.

4. Defective ROS and/or wiring -- check continuity of ROS and replace if necessary.

**B. No welding output. Fan operative.**

1. Improper jumper link placement on input terminal board -- See Primary Electrical Connections.

2. Power source magnetics overheating -- thermal switch (TS) tripped due to restricted cooling air flow, or overextended duty cycle. Allow unit to cool for at least 5 minutes with fan running to let TS reset.

3. Tig-Stick switch (TSS) in the TIG position without a remote contactor control connected to the Remote Control receptacle RTR. Place TSS in the PANEL position or make remote torch connection at RTR.

4. Defective TSS and/or wiring. Check continuity and replace if necessary.

5. Defective SCR PC board.

6. Defective Current Range switch (SW1, located on SCR PC board). Check continuity of SW1 and ensure that all connections are secure and correct. Replace SW1 if defective.

7. Defective Current Selector switch (CSS) and/or wiring. Check continuity of CSS and ensure that all connections are secure and correct. Replace CSS if defective.

8. Defective Current Control potentiometer CCP (located on SCR PC board). To check continuity of CCP, put Panel-Remote switch (PRS) in REMOTE position. Disconnect Remote Foot or Torch Control. Check resistance between terminals "X" and "W" on Remote Control receptacle (RCC) by rotating Current Control potentiometer (CCP). Resistance should vary between "0" and 9 K to 11 K ohms. If pot checks good, replace SCR PC board.

**C. Low or unstable open circuit voltage.**

1. Current control pot set too low for welding application. Increase setting of CCP.

2. Defective SCR in main bridge. Check the resistance across the SCR on the R x 1 scale. If the reading is high, the SCR is good. If the resistance is low or zero, the SCR is defective. To check the gate, connect the gate lead to the anode of the SCR and read the forward resistance across the SCR anode to cathode. If the internal voltage of the meter is high enough, the meter should read a low resistance.

3. Defective diode in main bridge. Place the Current Selector switch between positions so as to provide an open circuit across the diodes. On the R x 1 scale, check the resistance in the forward and reverse directions. A good diode will read high in the reverse direction and low in the forward direction. Replace defective diodes.

4. Defective CSS and/or wiring. See Troubleshooting paragraph B-7.

5. Defective SCR p/c board.

**D. Erratic output welding current.**

1. Intermittent shunt connections. Check connections to shunt.
2. Defective SCR and/or diode in main bridge. See Troubleshooting paragraphs C-2 and C-3.

3. Defective SCR PC board. Replace SCR PC board.

4. Excessive high frequency. Check spark gaps and adjust if necessary (see Maintenance Section). Check all connections and components in high frequency bypass circuit and replace any defective components.

5. Arc force potentiometer and/or wiring defective. Check continuity and resistance of potentiometer should be 100 K ohms. Replace if defective.

E. Low welding output in High range.

Current Range switch (SW1, located on SCR PC board) may not be closing when positioned in HIGH range. Check continuity of SW1 on SCR PC board -- replace if defective.

F. Minimum welding output in both current ranges.

Check for defective Current Control potentiometer (CCP, located on SCR PC board) using procedure outlined in paragraph B-8.

H. High weld output, current control does not vary the output.

1. Open shunt connection. Check connections to shunt.

2. Defective SCR PC board. Replace if defective.

3. Arc Force Pot connection open or not making solid electrical connection. Check connection on Arc Force Pot and J1 at SCR pc board.

I. Absence of High Frequency while selector switch (HFS) is in START mode only.

1. Low open circuit voltage -- check remote contactor switch or Tig-Stick Mode switch (TSS).

2. SCR PC board may be defective.

J. Insufficient or Absence of H.F.

1. High frequency switch in the OFF position. Check HFS and place in START or CONTINUOUS position.

2. Improper spark gap. Clean and adjust spark gaps, if necessary. See Spark Gap Servicing.

3. Defective HFS and/or wiring. Make continuity check and replace if necessary.

4. Defective Logic PC board.

K. No gas flow.

1. High Frequency switch (HFS) in OFF (Stick) position -- place in Start or Continuous Mode(s). Make continuity check, if necessary, and replace if defective.

2. Defective GS solenoid. Check 24 V ac across solenoid coil. If present and solenoid does not energize, replace solenoid.

L. No remote contactor control.

Tig-Stick switch in the STICK position. Place TSS switch in the TIG position.
Figure 5-1. Schematic Diagram for 208/230/460 V, Heliarc 250 ac/dc
Figure 5-3. Wiring Diagram for 208/230/460 V, Heliarc 250 AC/DC (Sheet 2 of 2)
6.1 General

Replacement Parts are illustrated on the following figures. When ordering replacement parts, order by part number and part name, as illustrated on the figure. DO NOT ORDER BY PART NUMBER ALONE.

Many of the parts on the illustrations, particularly electronic parts, are 'vendor item'. This means that they are standard commercial parts made by and purchased from other manufacturers.

Always provide the series or serial number of the unit on which the parts will be used. The serial number is stamped on the unit nameplate.

Replacement parts may be ordered from your distributor or from:

ESAB Welding & Cutting Products
P.O. Box 100545
Ebenezer Road
Florence, SC 29501-0545

Be sure to indicate any special shipping instructions when ordering replacement parts.

For technical assistance directly from an ESAB service representative, call (803) 664-4416 or 5550. Additionally, ESAB offers toll free facsimile (FAX) service via 1-800-446-5693.
**SECTION 6**

**REPLACEMENT PARTS**

![Diagram of Heliarc 250 AC/DC Front View](image)

*Figure 6-1. Heliarc 250 AC/DC Front View*

![Diagram of Heliarc 250 AC/DC Right Side View](image)

*Figure 6-2. Heliarc 250 AC/DC Right Side View*

*Designates recommended spare parts.*

---

**LOGIC P/C BOARD ASSY. - 675421A**

**CONTROL P/C BOARD ASSY. - 38002A**

**(BF) BRIDGE ASSY. - 31068**

Includes:

- (SCHR1) SCR THYRISTOR - 951510
- (C1) CAPACITOR - 0.2 MF/1KV - 674216

**(2) FILTER NETWORK - 680025**

Includes:

- (C2) CAP - 0.2 MF/1KV
- (C3) CAP - 22 MF/600V
- (R1) RES - 100 OHM/1W
- (R3) THERMAL SW - 950711

**(F0) FILTER NETWORK - 680042**

Includes:

- (C1, C2) CAP - 0.1 MF/125V
- (C3) CAP - 1.0 MF/600V
- (MOV) MET. OX. VAR - 995104

**(BP) BALANCE POT. - 92W64**

**TOP COVER - 30421**

**(RO) READY-OFF SW. - 950721**

**(CRS) CURRENT SEL. SW. - 680044**

**KNOB - 2062171**

**(CR, C7) CAPACITOR - 674216**

**LEFT-SIDE PANEL - 30419**

**(RC) REMOTE CURRENT CONTROL RECEPT. - 98W10**

**(C11, C12, C14) CAPACITOR - 674216**

**(TSS) TIG-STICK SW. - 950812**

**OUTPUT SAFETY COVER - 30448**

**(2) OUTPUT TARM. ASSYS. - 676740**

**SILKSCREENED FRONT PNLS.**

P/N 30410, for 250 HF
P/N 30456, for 250 HFpf

**AFP)** ARC FORCE POT. - 92W64

**KNOB - 950584**

**(HFS) HIGH FREQ. SW. - 950100 (part of logic P/C Bd. 675421)**

**(PFP) POST FLOW POT. - 950725 (part of Logic P/C Bd. 675421)**

**KNOB - 950584**

**(F1) FUSE 5A. S.B. - 97W06**

**FUSE HOLDER - 634709**

**(WARNING DECAL (on upper-rear of outer panel) - 995227)**

**(CCP) CURRENT CONTROL P/0. - 951010**

*(part of SCR Control P/C Bd. 675405)**

**KNOB - 950584**

**(PRS) CURRENT PANEL - REMOTE SW. - 950812**

**(SW1) CURRENT RANGE SEL. SW. - 950811**

*(part of SCR control P/C Bd. 674987)*

**(RTR) REMOTE TORCH (CONTACTOR) RECEPT. - 84W31**

**(C15, C16) CAPACITOR - 674216**

**(LOCATION FOR OPTIONAL WIND-VISIT - 30459:)**

**(WSV) WATER SOL. VALVE - 950249**

**(2) L.H. ADAPTOR - 111N6**

**(GSP) GAS SOL. VALVE - 950249**

**(2) R.H. ADAPTOR - 7457**

**(R5) RESISTOR, 470 OHM, 2W. - 71140147**

**RIGHT-SIDE PANEL - 30420**

**RIGHT-SIDE ACCESS PANEL - 30429**

*Replace decal if it becomes excessively worn or lost, or when replacing panel(s).*

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6-2
Figure 6-3. Heliarc 250 AC/DC Left Side View

- FAN SHROUD: 672002
- FAN BLADE: 672358
- FAN MOTOR: 2062034
- 3 CAPACITORS (C17, C18, C19): 950519
- MTG BRACKET: 678519
- DIODE SUB-ASSY: 680034
  - Includes:
    - (D1) REV. DIODE: 672384
    - (D2) FWD DIODE: 672259
    - (C9, C10) CAPACITOR: 02 MF/1KV
    - 674216
    - (2) INSUL STANDOFF: 672225
- (ACT) AIRCORE TRANSF.: 680024
- (SG) SPARK GAP ASSY: 680036
  - Includes:
    - P/C BOARD ASSY: 675425
    - HEAT SINK: 673579
    - SPARK GAP POINT: 673578
    - CAPACITOR: 950/256
    - (SH) SHUNT: 680019
    - HF TR: HI-FREQ. TRANSF.: 950573
- (FN1) FILTER P/C BOARD ASSY: 674971
  - Includes:
    - (C1-C4) CAPACITOR: 02 MF/1KV
    - (C5, C6) CAPACITOR: 22 MF/600V

▲ Designates recommended spare parts. ▲ Provided in Heli. 250 units with power factor only.
COMMUNICATION GUIDE - CUSTOMER SERVICES

A. CUSTOMER SERVICE QUESTIONS: Contact your Customer Service Representative. Fax: (800) 634-7546
Order Entry/Product Availability Pricing Order Changes Hours: 8:30 AM to 5:00 PM EST
Delivery Saleable Goods Returns Shipping Information

B. ENGINEERING SERVICE: Telephone: (803) 664-4416 or -5550 / Fax: (800) 446-5690
Welding Equipment Troubleshooting Warranty Returns Hours: 7:30 AM to 5:00 PM EST
Authorized Repair Stations

C. TECHNICAL SERVICE: Telephone: (803) 664-5547 / Fax: (803) 664-5575
Part Numbers Technical Applications Hours: 7:30 AM to 5:00 PM EST
Performance Features Technical Specifications

D. LITERATURE REQUESTS: Telephone: (803) 664-5501 / Fax: (803) 664-5575
Hours: 7:30 AM to 4:00 PM EST

E. WELDING EQUIPMENT REPAIRS: Telephone: (803) 664-4487 / Fax: (803) 664-5557
Repair estimates Repair status Hours: 7:30 AM to 3:30 PM EST

F. WELDING EQUIPMENT TRAINING:
Telephone: (803)664-5524 / Fax: (803) 664-5575
Training School Information and Registrations Hours: 7:30 AM to 4:30 PM EST

G. TO SET UP A NEW AUTHORIZED REPAIR STATION:
Telephone: (803)664-5524 / Fax: (803)664-5575
Hours: 7:30 AM to 4:00 PM EST

IF YOU DO NOT KNOW WHO TO CALL
Telephone: (800)664-5540 & (803)664-4460
Hours: 7:30 AM to 5:00 PM EST

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PO Box 100545, Florence SC 29501-0545