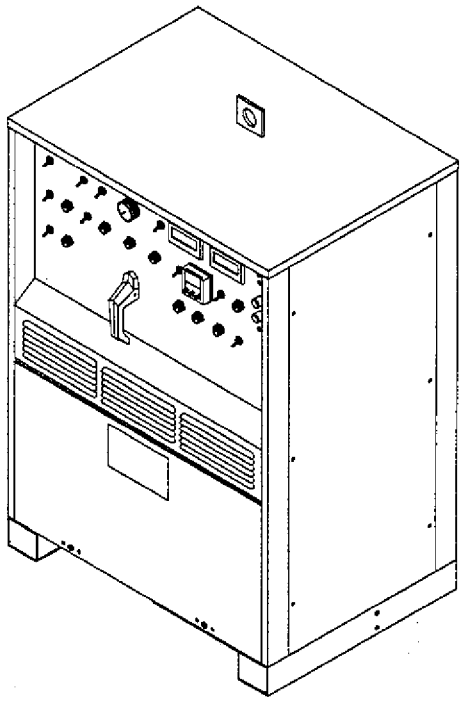
Miller®

December 1992 Form: OM-352F

Effective With Serial No. KC258281

OWNER'S MANUAL



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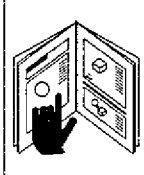

- Read and follow these instructions and all safety blocks carefully.
- Have only trained and qualified persons install, operate, or service this unit.
- Call your distributor if you do not understand the directions.

- Give this manual to the operator.

- For help, call your distributor
- or: MILLER ELECTRIC Mfg. Co., P.O. Box 1079, Appleton, WI 54912 414-734-9821

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MILLER'S TRUE BLUE™ LIMITED WARRANTY

Effective January 1, 1992
(Equipment with a serial number preface of "KC" or newer)

This limited warranty supersedes all previous MILLER warranties and is exclusive with no other guarantees or warranties expressed or implied.

LIMITED WARRANTY – Subject to the terms and conditions below, MILLER Electric Mfg. Co., Appleton, Wisconsin, warrants to its original retail purchaser that new MILLER equipment sold after the effective date of this limited warranty is free of defects in material and workmanship at the time it is shipped by MILLER. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS.

Within the warranty periods listed below, MILLER will repair or replace any warranted parts or components that fail due to such defects in material or workmanship. MILLER must be notified in writing within thirty (30) days of such defect or failure, at which time MILLER will provide instructions on the warranty claim procedures to be followed.

MILLER shall honor warranty claims on warranted equipment listed below in the event of such a failure within the warranty time periods. All warranty time periods start on the date that the equipment was delivered to the original retail purchaser, and are as follows:

1. 5 Years Parts – 3 Years Labor
   * Original main power rectifiers
2. 3 Years — Parts and Labor
   * Transformer/Rectifier Power Sources
   * Plasma Arc Cutting Power Sources
   * Semi-Automatic and Automatic Wire Feeders
   * Robots
3. 2 Years — Parts and Labor
   * Engine Driven Welding Generators
     (NOTE: Engines are warranted separately by the engine manufacturer.)
4. 1 Year — Parts and Labor
   * Motor Driven Guns
   * Process Controllers
   * Water Coolant Systems
   * HF Units
   * Grids
   * Spot Welders
   * Load Banks
   * SDX Transformers
   * Running Gear/Trailers
   * Field Options

   (NOTE: Field options are covered under True Blue™ for the remaining warranty period of the product they are installed in, or for a minimum of one year — whichever is greater.)
5. 6 Months — Batteries
6. 90 Days — Parts and Labor
   * MIG Guns/TIG Torches
   * Plasma Cutting Torches
   * Remote Controls
   * Accessory Kits
   * Replacement Parts

MILLER'S True Blue™ Limited Warranty shall not apply to:

1. Items furnished by MILLER, but manufactured by others, such as engines or trade accessories. These items are covered by the manufacturer's warranty, if any.
2. Consumable components, such as contact tips, cutting nozzles, contactors and relays.
3. Equipment that has been modified by any party other than MILLER, or equipment that has been improperly installed, improperly operated or misused based upon industry standards, or equipment which has not had reasonable and necessary maintenance, or equipment which has been used for operation outside of the specifications for the equipment.

MILLER PRODUCTS ARE INTENDED FOR PURCHASE AND USE BY COMMERCIAL/INDUSTRIAL USERS AND PERSONS TRAINED AND EXPERIENCED IN THE USE AND MAINTENANCE OF WELDING EQUIPMENT.

In the event of a warranty claim covered by this warranty, the exclusive remedies shall be, at MILLER'S option: (1) repair; or (2) replacement; or, where authorized in writing by MILLER in appropriate cases, (3) the reasonable cost of repair or replacement at an authorized MILLER service station; or (4) payment of or credit for the purchase price (less reasonable depreciation based upon actual use) upon return of the goods at customer's risk and expense. MILLER'S option of repair or replacement will be F.O.B., Factory at Appleton, Wisconsin, or F.O.B. at a MILLER authorized service facility as determined by MILLER. Therefore no compensation or reimbursement for transportation costs of any kind will be allowed.

TO THE EXTENT PERMITTED BY LAW, THE REMEDIES PROVIDED HEREIN ARE THE SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT SHALL MILLER BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING LOSS OF PROFIT), WHETHER BASED ON CONTRACT, TORT OR ANY OTHER LEGAL THEORY.

ANY EXPRESS WARRANTY NOT PROVIDED HEREIN AND ANY IMPLIED WARRANTY, GUARANTY OR REPRESENTATION AS TO PERFORMANCE, AND ANY REMEDY FOR BREACH OF CONTRACT, TORT OR ANY OTHER LEGAL THEORY WHICH, BUT FOR THIS PROVISION, MIGHT ARISE BY IMPLICATION, OPERATION OF LAW, CUSTOM OF TRADE OR COURSE OF DEALING, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE, WITH RESPECT TO ANY AND ALL EQUIPMENT FURNISHED BY MILLER IS EXCLUDED AND DISCLAIMED BY MILLER.

Some states in the U.S.A. do not allow limitations of how long an implied warranty lasts, or the exclusion of incidental, indirect, special or consequential damages, so the above limitation or exclusion may not apply to you. This warranty provides specific legal rights, and other rights may be available, but may vary from state to state.

In Canada, legislation in some provinces provides for certain additional warranties or remedies other than as stated herein, and to the extent that they may not be waived, the limitations and exclusions set out above may not apply. This Limited Warranty provides specific legal rights, and other rights may be available, but may vary from province to province.

RECEIVING-HANDLING

Before unpacking equipment, check carton for any damage that may have occurred during shipment. File any claims for loss or damage **with the delivering carrier**. Assistance for filing or settling claims may be obtained from distributor and/or equipment manufacturer's Transportation Department.

When requesting information about this equipment, always provide Model Designation and Serial or Style Number.

Use the following spaces to record Model Designation and Serial or Style Number of your unit. The information is located on the rating label or nameplate.

Model _____

Serial or Style No. _____

Date of Purchase _____

CERTIFICATE

NAME OF EQUIPMENT:_____ MODEL NO._____

SERIAL NO._____ DATE: _____

This equipment has been type-tested under standardized field test conditions as recommended by the Joint Industry Committee on High Frequency Stabilized Arc Welding Machines found to radiate less than 10 microvolts per meter at a distance of one mile, the maximum allowable limit established by the Federal Communications Commission for equipment of this type.

Installations using this equipment on the basis of these tests, may reasonably be expected to meet the radiation limitations established by the Federal Communications Commission, only when installed, operated and maintained as specified in the instruction book provided.

USER'S CERTIFICATION

The welding equipment identified above has been installed in accordance with the specific instructions applicable to this model as outlined in the instruction book furnished. It is being used only for the purpose for which it was intended and is being maintained and operated in accordance with the manufacturer's instructions.

Date Installed _____ Signed _____

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SECTION 1 – SAFETY RULES FOR OPERATION OF ARC WELDING POWER SOURCE

1-1. INTRODUCTION

We learn by experience. Learning safety through personal experience, like a child touching a hot stove is harmful, wasteful, and unwise. Let the experience of others teach you.

Safe practices developed from experience in the use of welding and cutting are described in this manual. Research, development, and field experience have evolved reliable equipment and safe installation, operation, and servicing practices. Accidents occur when equipment is improperly used or maintained. The reason for the safe practices may not always be given. Some are based on common sense, others may require technical volumes to explain. It is wiser to follow the rules.

Read and understand these safe practices before attempting to install, operate, or service the equipment. Comply with these procedures as applicable to the particular equipment used and their instruction manuals, for personal safety and for the safety of others.

Failure to observe these safe practices may cause serious injury or death. When safety becomes a habit, the equipment can be used with confidence.

These safe practices are divided into two Sections: 1-General Precautions, common to arc welding and cutting; and 2-Arc Welding (and Cutting) (only).

Reference standards: Published Standards on safety are also available for additional and more complete procedures than those given in this manual. They are listed in the Standards Index in this manual. ANSI Z49.1 is the most complete.

The National Electrical Code, Occupational Safety and Health Administration, local industrial codes, and local inspection requirements also provide a basis for equipment installation, use, and service.

1-2. GENERAL PRECAUTIONS

Different arc welding processes, electrode alloys, and fluxes can produce different fumes, gases, and radiation levels. In addition to the information in this manual, be sure to consult flux and electrode manufacturers Material Safety Data Sheets (MSDSs) for specific technical data and precautionary measures concerning their material.

A. Burn Prevention

Wear protective clothing-gauntlet gloves designed for use in welding, hat, and high safety-toe shoes. Button shirt collar and pocket flaps, and wear cuffless trousers to avoid entry of sparks and slag.

Wear helmet with safety goggles and glasses with side shields underneath, appropriate filter lenses or plates (protected by clear cover glass). This is a MUST for welding or cutting, (and chipping) to protect the eyes from radiant energy and flying metal. Replace cover glass when broken, pitted, or spattered. See 1-3A.2.

Avoid oily or greasy clothing. A spark may ignite them.

Hot metal such as electrode stubs and workpieces should never be handled without gloves.

Medical first aid and eye treatment. First aid facilities and a qualified first aid person should be available for each shift unless medical facilities are close by for immediate treatment of flash burns of the eyes and skin burns.

Ear plugs should be worn when working on overhead or in a confined space. A hard hat should be worn when others work overhead.

Flammable hair preparations should not be used by persons intending to weld or cut.

B. Toxic Fume Prevention

Severe discomfort, illness or death can result from fumes, vapors, heat, or oxygen enrichment or depletion that welding (or cutting) may produce. Prevent them with adequate ventilation as described in ANSI Standard Z49.1 listed in Standards Index. NEVER ventilate with oxygen.

Lead -, cadmium -, zinc -, mercury -, and beryllium-bearing and similar materials, when welded (or cut) may produce harmful concentrations of toxic fumes. Adequate local exhaust ventilation must be used, or each person in the area as well as the operator must wear an air-supplied respirator. For beryllium, both must be used.

Metals coated with or containing materials that emit toxic fumes should not be heated unless coating is removed from the work surface, the area is well ventilated and, if necessary, while wearing an air-supplied respirator.

Work in a confined space only while it is being ventilated and, if necessary, while wearing an air-supplied respirator.

Gas leaks in a confined space should be avoided. Leaked gas in large quantities can change oxygen concentration dangerously. Do not bring gas cylinders into a confined space.

Leaving confined space, shut OFF gas supply at source to prevent possible accumulation of gases in the space if downstream valves have been accidentally opened or left open. Check to be sure that the space is safe before re-entering it.

Vapors from chlorinated solvents can be decomposed by the heat of the arc (or flame) to form PHOSGENE, a highly toxic gas, and other lung and eye irritating products. The ultraviolet (radiant) energy of the arc can also decompose trichloroethylene and perchloroethylene vapors to form phosgene. DO NOT WELD or cut where solvent vapors can be drawn into the welding or cutting atmosphere or where the radiant energy can penetrate to

atmospheres containing even minute amounts of trichloroethylene or perchloroethylene.

C. Fire and Explosion Prevention

Causes of fire and explosion are: combustibles reached by the arc, flame, flying sparks, hot slag or heated material; misuse of compressed gases and cylinders; and short circuits.

BE AWARE THAT flying sparks or falling slag can pass through cracks, along pipes, through windows or doors, and through wall or floor openings, out of sight of the goggled operator. Sparks and slag can fly 35 feet.

To prevent fires and explosion:

Keep equipment clean and operable, free of oil, grease, and (in electrical parts) of metallic particles that can cause short circuits.

If combustibles are in area, do NOT weld or cut. Move the work if practicable, to an area free of combustibles. Avoid paint spray rooms, dip tanks, storage areas, ventilators. If the work cannot be moved, move combustibles at least 35 feet away out of reach of sparks and heat; or protect against ignition with suitable and snug-fitting, fire-resistant covers or shields.

Walls touching combustibles on opposite sides should not be welded on (or cut). Walls, ceilings, and floor near work should be protected by heat-resistant covers or shields.

Fire watcher must be standing by with suitable fire extinguishing equipment during and for some time after welding or cutting if:

a. appreciable combustibles (including building construction) are within 35 feet

b. appreciable combustibles are further than 35 feet but can be ignited by sparks

c. openings (concealed or visible) in floors or walls within 35 feet may expose combustibles to sparks

d. combustibles adjacent to walls, ceilings, roofs, or metal partitions can be ignited by radiant or conducted heat.

Hot work permit should be obtained before operation to ensure supervisor's approval that adequate precautions have been taken.

After work is done, check that area is free of sparks, glowing embers, and flames.

An empty container that held combustibles, or that can produce flammable or toxic vapors when heated, must never be welded on or cut, unless container has first been cleaned as described in AWS Standard A6.0, listed 7 in Standards Index.

This includes: a thorough steam or caustic cleaning (or a solvent or water washing, depending on the combustible's solubility) followed by purging and inerting with nitrogen or carbon dioxide, and using protective equipment as recommended in A6.0. Waterfilling just below working level may substitute for inerting.

A container with unknown contents should be cleaned (see preceding paragraph). Do NOT depend on sense of smell or sight to determine if it is safe to weld or cut.

Hollow castings or containers must be vented before welding or cutting. They can explode.

Explosive atmospheres. Never weld or cut where the air may contain flammable dust, gas, or liquid vapors (such as gasoline).

D. Compressed Gas Equipment

Standard precautions. Comply with precautions in this manual, and those detailed in CGA Standard P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, listed 11 in Standards Index.

1. Pressure Regulators

Regulator relief valve is designed to protect only the regulator from overpressure; it is not intended to protect any downstream equipment. Provide such protection with one or more relief devices.

Never connect a regulator to a cylinder containing gas other than that for which the regulator was designed.

Remove faulty regulator from service immediately for repair (first close cylinder valve). The following symptoms indicate a faulty regulator:

Leaks-if gas leaks externally.
Excessive Creep-if delivery pressure continues to rise with downstream valve closed.
Faulty Gauge-if gauge pointer does not move off stop pin when pressurized, nor returns to stop pin after pressure release.

Repair. Do NOT attempt to repair. Send faulty regulators for repair to manufacturer's designated repair center, where special techniques and tools are used by trained personnel.

2. Cylinders

Cylinders must be handled carefully to prevent leaks and damage to their walls, valves, or safety devices:

Avoid electrical circuit contact with cylinders including third rails, electrical wires, or welding circuits. They can produce short circuit arcs that may lead to a serious accident. (See 1-3C.)

ICC or DOT marking must be on each cylinder. It is an assurance of safety when the cylinder is properly handled.

Identifying gas content. Use only cylinders with name of gas marked on them; do not rely on color to identify gas content. Notify supplier if unmarked. NEVER DEFACE or alter name, number, or other markings on a cylinder. It is illegal and hazardous.

Empties: Keep valves closed, replace caps securely; mark MT; keep them separate from FULLS and return promptly.

Prohibited use. Never use a cylinder or its contents for other than its intended use, NEVER as a support or roller.

Locate or secure cylinders so they cannot be knocked over.

Passageways and work areas. Keep cylinders clear of areas where they may be struck.

Transporting cylinders. With a crane, use a secure support such as a platform or cradle. Do NOT lift cylinders off the ground by their valves or caps, or by chains, slings, or magnets.

Do NOT expose cylinders to excessive heat, sparks, slag, and flame, etc. that may cause rupture. Do not allow contents to exceed 130°F. Cool with water spray where such exposure exists.

Protect cylinders particularly valves from bumps, falls, falling objects, and weather. Replace caps securely when moving cylinders.

Stuck valve. Do NOT use a hammer or wrench to open a cylinder valve that can not be opened by hand. Notify your supplier.

Mixing gases. Never try to mix any gases in a cylinder.

Never refill any cylinder.

Cylinder fittings should never be modified or exchanged.

3. Hose

Prohibited use. Never use hose other than that designed for the specified gas. A general hose identification rule is: red for fuel gas, green for oxygen, and black for inert gases.

Use ferrules or clamps designed for the hose (not ordinary wire or other substitute) as a binding to connect hoses to fittings.

No copper tubing splices. Use only standard brass fittings to splice hose.

Avoid long runs to prevent kinks and abuse. Suspend hose off ground to keep it from being run over, stepped on, or otherwise damaged.

Coil excess hose to prevent kinks and tangles.

Protect hose from damage by sharp edges, and by sparks, slag, and open flame.

Examine hose regularly for leaks, wear, and loose connections. Immerse pressured hose in water; bubbles indicate leaks.

Repair leaky or worn hose by cutting area out and splicing (1-2D3). Do NOT tape.

4. Proper Connections

Clean cylinder valve outlet of impurities that may clog orifices and damage seats before connecting regulator. Except for hydrogen, crack valve momentarily, pointing outlet away from people and sources of ignition. Wipe with a clean lintless cloth.

Match regulator to cylinder. Before connecting, check that the regulator label and cylinder marking area, and that the regulator inlet and cylinder outlet match. NEVER CONNECT a regulator designed for a particular gas or gases to a cylinder containing any other gas.

Tighten connections. When assembling threaded connections, clean and smooth seats where necessary. Tighten. If connection leaks, disassemble, clean, and retighten using properly fitting wrench.

Adapters. Use a CGA adapter (available from your supplier) between cylinder and regulator, if one is required. use two wrenches to tighten adapter marked RIGHT and LEFT HAND threads.

Regulator outlet (or hose) connections may be identified by right hand threads for oxygen and left hand threads (with grooved hex on nut or shank) for fuel gas.

5. Pressurizing Steps:

Drain regulator of residual gas through suitable vent before opening cylinder (or manifold valve) by turning adjusting screw in (clockwise). Draining prevents excessive compression heat at high pressure seat by allowing seat to open on pressurization. Leave adjusting screw engaged slightly on single-stage regulators.

Stand to side of regulator while opening cylinder valve.

Open cylinder valve slowly so that regulator pressure increases slowly. When gauge is pressurized (gauge reaches regulator maximum) leave cylinder valve in following position: For oxygen, and inert gases, open fully to seal stem against possible leak. For fuel gas, open to less than one turn to permit quick emergency shutoff.

Use pressure charts (available from your supplier) for safe and efficient, recommended pressure settings on regulators.

Check for leaks on first pressurization and regularly there-after. Brush with soap solution (capfull of Ivory Liquid* or equivalent per gallon of water). Bubbles indicate leak. Clean off soapy water after test; dried soap is combustible.

E. User Responsibilities

Remove leaky or defective equipment from service immediately for repair. See User Responsibility statement in equipment manual.

F. Leaving Equipment Unattended

Close gas supply at source and drain gas.

G. Rope Staging-Support

Rope staging-support should not be used for welding or cutting operation; rope may burn.

*Trademark of Proctor & Gamble.

1-3. ARC WELDING

Comply with precautions in 1-1, 1-2, and this section. Arc Welding, properly done, is a safe process, but a careless operator invites trouble. The equipment carries high currents at significant voltages. The arc is very bright and hot. Sparks fly, fumes rise, ultraviolet and infrared energy radiates, weldments are hot, and compressed gases may be used. The wise operator avoids unnecessary risks and protects himself and others from accidents. Precautions are described here and in standards referenced in index.

A. Burn Protection

Comply with precautions in 1-2.

The welding arc is intense and visibly bright. Its radiation can damage eyes, penetrate lightweight clothing, reflect from light-colored surfaces, and burn the skin and eyes. Skin burns resemble acute sunburn, those from gas-shielded arcs are more severe and painful. DON'T GET BURNED; COMPLY WITH PRECAUTIONS.

1. Protective Clothing

Wear long-sleeve clothing (particularly for gas-shielded arc) in addition to gloves, hat, and shoes (1-2A). As necessary, use additional protective clothing such as leather jacket or sleeves, flame-proof apron, and fire-resistant leggings. Avoid outer garments of untreated cotton.

Bare skin protection. Wear dark, substantial clothing. Button collar to protect chest and neck and button pockets to prevent entry of sparks.

2. Eye and Head Protection

Protect eyes from exposure to arc. NEVER look at an electric arc without protection.

Welding helmet or shield containing a filter plate shade no. 12 or denser must be used when welding. Place over face before striking arc.

Protect filter plate with a clear cover plate.

Cracked or broken helmet or shield should NOT be worn; radiation can pass through to cause burns.

Cracked, broken, or loose filter plates must be replaced IMMEDIATELY. Replace clear cover plate when broken, pitted, or spattered.

Flash goggles with side shields MUST be worn under the helmet to give some protection to the eyes should the helmet not be lowered over the face before an arc is struck. Looking at an arc momentarily with unprotected eyes (particularly a high intensity gas-shielded arc) can cause a retinal burn that may leave a permanent dark area in the field of vision.

3. Protection of Nearby Personnel

Enclosed welding area. For production welding, a separate room or enclosed bay is best. In open areas, surround the operation with low-reflective, non-combustible screens or panels. Allow for free air circulation, particularly at floor level.

Viewing the weld. Provide face shields for all persons who will be looking directly at the weld.

Others working in area. See that all persons are wearing flash goggles.

Before starting to weld, make sure that screen flaps or bay doors are closed.

B. Toxic Fume Prevention

Comply with precautions in 1-2B.

Generator engine exhaust must be vented to the outside air. Carbon monoxide can kill.

C. Fire and Explosion Prevention

Comply with precautions in 1-2C.

Equipment's rated capacity. Do not overload arc welding equipment. It may overheat cables and cause a fire.

Loose cable connections may overheat or flash and cause a fire.

Never strike an arc on a cylinder or other pressure vessel. It creates a brittle area that can cause a violent rupture or lead to such a rupture under rough handling.

D. Compressed Gas Equipment

Comply with precautions in 1-2D.

E. Shock Prevention

Exposed hot conductors or other bare metal in the welding circuit, or in ungrounded, electrically-HOT equipment can fatally shock a person whose body becomes a conductor. DO NOT STAND, SIT, LIE, LEAN ON, OR TOUCH a wet surface when welding, without suitable protection.

To protect against shock:

Wear dry insulating gloves and body protection. Keep body and clothing dry. Never work in damp area without adequate insulation against electrical shock. Stay on a dry duckboard, or rubber mat when dampness or sweat can not be avoided. Sweat, sea water, or moisture between body and an electrically HOT part or grounded metal reduces the electrical resistance, and could enable dangerous and possibly lethal currents to flow through the body.

A voltage will exist between the electrode and any conducting object in the work circuit. Examples of conducting objects include, but are not limited to, buildings, electrical tools, work benches, welding power source cases, workpieces, etc. **Never touch the electrode and any metal object unless the welding power source is off.**

1. Grounding the Equipment

Arc welding equipment must be grounded according to the National Electrical Code, and the work must be grounded according to ANSI Z49.1 "Safety In Welding And Cutting."

When installing, connect the frames of each unit such as welding power source, control, work table, and water circulator to the building ground. Conductors must be adequate to carry ground currents safely. Equipment made

electrically HOT by stray current may shock, possibly fatally. Do NOT GROUND to electrical conduit, or to a pipe carrying ANY gas or flammable liquid such as oil or fuel.

Three-phase connection. Check phase requirements of equipment before installing. If only 3-phase power is available, connect single-phase equipment to only two wires of the 3-phase line. Do NOT connect the equipment ground lead to the third (live) wire, or the equipment will become electrically HOT-a dangerous condition that can shock, possibly fatally.

Before welding, check ground for continuity. Be sure conductors are touching bare metal of equipment frames at connections.

If a line cord with a ground lead is provided with the equipment for connection to a switchbox, connect the ground lead to the grounded switchbox. If a three-prong plug is added for connection to a grounded mating receptacle, the ground lead must be connected to the ground prong only. If the line cord comes with a three-prong plug, connect to a grounded mating receptacle. Never remove the ground prong from a plug, or use a plug with a broken off ground prong.

2. Electrode Holders

Fully insulated electrode holders should be used. Do NOT use holders with protruding screws.

3. Connectors

Fully insulated lock-type connectors should be used to join welding cable lengths.

4. Cables

Frequently inspect cables for wear, cracks and damage. IMMEDIATELY REPLACE those with excessively worn or damaged insulation to avoid possibly-lethal shock from bared cable. Cables with damaged areas may be taped to give resistance equivalent to original cable.

Keep cable dry, free of oil and grease, and protected from hot metal and sparks.

5. Terminals And Other Exposed Parts

Terminals and other exposed parts of electrical units should have insulating covers secured before operation.

6. Electrode

a. Equipment with output on/off control (contactor)

Welding power sources for use with the gas metal arc welding (GMAW), gas tungsten arc welding (GTAW) and similar processes normally are equipped with devices that permit on-off control of the welding power output. When so equipped the electrode wire becomes electrically HOT when the power source switch is ON and the welding gun switch is closed. Never touch the electrode wire or any conducting object in contact with the electrode circuit unless the welding power source is off.

b. Equipment without output on/off control (no contactor)

Welding power sources used with shielded metal arc welding (SMAW) and similar processes may not be equipped with welding power output on-off control devices. With such equipment the electrode is electrically HOT when the power switch is turned ON. Never touch the electrode unless the welding power source is off.

7. Safety Devices

Safety devices such as interlocks and circuit breakers should not be disconnected or shunted out.

Before installation, inspection, or service, of equipment, shut OFF all power and remove line fuses (or lock or red-tag switches) to prevent accidental turning ON of power. Disconnect all cables from welding power source, and pull all 115 volts line-cord plugs.

Do not open power circuit or change polarity while welding. If, in an emergency, it must be disconnected, guard against shock burns, or flash from switch arcing.

Leaving equipment unattended. Always shut OFF and disconnect all power to equipment.

Power disconnect switch must be available near the welding power source.

F. Protection For Wearers of Electronic Life Support Devices (Pacemakers)

Magnetic fields from high currents can affect pacemaker operation. Persons wearing electronic life support equipment (pacemaker) should consult with their doctor before going near arc welding, gouging, or spot welding operations.

1-4. STANDARDS BOOKLET INDEX

For more information, refer to the following standards or their latest revisions and comply as applicable:

1. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.
2. NIOSH, SAFETY AND HEALTH IN ARC WELDING AND GAS WELDING AND CUTTING obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
3. OSHA, SAFETY AND HEALTH STANDARDS, 29CFR 1910, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
4. ANSI Standard Z87.1, SAFE PRACTICES FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.
5. ANSI Standard Z41.1, STANDARD FOR MEN'S SAFETY-TOE FOOTWEAR obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

6. ANSI Standard Z49.2, FIRE PREVENTION IN THE USE OF CUTTING AND WELDING PROCESSES obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

7. AWS Standard A6.0, WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.

8. NFPA Standard 51, OXYGEN-FUEL GAS SYSTEMS FOR WELDING, CUTTING, AND ALLIED PROCESSES obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

9. NFPA Standard 70, NATIONAL ELECTRICAL CODE obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

10. NFPA Standard 51B, CUTTING AND WELDING PROCESSES obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

11. CGA Pamphlet P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS obtainable from the Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

12. CSA Standard W117.2, CODE FOR SAFETY IN WELDING AND CUTTING obtainable from the Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

13. NWSA booklet, WELDING SAFETY BIBLIOGRAPHY obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103.

14. American Welding Society Standard AWSF4.1, RECOMMENDED SAFE PRACTICES FOR THE PREPARATION FOR WELDING AND CUTTING OF CONTAINERS AND PIPING THAT HAVE HELD HAZARDOUS SUBSTANCES, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.

15. ANSI Standard Z88.2, PRACTICE FOR RESPIRATORY PROTECTION, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

SECTION 2 – SAFETY PRECAUTIONS AND SIGNAL WORDS

2-1. GENERAL INFORMATION AND SAFETY

A. General

Information presented in this manual and on various labels, tags, and plates on the unit pertains to equipment design, installation, operation, maintenance, and troubleshooting which should be read, understood, and followed for the safe and effective use of this equipment.

The nameplate of this unit uses international symbols for labeling the front panel controls. The symbols also appear at the appropriate section in the text.

B. Safety

The installation, operation, maintenance, and troubleshooting of arc welding equipment requires practices and procedures which ensure personal safety and the safety of others. Therefore, this equipment is to be installed, operated, and maintained only by qualified persons in accordance with this manual and all applicable codes such as, but not limited to, those listed at the end of Section 1 – Safety Rules For Operation Of Arc Welding Power Source.

2-2. SAFETY ALERT SYMBOL AND SIGNAL WORDS

The following safety alert symbol and signal words are used throughout this manual to call attention to and identify different levels of hazard and special instructions.

This safety alert symbol is used with the signal words WARNING and CAUTION to call attention to the safety statements.

WARNING statements identify procedures or practices which must be followed to avoid serious personal injury or loss of life.

CAUTION statements identify procedures or practices which must be followed to avoid minor personal injury or damage to this equipment.

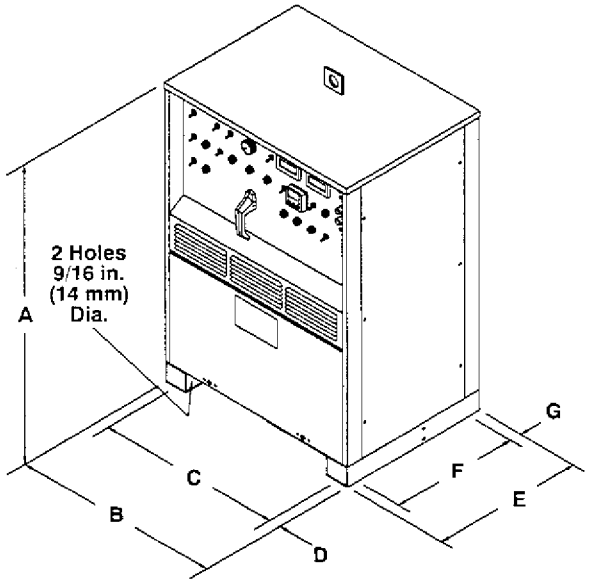
IMPORTANT *statements identify special instructions necessary for the most efficient operation of this equipment.*

SECTION 3 – SPECIFICATIONS

Table 3-1. Specifications

Model	Rated Welding Amperes	Welding Ranges Amperes	Max. Open-Circuit Voltage	Amperes Input At AC Balanced Rated Load Output 60 Hz Single-Phase 200V	230V	460V	575V	KVA	KW	Weight Net	Ship
Without PFC*	NEMA Class II 350 At 34 Volts 40% Duty Cycle	3-385	80	149.5	130	65	52	29.9	16.8	687 lbs. (312 kg)	702 lbs. (318 kg)
With PFC*				110.4	96	48	38.4	22	17	695 lbs. (316 kg)	710 lbs. (322 kg)
Without PFC*	NEMA Class 1 300 At 32 Volts 60 % Duty Cycle			131	114	57	45.6	26.2	13.5	687 lbs. (312 kg)	702 lbs. (318 kg)
With PFC*				89.7	78	39	31.2	17.9	13.7	695 lbs. (316 kg)	710 lbs. (322 kg)

*Power Factor Correction (optional).



	Inches	Millimeters
*A	44-1/4	1124
B	31-1/4	794
C	25-1/2	648
D	2-13/16	71
E	22-3/4	578
F	19	483
G	1-7/8	48

*47 in. (1194 mm) to top of lifting eye.

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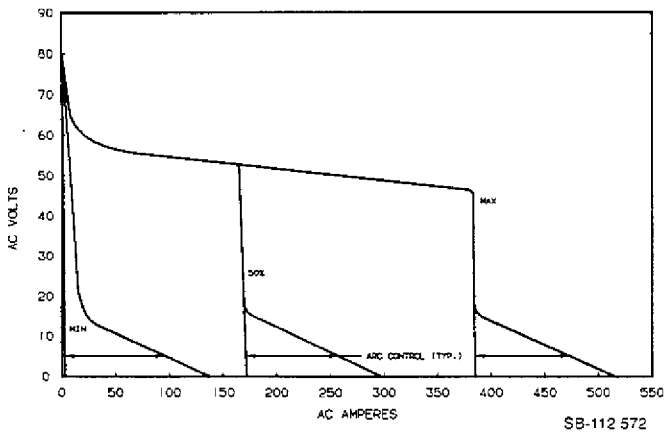
Figure 3-1. Dimensional Drawing

Chart 3-1. Volt-Ampere Curves

A. AC Mode



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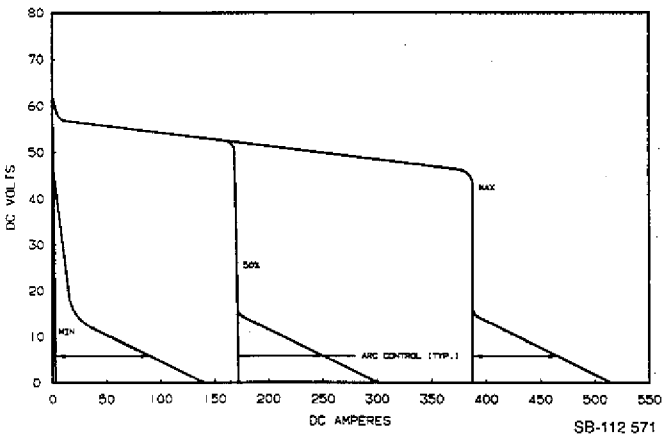
B. DC Mode



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3-1. VOLT-AMPERE CURVES (Chart 3-1)

RATED OUTPUT

The volt-ampere curves show the voltage and amperage output capabilities of the welding power source. Voltage and amperage adjustment is provided by the AMPERAGE ADJUSTMENT Control. Curves of other settings fall between the curves shown.

3-2. DUTY CYCLE (Chart 3-2)

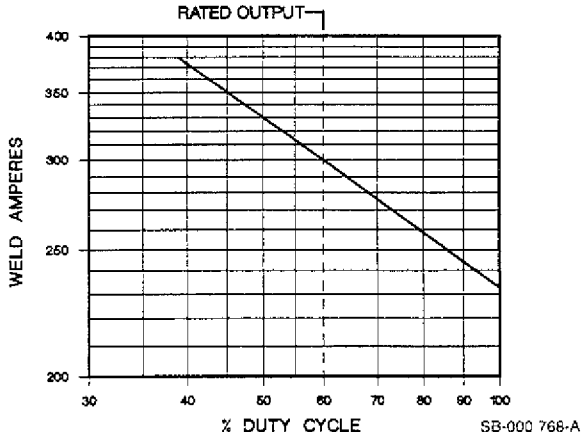
The duty cycle is the percentage of a ten minute period that a welding power source can be operated at a given output without overheating and damaging the unit. This welding power source has dual duty cycle ratings, each for a specific amperage output range. See Chart 3-2 for various amperage output ranges and associated duty cycles. If the unit is operated in the 350 amperage output range, this unit is rated at 40 percent duty cycle; therefore, the unit can be operated at 350 amperes for four consecutive minutes, but it must operate at no load for the remaining six minutes to allow proper cooling. If the welding amperes decrease, the duty cycle increases. When the welding power source is operated in the 300 ampere range, the unit is rated at 60 percent duty cycle.

Refer to the Duty Cycle Chart (Chart 3-2) to determine the output of the welding power source at various duty cycles.

CAUTION: EXCEEDING DUTY CYCLE RATINGS will damage the welding power source.

- *Do not exceed indicated duty cycles.*

Chart 3-2. Duty Cycle



3-3. DESCRIPTION

This unit produces constant current ac/dc weld output for the Gas Tungsten Arc (GTAW) or Shielded Metal Arc Welding (SMAW) process. This unit requires single-phase input power of the voltage specified on the rating label.

The Syncrowave welding power source produces square wave ac weld output. The 350 in the product designation refers to rated weld output (see Table 3-1 for specifications).

The following optional equipment can be provided on the welding power source and are covered within this Owner's Manual:

* Coolant Valve
* Preflow Time Switch And Control
* Spot Time Switch And Control
* Pulser Switch And Controls

IMPORTANT: *For a complete listing of Options and Accessories, see back cover of this manual.*

SECTION 4 – INSTALLATION OR RELOCATION

IMPORTANT: *Read entire Section 9 on equipment that produces output in the radio frequency range, such as high-frequency arc starters, for site selection information and installation requirements before beginning the installation procedure.*

4-1. SITE SELECTION

Select an installation site which provides the following:

1. Correct input power supply (see unit nameplate)
2. Shielding gas supply (if applicable)
3. Water supply (if applicable)
4. Adequate ventilation and fresh air supply
5. No flammables
6. A clean and dry area
7. Proper temperature that avoids extremes of heat or cold
8. Proper airflow around unit
9. Adequate space for removing top cover and outer panels for installation, maintenance, and repair functions.

Base mounting holes provide the capability to install and secure the unit on a running gear or in a permanent location. Figure 3-1 gives overall dimensions and base mounting hole layout. A permanent installation site for securing the unit should allow sufficient space on all sides and above the unit to open access door(s), or remove top cover and outer enclosure panels for maintenance and repair functions.

WARNING: FIRE OR EXPLOSION can result from placing unit on or over combustible surfaces; RESTRICTED AIRFLOW can cause overheating and possible damage to internal parts.

- *Do not locate unit over combustible surfaces.*
- *Maintain at least 18 inches (457 mm) of unrestricted space on all sides of unit, and keep underside free of obstructions.*
- *Do not place any filtering device over the intake air passages that provide airflow for cooling this unit.*

Warranty is void if any type of filtering device is used at intake air passages.

4-2. TRANSPORTING METHODS

This welding power source is equipped with a lifting eye for moving the unit during installation. Weight capacity of the lifting eye only allows for supporting the welding power source.

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Disconnect input power conductors from deenergized supply line BEFORE moving welding power source.*

FALLING EQUIPMENT can cause serious personal injury and equipment damage.

- *Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other heavy accessories or devices.*
- *Use equipment of adequate capacity to lift the unit.*
- *If lifting or moving this unit with lift forks under the base, be sure that lift forks are long enough to extend beyond opposite side of the base.*

Using lift forks too short can damage internal parts if tips of the lift forks penetrate the unit base, or may cause personal injury and/or equipment damage if unit falls off the lift forks.

4-3. WELD OUTPUT CONNECTIONS (Figure 4-1)

RATED OUTPUT

To obtain full rated output from this unit, it is necessary to select, prepare, and install proper weld cables. Failure to comply in any of these areas may result in unsatisfactory welding performance.

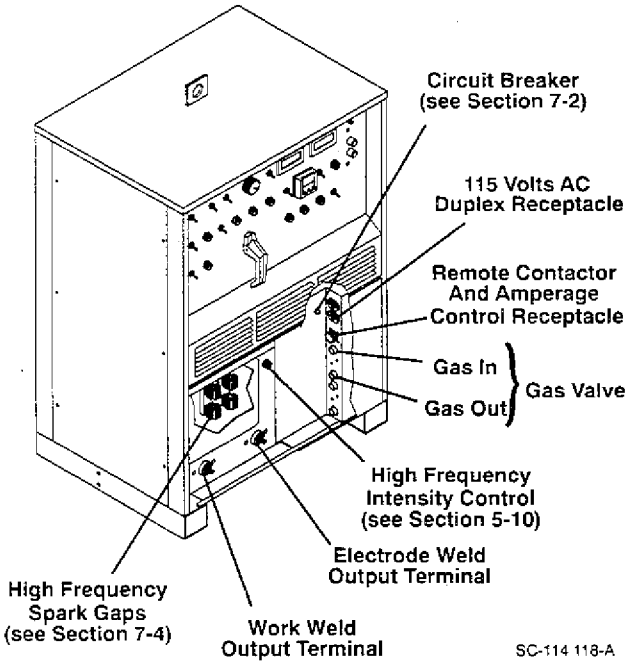


Figure 4-1. Lower Front Panel

A. Weld Cable Selection

Use the following guidelines to select weld cables:

1. Use the shortest possible cables, and place cables close together. Excessive cable lengths may reduce output or cause unit overload due to added resistance. Excessive cable length also increases high frequency radiation (see Section 9).
2. Use weld cable with an insulation voltage rating equal to or greater than the maximum open-circuit voltage (ocv) of the welding power source (see Table 3-1 for unit maximum ocv rating).
3. Select welding cable size according to maximum weld output and total length of connecting cables in weld circuit. For example, if a 25 foot (7.5 m) electrode holder (torch) cable is used with a 25 foot (7.5 m) work cable, select the cable size recommended in Table 4-1 for 50 feet (15 m). The maximum recommended total cable length when using high frequency is 50 ft. (15 m).
4. Do not use damaged or frayed cables.

B. Weld Cable Preparation

1. Install correct size lugs of adequate amperage capacity onto ends of both cables for connecting to work clamp, electrode holder if applicable, and weld output terminals.
2. If applicable, install electrode holder onto weld cable following manufacturer's instructions. An insulated electrode holder must be used to ensure operator safety.
3. Install work clamp onto cable.

Table 4-1. Weld Cable Size

Welding Amperes	Total Cable (Copper) Length In Weld Circuit Not Exceeding*							
	100 ft. Or Less (30 m)		150 ft. (45 m)	200 ft. (60 m)	250 ft. (70 m)	300 ft. (90 m)	350 ft. (105 m)	400 ft. (120 m)
	10 To 60% Duty Cycle	60 Thru 100% Duty Cycle	10 Thru 100% Duty Cycle					
100	4	4	4	3	2	1	1/0	1/0
150	3	3	2	1	1/0	2/0	3/0	3/0
200	3	2	1	1/0	2/0	3/0	4/0	4/0
250	2	1	1/0	2/0	3/0	4/0	2-2/0	2-2/0
300	1	1/0	2/0	3/0	4/0	2-2/0	2-3/0	2-3/0
350	1/0	2/0	3/0	4/0	2-2/0	2-3/0	2-3/0	2-4/0
400	1/0	2/0	3/0	4/0	2-2/0	2-3/0	2-4/0	2-4/0
500	2/0	3/0	4/0	2-2/0	2-3/0	2-4/0	3-3/0	3-3/0

*Weld cable size (AWG) is based on either a 4 volts or less drop or a current density of more than 300 circular mils per ampere.

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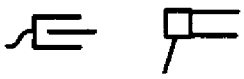
C. Weld Cable Connections



WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting or installing.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

IMPORTANT: *Weld polarity is determined by the position of the AC/DC Selector switch (see Section 5-2).*

1. Open lower front panel access door, and locate weld output terminals.
2. Route weld cables under horizontal bar on front of base.
3. For Gas Tungsten Arc Welding (GTAW)
   a. Connect torch cable or connector to ELECTRODE weld output terminal. Be sure that the torch connector does not touch the access door when closed.
   b. Connect work cable to WORK weld output terminal.
4. For Shielded Metal Arc Welding (SMAW)
   a. Connect end of electrode holder cable to ELECTRODE weld output terminal.
   b. Connect work cable to WORK weld output terminal.
5. Close and secure lower front panel access door.

4-4. REMOTE CONTACTOR AND AMPERAGE CONTROL RECEPTACLE INFORMATION AND CONNECTIONS (Figures 4-1 And 4-2)

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down welding power source before making receptacle connections.*

REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle RC2 is used to connect any of the following equipment to the welding power source circuitry:

a. Remote Contactor
b. Remote Amperage Control
c. Combination of the above.

To make connections, align keyway, insert plug, and rotate threaded collar fully clockwise.

The following socket information is included in case the supplied cord is not suitable, and it is necessary to wire a plug or cord to interface with REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle RC2.

The command signals required and output signals available at receptacle RC2 by means of the welding power source circuitry are as follows:

Socket A: 24VAC available to remote contactor control when contact closure is provided between Sockets A and B.

Socket B: 24VAC available to remote contactor control when contact closure is provided between Sockets A and B.

Socket C: Remote amperage control potentiometer clockwise (CW).

Socket D: PC1 circuit common.

Socket E: Remote amperage control potentiometer wiper.

IMPORTANT: *The remaining sockets in the receptacle are not used.*

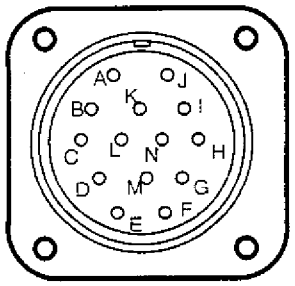


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Figure 4-2. Front View Of REMOTE CONTACTOR AND AMPERAGE CONTROL Receptacle With Socket Locations

4-5. SHIELDING GAS CONNECTIONS (Figure 4-1)

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down welding power source before making shielding gas connections.*

IMPORTANT: *The gas valve will no work unless the OUTPUT (CONTACTOR) switch is in the REMOTE 14 position and a remote contactor control is connected to the REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle.*

The GAS IN and GAS OUT fittings have 5/8-18 right-hand threads. Obtain proper size, type, and length hose and make connections as follows:

1. Open lower front panel access door.
2. Route hoses under horizontal bar on front of base.
3. Connect hose from shielding gas supply regulator/flowmeter to GAS IN fitting.
4. Connect shielding gas hose from torch to GAS OUT fitting.
5. Close and secure lower front panel access door.

The gas flow must be accurately controlled with a regulator and flow meter. Recommendations for rate of gas flow should be obtained from the torch manufacturer.

4-6. 115 VOLTS AC DUPLEX RECEPTACLE (Figure 4-1)

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down welding power source before making receptacle connections.*

IMPORTANT: *Route all cables under horizontal bar on front of base.*

The duplex receptacle located behind the lower front access panel door provides up to 15 amperes of 115 volts ac for operating accessory equipment. The unit must be energized before output is available at this receptacle.

4-7. COOLANT CONNECTIONS (Optional) (Figure 4-1)

CAUTION: OVERHEATING Gas Tungsten Arc Welding (GTAW) torch can damage torch.

- *If using a water-cooled torch and recirculating coolant system, make connections from the coolant system directly to the torch hoses. Do not use water connections on the welding power source.*

IMPORTANT: *The coolant valve will no work unless the OUTPUT (CONTACTOR) switch is in the REMOTE 14 position and a remote contactor control is connected to the REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle.*

The optional coolant valve is located on the lower front panel. The COOLANT IN and COOLANT OUT fittings have 5/8-18 left-hand threads. Obtain proper size, type, and length hose, and make connections as follows:

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down welding power source before making coolant connections.*

1. Open lower front panel access door.
2. Route hoses under horizontal bar on front of base.
3. Connect hose from coolant supply to COOLANT IN fitting.
4. Connect coolant hose from torch to COOLANT OUT fitting.
5. Close and secure lower front panel access door.

4-8. ELECTRICAL INPUT CONNECTIONS

IMPORTANT: *Read and comply with entire Section 9 regarding high-frequency equipment location and installation requirements before making electrical input connections.*

INPUT

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting or installing.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

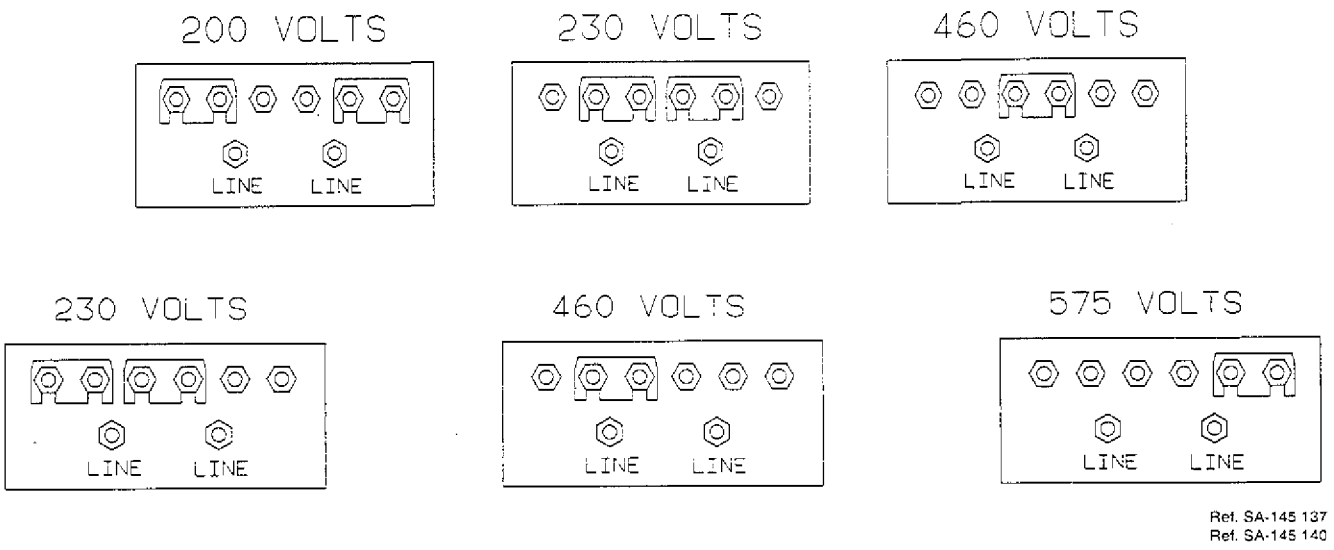

Figure 4-3. Input Voltage Labels

A. Electrical Input Requirements

Operate the welding power source from a single-phase, 60 Hertz, ac power supply. The input voltage must match one of the electrical input voltages shown on the rating label on the unit nameplate. Contact the local electric utility for information about the type of electrical service available, how proper connections should be made, and inspection required.

B. Jumper Link Installation (Figures 4-3 And 4-4)

WARNING: Read precautionary information at beginning of entire Section 4-8 before proceeding with this installation.

Jumper links are used to allow the equipment to operate from different line voltages.

1. Remove right side panel.
2. Compare position of jumper links on the input terminal board to the voltage link arrangement shown on input voltage label.

CAUTION: INCORRECT INPUT VOLTAGE JUMPER LINK PLACEMENT can damage unit.

- *Position jumper links as shown on the input voltage label (see Figures 4-3 and 4-4).*
- *Store unused jumper links across linked terminals.*

IMPORTANT: *If the input voltages stated on nameplate or rating label are different from those in Figure 4-3, check the input voltage label in the unit or call the Factory Service Department.*

3. Install jumper links onto the input terminal board to match the available input line voltage.

C. Welding Power Source Input Power Connections (Figure 4-4)

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Install a fusible line disconnect switch in the input circuit to the welding power source.*
- *Connect input conductors to the welding power source before connecting to the single-phase input power.*
- *Read and follow safety information at beginning of entire Section 4-8.*

The line disconnect switch provides a safe and convenient means to completely remove all electrical power from the welding power source whenever it is necessary to inspect or service the unit.

1. Use Table 4-2 as a guide to select input conductors for the installation. The input conductors should be covered with an insulating material that complies with national, state, and local electrical codes.
2. Install terminal lugs of adequate amperage capacity and correct stud size onto the input and ground conductors.
3. Obtain and install a standard conduit strain relief connector into the rear panel access hole.

4. Insert conductors through strain relief installed in Step 3. Route conductors to the input terminal board.

WARNING: ELECTRIC SHOCK can kill.

- *Do not connect an input conductor to the ground terminal in the unit.*
- *Do not connect the ground conductor to an input line terminal.*

Incorrect input connections can result in an electrically energized welding power source chassis. The ground terminal is connected to the welding power source chassis and is for grounding purposes only.

5. Connect input conductors to line terminals on the input terminal board (see Figure 4-4).
6. Connect the ground conductor to the ground terminal (see Figure 4-4).
7. Connect remaining end of ground conductor to a suitable ground. Use a grounding method that complies with all applicable electrical codes.
8. Connect remaining ends of input conductors to a deenergized line disconnect switch.
9. Secure the input cable in the strain relief.
10. Reinstall right side panel.
11. Use Table 4-2 as a guide to select line fuses for the disconnect switch. Obtain and install proper fuses.

Table 4-2. Input Conductor And Fuse Size*

Model	Input Voltage	Input Conductor Size (AWG)	Ground Conductor Size (AWG)	Fuse Size In Amperes
Without PFC**	200	1/0	6	225
	230	1	6	200
	460	6	8	100
	575	6	8	80
With PFC**	200	2	6	150
	230	3	6	125
	460	6	10	60
	575	8	10	50

*Conductor size is based on the 1990 Edition of the National Electrical Code (NEC) specifications for allowable ampacities of insulated copper conductors, having a temperature rating of 167°F (75°C), with not more than three single current-carrying conductors in a raceway (Article 310 of NEC). (The ground conductor is not counted as a current-carrying conductor.)

*Fuse size is based on not more than 200 percent of the rated input amperage of the welding power source (Article 630 of NEC).

**Power Factor Correction

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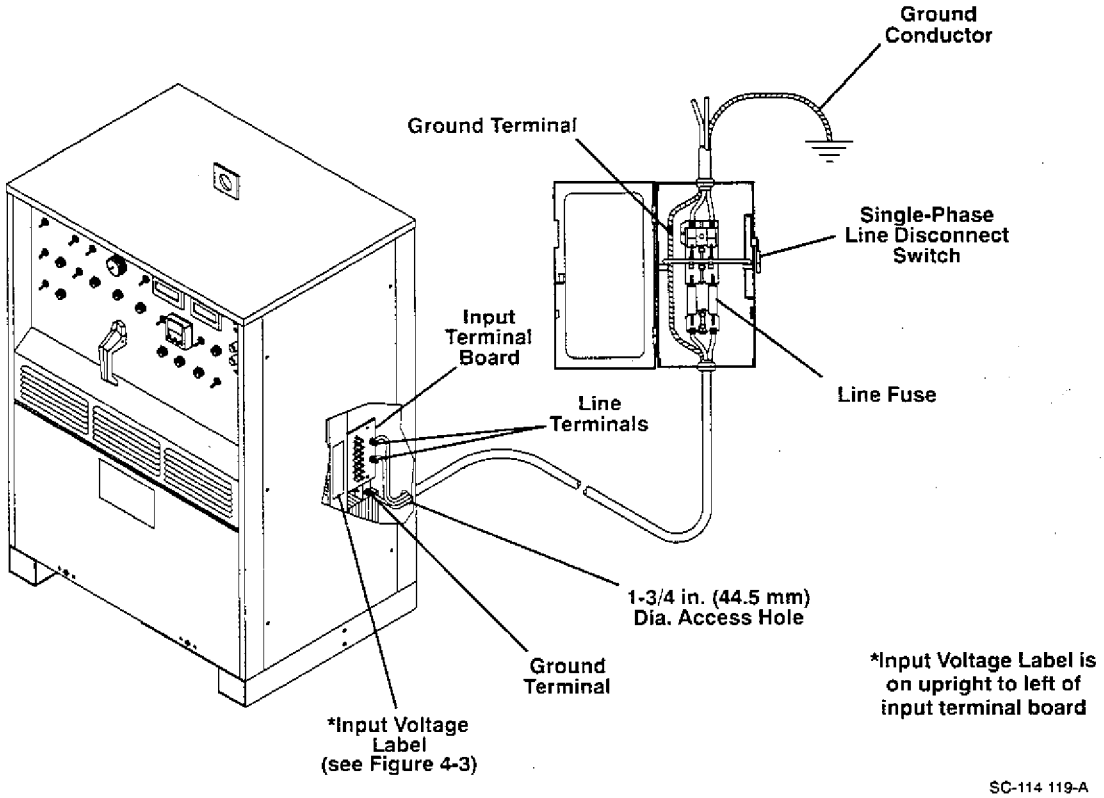


Figure 4-4. Location Of Electrical Input Connections And Components

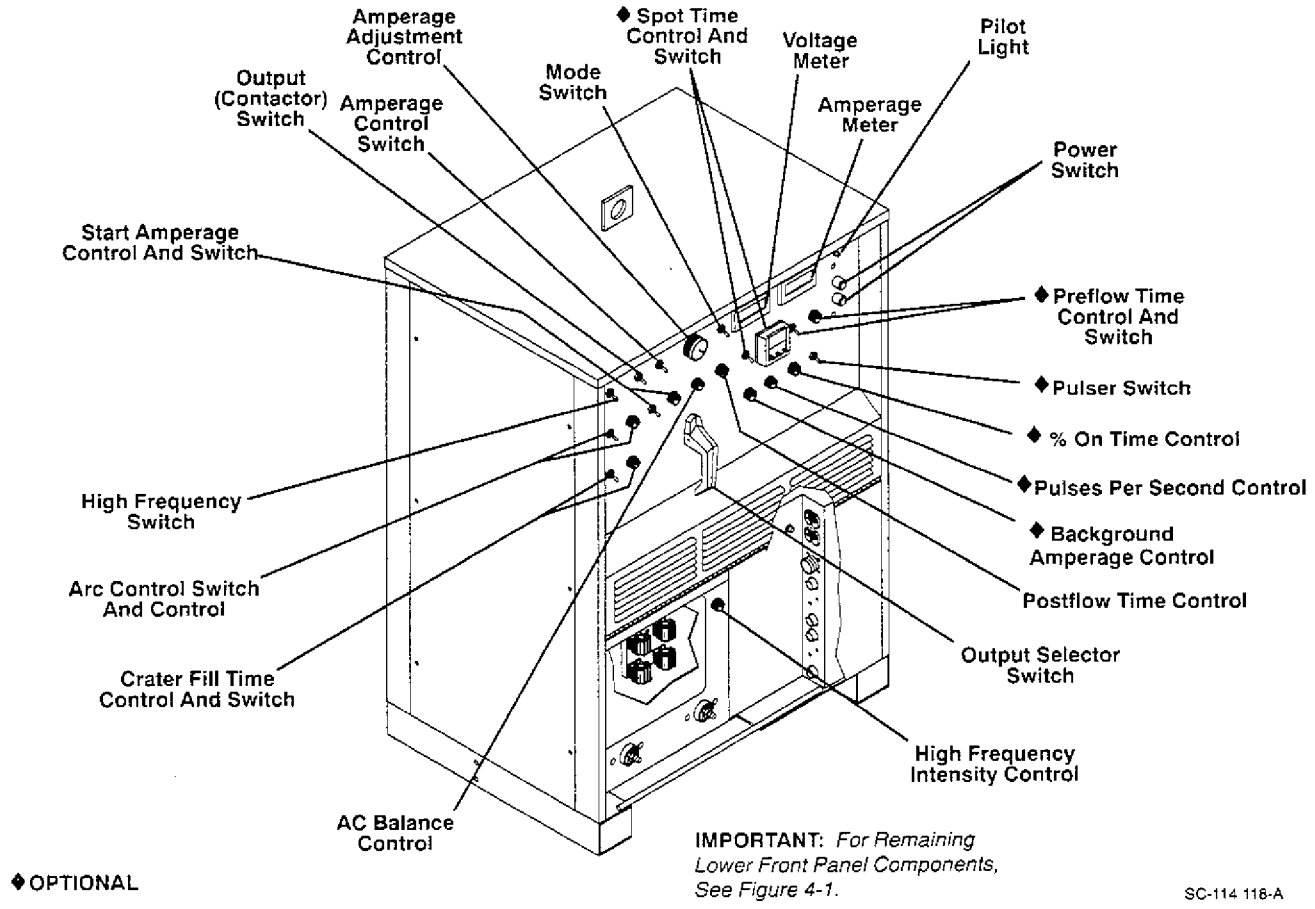
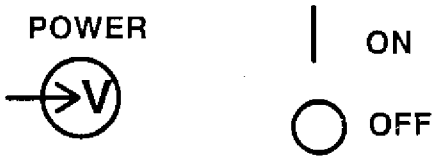


Figure 5-1. Front Panel View

5-1. POWER SWITCH AND PILOT LIGHT (Figure 5-1)



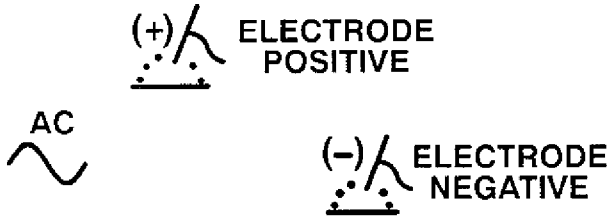
Pressing the Power switch ON push button energizes the welding power source. The pilot light and fan motor come on indicating that the unit is receiving input power.

Pressing the Power switch OFF push button shuts down the welding power source and fan, and turns off the pilot light.

The pilot light and fan motor stay on even if the unit shuts down due to overheating.

IMPORTANT: *After any interruption of input power, the Power switch ON push button must be pressed to reenergize the welding power source.*

5-2. OUTPUT SELECTOR SWITCH (Figure 5-1)



WARNING: ELECTRIC SHOCK can kill.

- *Do not use AC output in damp areas, if movement is confined, or if there is a danger of falling.*
- *Use AC output ONLY if required for the welding process.*
- *If AC output is required, use remote output control.*
- *Read and follow Safety Rules at beginning of this manual.*

The OUTPUT SELECTOR switch allows the operator to select AC, ELECTRODE POSITIVE, or ELECTRODE NEGATIVE output without changing weld output cable connections. To ensure that weld output matches the dc polarity positions, make weld output connections as instructed in Section 4-3.

DO NOT SWITCH UNDER LOAD

CAUTION: ARCING can damage switch contacts.

- *Do not change the position of the OUTPUT SELECTOR switch while welding or under load.*

Arcing causes the contacts to become pitted and eventually inoperative.

5-3. AMPERAGE ADJUSTMENT CONTROL (Figure 5-1)

AMPERAGE ADJUSTMENT

A

The AMPERAGE ADJUSTMENT control allows the operator to select the desired amperage for the welding process. The scale surrounding the control is calibrated in percent and should not be read as an amperage value. Rotating the control clockwise increases amperage.

IMPORTANT: *This unit will automatically go into a short preflow period (1 second or less) when the AMPERAGE ADJUSTMENT control is set between minimum (zero) and 6 (approximately 20 amps).*

IMPORTANT: *The AMPERAGE ADJUSTMENT control may be adjusted while welding.*

5-4. MODE SWITCH AND DIGITAL METERS (Figure 5-1)

A. MODE Switch

The MODE switch is a momentary-contact toggle switch used to preset weld amperage. When the MODE switch is in the ACTUAL position, the actual weld amperage is displayed on the digital AMPERAGE meter during welding. To preset weld amperage, hold the MODE switch in the PRESET position, rotate the AMPERAGE ADJUSTMENT control until the desired weld amperage appears on the AMPERAGE meter, and release the MODE switch.

B. AMPERAGE Meter

AMPERAGE

A

The AMPERAGE meter is a digital meter used to display weld amperage. Actual weld output is displayed while the unit is under load. The AMPERAGE meter will read zero during idling. Preset amperage is displayed while the unit is idling if the MODE switch is held in the PRESET position.

C. VOLTAGE Meter

VOLTAGE

V

The VOLTAGE meter is a digital meter used to display the voltage output of the welding power source but not actual arc voltage (due to cable resistance, poor connections, etc.). The VOLTAGE meter will read zero during idling.The VOLTAGE meter is blank during the presetting of weld amperage. The VOLTAGE meter displays average arc voltage when the contactor is energized.

5-5. START AMPERAGE (Figure 5-1)

The START AMPERAGE circuitry permits the operator to select an amperage setting for arc starting that is above or below the setting of the AMPERAGE ADJUSTMENT control. The starting amperage is available for the first second of the weld. After this time, the weld amperage steps up or down to the setting of the AMPERAGE ADJUSTMENT control.

A. Start Amperage Switch

| ON

○ OFF

Placing the START AMPERAGE switch in the ON position activates the start circuitry. When this switch is in the OFF position, weld output goes to the setting of the AMPERAGE ADJUSTMENT control for arc starting.

B. Start Amperage Control

The START AMPERAGE control allows the operator to select the desired starting amperage for the welding process. The scale surrounding the control is calibrated in percent and should not be read as an amperage value. Rotating the control clockwise increases amperage.

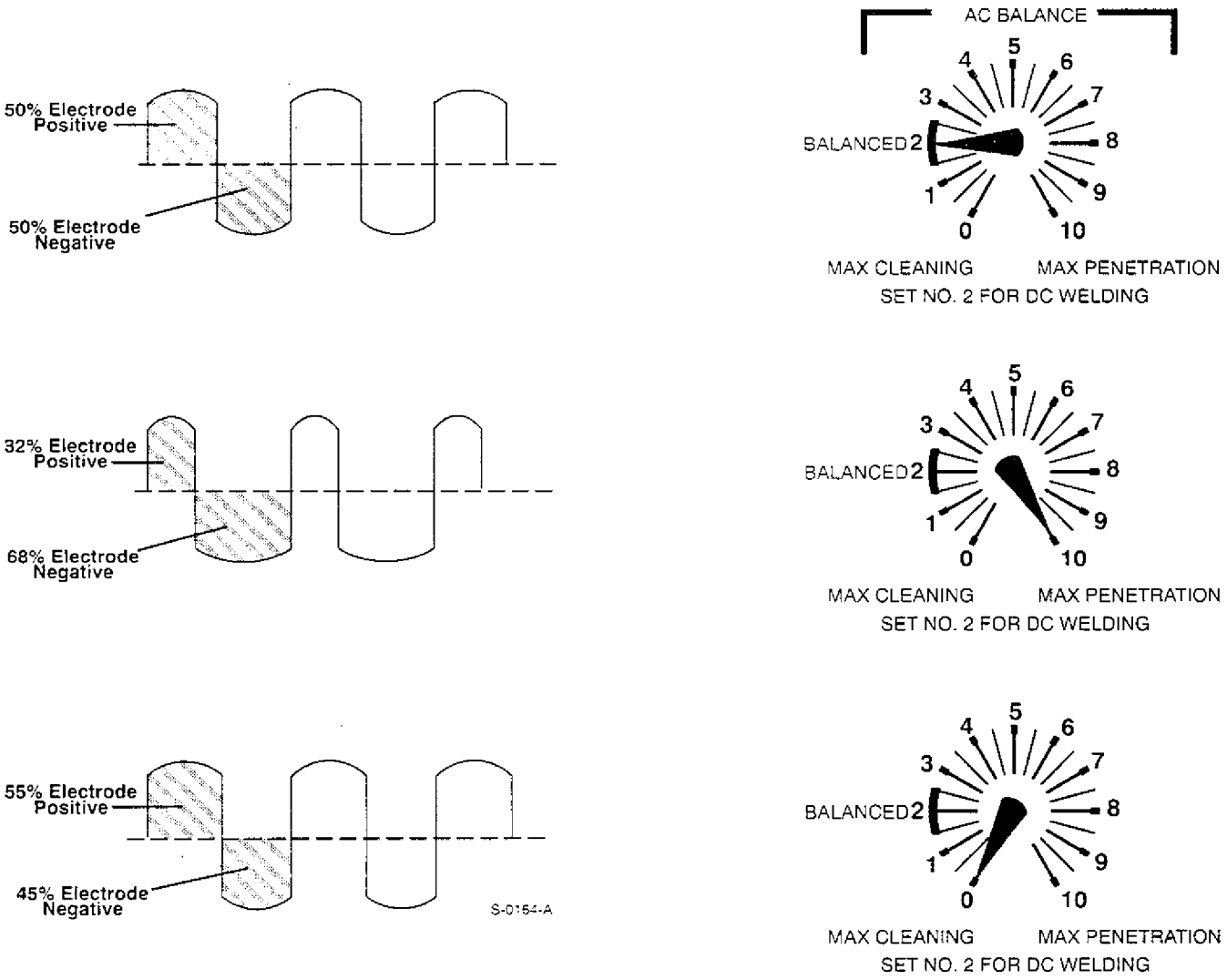


Figure 5-2. Square Wave Function Of AC Balance Control

5-6. AC BALANCE CONTROL (Figures 5-1 And 5-2)

The AC BALANCE control changes the ac output square wave. Rotating the control towards 10 provides deeper penetration. Rotating the control towards 0 provides more cleaning action of the workpiece which is necessary when welding oxide forming materials such as aluminum or magnesium.

When the control is in the BALANCED position, the wave shape provides equal penetration and cleaning action. The BALANCED position is recommended for dc Gas Tungsten Arc Welding (GTAW).

The scale surrounding the control goes from 0 to 10. The scale is not an amperage or voltage value.

IMPORTANT: *For the AC BALANCE control to work properly, the electrode cable must be connected to the ELECTRODE output terminal and the work cable must be connected to the WORK output terminal.*

5-7. ARC CONTROL (Figure 5-1)

The arc control circuitry is designed for use with the Shielded Metal Arc Welding (SMAW) process. This feature is useful for arc starting in out-of-position welds as well as for certain types of electrodes. The arc control circuitry provides increasing amperage when arc voltage is below 18 volts and is decreasing towards the short-circuit condition.

IMPORTANT: *The volt-ampere curves of Chart 3-1 illustrate how the amperage increases as the short-circuit condition is approached.*

A. Arc Control Switch

| ON

○ OFF

Placing the ARC CONTROL switch in the ON position activates the arc control circuitry. When the switch is in

the OFF position, no additional amperage is available at low arc voltages. Place the ARC CONTROL switch in the OFF position while performing Gas Tungsten Arc Welding (GTAW).

B. **Arc Control**

The ARC CONTROL varies the amperage available during low voltage conditions. Rotating the control clockwise increases amperage (see Chart 3-1). The scale surrounding the control is calibrated in percent and should not be read as an amperage or voltage value.

5-8. OUTPUT(CONTACTOR) SWITCH (Figure 5-1)

OUTPUT(CONTACTOR)

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Do not touch the weld output terminals when the contactor is energized.*
- *Do not touch torch or electrode and work clamp at the same time.*

If the OUTPUT(CONTACTOR) switch is ON, open-circuit voltage is present at the weld output terminals as long as the welding power source is energized.

ON

REMOTE 14

If remote contactor control is desired, make connections to the REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle as instructed in Section 4-4. Place the OUTPUT(CONTACTOR) switch in the REMOTE 14 position. Open-circuit voltage is present at the weld output terminals whenever the remote contactor switch is closed.

If a remote contactor control is not used, place the OUTPUT (CONTACTOR) switch in the ON position. High frequency is not available with the OUTPUT (CONTACTOR) switch in the ON position.

5-9. AMPERAGE CONTROL SWITCH (Figure 5-1)

AMPERAGE CONTROL

A

If remote amperage control is desired, make connections to the REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle as instructed in Section 4-4. Place the AMPERAGE CONTROL switch in the REMOTE 14 position.

PANEL

REMOTE 14

When a remote amperage control is used, the control functions as a fine adjustment for the AMPERAGE ADJUSTMENT control setting on the welding power source. For example, if the AMPERAGE ADJUSTMENT control on the welding power source is set at mid-range, the remote amperage control provides (from its minimum to maximum positions) fine amperage adjustment of one half the welding power source output. If full adjustment of the amperage is desired, the AMPERAGE ADJUSTMENT control on the welding power source must be set at the maximum position.

If remote amperage control is not desired, place the AMPERAGE CONTROL switch in the PANEL position. With this switch in the PANEL position, the front panel AMPERAGE ADJUSTMENT control has complete control of the output (except when START AMPERAGE control is used).

5-10. HIGH FREQUENCY CONTROLS (Figures 4-1 And 5-1)

High frequency is used during Gas Tungsten Arc Welding (GTAW) to aid starting and maintaining the welding arc. The OUTPUT(CONTACTOR) switch must be in the REMOTE 14 position for the high frequency to work.

A. **HIGH FREQUENCY Switch (Figure 5-1)**

HIGH FREQUENCY

WARNING: USING HIGH FREQUENCY WITH THE SHIELDED METAL ARC WELDING (SMAW) PROCESS can result in serious personal injury.

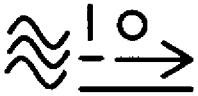
- *Place the HIGH FREQUENCY switch in the OFF position before using the Shielded Metal Arc Welding (SMAW) process.*

The attempted use of high frequency to establish an arc with a stick electrode could cause an arc to form between the electrode holder and operator.

The HIGH FREQUENCY switch allows the operator to choose whether high frequency is used or not and for how long.

1. **START**

START

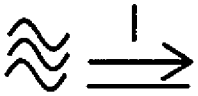


High frequency turns on when the contactor is energized. Once an arc is established, high frequency turns off. High frequency turns on any time the arc is broken to aid in restarting the arc.

2. OFF

High frequency is not available. The HIGH FREQUENCY switch must be in the OFF position while doing Shielded Metal Arc Welding (SMAW).

3. CONTINUOUS



CONTINUOUS

High frequency turns on when the contactor is energized and remains on for the duration of the weld.

B. HIGH FREQUENCY INTENSITY Control (Figure 5-1)

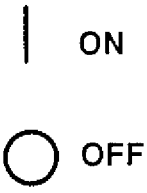
The HIGH FREQUENCY INTENSITY control governs the strength of the high frequency. Rotating the control clockwise increases the intensity of the high frequency.

IMPORTANT: *As the high frequency intensity is increased, the possibility of interfering with local electronic devices, especially communication equipment, also increases. Set the HIGH FREQUENCY INTENSITY control as low as practical to avoid such interference.*

5-11. CRATER FILL TIME (Figure 5-1)

The crater fill circuitry provides a gradual taper of the weld output for ending welds made using the Gas Tungsten Arc Welding (GTAW) process.

A. CRATER FILL TIME Switch



Placing the CRATER FILL TIME switch in the ON position activates the crater fill circuitry. When this switch is in the OFF position, crater fill is not available and the weld ends using the setting on the AMPERAGE ADJUSTMENT control. The crater fill circuit should not be used with the Shielded Metal Arc Welding (SMAW) process.

B. CRATER FILL TIME Control

The weld output tapers from the setting of the AMPERAGE ADJUSTMENT control to the minimum of the unit during the time set using the CRATER FILL TIME control. The scale surrounding the control is calibrated in seconds (0 to 15). Rotating the control clockwise increases the crater fill time.

IMPORTANT: *When using the crater fill circuit, be sure that the POSTFLOW TIME control is set for a longer time than the CRATER FILL TIME control. It is important to continue gas (and coolant if applicable) flow until after the arc is extinguished.*

5-12. POSTFLOW TIME CONTROL (Figure 5-1)

IMPORTANT: *The POSTFLOW TIME control and gas valve (and coolant valve) do not work unless the OUTPUT(CONTACTOR) switch is in REMOTE 14 and a remote control is connected to the REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle.*

The POSTFLOW TIME control allows the operator to select the length of time gas (and coolant if applicable) flows after the arc is extinguished. Postflow time begins when the arc is broken and the contactor opens. When postflow time ends, the gas valve (and coolant valve) close shutting off shielding gas (and coolant if applicable) flow to the torch.

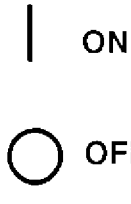
The scale surrounding the control is calibrated in seconds (0 to 60). Rotating the control clockwise increases postflow time.

5-13. PREFLOW TIME (Optional) (Figure 5-1)

IMPORTANT: *The OUTPUT(CONTACTOR) Switch must be in the REMOTE 14 position and a remote contactor control must be connected to the REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle to obtain preflow of shielding gas (and coolant if applicable).*

The PREFLOW TIME control circuitry allows gas (and coolant if applicable) to flow before the arc is started. Preflow time begins when the contactor switch is closed. Once the preflow time ends, the gas valve (and coolant valve) remain energized, the contactor closes, and weld output is available.

A. PREFLOW TIME Switch



Placing the PREFLOW TIME switch in the ON position activates the preflow time control circuitry. Placing the switch in the OFF position disables the preflow time control, circuitry and welding begins when the contactor switch closes. The switch should be OFF when performing Shielded Metal Arc Welding (SMAW).

B. PREFLOW TIME Control

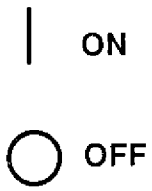
The PREFLOW TIME control allows the operator to choose the length of time gas (and coolant if applicable) flows before the contactor closes and weld output is available. The scale surrounding the control is calibrated in seconds (0 to 15). Rotating the control clockwise increases preflow time.

5-14. SPOT TIME (Optional) (Figure 5-1)

IMPORTANT: *The AMPERAGE CONTROL switch must be in the PANEL position, the OUTPUT(CONTACTOR) switch must be in the REMOTE 14 position, and a remote contactor control must be connected to the REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle for the spot time circuit to work.*

The spot time circuitry allows the operator to make Gas Tungsten Arc (GTAW) spot welds. Spot time begins at arc initiation. The remote contactor control must remain closed during the spot weld cycle. If the arc is broken or the contactor is opened during the spot time cycle, the timer stops but does not reset. When the spot time has ended, weld output stops. Postflow starts when the remote contactor control is opened. The spot timer resets after the contactor is opened.

A. SPOT TIME Switch



Placing the SPOT TIME switch in the ON position activates the spot weld circuitry in the welding power source. Placing the switch in the OFF position disables the spot weld circuitry. The switch should be in the OFF position while doing Shielded Metal Arc Welding (SMAW).

B. SPOT TIME Control

The SPOT TIME control allows the operator to set the desired spot time. Spot time can be changed in hundredths of a second from 0 to 9.99 seconds. Rotate the knobs on the timer clockwise to increase the spot weld setting.

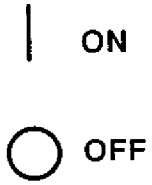
If the SPOT TIME control is set for less than one second and the START AMPERAGE switch is ON, spot weld amperage is governed by the setting of the START AMPERAGE control.

5-15. PULSER (Optional) (Figure 5-1)

Pulsing refers to the alternate raising and lowering of the weld output at a periodic rate. The raised portions of the weld output are controlled in width, height, and frequency, forming pulses of weld output. These pulses and the lower amperage level between them (called the background amperage) alternately heat and chill the molten weld puddle. The combined effect gives the operator better control of penetration, bead width, crowning, undercutting, and puddle sag in out-of-position welding, specifically vertical up.

IMPORTANT: *The Pulser controls may be adjusted while welding.*

A. PULSER Switch



Placing the PULSER switch in the ON position activates the pulsing circuitry in the welding power source. The % ON TIME and PULSES PER SECOND controls are active and weld output is determined by the settings of the BACKGROUND AMPERAGE and AMPERAGE ADJUSTMENT controls. When this switch is in the OFF position, the pulser controls are not active, and weld output is determined by the setting of the AMPERAGE ADJUSTMENT control.

If the PULSER switch is placed in the ON position before welding, the pulser circuitry turns on and begins pulsing. When the contactor is energized, pulsed weld output is available. Because the pulser circuitry is already pulsing when the contactor is energized, it cannot be determined where in the pulse cycle the weld will start.

If the PULSER switch is placed in the ON position after the contactor is energized, pulsed weld output is available starting with peak amperage as set on the AMPERAGE ADJUSTMENT control.

B. % ON TIME Control (Chart 5-1)

The % ON TIME control varies the percentage of time during each output pulse that the AMPERAGE ADJUSTMENT control sets weld output amperage (peak amperage). The scale surrounding the % ON TIME control is calibrated in percent (5 to 95) and should not be read as a time value. Rotating the control clockwise increases peak amperage on time.

C. PULSES PER SECOND Control (Chart 5-1)

The PULSES PER SECOND control varies the number of output pulses generated per second. The scale surrounding the PULSES PER SECOND control is calibrated in the number of pulses available per second (0.25 to 10). Rotating the control clockwise increases the number of pulses per second.

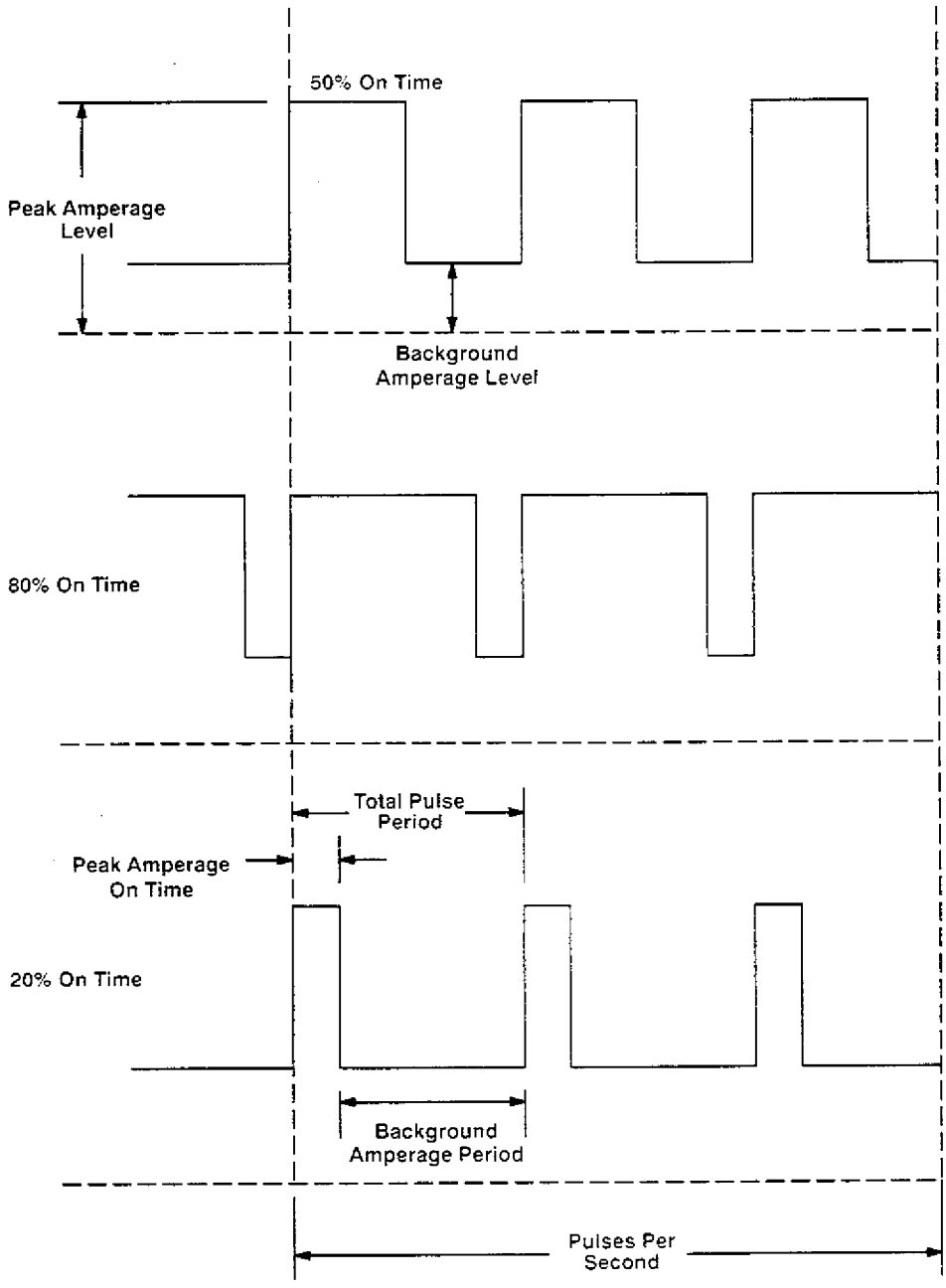
D. BACKGROUND AMPERAGE Control (Chart 5-1)

The BACKGROUND AMPERAGE control sets the weld output background level. The AMPERAGE ADJUSTMENT control sets the peak amperage level during pulsed welding.

These controls act independently; therefore, it is possible to set a background amperage higher than the peak amperage.

The scale surrounding the BACKGROUND AMPERAGE control is calibrated in percentage and should not be read as an amperage or voltage value. Rotating the control clockwise increases amperage.

Chart 5-1. Pulsed Output



SECTION 6 – SEQUENCE OF OPERATION

WARNING: ELECTRIC SHOCK can kill; MOVING PARTS can cause serious injury; IMPROPER AIR FLOW AND EXPOSURE TO ENVIRONMENT can damage internal parts.

- *Do not touch live electrical parts.*
- *Keep all covers and panels in place while operating.*

Warranty is void if the welding power source is operated with any portion of the outer enclosure removed.

ARC RAYS, SPARKS, AND HOT SURFACES can burn eyes and skin; NOISE can damage hearing.

- *Wear correct eye, ear, and body protection.*

FUMES AND GASES can seriously harm your health.

- *Ventilate to keep from breathing fumes and gases.*
- *If ventilation is inadequate, use approved breathing device.*

HOT METAL, SPATTER, AND SLAG can cause burns and fire.

- *Allow work and equipment to cool before handling.*
- *Watch for fire.*
- *Have a fire extinguisher nearby, and know how to use it.*

MAGNETIC FIELDS FROM HIGH CURRENTS can affect pacemaker operation.

- *Wearers should consult their doctor before going near arc welding, gouging or spot weld operations.*

See Section 1 – Safety Rules For Operation Of Arc Welding Power Source for basic welding safety information.

6-1. GAS TUNGSTEN ARC WELDING (GTAW)

WARNING: Read and follow safety information at beginning of entire Section 6 before proceeding.

1. Install and connect unit according to Section 4.
2. Select proper tungsten electrode (see Table 7-2).
3. Prepare tungsten electrode according to Section 7-3, and insert into torch.
4. Wear dry insulating gloves and clothing.
5. Connect work clamp to clean, bare metal at workpiece.
6. Place the Output Selector switch in the desired position (see Section 5-2).

WARNING: ELECTRIC SHOCK can kill.

- *Do not use AC output in damp areas, if movement is confined, or if there is a danger of falling.*
- *Use AC output ONLY if required for the welding process.*
- *If AC output is required, use remote output control.*
- *Read and follow Safety Rules at beginning of this manual.*

7. Place START AMPERAGE switch in desired position, and select start amperage if necessary (see Section 5-5).

IMPORTANT: *To accurately set a start amperage, hold the MODE switch in the PRESET position and rotate the AMPERAGE ADJUSTMENT control until the desired start amperage is displayed on the AMPERAGE meter. Read the position of the AMPERAGE ADJUSTMENT control and set the START AMPERAGE control to the same percentage value.*

8. Hold the MODE switch in the PRESET position, and adjust the AMPERAGE ADJUSTMENT control to desired setting (see Sections 5-3 and 5-4).
9. Rotate the AC BALANCE control to the desired position (see Section 5-6).
10. Place the ARC CONTROL switch in the OFF position.
11. Place the OUTPUT(CONTACTOR) switch in the desired position (see Section 5-8).
12. Place the AMPERAGE CONTROL switch in the desired position (see Section 5-9).
13. Place the HIGH FREQUENCY switch in desired position and rotate HIGH FREQUENCY INTENSITY control to desired position (see Section 5-10).
14. Place the CRATER FILL TIME switch in desired position and rotate control to desired position (see Section 5-11).
15. Rotate the POSTFLOW TIME control to desired position (see Section 5-12).
16. If PREFLOW TIME is available, place switch in desired position and rotate control to appropriate time setting (see Section 5-13).
17. If SPOT TIME is available, place switch in OFF position.
18. If PULSER is available, place switch in OFF position.
19. Make adjustments to remote control(s) as necessary.

20. Turn on shielding gas and water supplies as applicable.
21. Wear welding helmet with proper filter lens according to ANSI Z49.1.
22. Press the Power switch ON button.
23. Begin welding.

6-2. GAS TUNGSTEN ARC WELDING - PULSED ARC (GTAW-P)

WARNING: Read and follow safety information at beginning of entire Section 6 before proceeding.

1. Prepare unit as instructed in Section 6-1, Steps 1 through 17.
2. Place PULSER switch in ON position.
3. Rotate % ON TIME control to desired position (see Section 5-15B).
4. Rotate PULSES PER SECOND control to desired position (see Section 5-15C).
5. Rotate BACKGROUND AMPERAGE control to desired position (see Section 5-15D).
6. Make adjustments to remote control(s) as necessary.
7. Turn on shielding gas and water supplies as applicable.
8. Wear welding helmet with proper filter lens according to ANSI Z49.1.
9. Press the Power switch ON button.
10. Begin welding.

6-3. GAS TUNGSTEN ARC SPOT WELDING

WARNING: Read and follow safety information at beginning of entire Section 6 before proceeding.

1. Prepare unit as instructed in Section 6-1, Steps 1 through 10.
2. Place the OUTPUT(CONTACTOR) switch in the REMOTE position.
3. Place the AMPERAGE CONTROL switch in the PANEL position.
4. Place the HIGH FREQUENCY switch in desired position and rotate HIGH FREQUENCY INTENSITY control to desired position (see Section 5-10).
5. Place CRATER FILL TIME switch in the OFF position.
6. Rotate the POSTFLOW TIME control to desired position (see Section 5-12).
7. If PREFLOW TIME is available, place switch in desired position, and rotate control to desired time setting (see Section 5-13).
8. Place SPOT TIME switch in ON position, and set spot time (see Section 5-14).
9. If PULSER is available, place switch in desired position, and adjust controls accordingly (see Section 5-15).
10. Turn on shielding gas and water supplies as applicable.
11. Wear welding helmet with proper filter lens according to ANSI Z49.1.
12. Press the Power switch ON button.
13. Begin welding.

6-4. SHIELDED METAL ARC WELDING (SMAW)

WARNING: Read and follow safety information at beginning of entire Section 6 before proceeding.

1. Install and connect unit according to Section 4.
2. Wear dry insulating gloves and clothing.
3. Connect work clamp to clean, bare metal at workpiece.
4. Select proper electrode.
5. Place the Output Selector switch in the desired position (see Section 5-2).

WARNING: ELECTRIC SHOCK can kill.

- *Do not use AC output in damp areas, if movement is confined, or if there is a danger of falling.*
- *Use AC output ONLY if required for the welding process.*
- *If AC output is required, use remote output control.*
- *Read and follow Safety Rules at beginning of this manual.*

6. Place START AMPERAGE switch in desired position, and select start amperage if necessary (see Section 5-5).

IMPORTANT: *To accurately set a start amperage, hold the MODE switch in the PRESET position and rotate the AMPERAGE ADJUSTMENT control until the desired start amperage is displayed on the AMPERAGE meter. Read the position of the AMPERAGE ADJUSTMENT control and set the START AMPERAGE control to the same percentage value.*

7. Hold the MODE switch in the PRESET position and adjust the AMPERAGE ADJUSTMENT control to desired setting (see Sections 5-3 and 5-4).
8. Rotate the AC BALANCE control to the desired position (see Section 5-6).
9. Place the ARC CONTROL switch in the desired position and rotate control to desired position (see Section 5-7).
10. Place the OUTPUT(CONTACTOR) switch in the ON position.

11. Place the AMPERAGE CONTROL switch in the desired position (see Section 5-9).
12. Place the HIGH FREQUENCY switch in OFF position.
13. Place the CRATER FILL TIME switch in OFF position.
14. The POSTFLOW TIME control is not functional.
15. If PREFLOW TIME is available, place switch in OFF position.
16. If SPOT TIME is available, place switch in OFF position.
17. If PULSER is available, place switch in OFF position.
18. Make adjustments to remote control(s) as necessary.
19. Wear welding helmet with proper filter lens according to ANSI Z49.1.
20. Insert electrode into electrode holder.
21. Press the Power switch ON button.
22. Begin welding.

6-5. SHUTTING DOWN

1. Stop welding.
2. Press the Power switch OFF button.
3. Turn off the shielding gas and water supplies if applicable.

WARNING: HIGH CONCENTRATION OF SHIELDING GAS can harm health or kill.

- *Shut off gas supply when not in use.*

SECTION 7 – MAINTENANCE & TROUBLESHOOTING

7-1. ROUTINE MAINTENANCE (Table 7-1)

IMPORTANT: *Every six months inspect the labels on this unit for legibility. All precautionary labels must be maintained in a clearly readable state and replaced when necessary. See Parts List for part number of precautionary labels.*

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting, maintaining, or servicing.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

MOVING PARTS can cause serious injury.

- *Keep away from moving parts.*

HOT SURFACES can cause severe burns.

- *Allow cooling period before servicing.*

A. Fan Motor

This unit is equipped with an exhaust fan and relies on forced draft for adequate cooling. The fan motor is manufactured with lifetime sealed bearings and requires no maintenance.

B. Weld Cables

WARNING: Read and follow safety information at beginning of entire Section 7-1 before proceeding.

Every three months inspect cables for breaks in insulation. Repair or replace cables if insulation breaks are present. Clean and tighten connections at each inspection.

C. Internal Cleaning

WARNING: Read and follow safety information at beginning of entire Section 7-1 before proceeding.

Every six months blow out or vacuum dust and dirt from the inside of the welding power source. Remove the outer enclosure, and use a clean, dry airstream or vacuum suction for the cleaning operation. If dusty or dirty conditions are present, clean the unit monthly.

Table 7-1. Maintenance Schedule

Frequency*	Maintenance
Every month.	Units in heavy service environments: Check labels, weld cables, clean internal parts.
Every 3 months.	Check weld cables (Section 7-1B).
Every 6 months.	Check all labels (see IMPORTANT block, Section 7-1). Clean internal parts (Section 7-1C).

*Frequency of service is based on units operated 40 hours per week. Increase frequency of maintenance if usage exceeds 40 hours per week.

7-2. OVERLOAD PROTECTION

A. 115 Volts Control Circuit Protection (Figure 4-1)

If circuit breaker CB1 opens, high frequency and post-flow circuits are not functional, and no output is available at duplex receptacle RC1. If CB1 opens, correct the problem, and manually reset the circuit breaker.

B. Thermal Protection

The unit is protected against thermal overload by normally-closed thermostat TP1, located in the main transformer. If TP1 opens and weld output ceases, allow a cooling period with the unit on (fan running) before resuming operation.

7-3. TUNGSTEN ELECTRODE (Table 7-2 And Figures 7-1 And 7-2)

Use Table 7-2 to select the correct size and type tungsten electrode. Prepare the tungsten electrode using the following guidelines. A properly prepared tungsten electrode is essential in obtaining a satisfactory weld.

A. For AC Or DC Electrode Positive Welding (Figure 7-1)

Ball the end of tungsten electrodes used for ac or dc electrode positive welding before beginning the welding operation. Weld amperage causes the tungsten electrode to form the balled end. The diameter of the end should not exceed the diameter of the tungsten electrode by more than 1-1/2 times. For example, the end of a 1/8 in. (3.2 mm) diameter tungsten electrode should not exceed 3/16 in. (4.8 mm) diameter.

Table 7-2. Tungsten Size

Electrode Diameter	Amperage Range - Polarity - Gas Type			
Pure Tungsten (Green Band)	**DC-Argon Electrode Negative/Straight Polarity**	**DC-Argon Electrode Positive/Reverse Polarity**	**AC-Argon Using High Frequency**	**AC-Argon Balanced Wave Using High Freq.**
.010"	Up to 15	*	Up to 15	Up to 10
.020"	5-20	*	5-20	10-20
.040"	15-80	*	10-60	20-30
1/16"	70-150	10-20	50-100	30-80
3/32"	125-225	15-30	100-160	60-130
1/8"	225-360	25-40	150-210	100-180
5/32"	360-450	40-55	200-275	160-240
3/16"	450-720	55-80	250-350	190-300
1/4"	720-950	80-125	325-450	250-400
2% Thorium Alloyed Tungsten (Red Band)				
.010"	Up to 25	*	Up to 20	Up to 15
.020"	15-40	*	15-35	5-20
.040"	25-85	*	20-80	20-60
1/16"	50-160	10-20	50-150	60-120
3/32"	135-235	15-30	130-250	100-180
1/8"	250-400	25-40	225-360	160-250
5/32"	400-500	40-55	300-450	200-320
3/16"	500-750	55-80	400-500	290-390
1/4"	750-1000	80-125	600-800	340-525
Zirconium Alloyed Tungsten (Brown Band)				
.010"	*	*	Up to 20	Up to 15
.020"	*	*	15-35	5-20
.040"	*	*	20-80	20-60
1/16"	*	*	50-150	60-120
3/32"	*	*	130-250	100-180
1/8"	*	*	225-360	160-250
5/32"	*	*	300-450	200-320
3/16"	*	*	400-550	290-390
1/4"	*	*	600-800	340-525

*NOT RECOMMENDED

The figures listed are intended as a guide and are a composite of recommendations from American Welding Society (AWS) and electrode manufacturers.

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B. For DC Electrode Negative Welding (Figures 7-1 And 7-2)

CAUTION: HOT FLYING METAL PARTICLES can injure personnel, start fires, and damage equipment; TUNGSTEN CONTAMINATION can lower weld quality.

- *Shape tungsten electrode only on grinder with proper guards in a safe location wearing proper face, hand, and body protection.*
- *Do not use same wheel for any other job or the tungsten will become contaminated.*
- *Shape tungsten electrodes on a fine grit, hard abrasive wheel used only for tungsten shaping. Grind tungsten electrodes so that grinding marks run lengthwise with the electrode. These procedures reduce the possibility of the tungsten electrode transferring foreign matter into the weld and help reduce arc wander and instability at lower currents.*

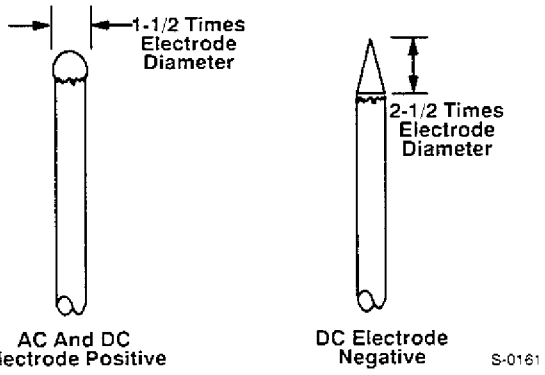


Figure 7-1. Properly Prepared Tungsten Electrodes

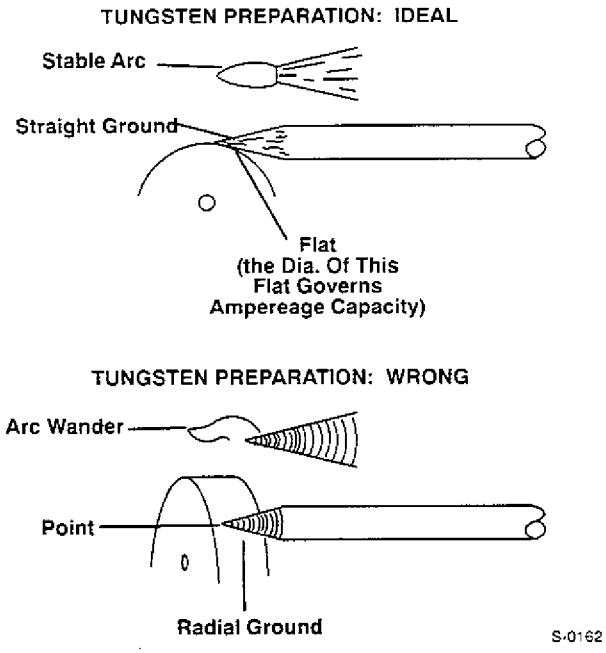


Figure 7-2. Tungsten Preparation

Grind the end of the tungsten electrode to a taper for a distance of 2 to 2-1/2 electrode diameters in length. For example, the ground surface for a 1/8 in. (3.2 mm) diameter tungsten electrode should be 1/4 to 5/16 in. (6.4 to 8.0 mm) long.

For additional information, see your distributor for a handbook on the Gas Tungsten Arc Welding (GTAW) process.

7-4. SPARK GAP ADJUSTMENT (Figure 7-3)

It is necessary to readjust the spark gaps every three to four months or when intermittent operation occurs. Normal spark gap setting for this unit is 0.008 in. (0.208 mm).

High-frequency output varies with the spark gap setting. When a great amount of high frequency is necessary, the spark gaps can be adjusted to 0.010 in. (0.254 mm). This increases high-frequency radiation which increases interference with communications equipment. It is suggested that a minimum spark gap setting of 0.004 to 0.008 in. (0.102 to 0.203 mm) be used.

IMPORTANT: *Spark gaps widen and points deteriorate with normal usage. Every three months check and maintain the spark gap setting to ensure consistent welding results and compliance with FCC radiation regulations. Do not clean or dress points. Replace the entire point when the tungsten section has completely disappeared.*

This unit is provided with a spark gap assembly located behind an access door on the left side of the lower front panel (see Figure 4-1). To adjust the spark gaps, proceed as follows.

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting, maintaining, or servicing.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

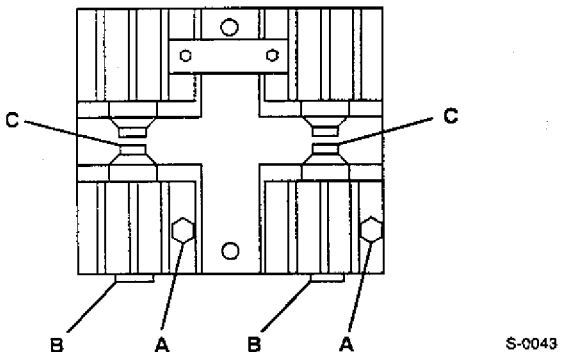


Figure 7-3. Spark Gap Adjustment

1. Open lower front panel access door.
2. Open spark gap access door.

3. Loosen screws A on both sides.
4. Place feeler gauge of proper thickness between points C.
5. Apply slight pressure to points B so feeler gauge is held firmly in gap.
6. Tighten screws A.
7. Close and secure both doors.

7-5. CIRCUIT BOARD HANDLING PRECAUTIONS

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down welding power source, and disconnect input power employing lockout/tagging procedures before inspecting, maintaining, or servicing.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

CAUTION: ELECTROSTATIC DISCHARGE (ESD) can damage circuit boards.

- *Put on properly grounded wrist strap BEFORE handling circuit boards.*
- *Transport circuit boards in proper static-shielding carriers or packages.*
- *Perform work only at a static-safe work area.*

INCORRECT INSTALLATION or misaligned plugs can damage circuit board.

- *Be sure that plugs are properly installed and aligned.*

EXCESSIVE PRESSURE can break circuit board.

- *Use only minimal pressure and gentle movement when disconnecting or connecting board plugs and removing or installing board.*

If a circuit board is not working, follow the precautions above, and contact the nearest Factory Authorized Service Station.

7-6. TROUBLESHOOTING (Table 7-3)

WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Turn off welding power source, and disconnect input power employing "lockout/tagging procedures" before inspecting, maintaining, or servicing.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

HOT SURFACES can cause severe burns.

- *Allow cooling period before servicing.*

MOVING PARTS can cause serious injury.

- *Keep away from moving parts.*

Troubleshooting to be performed only by qualified persons.

It is assumed that the unit was properly installed according to Section 4 of this manual, the operator is familiar with the function of controls, the welding power source was working properly, and the trouble is not related to the welding process. The following table is designed to diagnose and provide remedies for some of the troubles that may develop in this welding power source.

Use this table in conjunction with the circuit diagram while performing troubleshooting procedures. If the trouble is not remedied after performing these procedures, the nearest Factory Authorized Service Station should be contacted. In all cases of equipment malfunction, the manufacturer's recommendations should be strictly followed.

Table 7-3. Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
No weld output; unit completely inoperative; pilot light PL1 off.	Line disconnect switch in the OFF position.	Place line disconnect switch in the ON position.
	Line fuse(s) open.	Check and replace line fuse(s).
	Improper electrical input connections.	See Section 4-8 for proper input connections.
	Input voltage jumper links not in proper position.	See Section 4-8 for proper jumper link position.
	Power switch assembly.	Replace Power switch assembly parts.
No weld output; fan and pilot light PL1 on.	OUTPUT(CONTACTOR) switch S8 position.	Place S8 in the ON position if no remote control is used. Place S8 in the REMOTE 14 position, and be sure remote control is connected to the REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle RC2 (see Sections 4-4 and 5-8).
	Remote control device.	Check and repair, or replace remote control device.
	Thermostat TP1 open (thermal shutdown).	Allow unit to cool with fan on (see Section 7-2).
	Circuit Board PC1.	See Section 7-5, and contact nearest Factory Authorized Service Station.
Unit provides only maximum or minimum weld output.	Hall device HD1.	Replace HD1. Contact nearest Factory Authorized Service Station.
	Circuit board PC1.	See Section 7-5, and contact nearest Factory Authorized Service Station.
Weld output always above or below set values.	Hall device HD1.	Replace HD1. Contact nearest Factory Authorized Service Station.
	Circuit board PC1.	See Section 7-5, and contact nearest Factory Authorized Service Station.
Erratic weld output.	Circuit board PC1.	See Section 7-5, and contact nearest Factory Authorized Service Station.
No AC BALANCE control.	AC BALANCE control R13.	Check and replace R13.
	Circuit board PC1.	See Section 7-5, and contact nearest Factory Authorized Service Station.
No control of weld output.	AMPERAGE CONTROL switch S11 position.	Place S11 in the PANEL position if no remote control is used. Place S11 in the REMOTE 14 position, and be sure a remote control is connected to the REMOTE CONTACTOR AND AMPERAGE CONTROL receptacle RC2 (see Sections 4-4 and 5-9).
	AMPERAGE ADJUSTMENT control R1.	Check and replace R1.
	Circuit board PC1.	See Section 7-5, and contact nearest Factory Authorized Service Station.
No high frequency and no gas flow.	Circuit breaker CB1.	Reset CB1 (see Section 7-2).
	Circuit board PC2.	See Section 7-5, and contact nearest Factory Authorized Service Station.

Table 7-3. Troubleshooting (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Tungsten electrode oxidizing and not remaining bright after conclusion of weld.	Loose gas fittings on regulator or gas line. This will siphon oxygen into the weld zone.	Check and tighten all gas fittings.
	Insufficient gas flow.	Increase gas flow setting.
	Drafts blowing gas shield away from tungsten.	Shield weld zone from drafts.
	Dirty filler rod or material.	Use clean filler rod or material.
	Gas shutting off too quickly after end of weld.	Increase time setting of POSTFLOW TIME control (see Section 5-12).
	HIGH FREQUENCY switch S3 position.	Place S3 in START or CONTINUOUS position.
Lack of high frequency; difficulty in establishing arc.	Use tungsten larger than recommended for welding amperage.	Use proper size tungsten for welding application (see Table 7-2).
	Dissipation of high frequency from electrode holder lead.	Be sure that electrode holder cable is not close to any grounded metal.
	Weld cable leakage.	Check cables and torch for cracked or deteriorated insulation or bad connections. Repair or replace necessary parts.
	Improper spark gap.	Check spark gaps G and adjust if necessary (see Section 7-4).
	HIGH FREQUENCY INTENSITY control R20 setting.	Increase setting of R20 (see Section 5-10).
Wandering arc -- poor control of direction of arc.	Use of tungsten considerably larger than recommended.	Use proper size tungsten (see Table 7-2).
	Improperly prepared tungsten.	Prepare tungsten as instructed in Section 7-3.

NOTES

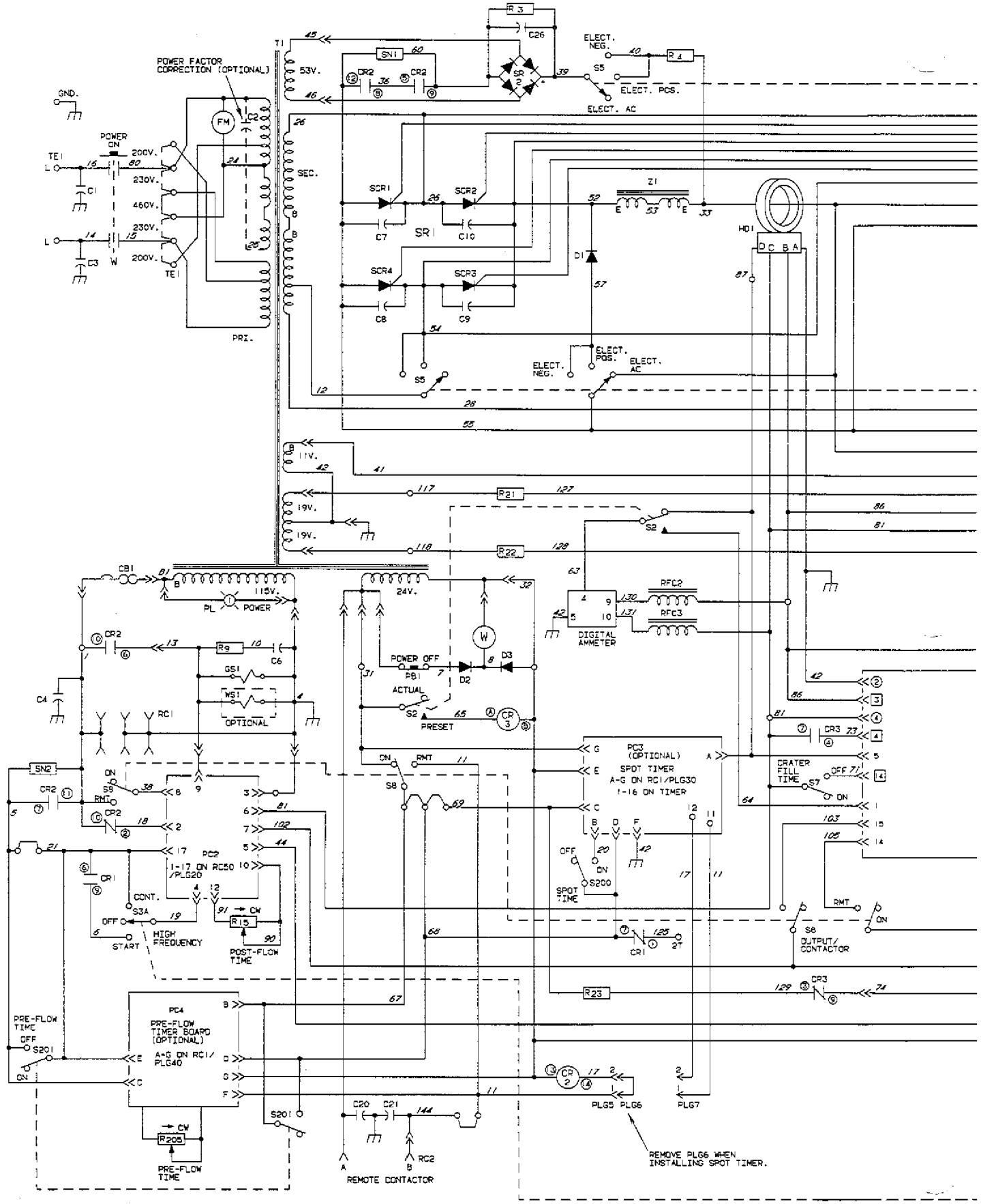
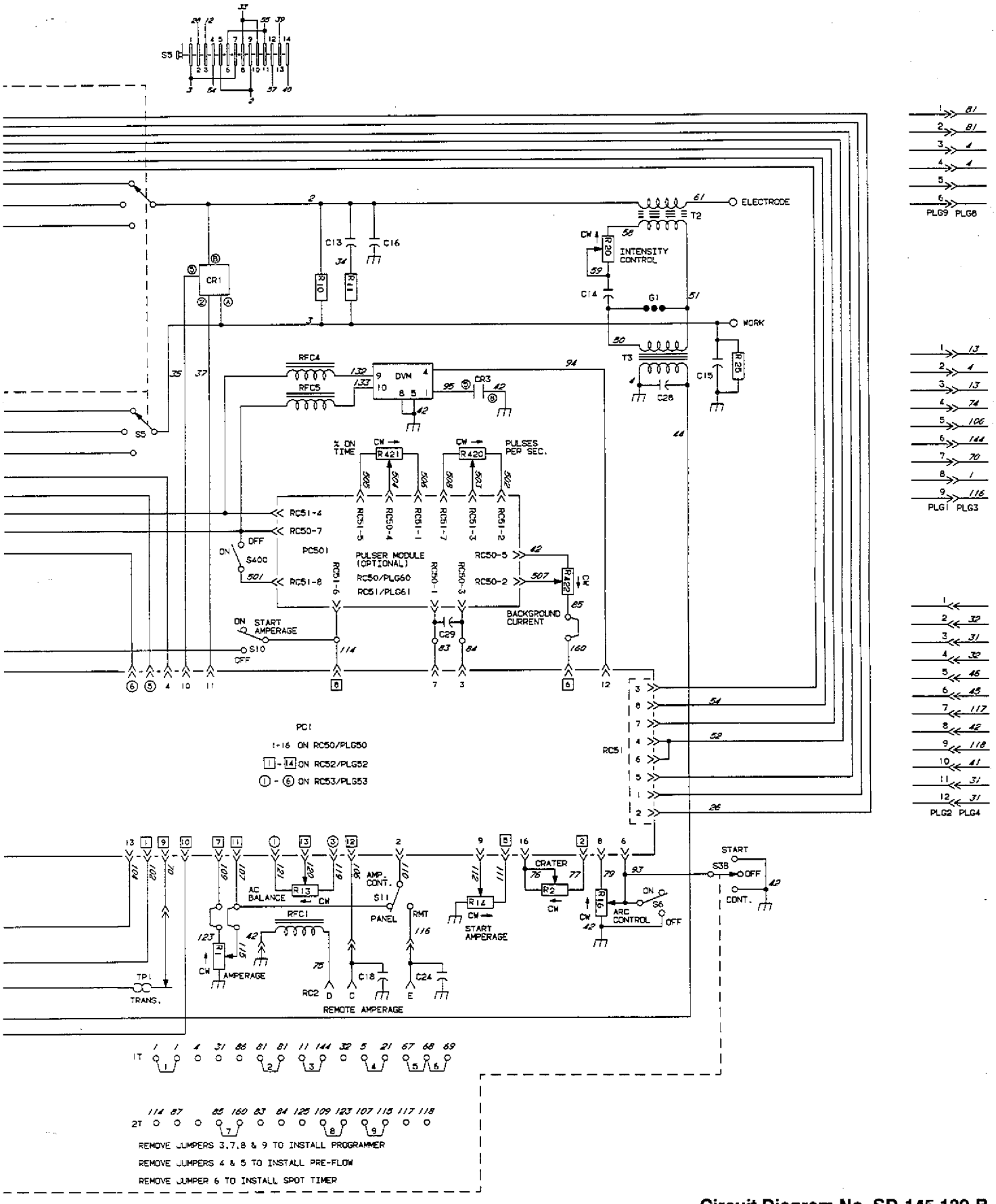


Diagram 8-1. Circuit Diagram For Welding Power Source



Circuit Diagram No. SD-145 139-B

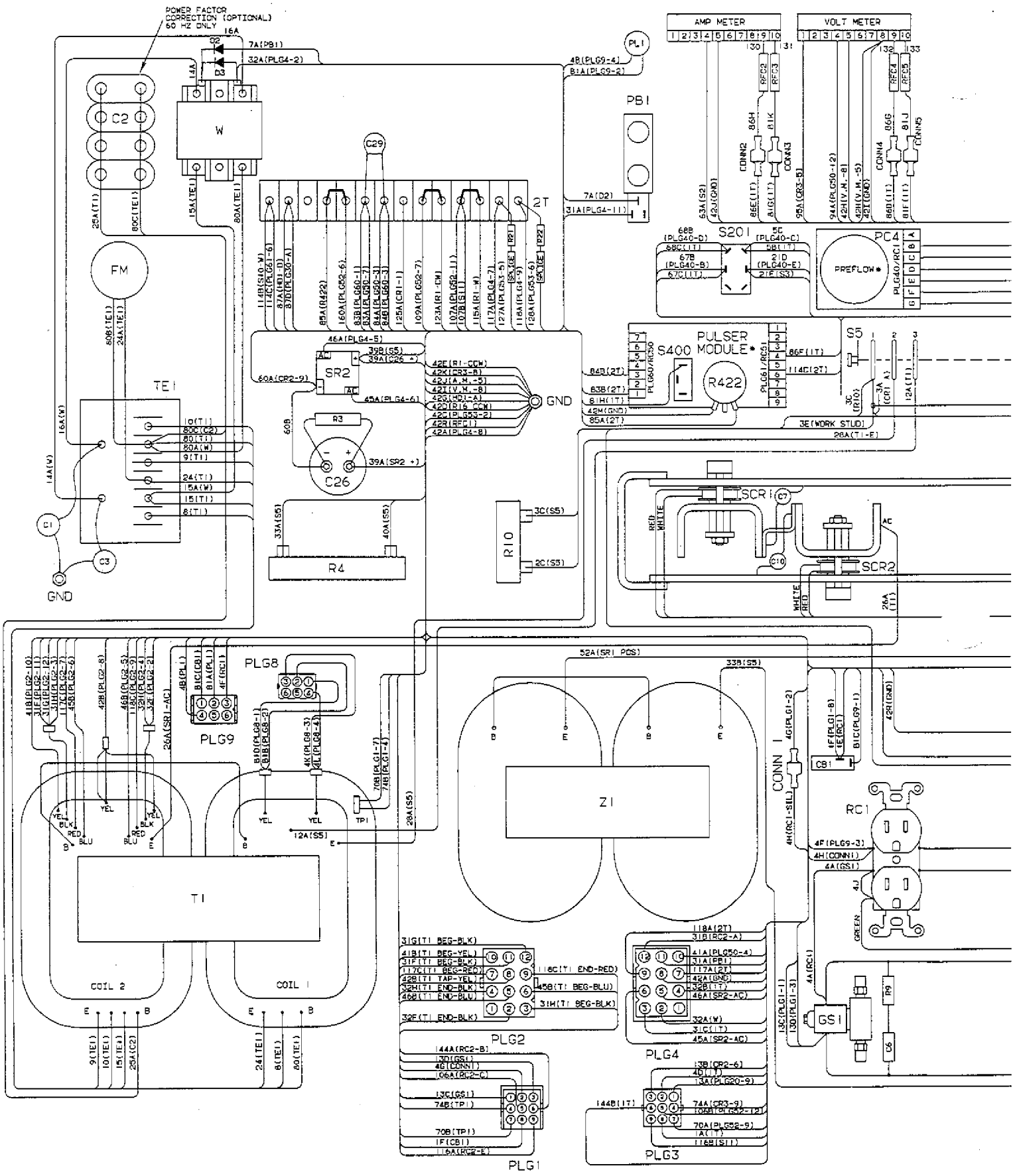
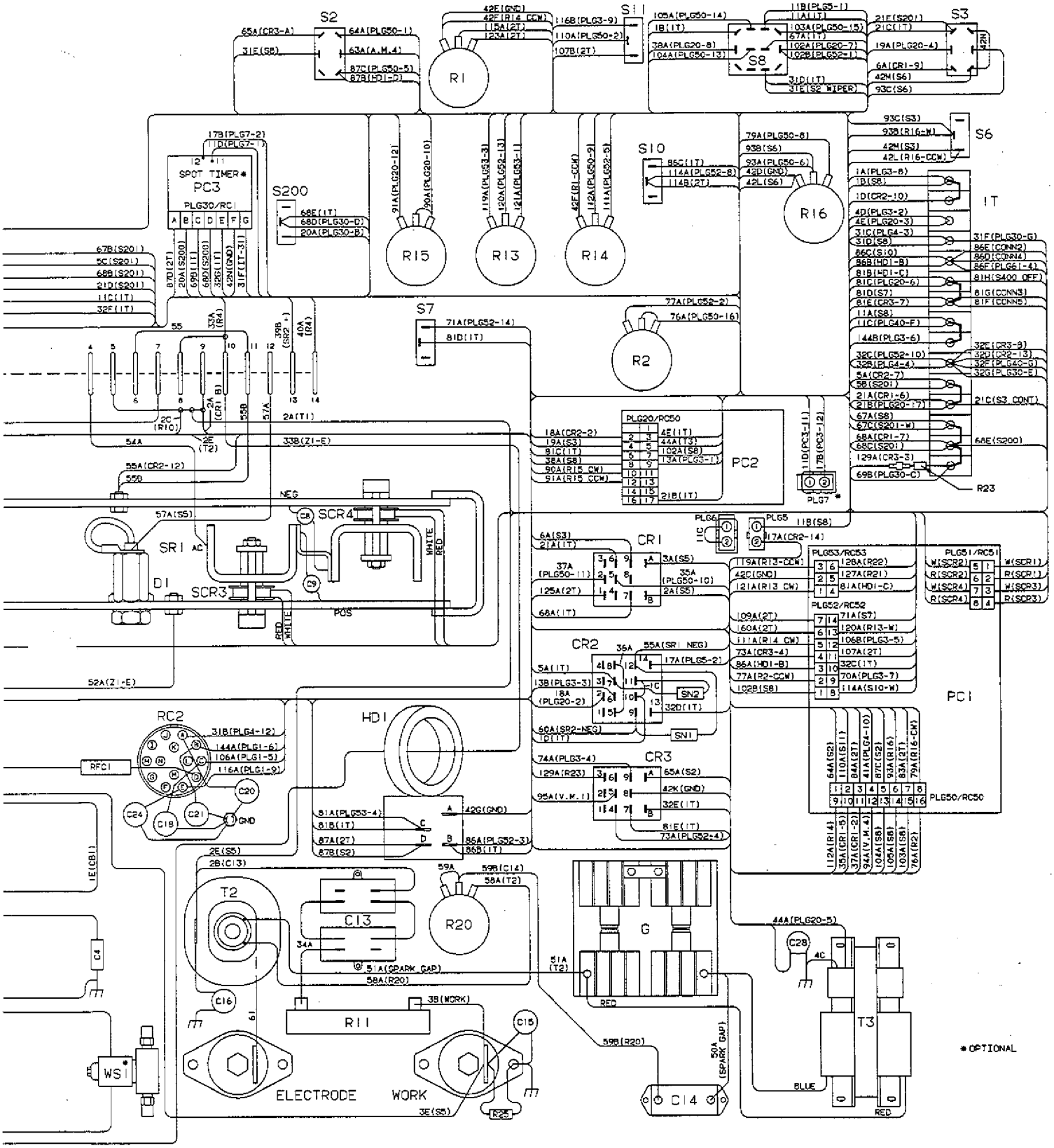


Diagram 8-2. Wiring Diagram For Welding Power Source



Wiring Diagram No. SD-145 138-B

SECTION 9 – CERTIFICATION FOR HIGH FREQUENCY ARC WELDING EQUIPMENT

9-1. GENERAL

The following information is necessary to make a proper installation of the high-frequency arc welding equipment described in this instruction manual. In order to comply with Part 18 of the Rules and Regulations of the Federal Communications Commission (FCC), the certificate in the front of this manual must be filled in completely and signed after the unit has been correctly installed. The certificate must be kept WITH THE EQUIPMENT AT ALL TIMES to comply with the regulation. The manufacturer of the equipment covered herein has conducted approved field tests and certifies that the radiation can be expected to be within the legal limits if the correct installation procedures, as outlined, are followed. The importance of a correct installation cannot be overemphasized since case histories of interference due to high-frequency stabilized arc welding equipment have shown that in most cases, an inadequate installation was at fault. In the event that interference with authorized FCC services occurs, the user is required to take suitable steps to clear the situation. The Factory Service Department personnel will assist the user by supplying technical information.

Instead of complying with the installation requirements and the certification of each individual installation, the user may elect to certify the entire plant by having a qualified engineer make a plant radiation survey. In such cases, these instructions could serve as a guide in minimizing interference that might be caused by the high-frequency arc welding equipment.

Many processes and applications of processes require open-circuit voltages sufficient to jump from the electrode to the work without making direct contact. The maximum open-circuit voltage (OCV) of a welding power source is not sufficient for this. In the Submerged Arc Welding (SAW) process, granules of flux often get between the electrode and the workpiece making starting of the arc difficult at normal open-circuit voltages. A higher voltage is also required to start and maintain a stable arc in processes like the Gas Tungsten Arc Welding (GTAW) process. In these cases it will take several thousand volts to cause an electrical spark to jump this gap between the electrode and the work, creating an initial path of ionization that the arc current can follow without the hazards that would be present at power frequency.

In order to provide these higher voltages, it is common practice to superimpose a high open-circuit voltage on the output of a welding power source by using high-frequency techniques. The high-frequency voltage can be a source of interference and will be discussed in this section.

9-2. DEFINITIONS

A. High-Frequency Assisted Arc Welding Power Sources

In the arc welding process, high frequency may be used for initiating an arc or stabilizing the arc once it is struck, or for both functions.

The energy from the high-frequency source must flow to the welding electrode via a good quality, low impedance, and well insulated connecting cable.

B. Welding Circuit

The welding circuit consists of all attachments connected to the welding terminals.

C. Welding Terminals

Welding terminals are the terminals which provide welding power and high-frequency energy to the arc.

D. Electrode Terminal

The electrode terminal is the terminal to which the electrode cable or welding torch is connected.

E. Welding Torch

A device used in the Gas Tungsten Arc Welding (GTAW) process to control the position of the electrode, to transfer current to the arc, and to direct the flow of shielding gas.

F. Work Terminal

The work terminal is the terminal to which the welding workpiece is connected.

G. Welding Zone

The welding zone is the space within 50 ft. (15 m) in all directions from the midpoint between the power source and the welding arc (see Figure 9-6).

H. Bonding

Bonding refers to connecting metallic objects together to cause the objects to be at the same potential regardless of any current flow between them (see Figures 9-3 and 9-4).

I. Grounding (Earthing)

Depending on the practices within jurisdictions, one of these terms is commonly used to indicate the connection, or bonding, of parts of the apparatus to the earth.The terms may be used interchangeably.

J. Receiver

A receiver is any device normally used for receiving electromagnetic energy and converting it to useful communications purposes.

K. Conduction

Conduction is the transmission of high-frequency energy via an electrical conductor or conducting medium.

L. High Frequency

High frequency is radio frequency energy, either continuous or pulsed, used to start or stabilize a welding arc.

M. High-Frequency Assisted Arc Welding

High-frequency assisted arc welding refers to any of the arc welding processes requiring high frequency.

N. Interference

Interference is the unwanted and problematic reception of high-frequency energy.

O. Radiation

Radiation is the transmission of high-frequency energy through space.

9-3. HIGH-FREQUENCY RADIATION

Installations using high frequency, either as an integral part of the power source or as an accessory unit, will produce some high-frequency radiation. Such radiation, if the signal strength is sufficient at the receiving device, can cause an inconvenience or disruption of communications or can cause malfunction in sensitive electronic controls and systems. The four major causes of high-frequency radiation are as follows:

A. Direct Radiation From The Power Source Or High-Frequency Accessory Unit

Direct radiation is that radiation emanating directly from the power source or accessory unit. Radiation from the power line and welding power source accessories is not considered to be direct radiation from the power source or accessory unit.

B. Direct Radiation From The Welding Circuit

Any attachment to the output terminals of the high-frequency source is capable of acting as an antenna and radiating high-frequency energy. Attachments include weld cables, torches, worktables, etc. Since direct radiation from the welding circuit is the major source of radiation, it is important to keep attachments to a minimum.

C. Conduction And Radiation From The Power Line

Most power lines are capable of conducting high-frequency energy which may cause interference directly or by reradiation from these power lines. Normally such radiation is small when compared to that caused by radiation from the weld cables.

D. Reradiation

Radiation from the welding circuit can be picked up by ungrounded metal objects or unshielded wiring in the immediate vicinity, conducted some distance, and reradiated. This can be a troublesome source of interference.

9-4. LOCATION

Locate the high-frequency power source as close to the welding process as possible. Also consider the nearness of a suitable ground connection when selecting a site for the installation of the power source. Ideally, the high-frequency power source should be located in an area where there is a limited amount of miscellaneous wiring (lighting, power, telephone, communications, and other unshielded conductors) located within the welding zone. Ungrounded, metallic conductors in the welding zone can act as antennas which will pick up, conduct, or reradiate the high-frequency energy transmitted by the welding circuit. All miscellaneous wiring in the welding zone should be enclosed in grounded, rigid metallic conduit, copper braid, or some other material having an equivalent shielding efficiency, and grounded at 50 ft. (15 m) intervals (see Figure 9-1).

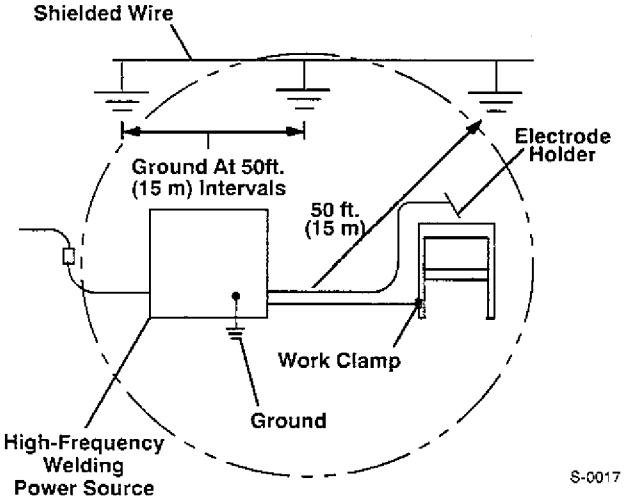


Figure 9-1. Requirements To Minimize Reradiation Pickup In The Vicinity Of The Welding Zone

9-5. GENERAL INSTALLATION PROCEDURES

A. Weld Cables

Keep the weld cables as short as possible and do not exceed 25 ft. (8 m) in length. Position the cables as close together and as close to the floor or ground plane as possible.

If the welding operation must be carried out at a point farther than 25 ft. (8 m) from the welding power source, use a portable high-frequency source and locate the portable unit within 25 ft. (8 m) of the welding electrode.

B. High-Frequency Assisted Arc Welding Power Sources

When the high-frequency assisted arc welding power source is in operation, all service doors and covers must be closed, securely fastened, and adequately bonded to ensure good contact around the entire perimeter of the opening. Except for changes and adjustments allowed by the manufacturer, the high-frequency assisted arc welding power source should not be modified.

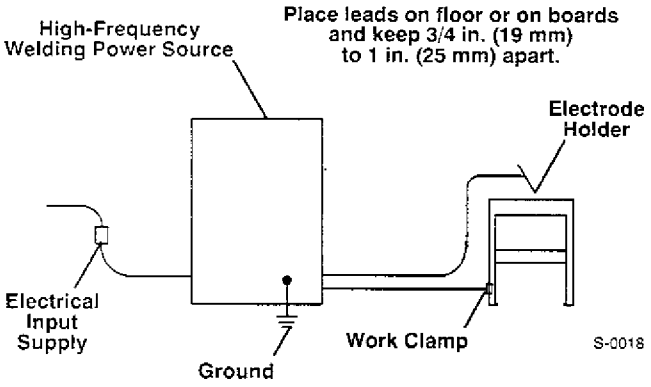


Figure 9-2. General Rules For Welding Leads

C. Grounding (Earthing) The Weld Cables

Be sure that the enclosure of the high-frequency power source is firmly grounded to the WORK terminal. If the high-frequency power source is not labeled as being internally high-frequency grounded, then this ground must be made by grounding the enclosure to the WORK terminal with No. 12 AWG gauge or smaller wire. Connect the ground wire to a driven ground rod or to a water pipe which enters the earth within 10 ft. (3 m) of the high-frequency power source.

D. Metal Buildings

Installation of a high-frequency power source within a suitably bonded and grounded (earthed) metal building can be an effective means of reducing high-frequency radiation. Wherever possible, install high-frequency power sources in such places.

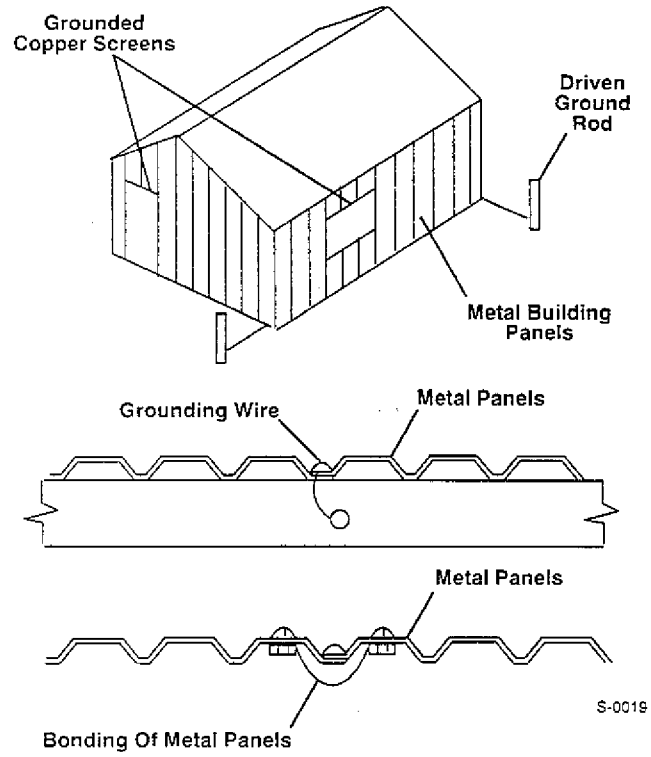


Figure 9-3. Grounding And Bonding Panels Of Metal Building

However, when the high-frequency power source is installed within a metal building, precautions must be taken to be sure that the building is properly bonded and grounded (earthed). This can be accomplished by placing several good electrical ground rods around the periphery of the building. During the construction of a new building of any type having metal in the structure, be sure that all the reinforcing and structural steel is bonded together (as by welding each piece of metal to all other adjacent pieces). For metal buildings, adjacent metal panels should be bolted or welded together at frequent intervals.All windows and doorways should be covered with grounded copper screen or galvanized hardware cloth of not more than 1/4 in. (6.4 mm) mesh.

E. Shielding Of Miscellaneous Wiring In The Welding Zone

Ungrounded, metallic conductors in the welding zone can act as antennas which will pick up, conduct, and/or reradiate the high-frequency energy transmitted by the welding circuit located within or near the welding zone. This means that all ungrounded water pipes must be grounded, and that all lighting, power, telephone, communications, and other conductors within the welding zone must be enclosed in grounded, rigid metallic conduit, copper braid, or some other material having an equivalent shielding capability (spirally wound, flexible, metallic conduit is not suitable). Shielding of the miscellaneous wiring in the welding zone must be grounded at 50 ft. (15 m) intervals. Excellent low resistance electrical connections must be maintained between conduit sections (see Figure 9-4).

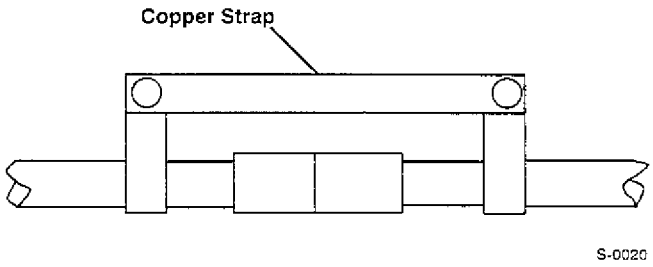


Figure 9-4. Bonding Method For Poor Conductors

F. Power Service

The high-frequency power source should be connected to the line input power supply as instructed in this manual. If the unit is equipped with a power cord, the supply conductors serving the high-frequency power source should be completely enclosed in solid metallic conduit, or in equivalent shielding, up to the point of connection with the power cord. The solid, metallic conduit, or equivalent shielding, should extend the entire distance from the power entrance location in the building to the high-frequency power source. Shielding should be electrically continuous throughout its length and should be connected so that good electrical contact is provided between the shield and the high-frequency power source.

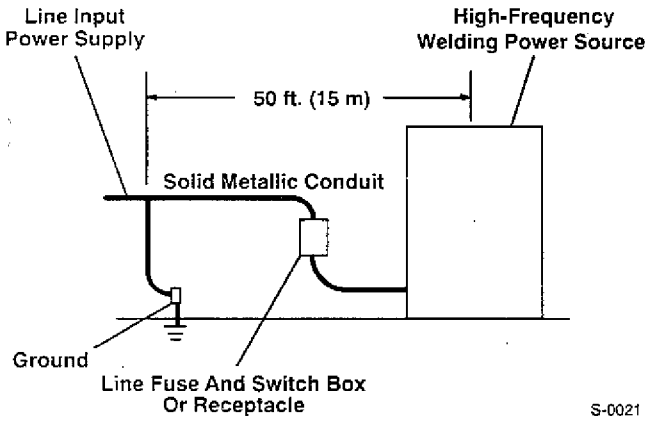


Figure 9-5. Installation Of High-Frequency Stabilized Arc Welding Power Source

9-6. GUIDELINES FOR INSTALLATION OF HIGH-FREQUENCY ASSISTED ARC WELDING POWER SOURCES

6. Locate the equipment so that the ground wire of the high-frequency power source can be kept as short as possible.

7. Shield the line input power leads up to the point of connection with the enclosure of the high-frequency power source as specified by the manufacture's requirements (see Section 9-5F).

8. Be sure that there is good electrical contact made at the enclosure of the high-frequency welding power source, through the conduit, and back to the service box. Be sure that the conduit system is continuous to a point at least 50 ft. (15 m) from the equipment, and that the conduit system is one complete run within the high-frequency zone. If rigid, metallic conduit is not used, be sure that the shielding used has equivalent shielding efficiency. Copper sleeving, lead covered cable, or the equivalent, is satisfactory. Spirally wound, flexible, metallic conduit is not suitable.

9. Keep WORK and ELECTRODE cables as short and straight as possible.

10. Keep weld cables to a maximum length of 25 ft. (8 m).

11. Keep weld cables as close together and as close to the ground plane as possible.

12. Adjust spark gap setting to the minimum setting given in this manual.

13. Secure all service and access doors before operating.

14. Visualize the welding zone as a sphere with a 50 ft. (15 m) radius centered on a point between the power source and the electrode holder (see Figure 9-6), and proceed as follows:

    a. Have all unshielded power, lighting, and communication wires within the welding zone placed in grounded shields or relocated outside the welding zone.

    b. Ground all large metallic objects, long guy wires, or support wires within the welding zone.

    c. Be sure that there are no external power or telephone wires, which may be off the immediate premises, within the welding zone.

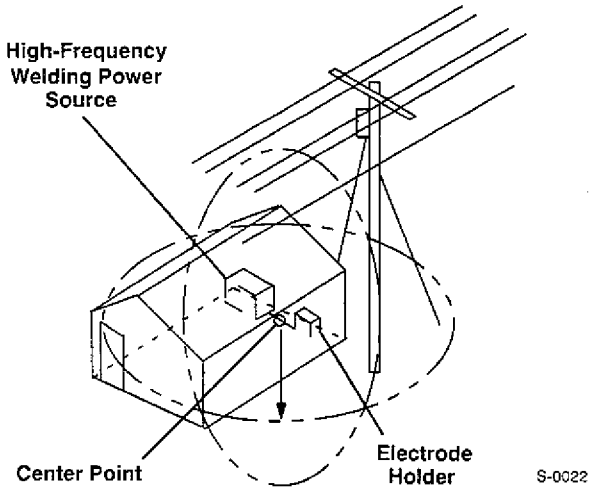


Figure 9-6. Welding Zone

15. Use driven ground rods which enter the ground 10 ft. (3 m) or less from the ground connection, or cold water pipes, as the ground for the high-frequency welding power source.

16. Be sure that all ground connections are clean and tight.

17. If the high-frequency welding power source is operated within a metal building, be sure that the building is properly grounded.

9-7. INSTALLATION GUIDELINES CHECKLIST

All items may not be necessary or practical for each installation. Complete the necessary items to eliminate interference with authorized FCC services.

1. Is equipment properly located?
   (See Sections 9-4, 9-5D, 9-5E, 9-6.1, and 9-6.9.)

2. Are ac input power connections properly made?
   (See Sections 9-5B, 9-6.2, and 9-6.3.)

3. Are weld cables and equipment properly installed?
   (See Sections 9-5A, 9-6.4, 9-6.5, and 9-6.6.)

4. Are ground connections properly made?
   (See Sections 9-5C, 9-6.1, 9-6.6, 9-6.11, and 9-6.12.)

5. Is equipment properly set up and adjusted?
   (See Sections 9-6.7 and 9-6.8.)

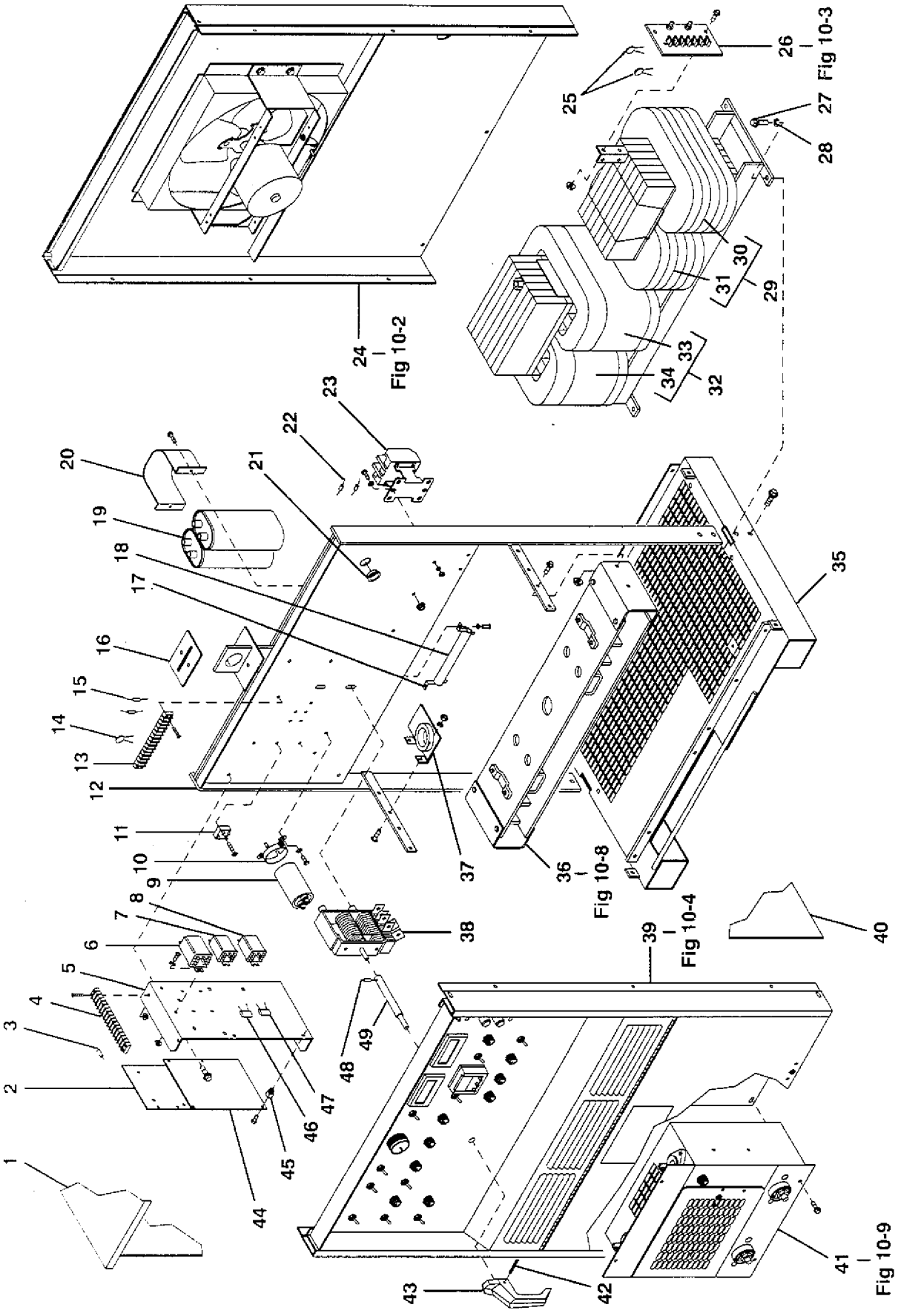


Figure 10-1. Main Assembly

Replace Coils at Factory or Factory Authorized Service Station

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 10-1. Main Assembly	
1		039 244	COVER, top	1
2	PC2	052 790	CIRCUIT CARD, HF & postflow	1
	PLG20	039 347	CONNECTOR, rect 17skt 2 row plug	1
		003 168	CONNECTOR, rect skt 18ga	17
3	R23	030 761	RESISTOR, C 1W 10 ohm	1
4	1T	117 372	BLOCK, term 10A 15P	1
		108 023	LINK, jumper	9
5		088 168	ENCLOSURE, circuit card	1
6	CR1	052 251	RELAY, volt sense 100V DPDT	1
7	CR2	140 772	RELAY, encl 24VAC 4PDT	1
	PLG5	136 924	CONNECTOR, rect rcpt cable	1
		009 418	CONNECTOR, rect skt 24-14ga	2
	PLG6	136 925	CONNECTOR, rect 2P/S plug cable	1
		009 419	CONNECTOR, rect 20-14ga	2
8	CR3	000 174	RELAY, encl 24VAC 3PDT	1
9	C26	031 668	CAPACITOR, elctlt 4000uf 100VDC	1
	R3	117 803	RESISTOR, WW fxd 10W 1K ohm	1
10		108 105	CLAMP, capacitor 2.500dia	1
11	SR2	035 704	RECTIFIER, integ 40A 800V	1
12		088 153	FRAME, upright base	1
13	2T	107 298	BLOCK, term 10A 14P	1
14	C29	122 348	CAPACITOR	1
15	R21,22	122 857	RESISTOR, M oxide 2W 2.7 ohm	2
16		026 627	GASKET, lifting eye	1
17		605 742	CLIP, mtg resistor .500 ID	2
18	R10	115 228	RESISTOR, WW fxd 100W 50 ohm	1
19	C2	♦114 543	CAPACITOR, polyp MF 40uf 480VAC	4
20		♦025 141	BRACKET, mtg capacitor	2
21		030 170	BUSHING, snap-in nyl .750 ID x 1.000mtg hole	1
22		082 456	DIODE, (consisting of)	1
	D2,3	153 434	DIODE, rect 3A 600V	2
23	W	137 902	CONTACTOR, 60A 2P 115V	1
24		Fig 10-2	PANEL, rear w/components	1
25	C1,3	111 634	CAPACITOR ASSEMBLY	1
26		034 587	TERMINAL ASSEMBLY, primary (Fig 10-3)	1
		601 835	NUT, brs hex 10-32	6
27		604 657	SCREW, .375-16 x 1.250 hexhd pln stl	4
28		602 213	WASHER, lock stl split .375	4
29	T1	139 111	TRANSFORMER, main 200/230/460 (consisting of)	1
29	T1	139 113	TRANSFORMER, main 230/460/575 (consisting of)	1
30		139 083	COIL, pri/sec RH 200/230/460	1
30		139 085	COIL, pri/sec RH 230/460/575	1
31		139 082	COIL, pri/sec LH 200/230/460	1
31		139 084	COIL, pri/sec LH 230/460/575	1
	TP1	020 520	THERMOSTAT, NC	1
32	Z1	122 228	REACTOR (consisting of)	1
33		124 671	COIL, RH	1
34		124 670	COIL, LH	1
35		088 169	BASE	1
36	SR1	105 359	RECTIFIER, SCR main (Fig 10-8)	1
37	HD1	125 630	CIRCUIT CARD, hall booster	1
38	S5	133 061	SWITCH, polarity/changeover	1
		010 150	TUBING, stl .500 OD x 17ga wall x 1.000 lg	2
39		Fig 10-4	PANEL, front w/components	1
40		+091 172	PANEL, side	2

Item No.	Dia. Mkgs.	Part No.	Description	Quantity

Figure 10-1. Main Assembly (Continued)

		109 035	LABEL, warning electric shock etc (located on RH side panel)	1
41		137 515	HF CONTROL, (Fig 10-9)	1
42		010 647	PIN, spring CS .156 x 1.250	1
43		098 279	HANDLE, switch	1
44	PC1	148 371	CIRCUIT CARD, main	1
	PLG50	131 052	HOUSING RECEPTACLE & SOCKETS, (consisting of)	1
		113 746	CONNECTOR, rect skt 24-18ga	16
	PLG51	115 092	HOUSING PLUG & SOCKETS, (consisting of) (included w/rectifier)	1
		113 746	CONNECTOR, rect skt 24-18ga	8
	PLG52	131 056	HOUSING RECEPTACLE & SOCKETS, (consisting of)	1
		113 746	CONNECTOR, rect skt 24-18ga	14
	PLG53	115 093	HOUSING PLUG & SOCKETS, (consisting of)	1
		113 746	CONNECTOR, rect skt 24-18ga	6
45		083 147	GROMMET, screw No. 8/10	6
46	SN1	145 835	SNUBBER	1
47	SN2	145 837	SNUBBER	1
48		106 398	PIN, spring CS .156 x .625	1
49		134 631	EXTENSION, handle switch	1

♦Part of 042 397 Optional Power Factor

+When ordering a component originally displaying a precautionary label, the label should also be ordered.

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 10-2. Panel, Rear w/Components (Fig 10-1 Item 24)	
1		131 361	CHAMBER, plenum 14 in	1
2		032 604	BLADE, fan 14 in 3wg 19deg .375 bore CCW	1
3		095 537	PANEL, rear	1
4	R4	115 812	RESISTOR, WW fxd 175W 20 ohm	1
5	FM	116 190	MOTOR, 1/12hp 230V 1550RPM	1

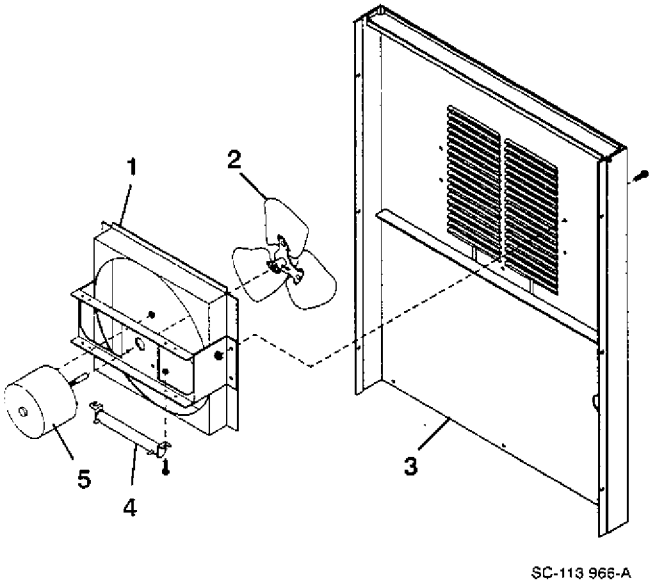


Figure 10-2. Panel, Rear w/Components

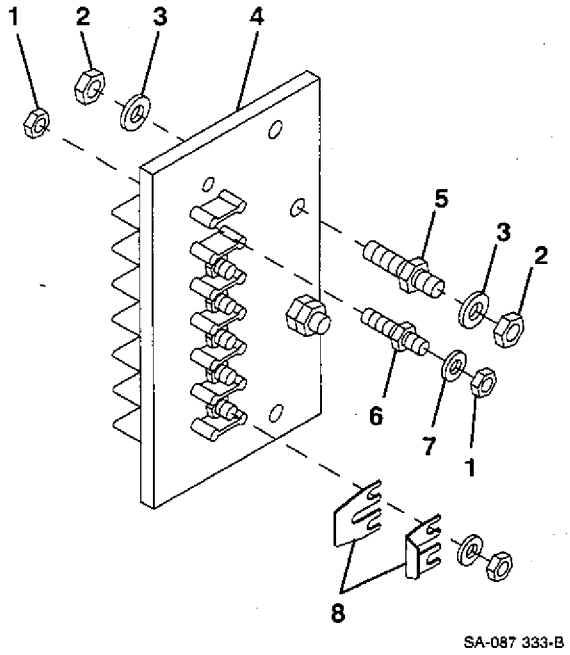


Figure 10-3. Terminal Assembly, Primary

Item No.	Part No.	Description	Quantity
	034 587	**Figure 10-3. Terminal Assembly, Primary (Fig10-1 Item 26)**	
1	601 835	NUT, brs hex 10-32	12
2	601 836	NUT, brs hex .250-20 jam	4
3	010 915	WASHER, flat brs .250 ID x .625 OD x .031thk	4
4	083 426	TERMINAL BOARD, pri	1
5	038 888	STUD, primary bd brs .250-20 x 1.500	2
6	038 887	STUD, primary bd brs 10-32 x 1.375	6
7	010 913	WASHER, flat brs .218 ID x .460 OD x .031thk	6
8	038 618	LINK, jumper term bd pri	2

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity

Figure 10-4. Panel, Front w/Components (Fig 10-1 Item 39)

1			NAMEPLATE, (order by model and serial number)	1
2		097 926	KNOB, pointer	1
3		072 590	LOCK, shaft pot .375-32 x .250dia shaft	1
4	A,V	119 265	METER, digital	2
5	RFC1–4	033 942	CHOKE, RF 250mA 3.8 ohm	4
6	PL1	027 645	LIGHT, ind red lens	1
7		602 222	WASHER, lock stl intl tooth .437	7
8		605 321	NUT, stl hex .468-32	7
9	S6,7,10,11	011 609	SWITCH, tgl SPDT 15A 125V	4
10	R2	028 768	POTENTIOMETER, C sltd sft 1/T 2W 350K ohm	1
11	S3	088 409	SWITCH, tgl 2PDT 15A 125V	1
12	S8	052 769	SWITCH, tgl 4PDT 15A 125V	1

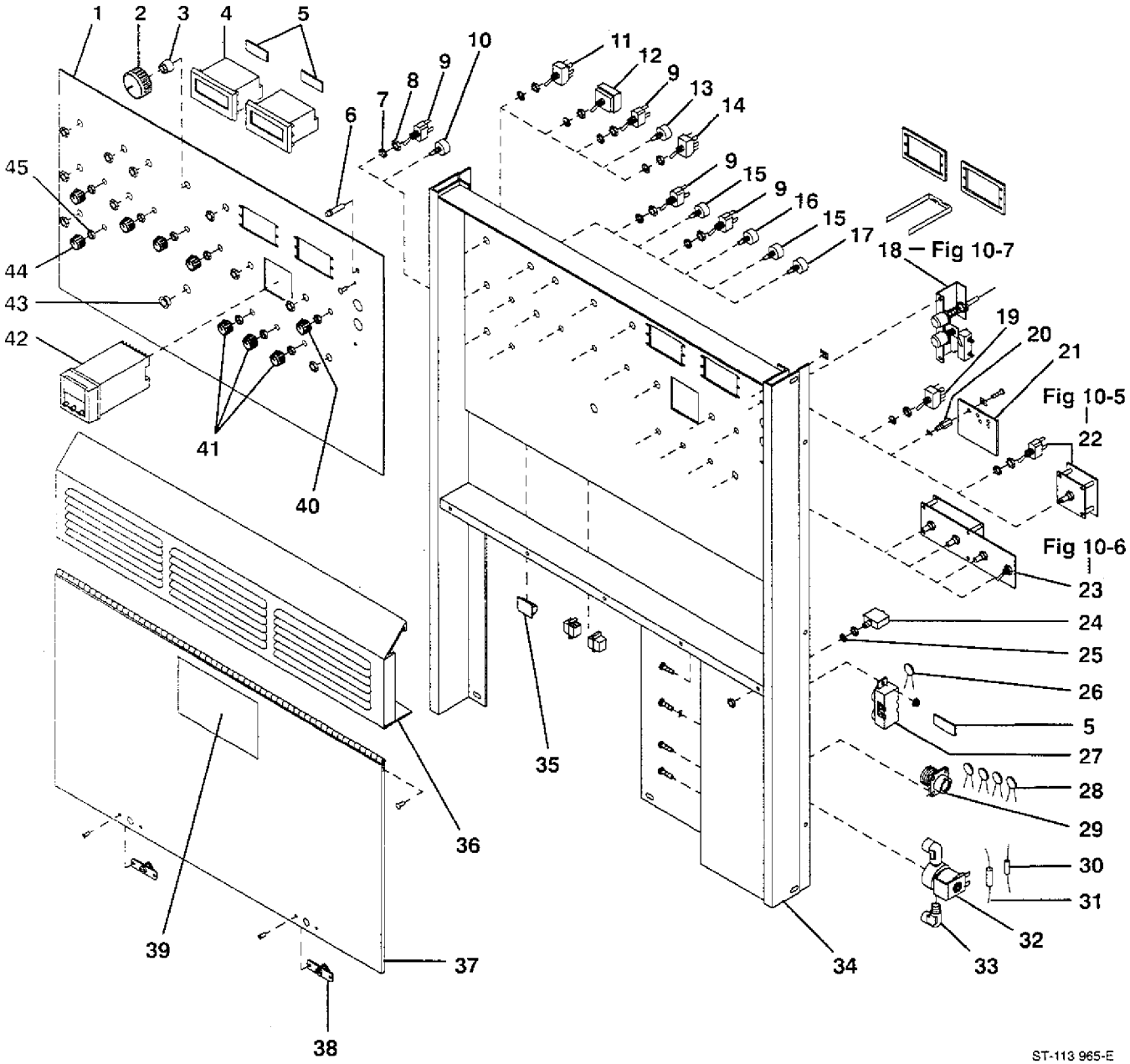


Figure 10-4. Panel, Front w/Components

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 10-4. Panel, Front w/Components (Fig 10-1 Item 39) (Continued)	
13	R1	072 623	POTENTIOMETER, C sltd sft 1/T 2W 1000 ohm	1
14	S2	118 681	SWITCH, tgl DPDT MC 15A 125V	1
15	R13,16	030 109	POTENTIOMETER, C sltd sft 1/T 2W 5000 ohm	2
16	R14	035 897	POTENTIOMETER, C sltd sft 1/T 2W 1000 ohm	1
17	R15	028 769	POTENTIOMETER, C sltd sft 1/T 2W 750K ohm	1
18	PB1	105 572	SWITCH, push button (Fig 10-7)	1
19	S200	♦011 609	SWITCH, tgl SPDT 15A 125V	1
20		♦098 691	STAND-OFF, No. 6-32 x .500	4
21	PC3	♦090 410	CIRCUIT CARD, spot timer	1
	PLG30	♦135 558	HOUSING PLUG & SOCKETS, (consisting of)	1
		079 747	CONNECTOR, rect skt 24-18ga	7
		♦079 747	CONNECTOR, rect skt 24-18ga	7
	PLG7	♦136 925	CONNECTOR, rect 2P/S plug cable	1
		♦009 419	CONNECTOR, rect pin 20-18ga	2
22		♦♦042 016	PREFLOW TIMER (Fig 10-5)	1
23		♦♦042 014	PULSER CONTROL (Fig 10-6)	1
24	CB1	093 995	CIRCUIT BREAKER, man reset 1P 15A 250VAC	1
25		605 339	WASHER, lock stl intl tooth .375	1
26	C4	135 664	CAPACITOR	1
27	RC1	604 176	RECEPTACLE, str dx grd 2P3W 15A 125V	1
		073 690	PLUG, str grd armd 2P 3W 15A 125V P&S 5266 DF	
28	C18	143 903	LEAD ASSEMBLY, elect	1
28	C20	143 902	LEAD ASSEMBLY, elect	1
28	C21	143 901	LEAD ASSEMBLY, elect	1
28	C24	143 904	LEAD ASSEMBLY, elect	1
29	RC2	143 976	RECEPTACLE w/TERMINALS, (consisting of)	1
		079 534	CONNECTOR, circ skt push-in 14-18ga	14
		134 734	CONNECTOR, circ 14 pin plug cable 213571-2 Amp	
		134 731	CONNECTOR, circ pin push-in 14-18ga 213603-1 Amp	
		079 739	CONNECTOR, circ clamp str rlf 206322-2 Amp	
30	C6	028 294	CAPACITOR, ploye MF 1uf 200VDC	1
31	R9	030 761	RESISTOR, C 1W 10 ohm	1
32	GS1	003 538	VALVE, 115VAC 2 way 1/4 IPS port 1/8 orf	1
33		010 296	FITTING, hose brs el M 1/4 NPT x .625-18	2
34		130 169	PANEL, front	1
35		045 852	CLIP, component .687dia mtg adh back	3
36		003 045	PANEL, front louvered	1
37		+088 156	DOOR, access front	1
38		605 583	CATCH, spring loaded door	2
39		134 327	LABEL, warning general precautionary	1
40		**097 922	KNOB, pointer	1
41		++097 922	KNOB, pointer	3
42		♦109 747	TIMER, digital	1
43		109 013	BUSHING, snap-in nyl .375 ID x .562mtg hole	1
44		097 922	KNOB, pointer	5
45		604 645	NUT, stl hex .375-32	5
		107 983	BLANK, snap-in nyl .500mtg hole	3
		119 951	BLANK, snap-in nyl .437mtg hole	4
		070 371	BLANK, snap-in nyl 1.093/1.125mtg hole	2

♦Part of 042 012 Optional Spot Weld Timer

♦♦OPTIONAL

When ordering a component originally displaying a precautionary label, the label should also be ordered.

**Part of 042 016 Optional Preflow Timer

++Part of 042 014 Optional Pulser

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
		042 016	**Figure 10-5. Preflow Timer (Fig 10-4 Item 22)**	
1	S201	011 611	SWITCH, tgl DPDT 15A 125V	1
2		106 625	SPACER, nyl .250 OD x .140 ID x 1.000 lg	4
3	PC4	048 324	CIRCUIT CARD, preflow timer	1
	PLG40	135 558	HOUSING PLUG & SOCKETS, (consisting of)	1
		079 747	. CONNECTOR, rect skt 24-18ga	7
4	R205	005 577	POTENTIOMETER, C sltd sft 1/T 2W 200K ohm	1
5		000 821	STRIP, mtg circuit card	1
		048 104	CONNECTOR, rect 7skt plug cable	1
		079 747	CONNECTOR, rect skt 24-18ga	7

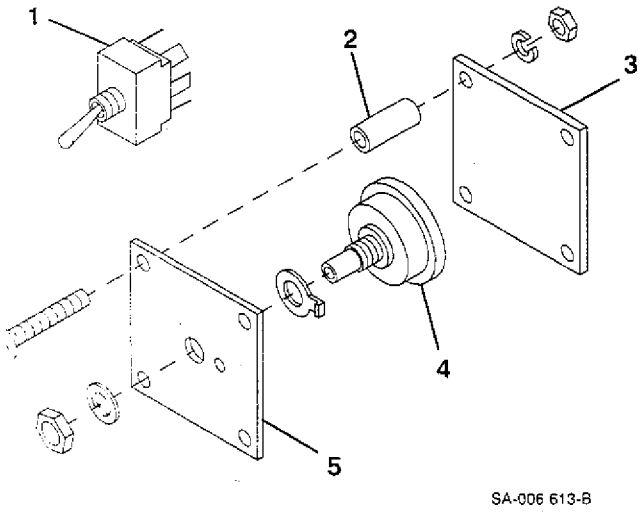


Figure 10-5. Preflow Timer

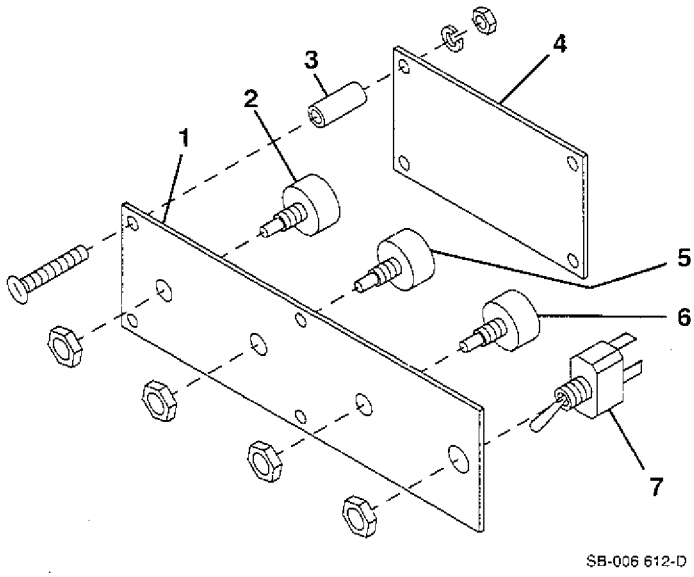


Figure 10-6. Pulser Control

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
		042 014	**Figure 10-6. Pulser Control (Fig 10-4 Item 23)**	
1		003 513	STRIP, mtg controls	1
2	R422	035 897	POTENTIOMETER, C sltd sft 1/T 2W 1000 ohm	1
3		106 625	SPACER, nyl .250 OD x .140 ID 1.000 lg	4
4	PC501	134 141	CIRCUIT CARD, pulser	1
	PLG60	135 558	HOUSING PLUG & SOCKETS, (consisting of)	1
		079 747	. CONNECTOR, rect skt 24-18ga	7
	PLG61	135 560	HOUSING PLUG & SOCKETS, (consisting of)	1
		079 747	. CONNECTOR, rect skt 24-18ga	9
5	R420	004 186	POTENTIOMETER, C sltd sft 1/T 2W 5000 ohm	1
6	R421	030 109	POTENTIOMETER, C sltd sft 1/T 2W 5000 ohm	1
7	S400	011 609	SWITCH, tgl SPDT 10A 125V	1

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
	PB1	**105 572**	**Figure 10-7. Switch, Push Button (Fig 10-4 Item 18)**	
. . . 1		059 885	. . BUTTON, push reset red	1
. . . 2		018 606	. . SPRING, compression	1
. . . 3		090 354	. . PUSH BUTTON, w/cable & housing	1
. . . 4		081 008	. . BRACKET, mtg switch PB	1
. . . 5		027 878	. . SWITCH, limit leaf actuating SPDT	1

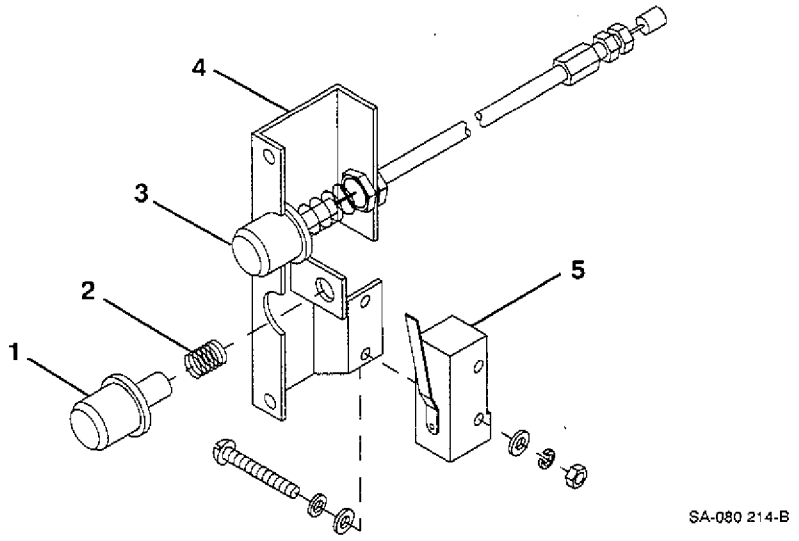


Figure 10-7. Switch, Push Button PB1

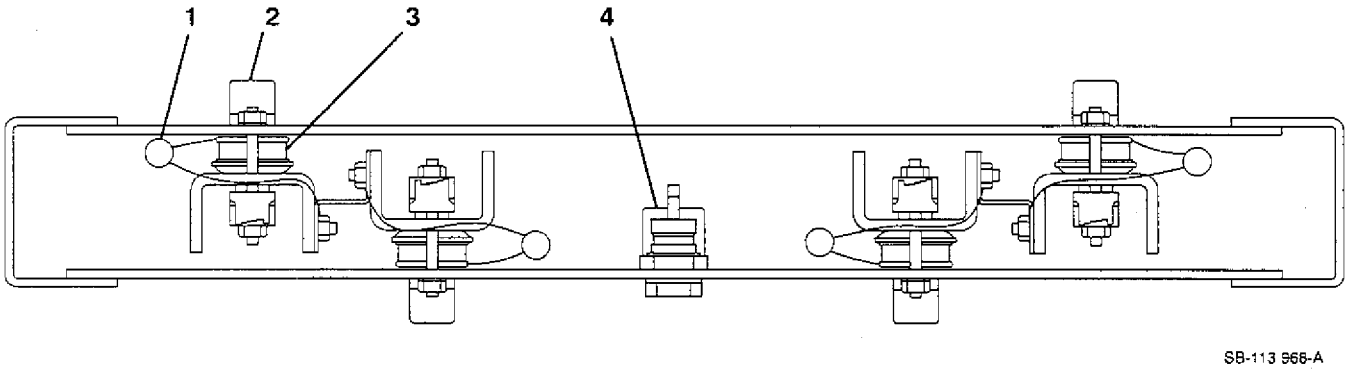


Figure 10-8. Rectifier, SCR Main SR1

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
	SR1	**105 359**	**Figure 10-8. Rectifier, SCR Main (Fig 10-1 Item 36)**	
. . . 1	C7-10	031 689	. . CAPACITOR, rectifier	4
. . . 2		028 388	. . CLAMP, thyristor rectifier 2.750	4
. . . 3	SCR1-4	119 371	. . THYRISTOR, SCR 300A 300V	4
. . . 4	D1	037 956	. . DIODE, rect 275A 300V SP	1

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

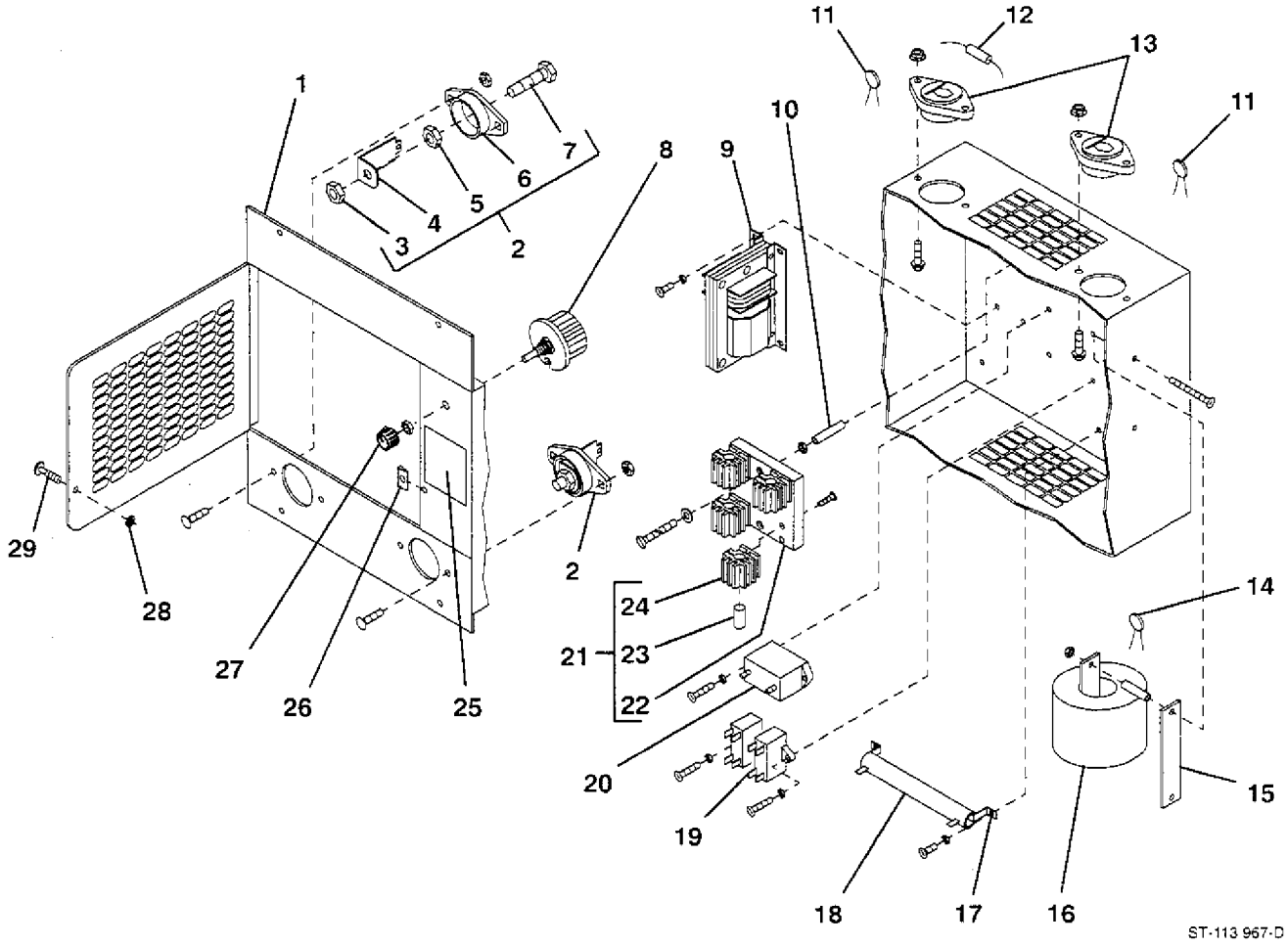


Figure 10-9. HF Control

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
		137 515	**Figure 10-9. HF Control (Fig 10-1 Item 41)**	
1		+127 477	ENCLOSURE, HF	1
2	POS	039 047	TERMINAL, power output red (consisting of)	2
3		601 879	NUT, stl hex full fnsh .500-13	1
4		039 044	BUS BAR, term bd	1
5		601 880	NUT, stl hex jam .500-13	1
6		039 049	TERMINAL BOARD, red	1
7		601 976	SCREW, cap stl hexhd .500-13 x 1.500	1
8	R20	605 828	RHEOSTAT, WW 50W 1.5 ohm	1
9	T3	074 398	TRANSFORMER, HV 115V pri 3600V sec 30mA	1
10		059 874	TUBING, stl .375 OD x .256 ID x 1.625	2
11	C15,16	125 691	CAPACITOR ASSEMBLY	2
12	R25	074 121	RESISTOR, C 2W 3.3K ohm	1
13		039 049	TERMINAL BOARD, red	2
14	C28	**122 235	CAPACITOR	1
15		000 681	STRIP, mtg HF coil	2
16	T2	111 527	COIL, coupling air HF	1
17		605 742	CLIP, mtg resistor .500 ID	2
18	R11	083 784	RESISTOR, WW fxd 100W 10 ohm	1
19	C13	106 935	CAPACITOR, polyp film 10uf 250VAC	2
20	C14	096 761	CAPACITOR, mica .002uf 10000V	1
21		020 623	SPARK GAP ASSEMBLY, (consisting of)	1
22		095 621	BASE, spark gap	1
23	G	*020 603	POINT, spark gap	4
24		020 622	HOLDER, point	4
25		128 230	LABEL, warning electric shock etc	1
26		010 357	NUT, speed No. 2 clip on	1
27		097 922	KNOB, pointer	1
28		010 855	RETAINER, scr No. 2	1
29		010 853	FASTENER, scr sltd hd No. 2	1

+When ordering a component originally displaying a precautionary label, the label should also be ordered.
**Item not included with HF Control.
*Recommended Spare Parts.
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

OPTIONS AND ACCESSORIES

NC RUNNING GEAR
(563)
Three 8 in. (203 mm) rubber–tired wheels with towing handle and rack for two cylinders.

PULSER
(#042 014 Factory)
(#042 015 Field)
For welding of thin materials. Provides heating and cooling effect of the weld puddle.

SPOT WELD TIMER
(#042 012 Factory)
(#042 013 Field)
Provides presettable digital spot weld time from 0.01 seconds to 999 seconds, with a repeat accuracy of ±10 ms at all settings.

PREFLOW TIMER
(#042 016 Factory)
(#042 017 Field)
Provides 0 to 15 seconds of gas preflow time. On/off switch included.

POWER FACTOR CORRECTION
(#042 397) Factory Only

WATER COOLANT SYSTEMS

RADIATOR 1
(#041 398)
1/4 HP, 115 VAC, 50/60 Hz motor. 1.5 gal. (5.7 L) capacity.

RADIATOR 2
(#041 399)
1/4 HP, 230 VAC, 50/60 Hz motor. 1.5 gal. (5.7 L) capacity.

WATERMATE™ 1
(#041 852)
1/4 HP, 115 VAC, 50/60 Hz motor. 1.5 gal. (5.7 L) capacity.

WATERMATE™ 2
(#041 853)
1/4 HP, 230 VAC, 50/60 Hz motor. 1.5 gal. (5.7 L) capacity.

COOLMATE™ 4
(#042 288)
1/4 HP, 115 VAC, 50/60 Hz motor. 4 gal. (15 L) capacity.

MILLER COOLANT
(#128 705)
1 gal. (3.8 L). Contains 35% pure ethylene glycol and 65% deionized water.

REMOTE CONTROLS AND SWITCHES

RHC–14 HAND CONTROL
(#129 340)
Miniature hand control for remote current and contactor control. Dimensions: 4 in. (102 mm) x 4 in. (102 mm) x 3–1/4 in. (82 mm). Includes 20 ft. (6 m) cord and 14–pin Amphenol plug.

RFC–14 FOOT CONTROL
(#129 339)
Foot current and contactor control. 20 ft. (6 m) cord and 14–pin Amphenol plug.

RMLS–14
(#129 337)
Momentary– and maintained–contact rocker switch for contactor control. Push forward for maintained contact and back for momentary contact. Includes 20 ft. (6 m) cord and 14–pin Amphenol plug.

PC–300
(#042 297)
This pulser control can be used with many different welding power source models to provide variable pulsed weld output primarily for the Gas Tungsten Arc Welding – Pulsed Arc (GTAW–P) process. When properly connected to the welding power source, the unit provides contactor control and control of peak amperage, background amperage, percent on time, and pulses per second. The unit also provides remote peak amperage, remote background amperage, and remote contactor control. The unit is equipped with an 8 ft. (2.4 m) interconnecting cord and plug, and an 8 ft. (2.4 m) input power cord and plug.

FTC–14 REMOTE CONTACTOR AND CURRENT CONTROL
(#129 338)
Fastens to TIG torch handle. Includes 28 ft. (8.5 m) cord and plug.

ADAPTER CORD
(#129 341)
1 ft. (305 mm) length with 5–pin Amphenol plug to 14–socket Amphenol receptacle for use between 5–socket receptacle power source and new 14–pin controls.

ADAPTER CORD
(#041 947)
1 ft. (305 mm) length with 14–pin Amphenol plug to 5–socket Amphenol receptacle for use with 5–pin remote controls.

EXTENSION CORDS

For 14–Pin Remote Controls.

10 ft. (3 m)	**(#122 972)**
25 ft. (7.6 m)	**(#122 973)**
50 ft. (15.2 m)	**(#122 974)**
75 ft. (22.9 m)	**(#122 975)**

OPTIONS AND ACCESSORIES

SP12 PROGRAMMER
Electroslope and Pulser
(#042 019 Factory)
(#042 020 Field)
Controls the rate of weld heat input during initial and final modes. Operates on 50 to 60 Hz.

Pulsed current provides controlled penetration, reduced warping, and better control of the weld puddle.

Installation of preflow option is recommended when spot welding.

SP34 PROGRAMMER
Electroslope, Pulser, and Sequencer
(#042 021 Factory)
(#042 022 Field)
Provides weld programming by means of solid–state timers.

Initial current: dwell to time interval from start weld current to beginning of upslope.
Upslope and weld: begins at end of initial current. Times upslope and weld current.
Downslope and final current: starts at end of weld current. Times downslope and final current.

Pulsed current provides controlled penetration, reduced warping, and better control of the weld puddle.

Installation of preflow option is recommended when spot welding.

Dimensions for SP12 and SP

Height	Width	Depth	Weight
8–3/4 in. (222 mm)	31–3/4 in. (806 mm)	10 in. (254 mm)	32 lbs. (15 kg)

DIGITAL TIMERS

The timers used in the SP34 programmer can be easily changed to display in seconds, minutes, or hours (0.01 to 99.9).

- Noise (High Frequency) Immunity
- Dust Tight
- Reliable/Rugged
- Presettable Digital Display