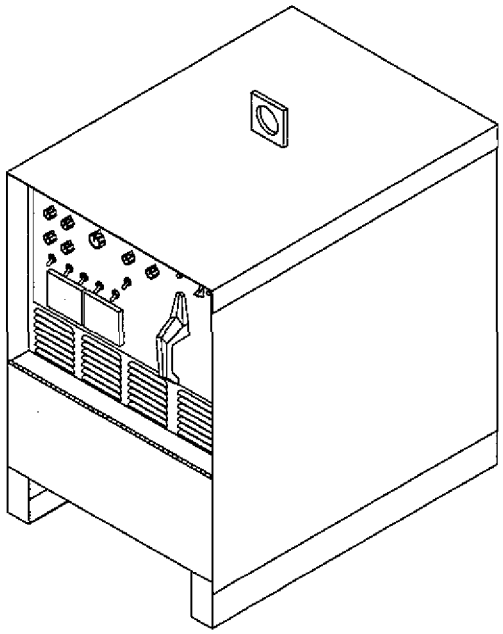
Miller®

September 1996 Form: OM-353P
Effective With Serial No. KG164875

OWNER'S MANUAL



Syncrowave® 250 (60 Hz, 50 Hz - CE)

CC AC/DC Welding Power Source For GTAW and SMAW Welding

Rated Welding Output	PFC**	Amperes Input at AC Balanced Rated Load Output, 50/60 Hz, Single-Phase							KVA	KW	Amperage Range	Max OCV	IP Rating
		200 V	220 V	230 V	380 V	415 V	460 V	575 V					
NEMA Class II (40) – 250 Amperes, 30 Volts AC, 40% Duty Cycle	No PFC	106 (4.6*)		92 (4*)			46 (2*)	37 (1.6*)	21 (0.89*)	11.4 (0.68*)	5 – 310A	80	21S
	With PFC	76		66			33	26	15.2	11.4			
NEMA Class I (60) – 200 Amperes, 28 Volts AC, 60% Duty Cycle	No PFC	85 (4.6*)	70	74 (4*)	58	53	37 (2*)	30 (1.6*)	17 (0.89*)	8.3 (0.68*)			
	With PFC	55 (57*)	64	48 (49*)	37	34	24 (25*)	19 (20*)	11 (11.3*)	8.3 (0.61*)			

*While idling
**Power Factor Correction

MILLER'S TRUE BLUE® LIMITED WARRANTY

Effective February 7, 1996
(Equipment with a serial number preface of "KD" 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, or one year after the equipment is sent to a North American distributor or eighteen months after the equipment is sent to an International distributor.

1. 5 Years Parts – 3 Years Labor
   * Original main power rectifiers
   * Inverters (input and output rectifiers only)
2. 3 Years — Parts and Labor
   * Transformer/Rectifier Power Sources
   * Plasma Arc Cutting Power Sources
   * Semi-Automatic and Automatic Wire Feeders
   * Inverter Power Supplies
   * Intellitig
   * Robots (1 year labor)
3. 2 Years — Parts and Labor
   * Engine Driven Welding Generators
     (NOTE: Engines are warranted separately by the engine manufacturer.)
   * Air Compressors
4. 1 Year — Parts and Labor
   * Motor Driven Guns
   * Process Controllers
   * IHPS Power Sources
   * Water Coolant Systems
   * HF Units
   * Grids
   * Spot Welders
   * Load Banks
   * SDX Transformers
   * Miller Cyclomatic Equipment
   * Running Gear/Trailers
   * Plasma Cutting Torches (except APT, ZIPCUT & PLAZCUT Models)
   * Tecumseh Engines
   * Deutz Engines (outside North America)
   * 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
   * APT, ZIPCUT & PLAZCUT Model 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 or parts that fail due to normal wear.
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.

WHO DO I CONTACT?

For help,
- contact your distributor

For additional information, such as

Technical Manuals (Service And Parts)
Engine Manuals
Circuit And Wiring Diagrams
Process Handbooks
User's Guides
Distributor Directories

- contact your distributor

To file a claim for loss or damage during shipment,
- contact the delivering carrier

For assistance in filing or settling claims,
- contact your distributor and/or equipment manufacturer's Transportation Department

Miller Electric Mfg. Co.

- CALL:
  414-735-4505

- FAX:
  800-637-2348 (in USA), or
  414-735-4136 (outside USA)

- WRITE:
  Miller Electric Mfg. Co.
  P.O. Box 1079
  Appleton, WI 54912 USA

Always provide Model Name and Serial or Style Number

Declaration of Conformity For European Community (CE) Products

NOTE ☞	*This information is provided for units with CE certification (see rating label on unit.)*

Manufacturer's Name: Miller Electric Mfg. Co.

Manufacturer's Address: 1635 W. Spencer Street
Appleton, WI 54914 USA

Declares that the product: **Syncrowave® 250**

conforms to the following Directives and Standards:

Directives

Low Voltage Directive: 73/23/EEC

Machinery Directives: 89/392/EEC, 91/368/EEC, 93/C 133/04, 93/68/EEC

Electromagnetic Capability Directives: 89/336, 92/31/EEC

Standards

Safety Requirements for Arc Welding Equipment part 1: EN 60974-1: 1990

Arc Welding Equipment Part 1: Welding Power Sources: IEC 974-1
(April 1995 – Draft revision)

Degrees of Protection provided by Enclosures (IP code): IEC 529: 1989

Insulation coordination for equipment within low-voltage systems:
Part 1: Principles, requirements and tests: IEC 664-1: 1992

Electromagnetic compatibility (EMC) Product standard for arc welding equipment:
EN50199: August 1995

European Contact: Mr. Luigi Vacchini, Managing Director
MILLER Europe S.P.A.
Via Privata Iseo
20098 San Giuliano
Milanese, Italy

Telephone: 39(02)98290-1
Fax: 39(02)98281-552

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SECTION 1 – SAFETY PRECAUTIONS FOR ARC WELDING

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1-1. Symbol Usage

Means Warning! Watch Out! There are possible hazards with this procedure! The possible hazards are shown in the adjoining symbols.

▲ **Marks a special safety message.**

☞ *Means NOTE; not safety related.*

This group of symbols means Warning! Watch Out! possible ELECTRIC SHOCK, MOVING PARTS, and HOT PARTS hazards. Consult symbols and related instructions below for necessary actions to avoid the hazards.

1-2. Arc Welding Hazards

⚠ WARNING

The symbols shown below are used throughout this manual to call attention to and identify possible hazards. When you see the symbol, watch out, and follow the related instructions to avoid the hazard. The safety information given below is only a summary of the more complete safety information found in the Safety Standards listed in Section 1-4. Read and follow all Safety Standards.

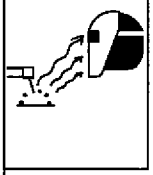
Only qualified persons should install, operate, maintain, and repair this unit.

During operation, keep everybody, especially children, away.

ELECTRIC SHOCK can kill.

Touching live electrical parts can cause fatal shocks or severe burns. The electrode and work circuit is electrically live whenever the output is on. The input power circuit and machine internal circuits are also live when power is on. In semiautomatic or automatic wire welding, the wire, wire reel, drive roll housing, and all metal parts touching the welding wire are electrically live. Incorrectly installed or improperly grounded equipment is a hazard.

1. Do not touch live electrical parts.
2. Wear dry, hole-free insulating gloves and body protection.
3. Insulate yourself from work and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground.
4. Disconnect input power or stop engine before installing or servicing this equipment. Lockout/tagout input power according to OSHA 29 CFR 1910.147 (see Safety Standards).
5. Properly install and ground this equipment according to its Owner's Manual and national, state, and local codes.
6. Always verify the supply ground – check and be sure that input power cord ground wire is properly connected to ground terminal in disconnect box or that cord plug is connected to a properly grounded receptacle outlet.
7. When making input connections, attach proper grounding conductor first – double-check connections.
8. Frequently inspect input power cord for damage or bare wiring – replace cord immediately if damaged – bare wiring can kill.
9. Turn off all equipment when not in use.
10. Do not use worn, damaged, undersized, or poorly spliced cables.
11. Do not drape cables over your body.
12. If earth grounding of the workpiece is required, ground it directly with a separate cable – do not use work clamp or work cable.
13. Do not touch electrode if you are in contact with the work, ground, or another electrode from a different machine.
14. Use only well-maintained equipment. Repair or replace damaged parts at once. Maintain unit according to manual.
15. Wear a safety harness if working above floor level.
16. Keep all panels and covers securely in place.
17. Clamp work cable with good metal-to-metal contact to workpiece or worktable as near the weld as practical.



ARC RAYS can burn eyes and skin; NOISE can damage hearing; FLYING SLAG OR SPARKS can injure eyes.

Arc rays from the welding process produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin. Noise from some processes can damage hearing. Chipping, grinding, and welds cooling throw off pieces of metal or slag.

NOISE

1. Use approved ear plugs or ear muffs if noise level is high.

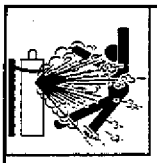
ARC RAYS

2. Wear a welding helmet fitted with a proper shade of filter to protect your face and eyes when welding or watching (see ANSI Z49.1 and Z87.1 listed in Safety Standards).
3. Wear approved safety glasses with side shields.
4. Use protective screens or barriers to protect others from flash and glare; warn others not to watch the arc.
5. Wear protective clothing made from durable, flame-resistant material (wool and leather) and foot protection.

FUMES AND GASES can be hazardous to your health.

Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health.

1. Keep your head out of the fumes. Do not breathe the fumes.
2. If inside, ventilate the area and/or use exhaust at the arc to remove welding fumes and gases.
3. If ventilation is poor, use an approved air-supplied respirator.
4. Read the Material Safety Data Sheets (MSDSs) and the manufacturer's instruction for metals, consumables, coatings, cleaners, and degreasers.
5. Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Always have a trained watchperson nearby. Welding fumes and gases can displace air and lower the oxygen level causing injury or death. Be sure the breathing air is safe.
6. Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the arc can react with vapors to form highly toxic and irritating gases.
7. Do not weld on coated metals, such as galvanized, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and if necessary, while wearing an air-supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.



CYLINDERS can explode if damaged.

Shielding gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are normally part of the welding process, be sure to treat them carefully.

1. Protect compressed gas cylinders from excessive heat, mechanical shocks, slag, open flames, sparks, and arcs.
2. Install cylinders in an upright position by securing to a stationary support or cylinder rack to prevent falling or tipping.
3. Keep cylinders away from any welding or other electrical circuits.
4. Never drape a welding torch over a gas cylinder.
5. Never allow a welding electrode to touch any cylinder.
6. Never weld on a pressurized cylinder – explosion will result.
7. Use only correct shielding gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition.
8. Turn face away from valve outlet when opening cylinder valve.
9. Keep protective cap in place over valve except when cylinder is in use or connected for use.
10. Read and follow instructions on compressed gas cylinders, associated equipment, and CGA publication P-1 listed in Safety Standards.

WELDING can cause fire or explosion.

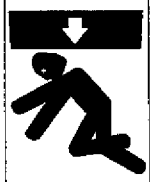
Welding on closed containers, such as tanks, drums, or pipes, can cause them to blow up. Sparks can fly off from the welding arc. The flying sparks, hot workpiece, and hot equipment can cause fires and burns. Accidental contact of electrode to metal objects can cause sparks, explosion, overheating, or fire. Check and be sure the area is safe before doing any welding.

1. Protect yourself and others from flying sparks and hot metal.
2. Do not weld where flying sparks can strike flammable material.
3. Remove all flammables within 35 ft (10.7 m) of the welding arc. If this is not possible, tightly cover them with approved covers.
4. Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
5. Watch for fire, and keep a fire extinguisher nearby.
6. Be aware that welding on a ceiling, floor, bulkhead, or partition can cause fire on the hidden side.
7. Do not weld on closed containers such as tanks, drums, or pipes, unless they are properly prepared according to AWS F4.1 (see Safety Standards).
8. Connect work cable to the work as close to the welding area as practical to prevent welding current from traveling long, possibly unknown paths and causing electric shock and fire hazards.
9. Do not use welder to thaw frozen pipes.
10. Remove stick electrode from holder or cut off welding wire at contact tip when not in use.
11. Wear oil-free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes, and a cap.
12. Remove any combustibles, such as a butane lighter or matches, from your person before doing any welding.

1-3. Additional Installation, Operation, And Maintenance Hazards

FIRE OR EXPLOSION can result from placing unit on, over, or near combustible surfaces.

1. Do not locate unit on, over, or near combustible surfaces.
2. Do not install unit near flammables.



FALLING EQUIPMENT can cause serious personal injury and equipment damage.

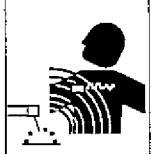
1. Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other accessories.
2. Use equipment of adequate capacity to lift unit.
3. If using lift forks to move unit, be sure forks are long enough to extend beyond opposite side of unit.

HOT PARTS can cause severe burns.

1. Do not touch hot parts bare handed.
2. Allow cooling period before working on gun or torch.

MOVING PARTS can cause injury.

1. Keep away from moving parts such as fans.
2. Keep all doors, panels, covers, and guards closed and securely in place.



MAGNETIC FIELDS FROM HIGH CURRENTS can affect pacemaker operation.

1. Pacemaker wearers keep away.
2. Wearers should consult their doctor before going near arc welding, gouging, or spot welding operations.

MOVING PARTS can cause injury.

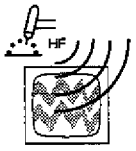
1. Keep away from moving parts.
2. Keep away from pinch points such as drive rolls.

FLYING PIECES OF METAL or DIRT can injure eyes.

1. Wear safety glasses with side shields or face shield.

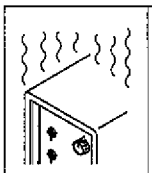
WELDING WIRE can cause puncture wounds.

1. Do not press gun trigger until instructed to do so.
2. Do not point gun toward any part of the body, other people, or any metal when threading welding wire.



HIGH-FREQUENCY RADIATION can interfere with radio navigation, safety services, computers, and communications equipment.

1. Have only qualified persons familiar with electronic equipment perform this installation.
2. The user is responsible for having a qualified electrician promptly correct any interference problem resulting from the installation.
3. If notified by the FCC about interference, stop using the equipment at once.
4. Have the installation regularly checked and maintained.
5. Keep high-frequency source doors and panels tightly shut, keep spark gaps at correct setting, and use grounding and shielding to minimize the possibility of interference.

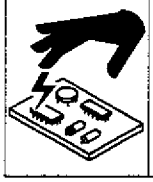


OVERUSE can cause OVERHEATED EQUIPMENT.

1. Allow cooling period.
2. Reduce current or reduce duty cycle before starting to weld again.
3. Follow rated duty cycle.

SIGNIFICANT DC VOLTAGE exists after removal of input power on inverters.

1. Turn Off inverter, disconnect input power, and discharge input capacitors according to instructions in Maintenance Section before touching any parts.



STATIC ELECTRICITY can damage parts on circuit boards.

1. Put on grounded wrist strap BEFORE handling boards or parts.
2. Use proper static-proof bags and boxes to store, move, or ship PC boards.

BUILDUP OF SHIELDING GAS can harm health or kill.

1. Shut off shielding gas supply when not in use.

1-4. Principal Safety Standards

Safety in Welding and Cutting, ANSI Standard Z49.1, from American Welding Society, 550 N.W. LeJeune Rd, Miami FL 33126

Safety and Health Standards, OSHA 29 CFR 1910, from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, American Welding Society Standard AWS F4.1, from American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, from Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Code for Safety in Welding and Cutting, CSA Standard W117.2, from Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

Safe Practices For Occupation And Educational Eye And Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting And Welding Processes, NFPA Standard 51B, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

1-5. EMF Information

Considerations About Welding And The Effects Of Low Frequency Electric And Magnetic Fields

The following is a quotation from the General Conclusions Section of the U.S. Congress, Office of Technology Assessment, *Biological Effects of Power Frequency Electric & Magnetic Fields – Background Paper*, OTA-BP-E-53 (Washington, DC: U.S. Government Printing Office, May 1989): ". . . there is now a very large volume of scientific findings based on experiments at the cellular level and from studies with animals and people which clearly establish that low frequency magnetic fields can interact with, and produce changes in, biological systems. While most of this work is of very high quality, the results are complex. Current scientific understanding does not yet allow us to interpret the evidence in a single coherent framework. Even more frustrating, it does not yet allow us to draw definite conclusions about questions of possible risk or to offer clear science-based advice on strategies to minimize or avoid potential risks."

To reduce magnetic fields in the workplace, use the following procedures:

1. Keep cables close together by twisting or taping them.
2. Arrange cables to one side and away from the operator.
3. Do not coil or drape cables around the body.
4. Keep welding power source and cables as far away as practical.
5. Connect work clamp to workpiece as close to the weld as possible.

About Pacemakers:

The above procedures are also recommended for pacemaker wearers. Consult your doctor for complete information.

SECTION 1 – CONSIGNES DE SÉCURITÉ POUR LE SOUDAGE À L'ARC

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1-1. Signification des symboles

Signifie Mise en garde! Attention! Ce mode opératoire peut présenter des dangers! Les dangers possibles sont indiqués par les divers symboles.

▲ **Indique un message de sécurité spécial.**

☞ *Signifie NOTA; pas lié à la sécurité*

Ce groupe de symboles signifie Mise en garde! Attention!, risque de CHOCS ÉLECTRIQUES, dangers présentés par les PIÈCES MOBILES et les PIÈCES CHAUDES. Voir les symboles et les consignes associées ci-après pour prendre les mesures nécessaires afin de se prémunir contre les dangers.

1-2. Dangers du soudage à l'arc

⚠ MISE EN GARDE

Les symboles donnés ci-après sont utilisés dans tout le manuel pour attirer l'attention sur les dangers possibles et pour indiquer le type de danger dont il s'agit. Quand on voit le symbole, prendre garde et suivre les directives correspondantes pour éviter le danger. Les consignes de sécurité données ci-après ne font que résumer l'information contenue dans les normes de sécurité énumérées à la section 1-4. Lire et respecter toutes ces normes de sécurité.

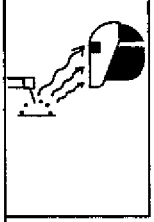
L'installation, l'utilisation, l'entretien et les réparations ne doivent être confiés qu'à des personnes qualifiées.

Aucune personne, et particulièrement les enfants, ne doit se trouver à proximité du poste de soudage.

UN CHOC ÉLECTRIQUE peut tuer.

Un simple contact avec des pièces électriques peut provoquer une électrocution ou des blessures graves. L'électrode et le circuit de soudage sont sous tension dès que l'appareil est sur ON. Le circuit d'entrée et les circuits internes de l'appareil sont également sous tension à ce moment-là. En soudage semi-automatique ou automatique, le fil, le dévidoir, le logement des galets d'entraînement et les pièces métalliques en contact avec le fil de soudage sont sous tension. Des matériels mal installés ou mal mis à la terre présentent un danger.

1. Ne jamais toucher les pièces électriques sous tension.
2. Porter des gants et des vêtements de protection secs ne comportant pas de trous.
3. S'isoler de la pièce et de la terre au moyen de tapis ou d'autres moyens isolants suffisamment grands pour empêcher le contact physique éventuel avec la pièce ou la terre.
4. Couper l'alimentation ou arrêter le moteur avant de procéder à l'installation, à la réparation ou à l'entretien de l'appareil. Déverrouiller l'alimentation selon la norme OSHA 29 CFR 1910.147 (voir normes de sécurité).
5. Installer et mettre à la terre correctement cet appareil conformément à son manuel d'utilisation et au codes nationaux, provinciaux et municipaux.
6. Toujours vérifier la terre du cordon d'alimentation – Vérifier et s'assurer que le fil de terre du cordon d'alimentation est bien raccordé à la borne de terre du sectionneur ou que la fiche du cordon est raccordée à une prise correctement mise à la terre.
7. En effectuant les raccordements d'entrée fixer d'abord le conducteur de mise à la terre approprié et contre-vérifier les connexions.
8. Vérifier fréquemment le cordon d'alimentation pour voir s'il n'est pas endommagé ou dénudé – remplacer le cordon immédiatement s'il est endommagé – un câble dénudé peut provoquer une électrocution.
9. Mettre l'appareil hors tension quand on ne l'utilise pas.
10. Ne pas utiliser des câbles usés, endommagés, de grosseur insuffisante ou mal épissés.
11. Ne pas enrouler les câbles autour du corps.
12. Si la pièce soudée doit être mise à la terre, le faire directement avec un câble distinct – ne pas utiliser le connecteur de pièce ou le câble de retour.
13. Ne pas toucher l'électrode quand on est en contact avec la pièce, la terre ou une électrode provenant d'une autre machine.
14. N'utiliser qu'un matériel en bon état. Réparer ou remplacer sur-le-champ les pièces endommagées. Entretenir l'appareil conformément à ce manuel.
15. Porter un harnais de sécurité quand on travaille en hauteur.
16. Maintenir solidement en place tous les panneaux et capots.
17. Fixer le câble de retour de façon à obtenir un bon contact métal-métal avec la pièce à souder ou la table de travail, le plus près possible de la soudure.



LE RAYONNEMENT DE L'ARC peut brûler les yeux et la peau. Le BRUIT peut endommager l'ouïe; les PROJECTIONS DE LAITIER OU LES ÉTINCELLES peuvent blesser les yeux.

L'arc de soudage produit des rayons visibles et invisibles intenses (ultraviolets et infrarouges) qui peuvent brûler les yeux et la peau. Le bruit produit par certains procédés peut endommager l'ouïe. Des projections de métal ou de laitier sont produites par le piquage, le meulage ou le refroidissement des soudures.

BRUIT

1. Utiliser des bouche-oreilles ou des serre-tête antibruit approuvés si le niveau de bruit est élevé.

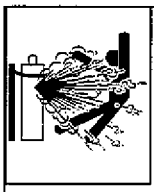
RAYONNEMENT DE L'ARC

2. Porter un masque à serre-tête muni d'un verre filtrant de nuance appropriée pour protéger le visage et les yeux quand on soude ou observe le travail de soudage (voir les normes ANSI Z49.1 et Z87.1 données sous la rubrique Principales normes de sécurité).
3. Porter des lunettes de sécurité approuvées avec écrans latéraux.
4. Utiliser des paravents ou des barrières de protection pour protéger les personnes à proximité contre les coups d'arc et l'éblouissement; avertir les autres personnes de ne pas regarder l'arc.
5. Porter des vêtements de protection en tissu ignifuge durable (laine et cuir) et des chaussures de sécurité.

LES VAPEURS ET LES FUMÉES peuvent être dangereuses pour la santé.

Le soudage produit des vapeurs et des fumées qu'il est dangereux de respirer.

1. Garder la tête à l'extérieur des vapeurs et des fumées et ne pas les respirer.
2. À l'intérieur, ventiler le poste de travail ou utiliser un dispositif placé au niveau de l'arc pour évacuer les vapeurs et fumées de soudage.
3. Si la ventilation est mauvaise, utiliser un appareil respiratoire à adduction d'air pur approuvé.
4. Consulter les fiches signalétiques et les consignes du fabricant relatives au métaux, produits d'apport, revêtements, nettoyants et dégraissants.
5. Ne travailler dans un espace confiné que s'il est bien ventilé, ou en portant un appareil respiratoire à adduction d'air pur. Demander à un observateur ayant reçu la bonne formation de toujours se tenir à proximité. Les vapeurs et fumées de soudage peuvent déplacer l'air et abaisser le niveau d'oxygène et causer des blessures graves voire mortelles. S'assurer que l'air est propre à la respiration.
6. Ne pas souder à proximité d'opérations de dégraissage, de nettoyage ou de pulvérisation. La chaleur et les rayons de l'arc peuvent réagir avec les vapeurs pour former des gaz hautement toxiques et irritants.
7. Ne pas souder sur des métaux revêtus comme l'acier galvanisé, au plomb ou cadmié à moins que la pièce n'ait été entièrement décapée, que le poste de travail soit bien ventilé. S'il y a lieu, porter un appareil respiratoire à adduction d'air pur. Les revêtements et les métaux qui contiennent de tels éléments peuvent dégager des vapeurs toxiques lors du soudage.



LES BOUTEILLES peuvent exploser si elles sont endommagées.

Les bouteilles contenant des gaz de protection sont à haute pression. Une bouteille endommagée peut exploser. Étant donné que les bouteilles de gaz font normalement partie du matériel de soudage, les traiter avec le plus grand soin.

1. Protéger les bouteilles de gaz comprimé contre la chaleur intense, les chocs, le laitier, les flammes nues, les étincelles et l'arc.
2. Placer les bouteilles à la verticale en les fixant à un support fixe ou à un chariot pour éviter qu'elles ne tombent ou ne basculent.
3. Tenir les bouteilles à l'écart du poste de soudage ou d'autres circuits électriques.
4. Ne jamais poser un chalumeau soudeur sur une bouteille de gaz.
5. Ne jamais laisser une électrode de soudage toucher une bouteille.
6. Ne jamais souder sur une bouteille sous pression : elle exploserait.
7. N'utiliser que des bouteilles de gaz de protection, des détendeurs, des tuyaux souples et des raccords appropriés conçus pour l'application particulière; conserver ces matériels et leurs pièces en bon état.
8. Éloigner le visage de la sortie du robinet de la bouteille quand on l'ouvre.
9. Replacer le chapeau sur la bouteille après utilisation.
10. Lire et suivre les consignes relatives aux bouteilles de gaz comprimé, au matériel connexe ainsi que la publication P-1 de la CGA donnée sous la rubrique Principales normes de sécurité.

LE SOUDAGE peut causer un incendie ou une explosion.

Ne pas souder sur des récipients fermés comme des réservoirs, des fûts ou des tuyaux : ils peuvent exploser. L'arc de soudage peut produire des étincelles. Des étincelles, une pièce chaude et un matériel chaud peuvent provoquer des incendies et des blessures. Le contact accidentel de l'électrode sur des objets métalliques peut produire des étincelles, l'explosion, la surchauffe ou un incendie. S'assurer que le lieu ne présente pas de danger avant d'effectuer le soudage.

1. Se protéger et protéger les personnes à proximité des étincelles et du métal chaud.
2. Ne pas souder dans un endroit où les étincelles peuvent atteindre des matériaux inflammables.
3. Enlever toutes les matières inflammables dans un rayon de moins de 10 m de l'arc. Si cela n'est pas possible, bien les recouvrir en utilisant des bâches approuvées.
4. Prendre garde que les étincelles et les projections ne pénétrent dans des zones adjacentes en s'infiltrant dans des petites fissures et ouvertures.
5. Prendre garde aux incendies et toujours avoir un extincteur à proximité.
6. Se rappeler que si l'on soude sur un plafond, un plancher, une cloison ou autre, le feu peut prendre de l'autre côté.
7. Ne pas souder sur des récipients fermés comme des réservoirs, des fûts ou des tuyaux à moins qu'ils ne soient préparés de façon appropriée conformément à la norme F4.1 de l'AWS (voir la rubrique Principales normes de sécurité).
8. Raccorder le câble de retour à la pièce, le plus près possible de la zone de soudage, pour empêcher que le courant de soudage ne suive une trajectoire longue et éventuellement inconnue et qu'il ne provoque des risques d'électrocution et d'incendie.
9. Ne pas utiliser le chalumeau soudeur pour dégeler des tuyaux.
10. Enlever l'électrode enrobée du porte-électrode ou couper le fil de soudage au ras du bec contact quand on ne l'utilise pas.
11. Porter des vêtements de protection non huileux comme des gants en cuir, une chemise épaisse, des pantalons sans revers, des chaussures montantes et un casque.
12. Ne pas porter des matières combustibles sur soi comme un briquet à gaz ou des allumettes quand on soude.

1-3. Autres dangers relatifs à l'installation, l'utilisation et l'entretien

UN INCENDIE OU UNE EXPLOSION peut être causé par un appareil placé au contact, au-dessus ou à côté de surfaces combustibles.

1. Ne pas placer l'appareil au contact, au-dessus, ou à côté d'une surface combustible.
2. Ne pas installer l'appareil à côté d'un objet ou d'un produit inflammable.

EN TOMBANT, LE MATÉRIEL peut s'endommager ou causer des blessures graves.

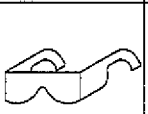
1. N'utiliser l'anneau de levage que pour soulever l'appareil; NE PAS l'utiliser pour soulever les chariots, les bouteilles de gaz ou autres accessoires.
2. Pour soulever la source de courant, utiliser des appareils de puissance suffisante.
3. Si l'on utilise un élévateur à fourche pour déplacer l'appareil, s'assurer que la fourche est suffisamment longue et dépasse de l'autre côté de l'appareil.

LES PIÈCES CHAUDES peuvent provoquer des brûlures graves.

1. Ne pas toucher les pièces chaudes les mains nues.
2. Laisser une période de refroidissement avant de toucher le pistolet ou la torche.

LES PIÈCES MOBILES peuvent causer des blessures.

1. Se tenir à l'écart des pièces en mouvement comme les ventilateurs.
2. S'assurer que tous les capots, panneaux, portes et protecteurs sont bien fermés et fermement maintenus.



LES ÉCLATS DE MÉTAL ou LES SALETÉS peuvent provoquer des lésions aux yeux.

1. Porter des lunettes de sécurité avec écrans latéraux ou écran facial.

LES CHAMPS MAGNÉTIQUES PRODUITS PAR LES COURANTS ÉLEVÉS peuvent nuire au fonctionnement du stimulateur cardiaque

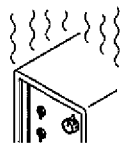
1. Les personnes qui portent un stimulateur cardiaque doivent se tenir éloignées du poste de soudage.
2. Les personnes qui portent un stimulateur cardiaque devraient consulter leur médecin avant de s'approcher d'un poste de soudage ou de gougeage à l'arc ou de soudage par points.

LES PIÈCES MOBILES peuvent provoquer des blessures.

1. Se tenir à l'écart des pièces mobiles.
2. Se tenir à l'écart des points de pincement, ex. : galets d'entraînement.

LE FIL DE SOUDAGE peut percer la peau.

1. Attendre les instructions avant d'appuyer sur la gâchette.
2. Ne pas pointer le pistolet sur une partie du corps, sur d'autres personnes, ou sur une pièce métallique lorsqu'on enfile le fil de soudage.

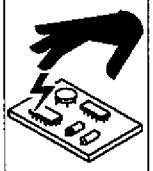


UNE UTILISATION EXCESSIVE peut se traduire par une SURCHAUFFE DU MATÉRIEL.

1. Laisser une période de refroidissement.
2. Réduire le courant ou le facteur de marche avant de recommencer à souder.
3. Utiliser le facteur de marche nominal.

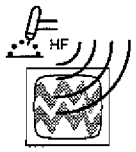
L'ACCUMULATION DE GAZ DE PROTECTION peut être nuisible à la santé voire mortel.

1. Quand on n'utilise pas le gaz de protection, fermer le robinet de la bouteille.



L'ÉLECTRICITÉ STATIQUE peut endommager les pièces des circuits imprimés.

1. Mettre un bracelet antistatique AVANT de manipuler les cartes de circuits imprimés ou les pièces.
2. Utiliser des sacs et boîtes antistatiques adéquats pour ranger, déplacer ou expédier les cartes de circuits imprimés.



LA HAUTE FRÉQUENCE peut créer des interférences dans les systèmes de radionavigation, les services de sécurité, les ordinateurs et le matériel de télécommunications.

1. Ne confier cette installation qu'à un personnel qualifié et connaissant bien l'équipement électronique.
2. L'utilisateur a la responsabilité de faire corriger rapidement par un électricien qualifié les problèmes d'intrférences résultant de l'installation.
3. Dans le cas d'un avertissement d'interférence donné par le Conseil fédéral des communications, arrêter d'utiliser immédiatement l'équipement.
4. Faire vérifier et entretenir régulièrement l'installation.
5. Tenir les portes et panneaux de la source de haute fréquence bien fermés, maintenir les éclateurs au bon réglage et utiliser une mise à la terre et un écran de protection afin de réduire au minimum la possibilité d'interférences.

UNE TENSION C.C. IMPORTANTE est présente sur les onduleurs après que l'on ait coupé l'alimentation.

1. Avant de toucher les pièces, mettre l'onduleur hors tension, couper l'alimentation et décharger les condensateurs d'entrée conformément aux directives de la section Entretien.

1-4. Principales normes de sécurité

Safety in Welding and Cutting, norme ANSI Z49.1, de l'American Welding Society, 550 N.W. Lejeune Rd, Miami FL 33126

Safety and Health Sandards, OSHA 29 CFR 1910, du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practice for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, norme AWS F4.1, de l'American Welding Society, 550 N.W. Lejeune Rd, Miami FL 33126

National Electrical Code, NFPA Standard 70, de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, de la Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Règles de sécurité en soudage, coupage et procédés connexes, norme CSA W117.2, de l'Association canadienne de normalisation, vente de normes, 178 Rexdale Boulevard, Rexdale (Ontario) Canada M9W 1R3.

Safe Practices For Occupation And Educational Eye And Face Protection, norme ANSI Z87.1, de l'American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting and Welding Processes, norme NFPA 51B, de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

1-5. Informations sur les champs électromagnétiques

NOTA Données sur le soudage et sur les effets des champs électriques et magnétiques basse fréquence.

Voici une citation tirée des conclusions générales du document Biological Effects of Power Frequency Electric & Magnetic Fields - Background Paper (Effets biologiques des champs électriques et magnétiques aux fréquences d'utilisation - Document de base), OTA-BP -E-53 (Washington, DC : U.S Government Printing Office, mai 1989) publié par l'Office of Technology Assessment (Congrès des États-Unis): «... des expériences au niveau cellulaire et des études sur l'homme et l'animal nous ont apporté une foule de renseignements : il est maintenant clair que les champs magnétiques basse fréquence peuvent influer sur les systèmes biologiques et les modifier. Ces travaux sont généralement d'excellente qualité, mais les résultats obtenus sont complexes. Dans l'état actuel de nos connaissances dans le domaine scientifique, nous ne sommes pas en mesure d'interpréter nos observations à la lumière d'une théorie générale. Et, ce qui est encore plus regrettable, nous ne pouvons rien affirmer de définitif au sujet des risques éventuels, ni proposer des méthodes scientifiques précises pour réduire ces risques ou pour les éviter.»

Pour réduire l'intensité des champs magnétiques au poste de travail :

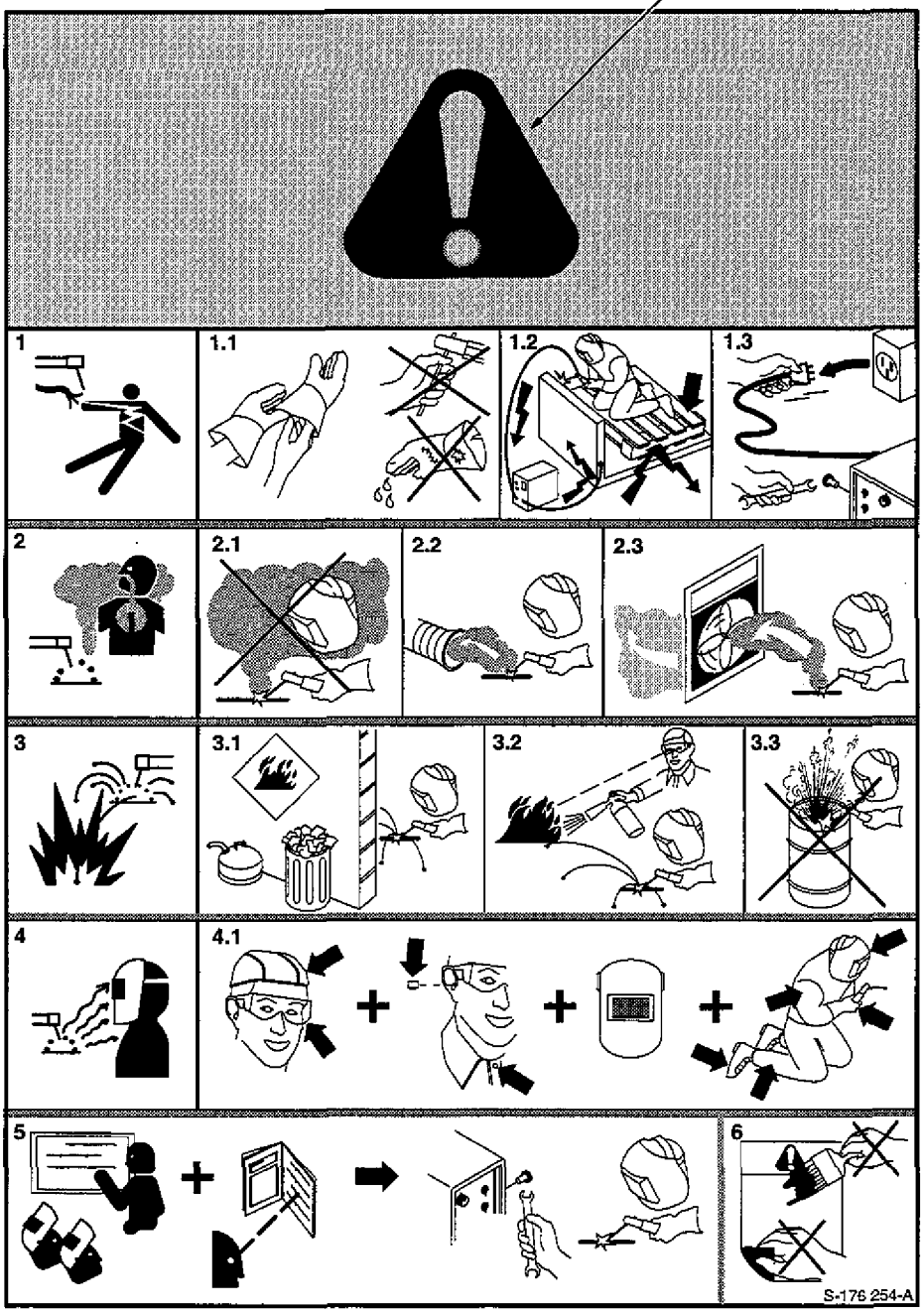
1. Grouper solidement les câbles en les entrelaçant ou en les serrant avec un ruban adhésif.
2. Disposer les câbles sur un seul côté et à l'écart de l'opérateur.
3. Éviter d'enrouler les câbles ou de les poser sur l'épaule.
4. Éloigner le plus possible la source de courant et les câbles de soudage.
5. Raccorder le connecteur de pièce à la pièce à souder, le plus près possible de la soudure.

Stimulateurs cardiaques :

Les recommandations ci-avant s'adressent aussi, normalement, aux personnes qui utilisent un stimulateur cardiaque. Pour de plus amples renseignements, consultez votre médecin.

SECTION 2 – DEFINITIONS

2-1. Warning Label Definitions



Warning! Watch Out! There are possible hazards as shown by the symbols.

1 Electric shock from welding electrode or wiring can kill.

1.1 Wear dry insulating gloves. Do not touch electrode with bare hand. Do not wear wet or damaged gloves.

1.2 Protect yourself from electric shock by insulating yourself from work and ground.

1.3 Disconnect input plug or power before working on machine.

2 Breathing welding fumes can be hazardous to your health.

2.1 Keep your head out of the fumes.

2.2 Use forced ventilation or local exhaust to remove the fumes.

2.3 Use ventilating fan to remove fumes.

3 Welding sparks can cause explosion or fire.

3.1 Keep flammables away from welding. Don't weld near flammables.

3.2 Welding sparks can cause fires. Have a fire extinguisher nearby and have a watch person ready to use it.

3.3 Do not weld on drums or any closed containers.

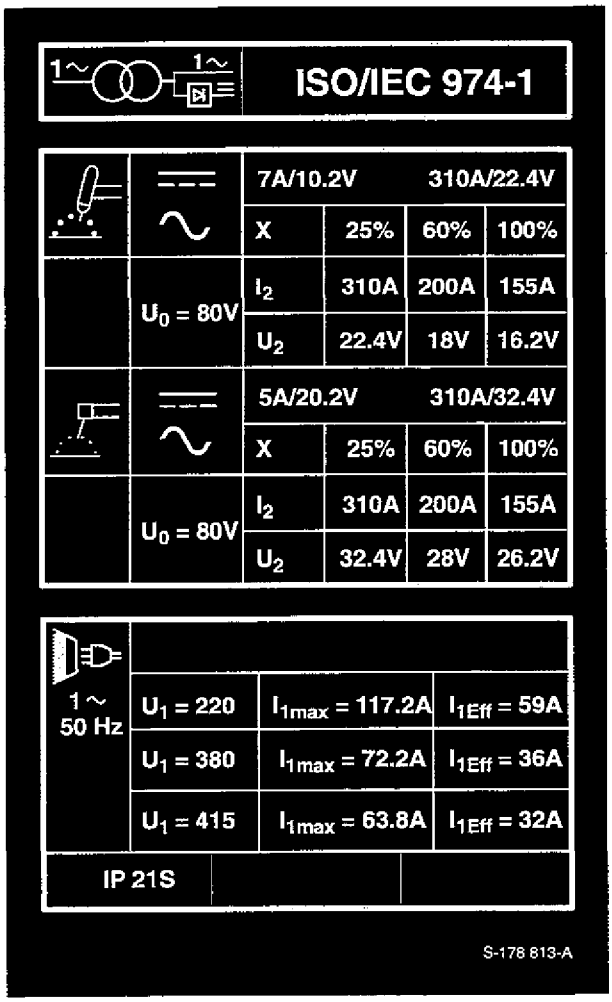
4 Arc rays can burn eyes and injure skin.

4.1 Wear hat and safety glasses. Use ear protection and button shirt collar. Use welding helmet with correct shade of filter. Wear complete body protection.

5 Become trained and read the instructions before working on the machine or welding.

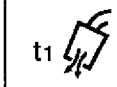
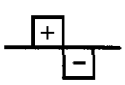
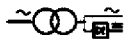
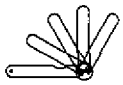
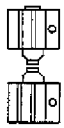
6 Do not remove or paint over (cover) the label.

2-2. Rating Label For CE Products



2-3. Symbols And Definitions

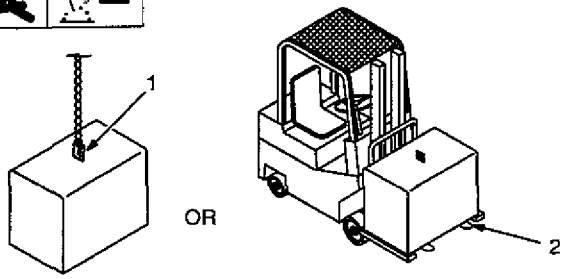
NOTE ☞	*Some symbols are found only on CE products.*

A	Amperes		Panel–Local		Gas Tungsten Arc Welding (GTAW)		Shielded Metal Arc Welding (SMAW)
V	Volts		Do Not Switch While Welding		Arc Force (DIG)	●●●●t	Spot Timer
	Output		Circuit Breaker		Remote		Temperature
	Protective Earth (Ground)		Alternating Current		High Frequency - Start		Input
	Postflow Timer		Preflow Timer		High Frequency - Continuous	HF	High Frequency
	Gas (Supply)		Gas Input		Gas Output		Increase/Decrease Of Quantity
I	On	O	Off	%	Percent		Direct Current
	Balance Control		Maximum Cleaning		Maximum Penetration		Electrode Positive
	Electrode Negative		Crater Time		Meter		Single-Phase
U_0	Rated No Load Voltage (Average)	U_1	Primary Voltage	U_2	Conventional Load Voltage		Line Connection
I_1	Primary Current	I_2	Rated Welding Current	X	Duty Cycle		Single-Phase Combined AC/DC Power Source
IP	Degree Of Protection	I_{1eff}	Maximum Effective Supply Current	I_{1max}	Rated Maximum Supply Current	Hz	Hertz
	Electrode		Work		Thickness Gauge		Spark Gap
S	Seconds						

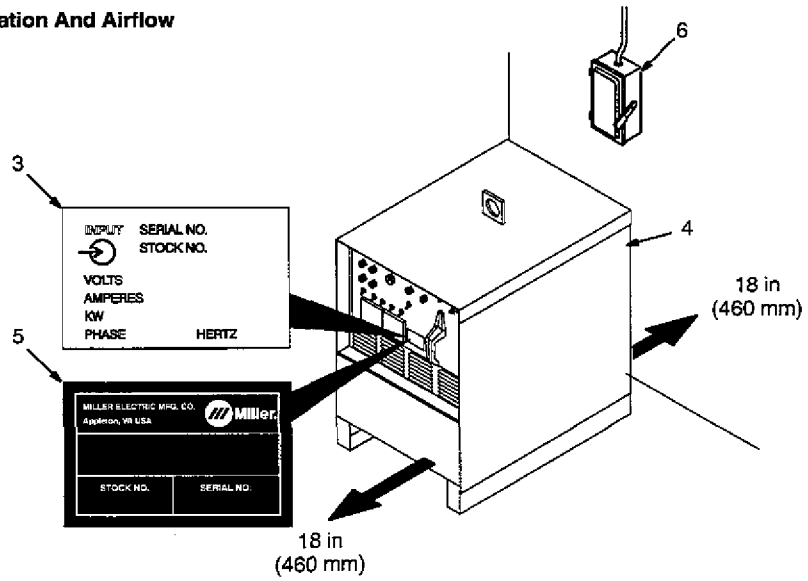
SECTION 3 – INSTALLATION

3-1. Selecting A Location

Movement



Location And Airflow



1 Lifting Eye
2 Lifting Forks

Use lifting eye or lifting forks to move unit.

If using lifting forks, extend forks beyond opposite side of unit.

3 Rating Label (Non CE Models Only)
4 Rating Label (CE Models Only, See Section 2-2)

Use rating label to determine input power needs. CE label located on rear panel.

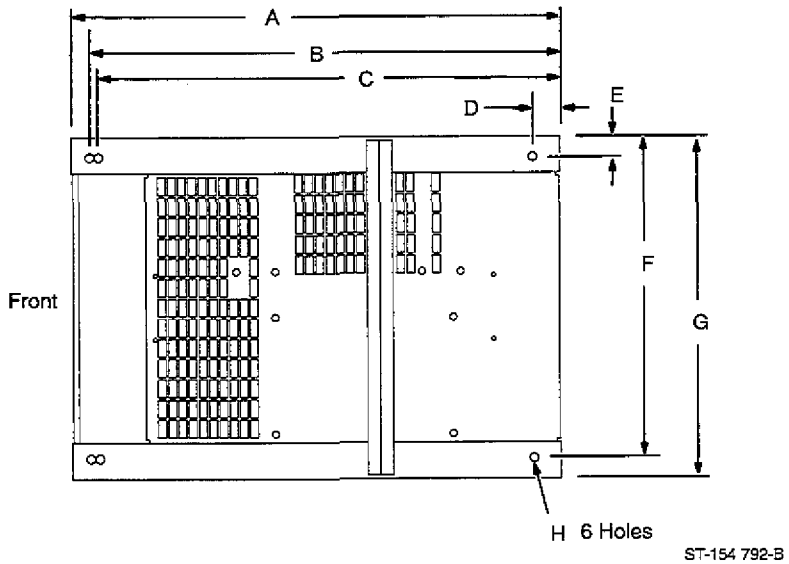
5 Plate Label (CE Models Only)
6 Line Disconnect Device

Locate unit near correct input power supply.

▲ **Special installation may be required where gasoline or volatile liquids are present – see NEC Article 511 or CEC Section 20.**

ST-800 402 / ST-117 264-F

3-2. Dimensions And Weights

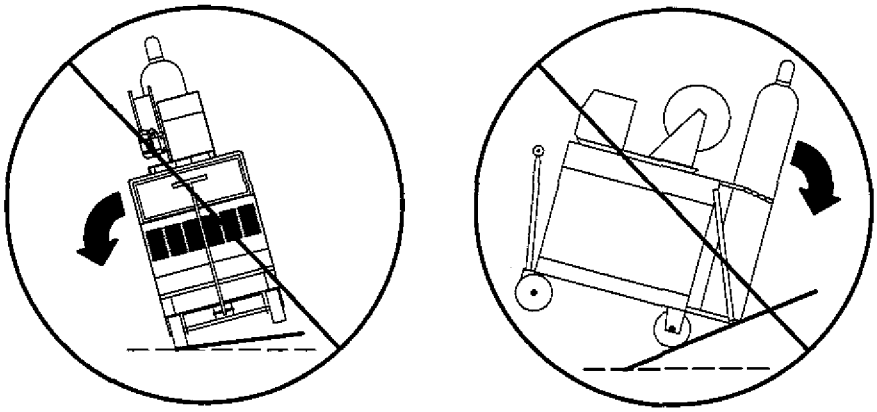


ST-154 792-B

Dimensions	
Height	30-3/4 in (781 mm)
Width	19-3/4 in (502 mm)
Length	27-1/2 in (698 mm)
A	27 in (686 mm)
B	26 in (661 mm)
C	25-1/4 in (642 mm)
D	1-1/2 in (38 mm)
E	1-1/8 (29 mm)
F	17-7/8 (454 mm)
G	19-1/4 (489 mm)
H	1/2 in (13 mm) Dia
Weight	
Net: 355 lbs (161 kg) Ship: 365 lbs (166 kg)	

3-3. Tipping

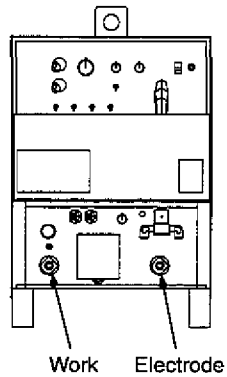
▲ **Be careful when placing or moving unit over uneven surfaces.**



3-4. Weld Output Terminals And Selecting Cable Sizes

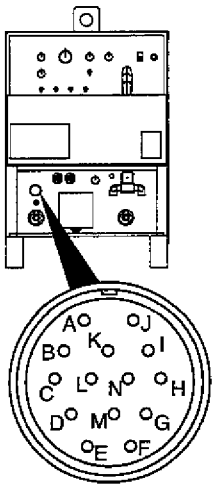
▲ **ARC WELDING can cause Electromagnetic Interference.**

To reduce possible interference, keep weld cables as short as possible, close together, and down low, such as on the floor. Locate welding operation 100 meters from any sensitive electronic equipment. Be sure this welding machine is installed and grounded according to this manual. If interference still occurs, the user must take extra measures such as moving the welding machine, using shielded cables, using line filters, or shielding the work area.

Weld Output Terminals	Welding Amperes	Total Cable (Copper) Length In Weld Circuit Not Exceeding							
		100 ft (30 m) Or Less		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 – 60% Duty Cycle	60 – 100% Duty Cycle	10 – 100% Duty Cycle					
 Work Electrode ST-154 795-C	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 at least 300 circular mils per ampere. S-0007-D

3-5. Remote 14 Receptacle

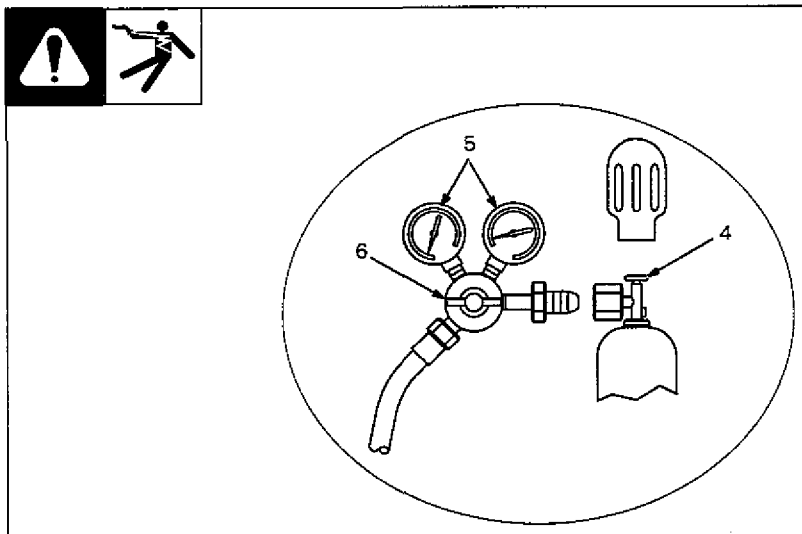


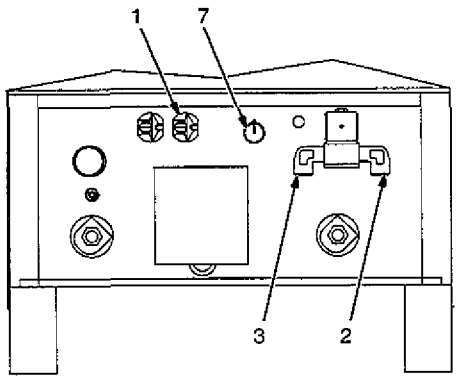
ST-154 795-C

	Socket*	Socket Information
	A	24 volts ac.
	B	Contact closure to A completes 24 volts ac contactor control circuit.
A	C	Command reference; 0 to +10 volts dc output to remote control.
	D	Remote control circuit common.
	E	0 to +10 volts dc input command signal from remote control.
	K	Chassis common.

*The remaining sockets are not used.

3-6. 115 Volts AC Duplex Receptacle And Shielding Gas Connections





▲ **Turn Off power before connecting to receptacle.**

1 115 V AC Receptacle

Receptacle is protected from overload by circuit breaker CB1 (see Section 5-2).

2 Gas Valve In Fitting

3 Gas Valve Out Fitting

Fittings have 5/8-18 right-hand threads

4 Cylinder Valve

Open valve slightly so gas flow blows dirt from valve. Close valve.

5 Regulator/Flow Gauge

6 Flow Adjust

Typical flow rate is 20 cfh (cubic feet per hour) (9.4 L/min)

7 High Frequency Control (see Section 4-1)

Ref. ST-154 795-C / Ref. ST-157 858

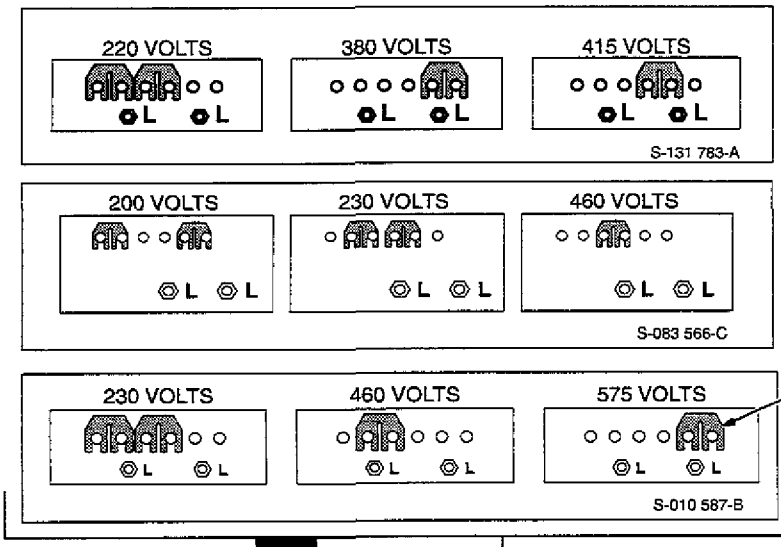
3-7. Electrical Service Guide

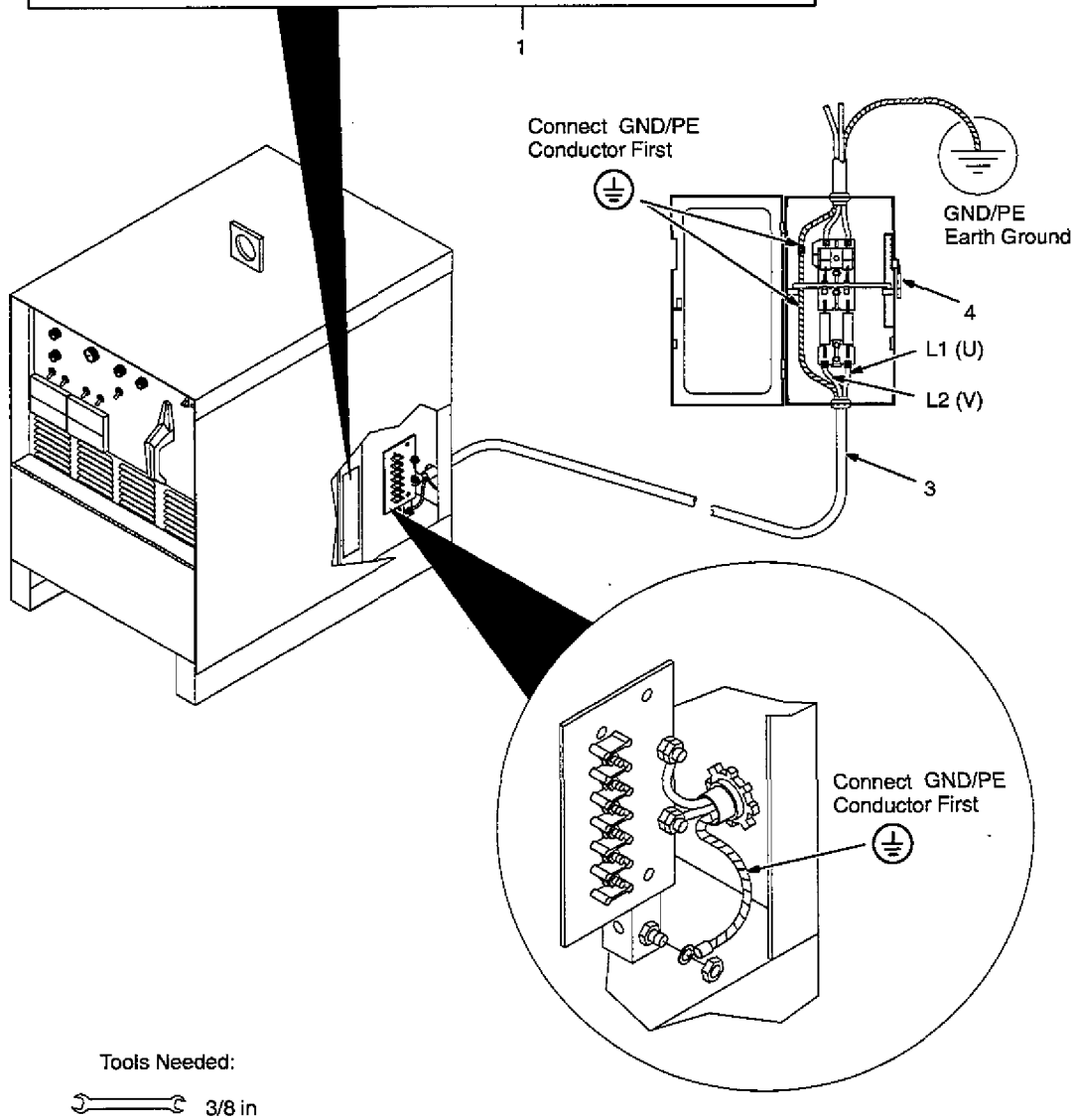
NOTE ☞	*All values calculated at 60% duty cycle.*

60 Hertz Models	Without Power Factor Correction				With Power Factor Correction			
Input Voltage	200	230	460	575	200	230	460	575
Input Amperes At Rated Output	85	74	37	30	55	48	24	19
Max Recommended Standard Fuse Or Circuit Breaker Rating In Amperes	125	110	60	45	80	70	35	30
Min Input Conductor Size In AWG/Kcmil	4	6	10	10	8	8	12	14
Max Recommended Input Conductor Length In Feet (Meters)	173 (53)	158 (48)	291 (89)	455 (139)	86 (26)	114 (35)	186 (58)	189 (48)
Min Grounding Conductor Size In AWG/Kcmil	6	6	10	10	8	8	12	14
Reference: 1996 National Electrical Code (NEC)								S-0092-J

50 Hertz Models	Without Power Factor Correction			With Power Factor Correction		
Input Voltage	220	380	415	220	380	415
Input Amperes At Rated Output	100	58	53	64	37	34
Max Recommended Standard Fuse Or Circuit Breaker Rating In Amperes	150	90	80	90	60	50
Min Input Conductor Size In AWG/Kcmil	4	8	8	6	10	10
Max Recommended Input Conductor Length In Feet (Meters)	159 (49)	221 (67)	263 (80)	145 (44)	291 (89)	347 (106)
Min Grounding Conductor Size In AWG/Kcmil	6	8	8	6	8	10
Reference: 1996 National Electrical Code (NEC)						S-0092-J

3-8. Placing Jumper Links And Connecting Input Power





Check input voltage available at site.

1 Jumper Link Label

Check label – only one is on unit.

2 Jumper Links

Move jumper links to match input voltage.

3 Input And Grounding Conductors

Select size and length using Section 3-7.

4 Line Disconnect Device

Select type and size of overcurrent protection using Section 3-7.

Reinstall side panel.

▲ **Special installation may be required where gasoline or volatile liquids are present – see NEC Article 511 or CEC Section 20.**

Tools Needed:

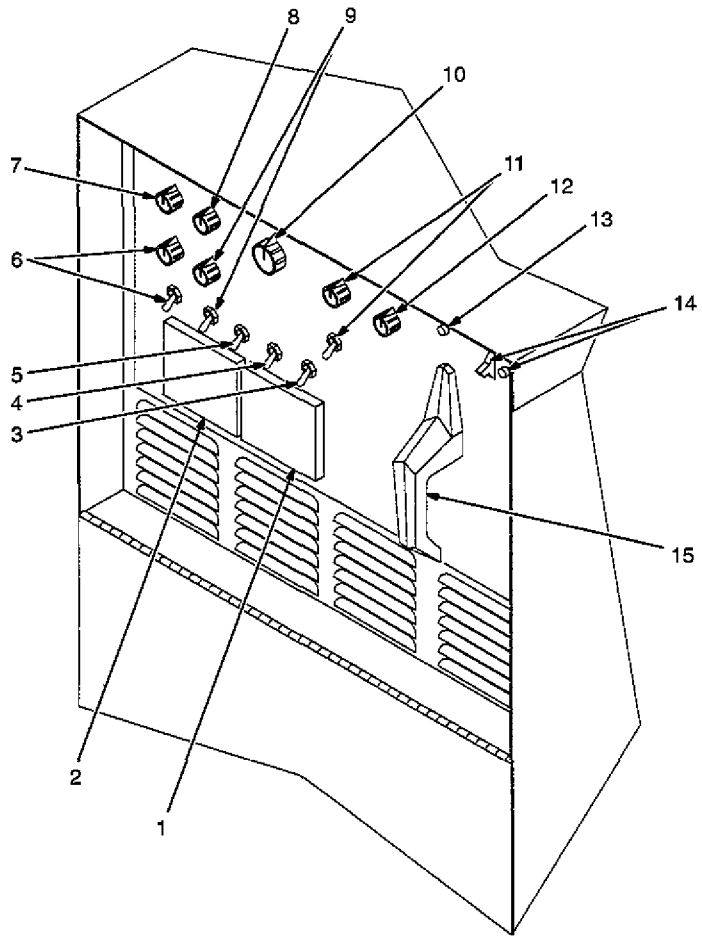
3/8 in

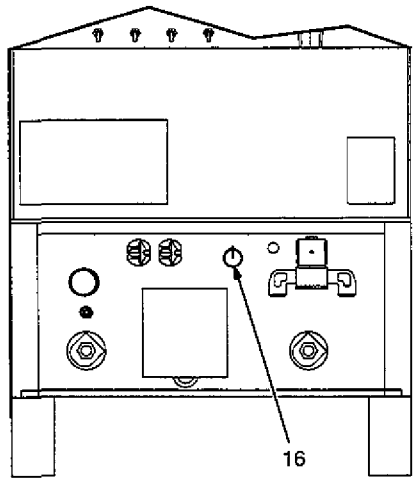
3/8, 1/2, 7/16 in

ST-117 263-K

SECTION 4 – OPERATION

4-1. Controls





Ref. ST-117 264-F / Ref. ST-154 795-C

1 Ammeter (Optional)

2 Voltmeter (Optional)

3 High Frequency Switch

Use switch to select continuous HF, HF for arc starting only, or no HF.

4 Output (Contactor) Switch

5 Amperage Control Switch

Switch selects front panel or remote amperage control.

6 Spot Time Switch And Control (Optional)

Control sets spot weld time. Timer begins when arc starts. If arc is broken during spot time cycle, timer stops but does not reset. When spot time ends, arc stops and timer resets for next cycle. Set switch to Off for SMAW.

7 Preflow Time Control (Optional)

Control sets length of time gas flows before arc starts.

8 AC Balance Control (See Figure 4-2)

9 Crater Time Switch And Control

Control sets length of time to taper weld output from amperage control setting to the minimum of the unit. Set switch to Off for SMAW.

10 Amperage Adjustment Control

For remote amperage control, front panel control setting is the maximum amperage available. For example: If front panel control is set to 200 A, the range of the remote amperage control is 0 to 200 A.

11 Arc Force (Dig) Switch And Control

For SMAW, use control to help start an arc or make vertical or overhead welds. Control increases short-circuit amperage which allows the operator to use a very short arc length without sticking the electrode. Set switch to Off for GTAW.

12 Postflow Time Control

Control sets length of time gas flows after welding stops.

13 High Temperature Shutdown Light (CE Models Only)

Lights when unit overheats and shuts down (see Section 4-3).

14 Power Switch And Pilot Light

15 Output Selector Switch

Switch selects front panel or remote output control.

▲ **Weld output terminals are energized when Output (Contactor) switch is On and Power is On.**

16 High Frequency Control

Use control to set HF intensity; keep as low as possible.

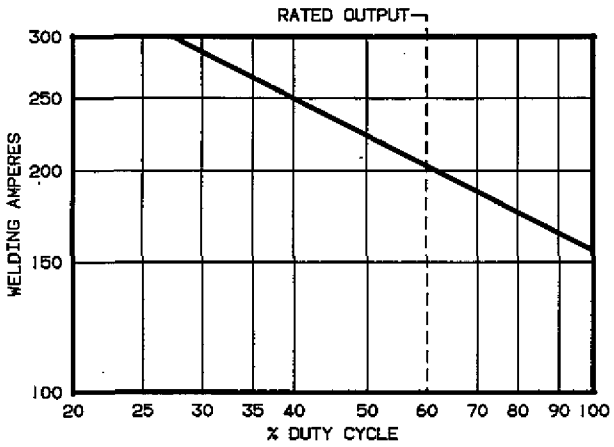
4-2. Balance Control

Setting	Output Waveforms	Arc
Balanced 3	50% Electrode Positive 50% Electrode Negative	
More Penetration 10	32% Electrode Positive 68% Electrode Negative	
More Cleaning 0	55% Electrode Positive 45% Electrode Negative	

Use Balance control to change the ac output square wave for more cleaning or more penetration. Position 3 provides equal cleaning and penetration.

Ref. S-0795-A

4-3. Duty Cycle And Overheating

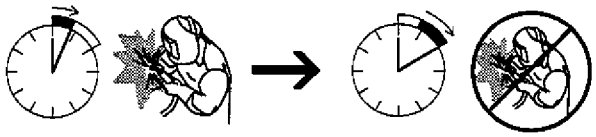


Duty Cycle is percentage of 10 minutes that unit can weld at rated load without overheating.

If unit overheats, thermostat opens, output stops, light goes on (CE models only), and cooling fan runs. Wait fifteen minutes for unit to cool. Reduce amperage or duty cycle before welding.

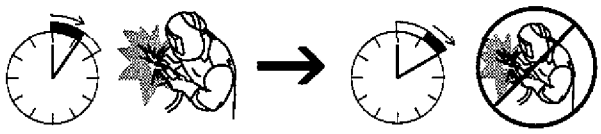
▲ **Exceeding duty cycle can damage unit and void warranty.**

40% Duty Cycle At 250 Amperes (60 Hz Models Only)



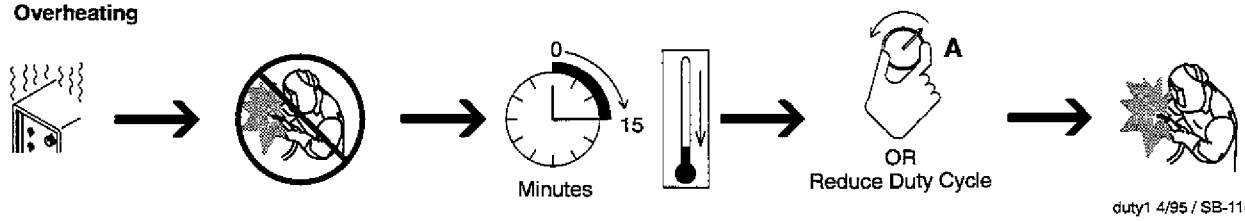
4 Minutes Welding — 6 Minutes Resting

60% Duty Cycle At 200 Amperes



6 Minutes Welding — 4 Minutes Resting

Overheating



duty1 4/95 / SB-116 198

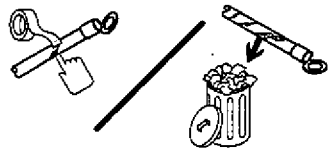
SECTION 5 – MAINTENANCE & TROUBLESHOOTING

5-1. Routine Maintenance

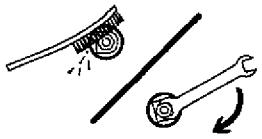
▲ **Disconnect power before maintaining.**

3 Months

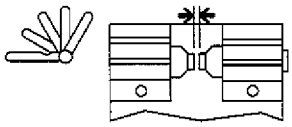
Replace Unreadable Labels



Repair Or Replace Cracked Weld Cables



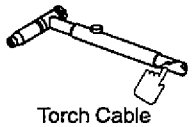
Clean And Tighten Weld Terminals



Adjust Spark Gaps

14-Pin Cord

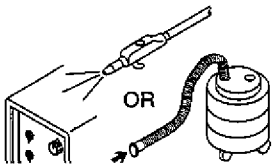
Gas Hose



Torch Cable

Replace Cracked Parts

6 Months

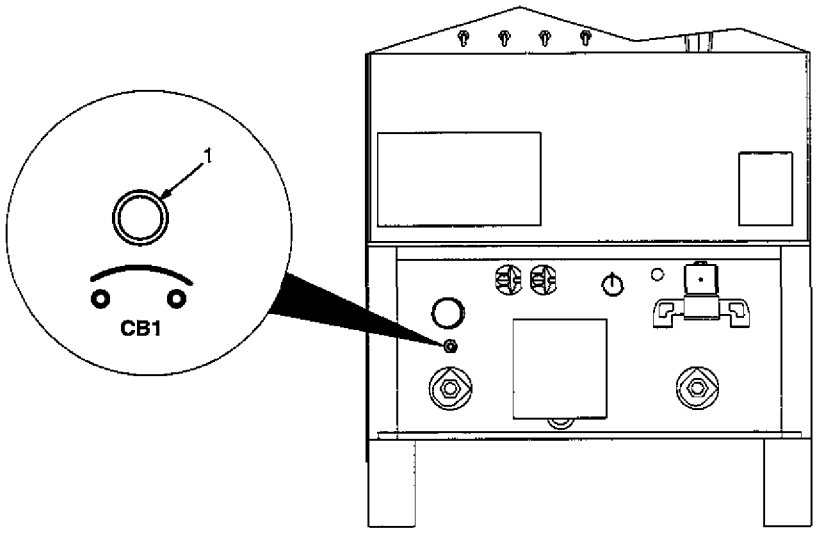


Blow Out Or Vacuum Inside, During Heavy Service, Clean Monthly

5-2. Circuit Breaker CB1

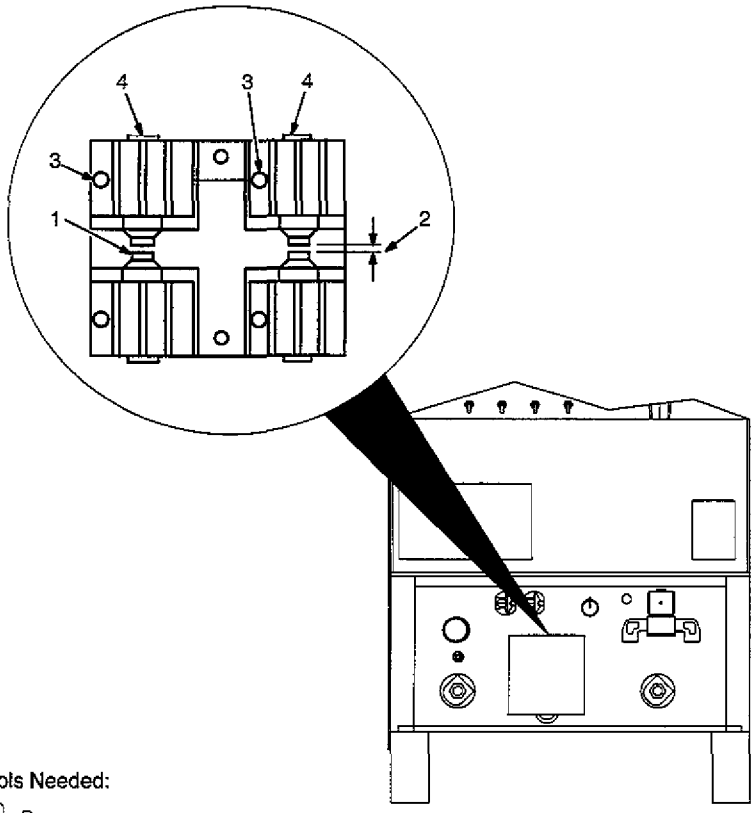
1 Circuit Breaker CB1

If CB1 opens, output to the 115 volts ac duplex receptacle, high frequency, and gas flow stop. Press button to reset breaker.



Ref. ST-154 795-C

5-3. Adjusting Spark Gaps



▲ Turn Off power before adjusting spark gaps.

Open access door.

1 Tungsten End Of Point

Replace point if tungsten end disappears; do not clean or dress tungsten.

2 Spark Gap

Normal spark gap is 0.008 in (0.203 mm).

If adjustment is needed, proceed as follows:

3 Adjustment Screws

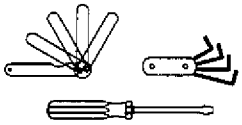
Loosen screws. Place gauge of proper thickness in spark gap.

4 Pressure Point

Apply slight pressure at point until gauge is held firmly in gap. Tighten screws. Adjust other gap.

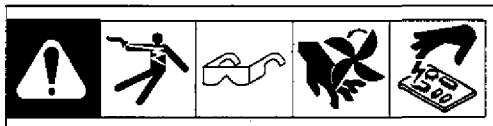
Close access door.

Tools Needed:



Ref. ST-154 795-C / Ref. S-0043

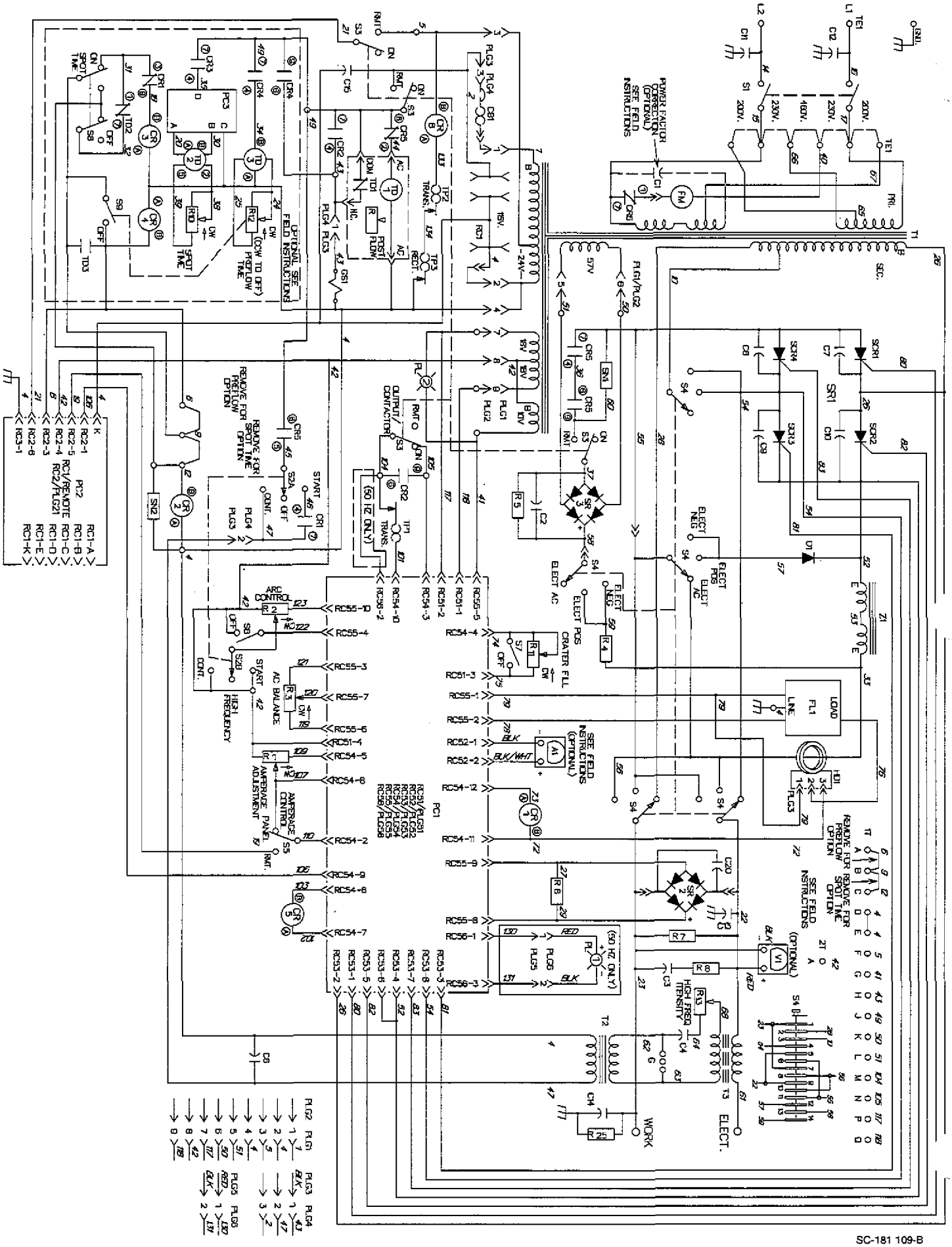
5-4. Troubleshooting



Trouble	Remedy
No weld output; unit completely inoperative.	Place line disconnect switch in On position (see Section 3-8).
	Check and replace line fuse(s), if necessary (see Section 3-8).
	Check for proper input power connections (see Section 3-8).
	Check for proper jumper link position (see Section 3-8).
No weld output; unit on.	If using remote control, place Output switch in Remote 14 position, and make sure remote control is connected to Remote 14 receptacle. If remote is not being used, place Output (Contactor) switch in On position.
	Check, repair, or replace remote control.
	Unit overheated. Allow unit to cool with fan On (see Section 4-3).
	Have Factory Authorized Service Agent check control board PC1.

Trouble	Remedy
Fan not operating. NOTE: fan only runs when cooling is necessary.	Check and remove anything blocking fan movement.
	Have Factory Authorized Service Agent check fan motor.
Unit provides only maximum or minimum weld output.	Have Factory Authorized Service Agent check control board PC1.
Weld output always above or always below set value.	Have Factory Authorized Service Agent check control board PC1 and hall device HD1.
Erratic or improper weld output.	Use proper size and type of weld cable (see Section 3-4).
	Clean and tighten all weld connections.
	Check position of Output Selector switch (see Section Figure 4-1).
	Have Factory Authorized Service Agent check control board PC1 and hall device HD1.
No AC Balance control.	Have Factory Authorized Service Agent check AC Balance control and control board PC1.
No control of weld output.	If using remote control, place Output switch in Remote 14 position, and make sure remote control is connected to Remote 14 receptacle. If remote is not being used, place Output switch in On position.
	Have Factory Authorized Service Agent check Amp Adjust control and control board PC1.
No high frequency, no gas flow, and no 115 volts ac output from duplex receptacle.	Reset circuit breaker CB1 (see Section 5-2).
Lack of high frequency; difficulty in starting GTAW arc.	Select proper size tungsten.
	Check High Frequency control setting (see Figure 4-1).
	Be sure electrode holder cable is not close to any grounded metal.
	Check cables and torch for cracked insulation or bad connections. Repair or replace.
	Check spark gaps (see Section 5-3).
Wandering arc – poor control of direction of arc.	Reduce gas flow rate.
	Select proper size tungsten.
	Properly prepare tungsten.
Tungsten electrode oxidizing and not remaining bright after conclusion of weld.	Shield weld zone from drafts.
	Increase postflow time.
	Check and tighten all gas fittings.
	Properly prepare tungsten.
	Check for water in torch, and repair torch if necessary. See torch Owner's Manual.

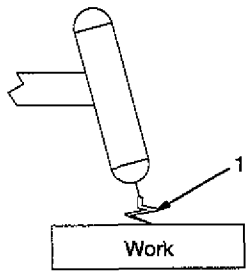
5-5. Circuit Diagram



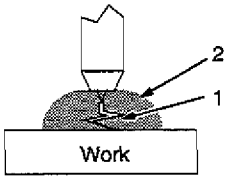
SC-181 109-B

SECTION 6 – HIGH FREQUENCY (HF)

6-1. Welding Processes Using HF



Gas Tungsten Arc Welding (GTAW)



Submerged Arc Welding (SAW)

1 HF Voltage

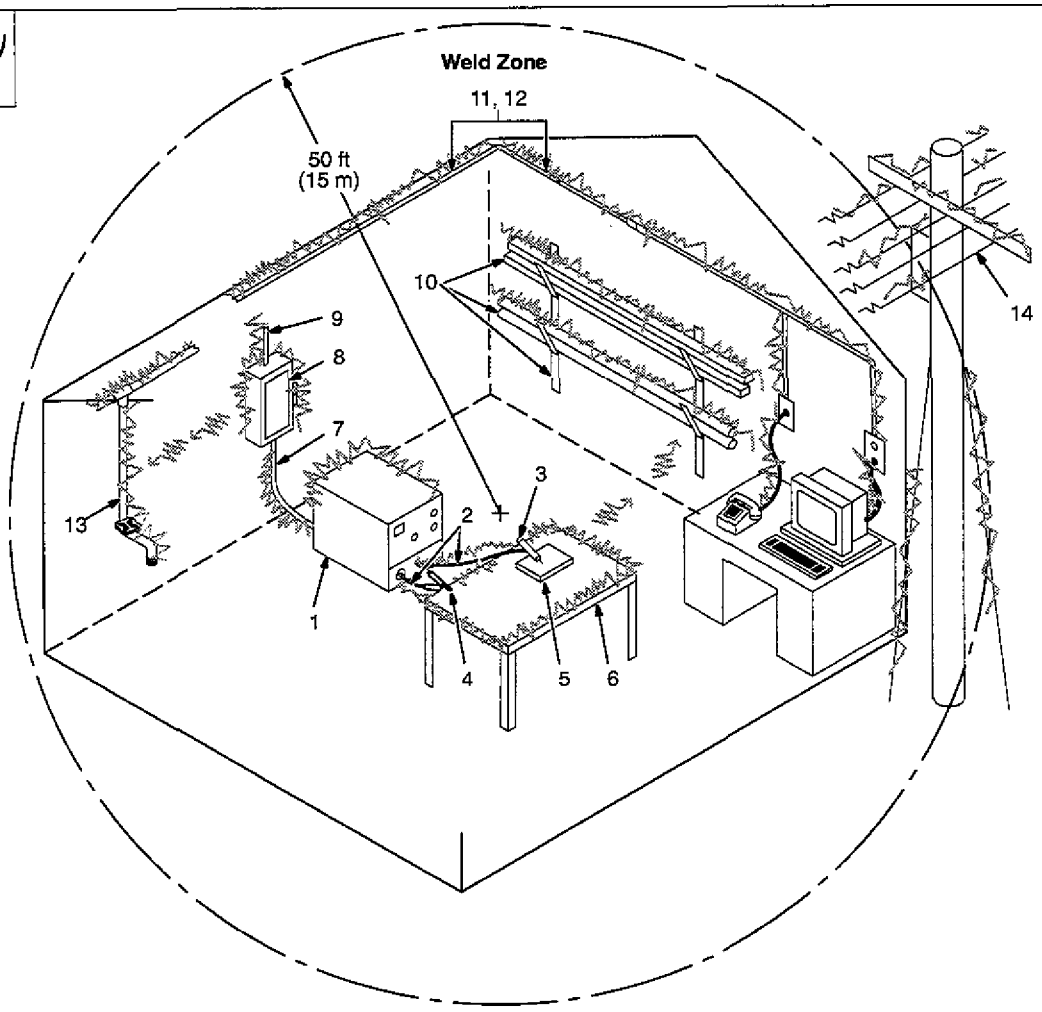
GTAW – helps arc jump air gap between torch and workpiece and/ or stabilize the arc.

SAW – helps arc reach workpiece through flux granules.

2 Flux

high_freq1 7/95 – S-0693

6-2. Sources Of HF Radiation From Incorrect Installation



S-0694

Sources Of Direct HF Radiation

1 HF source (welding power source with built-in HF or separate HF unit)
2 Weld Cables
3 Torch
4 Work Clamp
5 Workpiece
6 Work Table

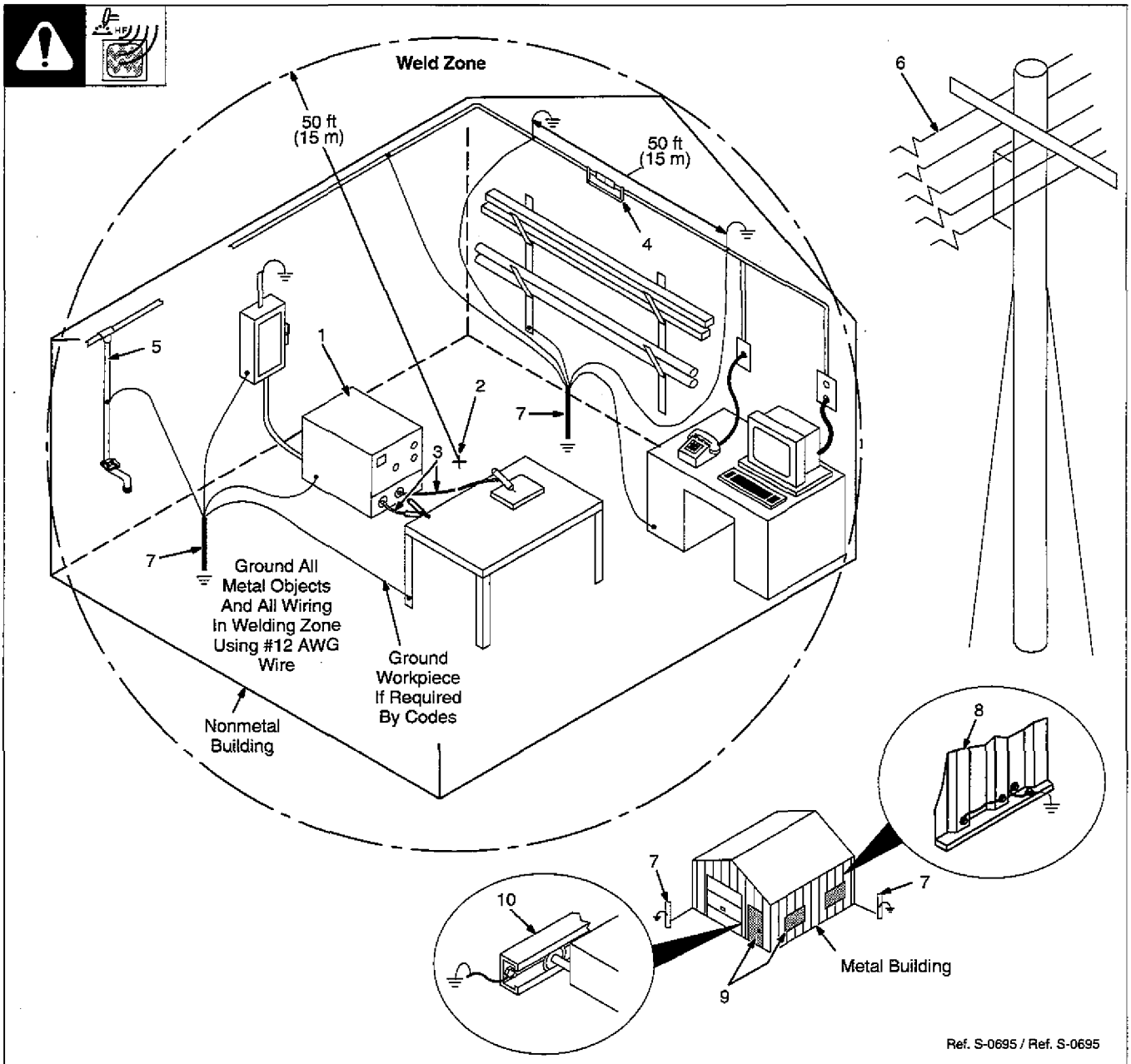
Sources Of Conduction Of HF

7 Input Power Cable
8 Line Disconnect Device
9 Input Supply Wiring

Sources Of Reradiation Of HF

10 Ungrounded Metal Objects
11 Lighting
12 Wiring
13 Water Pipes And Fixtures
14 External Phone And Power Lines

6-3. Correct Installation



1 HF Source (Welder With Built-In HF Or Separate HF Unit)

Ground metal machine case, work output terminal, line disconnect device, input supply, and worktable.

2 Welding Zone And Centerpoint

A circle 50 ft (15 m) from centerpoint between HF source and welding torch in all directions.

3 Weld Output Cables

Keep cables short and close together.

4 Conduit Joint Bonding And Grounding

Electrically join (bond) all conduit sections using copper straps or braided wire. Ground conduit every 50 ft (15 m).

5 Water Pipes And Fixtures

Ground water pipes every 50 ft (15 m).

6 External Power Or Telephone Lines

Locate HF source at least 50 ft (15 m) away from power and phone lines.

7 Grounding Rod

Consult the National Electrical Code for specifications.

8 Metal Building Panel Bonding Methods

Bolt or weld building panels together, install copper straps or braided wire across seams, and ground frame.

9 Windows And Doorways

Cover all windows and doorways with grounded copper screen of not more than 1/4 in (6.4 mm) mesh.

10 Overhead Door Track

Ground the track.

NOTES

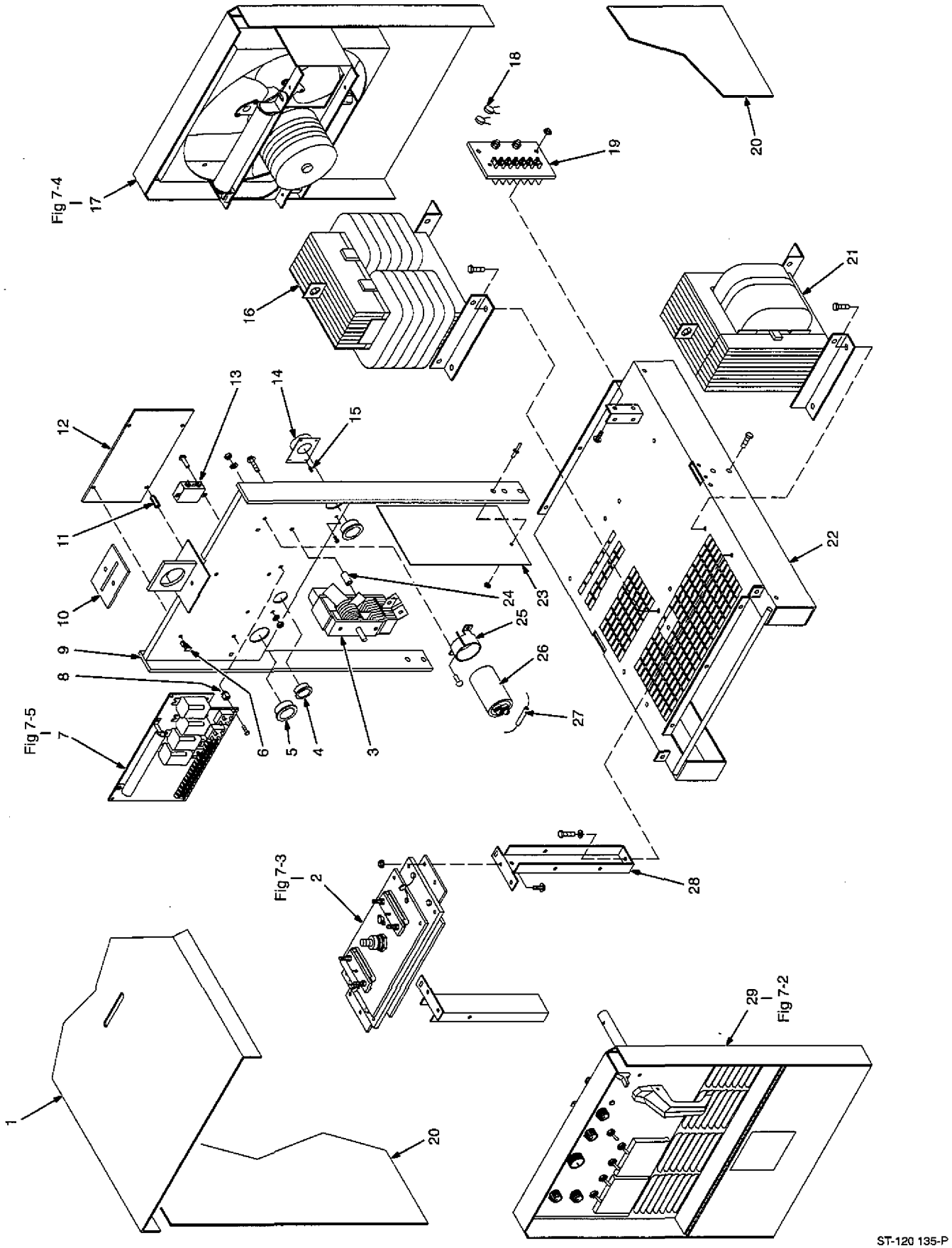


Figure 7-1. Main Assembly

Replace Coils at Factory or Authorized Factory Service Station

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 7-1. Main Assembly	
1		182 605	COVER, top	1
2	SR1	181 106	RECTIFIER, si diode (Fig 7-3)	1
3	S4	133 061	SWITCH, plrty/changeover	1
4		057 357	BUSHING, snap-in nyl .937 ID x 1.125mtg hole	1
5		010 494	BUSHING, snap-in nyl 1.375 ID x1.750mtg hole	2
6		134 201	STAND-OFF SUPPORT, PC card No. 6 screw	3
7		Fig 7-5	PANEL, mtg components	1
8		083 147	GROMMET, screw No. 8/10 panel hole .312sq .500 high	4
9		181 101	FRAME, lifting	1
10		026 627	GASKET, lift eye	2
11		070 026	STAND-OFF, No. 6-32 x .437 lg	1
12	PC1	178 979	CIRCUIT CARD, control	1
	PLG51	115 093	CONNECTOR PLUG & SOCKETS	1
	PLG54	130 203	CONNECTOR PLUG & SOCKETS	1
	PLG55	115 091	CONNECTOR PLUG & SOCKETS	1
13	FL1	084 171	FILTER, line power 115/250V	1
14	HD1	156 313	TRANSDUCER, current 300A	1
15		073 756	STAND-OFF, 6-32 x .625 lg	2
16	Z1	114 826	REACTOR	1
	C13	097 750	CAPACITOR, cer disc .05uf 500VDC	1
17		Fig 7-4	PANEL, rear w/components	1
18	C11,12	111 634	CAPACITOR	1
19	TE1	034 587	TERMINAL ASSEMBLY, pri (consisting of)	1
		601 835	NUT, brs hex 10-32	12
		601 836	NUT, brs hex .250-20 jam hvy	4
		010 915	WASHER, flat brs .250 ID x .625 OD x .031thk	4
		083 426	TERMINAL BOARD, primary	1
		038 888	STUD, primary board brs .250-20 x 1.500	2
		010 913	WASHER, flat brs .218 ID x 460 OD x .031thk	6
		038 887	STUD, primary board brs 10-32 x 1.375	6
		038 618	LINK, jumper term bd pri	2
20		+182 606	PANEL, side	2
		109 035	LABEL, warning electric shock can kill etc	1
21	T1	180 674	TRANSFORMER, pwr main 200/230/460 (consisting of)	1
21	T1	180 673	TRANSFORMER, pwr main 220/380/415 (consisting of)	1
21	T1	180 672	TRANSFORMER, pwr main 230/460/575 (consisting of)	1
	TP1	020 520	THERMOSTAT, NC open 135C w/insulator	1
	TP2	168 891	THERMOSTAT, NC open 80C close 50C	1
22		171 677	BASE	1
23		157 196	INSULATOR, upright	1
24		010 150	TUBING, stl .500 OD x 17ga x 1	2
25		108 105	CLAMP, capacitor 2.500dia	1
26	C2	031 668	CAPACITOR, elctlt 4000uf 100VDC	1
27	R5	117 803	RESISTOR, WW fxd 10W 1K ohm	1
28		114 722	BRACKET, mtg rectifier	2
29		Fig 7-2	PANEL, front w/components	1

+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.

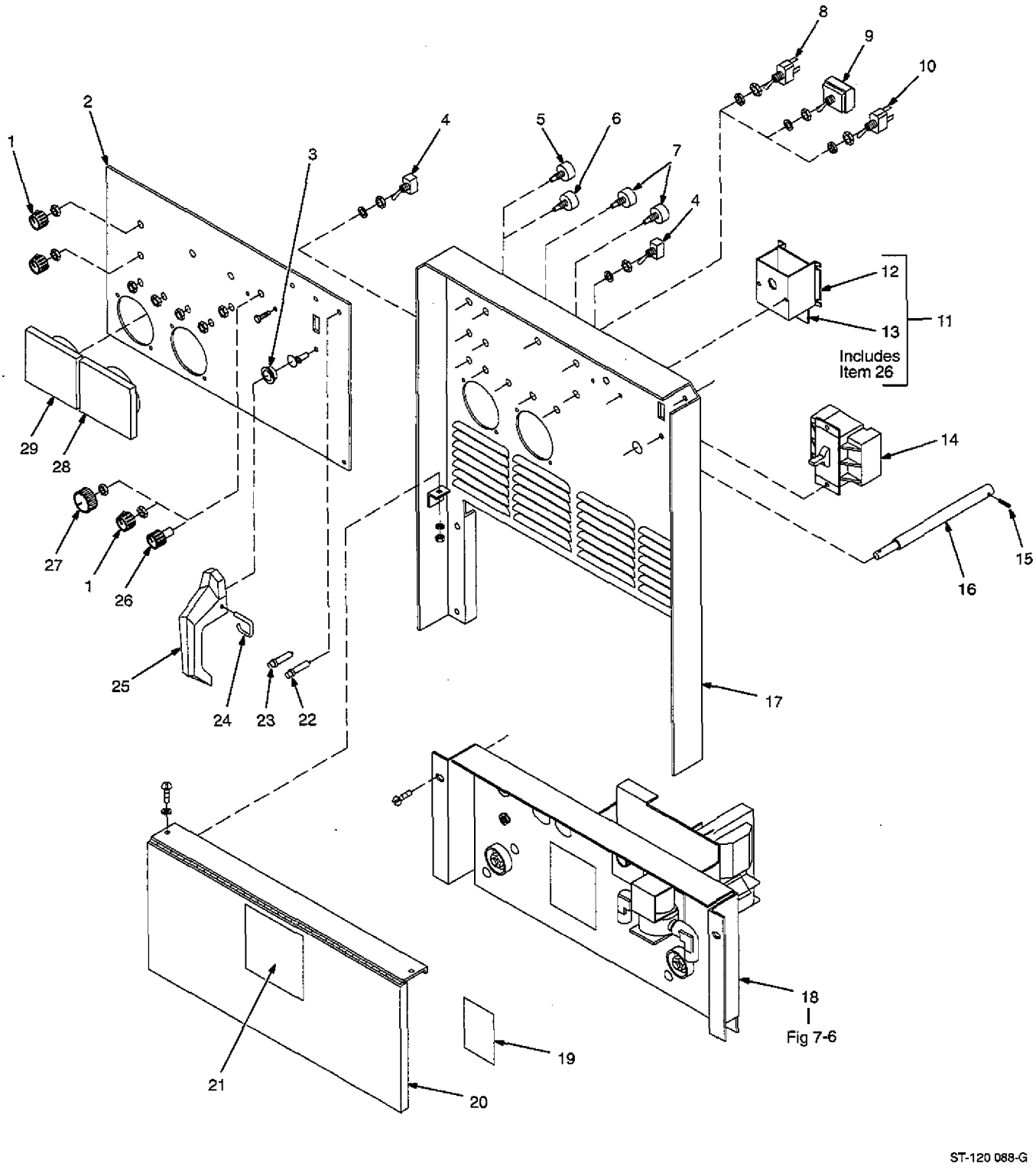
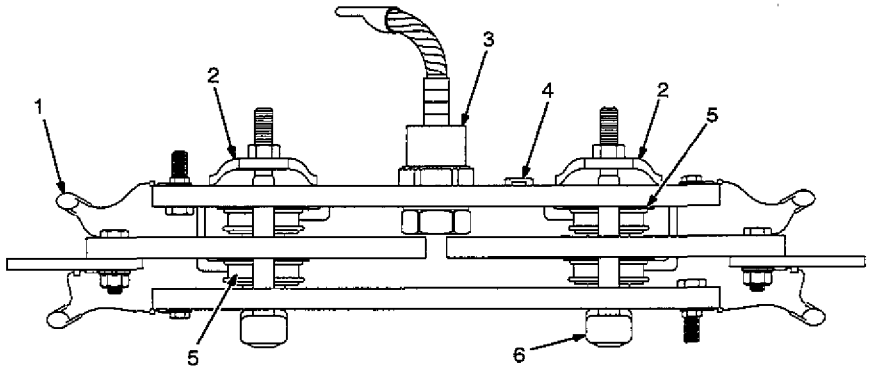


Figure 7-2. Panel, Front w/Components

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 7-2. Panel, Front w/Components (Fig 7-1 Item 29)	
1		097 922	KNOB, pointer	3
2			NAMEPLATE, (order by model and serial number)	1
3		109 013	BUSHING, snap-in nyl .375 ID x .562mtg hole	1
4	S6,7	176 882	SWITCH, tgl SPST 15A 125VAC	2
		107 983	BLANK, snap-in nyl .500mtg hole	1
		057 359	BLANK, snap-in nyl .375mtg hole	2
5	R3	030 109	POTENTIOMETER, C sltd sft 1/T 2W 5K ohm	1
6	R11	030 684	POTENTIOMETER, C sltd sft 1/T 2W 5 meg ohm	1
7	R1,2	035 897	POTENTIOMETER, C sltd sft 1/T 2W 1K ohm	2
8	S5	011 609	SWITCH, tgl SPDT 15A 125VAC	1
9	S3	052 769	SWITCH, tgl 4PDT 15A 125VAC	1
10	S2	088 409	SWITCH, tgl 2PDT 15A 125VAC	1
11	TD1	052 192	TIMER, delay on make – postflow (consisting of)	1
12		039 449	BRACKET, mtg circuit card	1
13		044 723	CIRCUIT CARD, postflow	1
14	S1	128 757	SWITCH, tgl DPST 60A 600VAC	1
15		106 398	PIN, spring CS .156 x .625	1
16		171 420	EXTENSION, handle switch	1
17		181 096	PANEL, front	1
18		174 067	CONTROL PANEL, lower (Figure 7-6)	1
19		128 230	LABEL, warning electric shock etc	1
20		+181 589	DOOR, access front	1
21		134 327	LABEL, warning general precautionary	1
22		157 958	LIGHT, ind wht lens 28V (power indicator)	1
23		155 500	LED, yellow (50Hz model)	1
24		169 136	PIN, spring CS .156 x 1.250	1
25		175 952	HANDLE, plrty/changeover switch	1
26		052 370	KNOB, indicator	1
27		097 924	KNOB, pointer	1
28		♦115 920	METER, amp AC/DC 100MV D-300 scale	1
29		♦004 189	METER, volt AC/DC 0-100 scale	1

+When ordering a component originally displaying a precautionary label, the label should also be ordered.
♦Optional
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
		181 106	**Figure 7-3. Rectifier, Si Diode (Fig 7-1 Item 2)**	
1	C7-10	031 689	CAPACITOR, rectifier	4
2		166 667	CLAMP, spring rectifier	2
3	D1	037 956	DIODE, rect 275A 300V SP	1
4	TP3	168 898	THERMOSTAT, NC, open 125°C	1
5	SCR1-4	115 114	THYRISTOR, SCR 300A 300V	4
6		173 714	CLAMP, thyristor	2
		028 516	PIN, spring CS .125 x .250	2
	PLG53	115 092	CONNECTOR PLUG & SOCKETS	1



ST-120 205-A

Figure 7-3. Rectifier, Si Diode

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 7-4. Panel, Rear w/Components (Fig 7-1 Item 17)	
1	R4	115 812	RESISTOR, WW fxd 175W 20 ohm	1
2		180 165	BLADE, fan 14 in 3wg 28deg .375 bore	1
3		181 099	PANEL, rear	1
4		173 283	CHAMBER, plenum 14 in (50Hz only)	1
5		124 274	BRACKET, mtg fan motor	1
6	FM	116 190	MOTOR, 1/12 hp 230V 1550 RPM 50/60Hz 1.5A	1
		176 272	CONNECTOR, cable clamp (50Hz model)	1

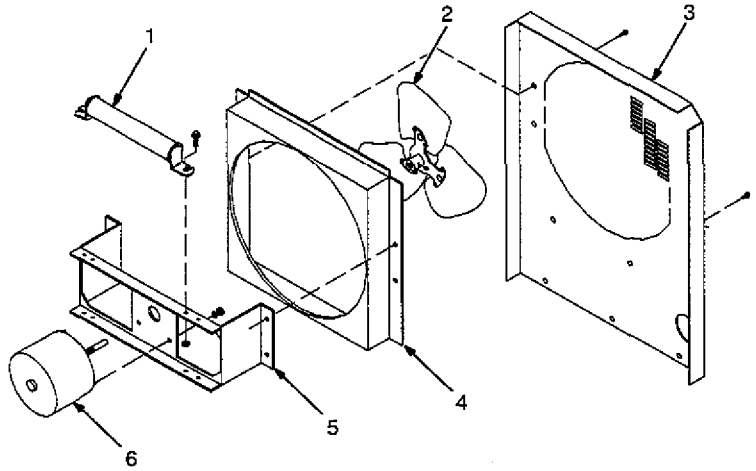


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Figure 7-4. Panel, Rear w/Components

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

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

Figure 7-5. Panel, Mtg Components (Fig 7-1 Item 7)

1		605 742	CLIP, mtg resistor .500 ID core	2
2	R7	115 228	RESISTOR, WW fxd 100W 50 ohm	1
3		117 721	PANEL, mtg relay	1
4	CR2,6	110 386	RELAY, encl 24VAC DPDT	2
5	2T	072 253	STUD, single connection 10-32	1
6	SR2,3	035 704	RECTIFIER, integ 40A 800V	2
7	SN1	110 079	SNUBBER, poly metal film .5uf 200VDC 100 ohm	1
8	R6	117 803	RESISTOR, WW fxd 10W 1K ohm	1
9	C20	119 834	CAPACITOR, cer disc .05uf 500V	1
10	1T	117 372	BLOCK, term 10A 15P	1
		108 023	LINK, jumper term blk 10A	3
11	CR5	000 770	RELAY, encl 24VDC 3PDT	1
12	CR1	052 964	RELAY, encl 24VDC DPDT	1

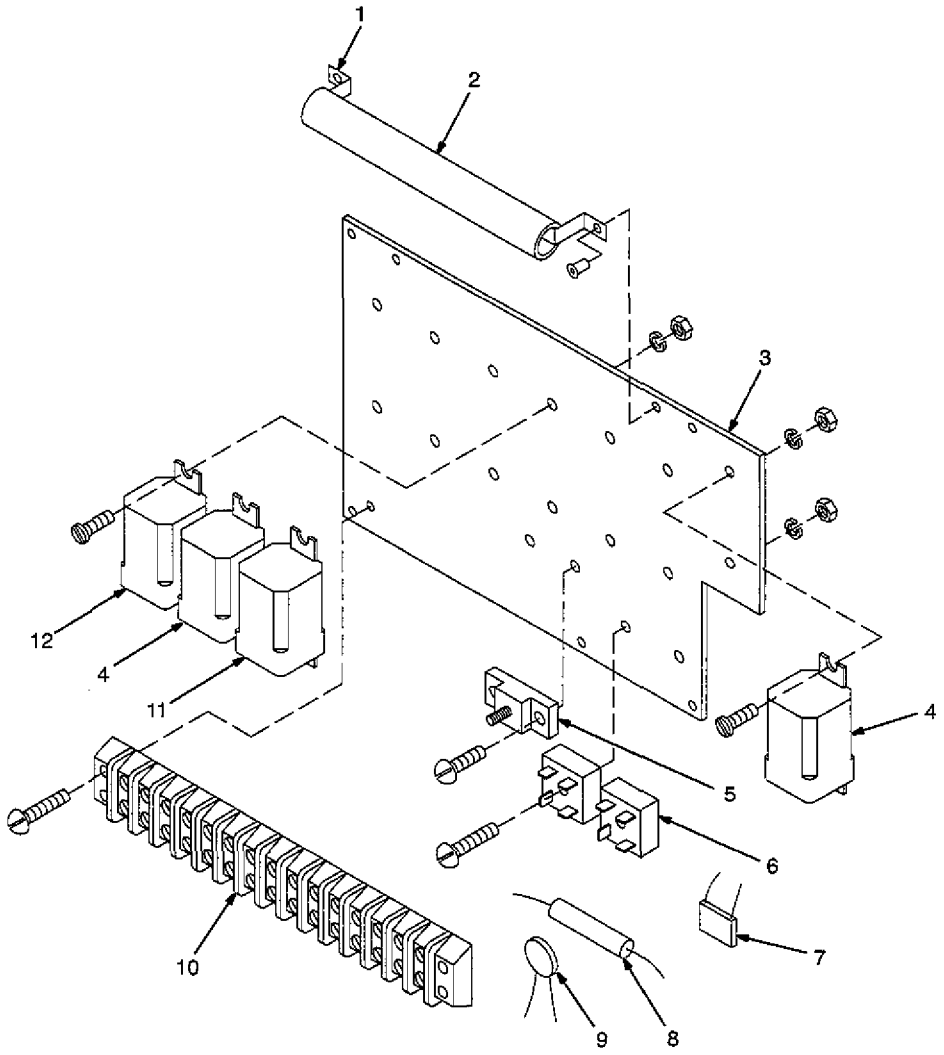

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Figure 7-5. Panel, Mtg Components

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

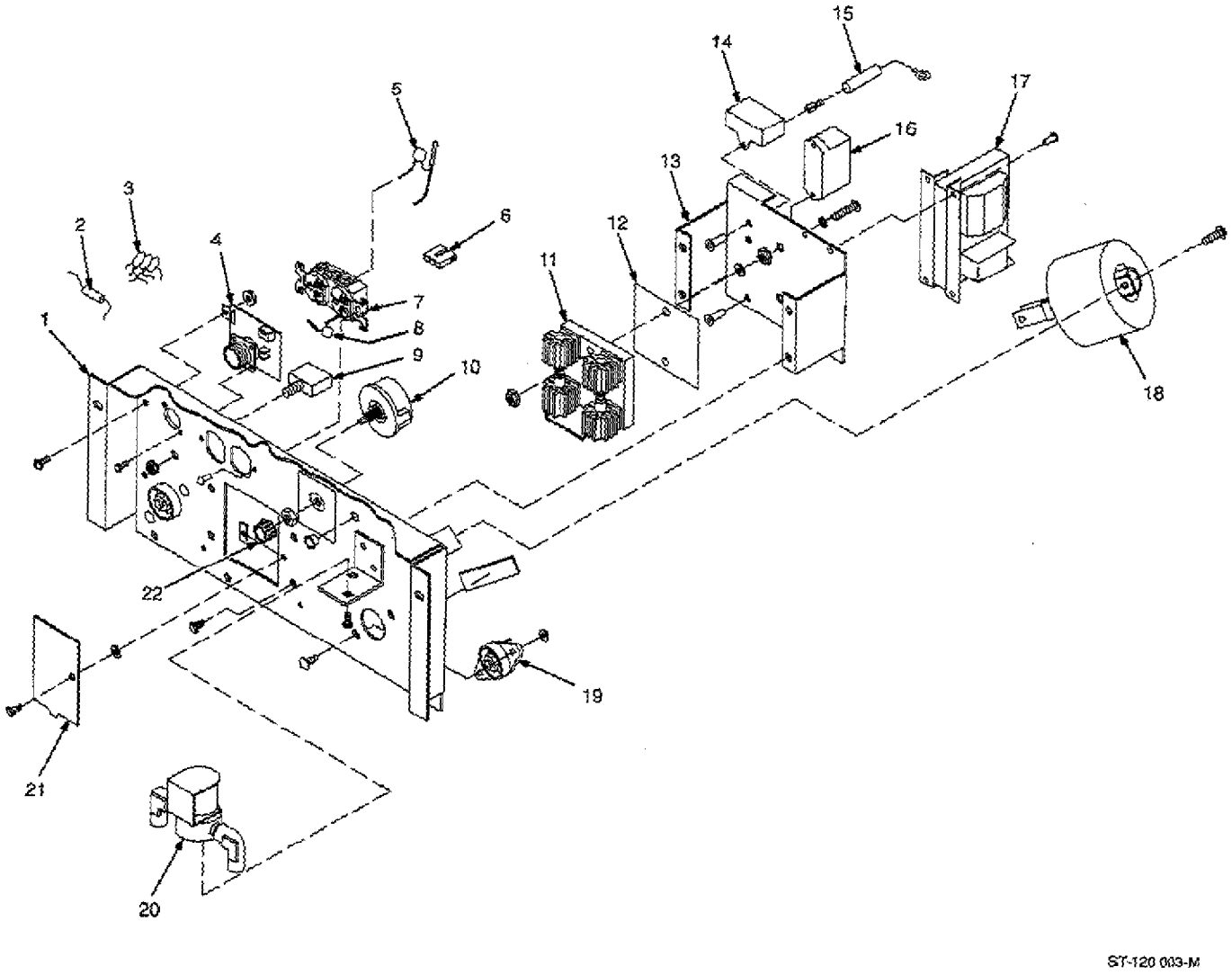

Figure 7-6. Control Panel, Lower Front

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
		174 067	**Figure 7-6. Control Panel, Lower Front (Fig 7-2 Item 18)**	
... 1		171 652	PANEL, front lower	1
... 2		137 429	RESISTOR, C2 W .3K	1
... 3		132 433	CAPACITOR, cer disc .05uf 500 VDC	3
... 4	PC2	157 959	CIRCUIT CARD ASSEMBLY, (consisting of)	1
.....	RC21	176 283	. RECEPTACLE ASSEMBLY, 6skt	1
.....		155 147	. CONNECTOR, rect univ 39 6 pin 3 row	1
... 5		164 290	CAPACITOR, polyp film .01uf 500VDC	1
... 6		131 198	CONNECTOR, rect mini .045 3skt 1 row	1
... 7	RC1	604 176	RECEPTACLE, str dx grd 15A 125V	1
... 8	C15	170 920	CAPACITOR	1
... 9		093 995	CIRCUIT BREAKER, man reset 1P 15A 250VDC	1
.. 10		174 037	RHEOSTAT, WW 50W 1.5 ohm	1
.. 11	G	020 623	SPARK GAP ASSEMBLY	1
.. 12		097 712	STRIP, insulator	1
.. 13		174 070	BRACKET, mounting components	1
.. 14	C3	106 935	CAPACITOR, polyp met film	1
.. 15	R8	181 107	RESISTOR ASSEMBLY, w/leads	1
.. 16	C4	096 761	CAPACITOR, mica .002uf 10,000V panel mtg	1
.. 17	T2	074 398	TRANSFORMER, high voltage 115V	1
.. 18		174 692	COIL, HF coupling	1
.. 19		039 047	TERMINAL, pwr output (consisting of)	2
.....		601 976	. SCREW, stl hexhd .500-13 x 1500	1
.....		039 049	. TERMINAL BOARD, red	1
.....		601 880	. NUT, stl hex jam .500-13	1
.....		039 044	. BUS BAR, term bd	1
.....		601 879	. NUT, stl hex full fnsh .500-13	1
.. 20	GS1	174 036	VALVE, w/fitting and leads (consisting of)	1
.....		035 601	. VALVE, 115VAC 2 way	1
.....		010 296	. FITTING, pipe brs elbow 1/4NPT x .625-18R	2
.....		113 746	. CONNECTOR, rect mini .045skt 24-18ga	1
.. 21		174 038	PANEL, door access HF	1
.. 22		097 922	KNOB, pointer .875dia x .250 ID w/set screw	1

*Recommended Spare Parts
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

OPTIONS AND ACCESSORIES

NO. 22 RUNNING GEAR
(#042 258)
Includes two 10 in. (254 mm) wheels and two 5 in. (127 mm) casters and a two–compartment rack for gas cylinder(s) or Watermate™ coolant system.

VOLTMETER AND AMMETER
(#042 140 Field)
Indicates AC and DC output. Meters mount in front panel.

PREFLOW TIMER
(#042 144 Field)
Provides 0 to 15 seconds of gas preflow time. On/Off switch included.

SPOT WELD TIMER
(#042 142 Field)
Adjustable 0 to 5.7 second time control for TIG spot welding. On/Off switch included.

POWER FACTOR CORRECTION
(#042 353 Field)

PC–300 PULSED GTAW CONTROL
(#042 297)
Can be used with power sources that have built–in high frequency, or it can be used with a power source and an external high–frequency unit. Includes 8 ft.(2.4 m) interconnecting cord and 115 VAC power cord. Front panel controls include:

- Peak Amperage Adjustment
- Background Amperage Adjustment
- Pulses–Per–Second Adjustment (0.5 to 20 pulses–per–second scale or 10 to 300 pulses–per–second scale)

Note: High scale not recommended when using Syncrowave power source.

- Percent On Time Control
- Amperage Remote/Panel Control
- Output Contactor On/Off Switch
- Pulser On/Off Switch
- Power On/Off Switch
- Remote Control Receptacle (for remote hand or foot controls)

REMOTE CONTROLS AND SWITCHES

RFC–14 FOOT CONTROL
(#129 339)
Heavy duty foot current and contactor control. Includes 20 ft. (6 m) cord and 14–pin plug.

RCC-14 REMOTE CONTACTOR AND CURRENT CONTROL
(#151 086)
Rotary motion fingertip control. Fastens to TIG torch using two Velcro strips. Includes 28 ft. (8.5 m) cord and plug.

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 plug.

RMLS-14 CONTACTOR SWITCH
(#129 337)
Push forward for maintained contact and back for momentary contact. Includes 20 ft. (6 m) cord and 14–pin plug.

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

EXTENSION CORDS
For 14–Pin Remote Controls

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

GAS TUNGSTEN ARC (TIG) WELDING BOOK
(#170 555)
A comprehensive text on all aspects of the GTAW process. Filled with figures and tables to illustrate process technique and equipment setup. Glossary of TIG terms also provided. 86 pages – 8-1/2 x 11 in.
To order, call Miller Literature Distribution Center at 1 (414) 751-2120, or FAX 1 (414) 751-2121.

VIDEO-GTAW SETUP PROCEDURES
(#108 241) 13:00 minutes
A detailed demonstration on preparing your equipment for TIG welding. Uses a Syncrowave 250 power source, but topics fit any TIG setup including air- or water-cooled systems. In-depth discussion of tungstens and gases.

WATER COOLANT SYSTEMS

For detailed information on Coolant Systems, refer to Literature Index No. AY/7.2.

RADIATOR 1A
(#042 492)
1/4 HP, 115 VAC, 50/60 Hz motor. 1.5 gal. (5.7 L) capacity.

RADIATOR 2A
(#042 493)
1/4 HP, 230 VAC, 50/60 Hz motor. 1.5 gal. (5.7 L) capacity.

WATERMATE™ 1A
(#042 495)
1/4 HP, 115 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
(For freezing protection)
(#128 705)
1 gal. (3.8 L). Contains 35% pure ethylene glycol and 65% deionized water.