FORM: OM-116

SPITFIRE
SL-225AC

MODEL/STOCK NO.	SERIAL/STYLE NO.	DATE PURCHASED

OWNER'S MANUAL

Forney

Ft. Collins Colorado U.S.A. Regina, Sask., Canada

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⚠ WARNING

ARC WELDING can be hazardous.

PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS KEEP AWAY UNTIL CONSULTING YOUR DOCTOR.

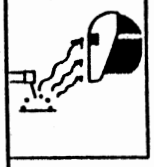
In welding, as in most jobs, exposure to certain hazards occurs. Welding is safe when precautions are taken. The safety information given below is only a summary of the more complete safety information that will be found in the Safety Standards listed on the next page. Read and follow all Safety Standards.

HAVE ALL INSTALLATION, OPERATION, MAINTENANCE, AND REPAIR WORK PERFORMED ONLY BY QUALIFIED PEOPLE.

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.

⚠ WARNING — ENGINES can be hazardous.

ENGINE EXHAUST GASES can kill.

Engines produce harmful exhaust gases.

1. Use equipment outside in open, well-ventilated areas.
2. If used in a closed area, vent engine exhaust outside and away from any building air intakes.

ENGINE FUEL can cause fire or explosion.

Engine fuel is highly flammable.

1. Stop engine and let it cool off before checking or adding fuel.
2. Do not add fuel while smoking or if unit is near any sparks or open flames.
3. Do not overfill tank – allow room for fuel to expand.
4. Do not spill fuel. If fuel is spilled, clean up before starting engine.

MOVING PARTS can cause injury.

Moving parts, such as fans, rotors, and belts can cut fingers and hands and catch loose clothing.

1. Keep all doors, panels, covers, and guards closed and securely in place.
2. Stop engine before installing or connecting unit.
3. Have only qualified people remove guards or covers for maintenance and troubleshooting as necessary.
4. To prevent accidental starting during servicing, disconnect negative (–) battery cable from battery.
5. Keep hands, hair, loose clothing, and tools away from moving parts.
6. Reinstall panels or guards and close doors when servicing is finished and before starting engine.

SPARKS can cause BATTERY GASES TO EXPLODE; BATTERY ACID can burn eyes and skin.

Batteries contain acid and generate explosive gases.

1. Always wear a face shield when working on a battery.
2. Stop engine before disconnecting or connecting battery cables.
3. Do not allow tools to cause sparks when working on a battery.
4. Do not use welder to charge batteries or jump start vehicles.
5. Observe correct polarity (+ and –) on batteries.

STEAM AND PRESSURIZED HOT COOLANT can burn face, eyes, and skin.

It is best to check coolant level when engine is cold to avoid scalding.

1. If the engine is warm and checking is needed, follow steps 2 and 3.
2. Wear safety glasses and gloves and put a rag over cap.
3. Turn cap slightly and let pressure escape slowly before completely removing cap.

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.

Table 2-1. Specifications

Model	Weld Current Ranges In Amperes		Rated Current Output at 25 Volts 20% Duty Cycle	Maximum Open-Circuit Volts	Input At Rated Load Output 60 Hertz Single-Phase					Weight	
					Amperes At						
	High	Low			230V	380V	460V	575V	kw	Net	Ship
Without P.F. Correction	40-225	30-150	225	80	45.5	27.5	22.7	18.2	7.2	100 lb. (45 kg)	105 lb. (48 kg)
With P.F. Correction	40-225	30-150	225	80	39.5	23.9	19.7	15.7	7.2	104 lb. (47 kg)	109 lb. (49 kg)

NOTE: "The power factor correcting capacitors supplied in this product contain no PCB's. The dielectric material is an OSHA Class III B fluid having a flash point of 440°F (227°C). Each individual capacitor is protected by an internal UL recognized pressure sensitive disconnect and an internal fuse."

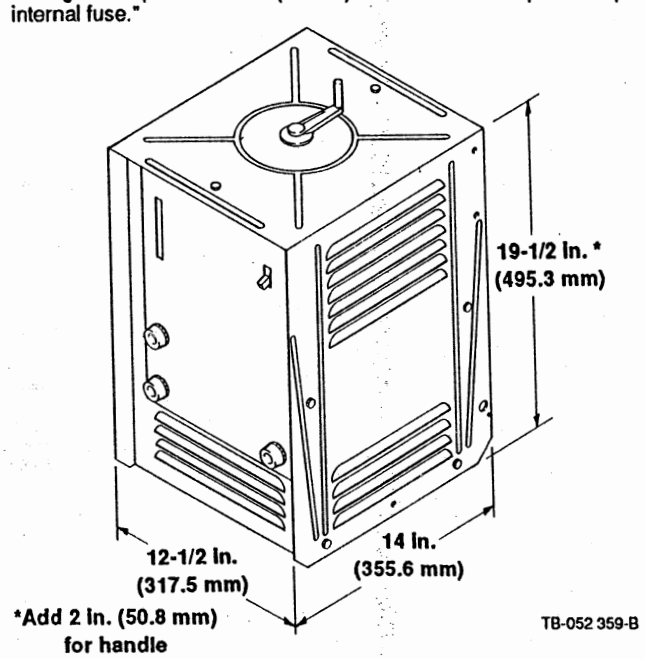


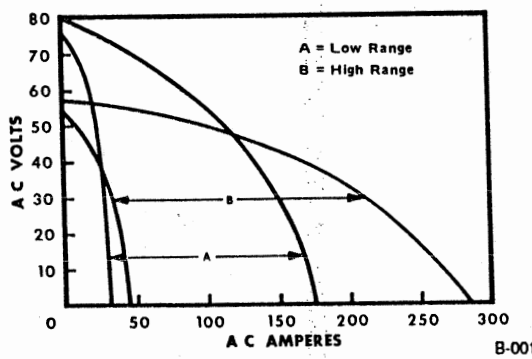
Figure 2-1. Overall Dimensions

2-1. VOLT-AMPERE CURVES (Chart 2-1)

RATED OUTPUT

The volt-ampere curves show the voltage and amperage output capabilities of the welding power source.

Chart 2-1. Volt-Ampere Curves



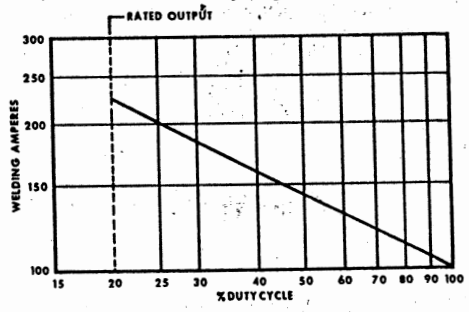
2-2. DUTY CYCLE (Chart 2-2)

The duty cycle of a welding power source is the percentage of a ten minute period that a welding power source can be operated at a given output without causing overheating and damage to the unit. This welding power source is rated at 20 percent duty cycle. This means the welding power source can be operated at rated load for two minutes out of every ten. For the remaining eight minutes, the unit should idle to permit proper cooling. If the welding amperes are decreased, the duty cycle will increase. Chart 2-2 enables the operator 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 cycle.*

Chart 2-2. Duty Cycle Chart



2-3. GENERAL INFORMATION AND SAFETY

A. General

Information presented in this manual and on various labels, tags, and plates provided on this 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.

Safety instructions specifically pertaining to this unit appear throughout this manual highlighted by the signal words **WARNING** and **CAUTION** which identify different levels of hazard.

WARNING statements include installation, operation, and maintenance procedures or practices which if not carefully followed could result in serious personal injury or loss of life.

CAUTION statements include installation, operation, and maintenance procedures or practices which if not carefully followed could result in minor personal injury or damage to this equipment.

A third signal word, **IMPORTANT**, highlights instructions which need special emphasis to obtain the most efficient operation of this equipment.

2-4. 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 the distributor and/or the equipment manufacturer's Transportation Department.

When requesting information concerning this equipment, always provide Model Description and Serial Number.

2-5. DESCRIPTION

This unit is a single-phase welding power source which produces ac welding current. It is designed to be used as the welding power source for the Shielded Metal Arc (SMAW) Welding process.

SECTION 3 – INSTALLATION

3-1. LOCATION

RESTRICTED AIR FLOW causes overheating and possible damage to internal parts.

- *Maintain at least 18 inches (457 mm) of unrestricted space on all sides of unit.*
- *Do not place any filtering device over the intake air passages of this welding power source.*

Warranty is void if any type of filtering device is used.

The service life and efficiency of this unit are reduced when the unit is subjected to high levels of dust, dirt, moisture, corrosive vapors, and extreme heat.

3-2. WELD OUTPUT CONNECTIONS (Table 3-1 And Figure 4-1)

RATED OUTPUT

To obtain the full rated output from this unit, it is necessary to select, install, and maintain proper welding cables. Failure to comply in any of these areas may result in less than satisfactory welding performance.

A. Welding Cables (Table 3-1)

Perform the following steps to ensure the best welding performance:

1. Keep cables as short as possible, and place cables close together. Excessive cable length adds resistance which may reduce output or cause overloading of the unit.
2. Use weld cable with an insulation voltage rating equal to or greater than the maximum open-circuit voltage (OCV) of the welding generator (see Table 2-1 for maximum OCV rating).

Table 3-1. 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

*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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3. Select adequate size welding cable for the anticipated maximum weld amperage. Use total length of welding cables in the circuit to determine cable size. For example, if the electrode holder cable is 75 feet (23 m) long and the work cable is 25 feet (8 m) long, select the size cable recommended in Table 3-1 for 100 ft (31 m).
4. Do not use damaged or frayed cables.
5. Install lugs of adequate size and amperage capacity onto ends of cables for connecting to work clamp and electrode holder.
6. Install electrode holder onto cable following manufacturer's instructions. An insulated electrode holder must be used to ensure operator safety.
7. Install work clamp onto cable.
8. Install jack plugs onto cables as instructed in Subsection B.

B. Jack Plug Installation (Figure 3-1)

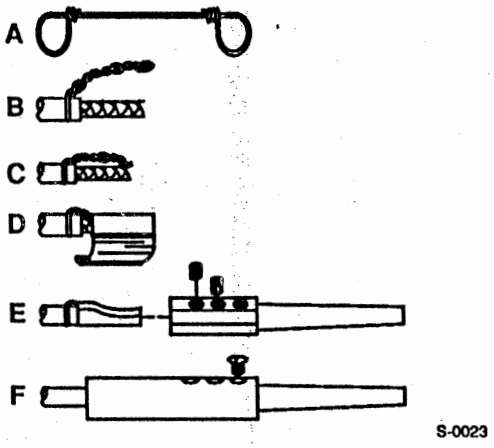
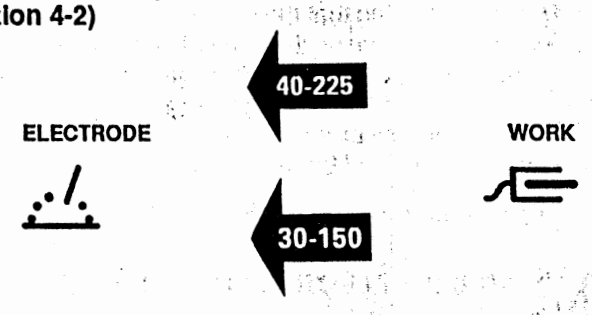


Figure 3-1. Jack Plug Installation

1. Remove 1 inch (25.4 mm) of insulation from one end of each welding cable.
2. Clamp cable in a vise with the uninsulated end extending upward out of vise approximately 1-3/4 inches (44.5 mm).
3. Place steel tie wire (item A) approximately 1/4 inch (6.4 mm) from end of insulation.
4. Make a half turn around the cable bringing looped ends of tie wire together.
5. Insert a 3/8 inch (9.5 mm) diameter rod through looped ends of tie wire.
6. Twist tie wire (B) until entire tie wire is twisted and is tight around insulation of cable.
7. Cut off looped ends of tie wire.
8. Bend the twisted tie wire over and along the side (C) of uninsulated portion of cable.
9. Wrap the strip of copper foil tightly around uninsulated end of cable and twisted tie wire (D).
10. Push the jack plug onto cable over copper foil (E).
11. Insert the 1/4-20 setscrews into the center and bottom holes in jack plug and tighten (E).
12. Remove cable from vise, and insert jack plug into insulating sleeve. Slide insulating sleeve over jack plug and cable until hole in insulating sleeve lines up with remaining hole in jack plug (F).
13. Insert the 8-32 self-tapping screw (F) through hole in insulating sleeve into jack plug and tighten.

C. Weld Output Connections (Figure 4-1 And Section 4-2)



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.

- *Be sure that unit is completely shut down before making weld output connections.*
- *Do not change position of the welding cable jack plugs while welding.*
- *Be sure jack plugs are secure in correct receptacles before welding.*

IMPORTANT: *For welding applications requiring less than 150 amperes, use the ELECTRODE 30-150 amperage range rather than the ELECTRODE 40-225 amperage range since better arc characteristics are obtained due to higher open-circuit voltage (see Section 4-2).*

1. ELECTRODE 40-225 Weld Output
   a. Insert electrode cable jack plug into ELECTRODE 40-225 receptacle, and rotate plug 1/4 turn clockwise.
   b. Insert work cable jack plug into WORK receptacle, and rotate plug 1/4 turn clockwise.
2. ELECTRODE 30-150 Weld Output
   a. Insert electrode cable jack plug into ELECTRODE 30-150 receptacle, and rotate plug 1/4 turn clockwise.
   b. Insert work cable jack plug into WORK receptacle, and rotate plug 1/4 turn clockwise.

IMPORTANT: *To remove jack plugs from receptacles, rotate 1/4 turn counterclockwise while withdrawing plug.*

3-3. ELECTRICAL INPUT CONNECTIONS (Table 3-2 And Figure 3-2)

INPUT

A. Electrical Input Requirements

This welding power source is designed to be operated from a single-phase, 60 Hertz, ac power supply which has a line voltage rating that matches one of the electrical input voltages shown on the nameplate or input data label. Consult the local electric utility if there is any question about the type of electrical system available at the installation site or how proper connections to the welding power source should be made.

B. Input Conductor Connections

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.*

The input circuit 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.

- *Employ lockout/tagging procedures on input line before making input connections to the welding power source.*

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

- *Connect input conductors to the welding power source before connecting to single-phase input power.*

Table 3-2. Input Conductor And Fuse Size

Model	Input Conductor Size AWG*			
	230V	380V	460V	575V
W/O PFC	10 (12)	12 (14)	14 (14)	14 (14)
W/PFC	12 (12)	12 (14)	14 (14)	14 (14)

Model	Fuse Size In Amperes			
W/O PFC	230V	380V	460V	575V
W/PFC	90	60	45	35

*Input conductor sizes are used on National Electrical Code specifications for allowable ampacities of insulated copper conductors, having a temperature rating of 75°C, with not more than three conductors in a raceway or cable. Numbers in ( ) are equipment ground conductor sizes.

Table 3-2 provides guidelines for selecting the proper size input conductors and line fuses. The input conductors should be covered with an insulating material that complies with national, state, and local electrical codes.

C. Wall Receptacle And Power Cable Connections (Figure 3-2)

All models are equipped with a three-conductor power cable.Models requiring 230 volts input are equipped with a three-prong polarized plug and wall receptacle. The wall receptacle should be installed in a convenient location by a competent electrician. Install wall receptacle with the grounding terminal at the top, allowing the power cable to hang downward, without undue bending or twisting.

Models having an electrical input voltage above 250 volts have prewired power cables with three conductors. The black and white conductors must be connected to the line terminals and the green conductor to a proper ground. Use a grounding method that is acceptable to the local electrical inspection authority.

WARNING: ELECTRIC SHOCK can kill.

- *Do not connect an input (white or black) conductor to the ground terminal.*
- *Do not connect the ground (green) conductor to an input line terminal.*

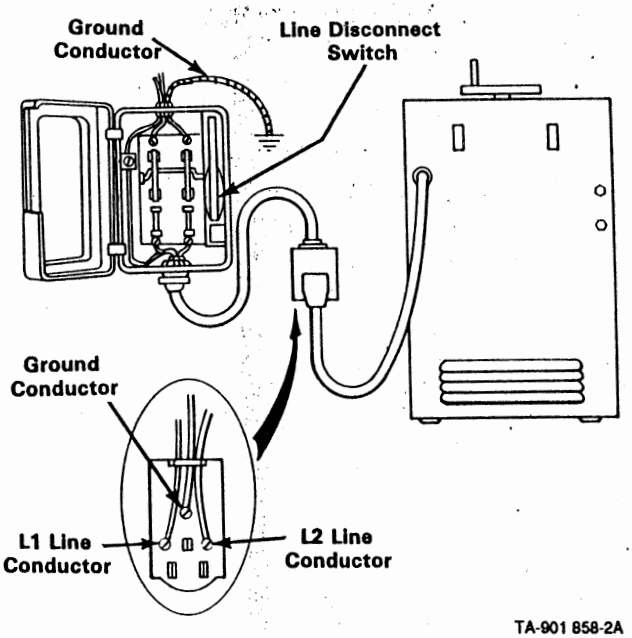


Figure 3-2. Input Conductor Connections

SECTION 4 – OPERATOR CONTROLS

4-1. POWER SWITCH (Figure 4-1)

Placing the POWER switch in the ON position energizes the welding power source. Placing the POWER switch in the OFF position shuts down the unit.

4-2. ELECTRODE RANGE RECEPTACLES (Figure 4-1)

The receptacles labeled ELECTRODE 40-225 and ELECTRODE 30-150 provide a selection of either a high amperage range (40 to 225 amperes) or a low amperage range (30 to 150 amperes). Refer to Section 3-2 to obtain desired welding amperage range.

4-3. AMPERAGE CONTROL (Figure 4-1)

The AMPERAGE Control provides selection of desired amperage within the selected ELECTRODE range. Rotating the control clockwise increases amperage output.

IMPORTANT: *The AMPERAGE Control may be adjusted while welding.*

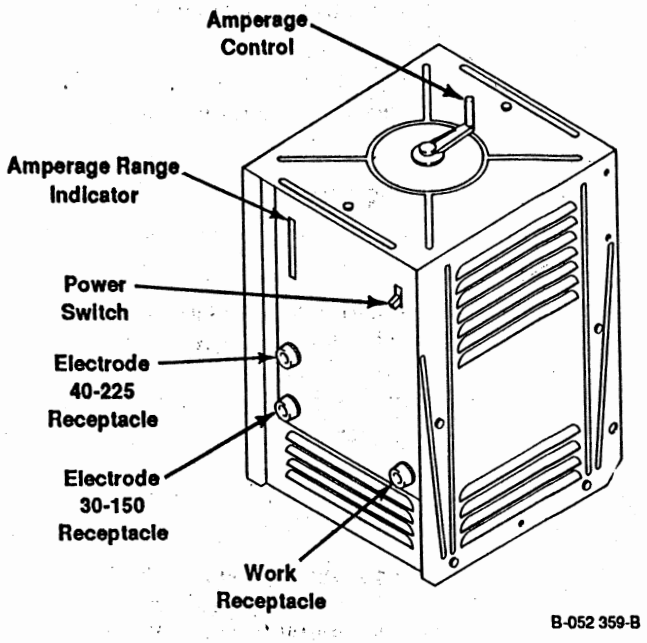


Figure 4-1. Control Location

4-4. AMPERAGE INDICTOR SCALE (Figure 4-1)

An indicator scale on the front panel displays the amperage selected by the AMPERAGE Control (see Section 4-3). The reading on the indicator will change when the AMPERAGE Control is rotated. When the electrode cable jack plug is in the ELECTRODE 40-225 receptacle, read the 40-225 indicator scale. When the electrode cable jack plug is in the 30-150 receptacle, read the ELECTRODE 30-150 indicator scale.

SECTION 5 – SEQUENCE OF OPERATION

WARNING: ELECTRIC SHOCK can kill; MOVING PARTS can cause serious injury; IMPROPER AIRFLOW 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.

- *Keep your head out of the fumes.*
- *Ventilate to keep from breathing fumes and gases.*
- *If ventilation is inadequate, use approved breathing device.*

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

- *Watch for fire.*
- *Keep a fire extinguisher nearby, and know how to use it.*
- *Do not use near flammable material.*
- *Allow work and equipment to cool before handling.*

MAGNETIC FIELDS FROM HIGH CURRENTS can affect pacemaker operation.

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

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

5-1. SHIELDED METAL ARC WELDING (SMAW)

1. Install and connect unit as instructed in Section 3.
2. Rotate the AMPERAGE Control to the desired amperage (see Section 4-3).
3. Wear dry insulating gloves and clothing, and wear welding helmet with proper filter lens according to ANSI Z49.1.
4. Prepare for welding as follows:
   a. Connect work clamp to clean, bare metal at workpiece.
   b. Select and obtain proper electrode, and insert into electrode holder.
5. Place the POWER switch in the ON position.
6. Begin welding.
7. Readjust the AMPERAGE Control if necessary. The AMPERAGE Control may be adjusted while welding.

5-2. SHUTTING DOWN

1. Stop welding.
2. Allow the welding power source to idle for 3 minutes with no load applied.
3. Place the POWER switch in the OFF position.

SECTION 6 – MAINTENANCE & TROUBLESHOOTING

6-1. ROUTINE MAINTENANCE

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 removing plug from receptacle, 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.*

Table 6-1. Maintenance Schedule

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

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

A. Fan Motor

This unit is equipped with an exhaust fan and relies on forced draft for adequate cooling. The fan motor bearings should be kept dirt-free. The fan motor requires no maintenance, and the oiling of bearings is not recommended.

IMPORTANT: *Warranty is void if unit failure is due to accumulation of dirt in components.*

B. Weld Cables

WARNING: Read and follow safety information at beginning of entire Section 6-1 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 6-1 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.

6-2. MOVABLE SHUNT (Figure 6-1)

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 removing plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

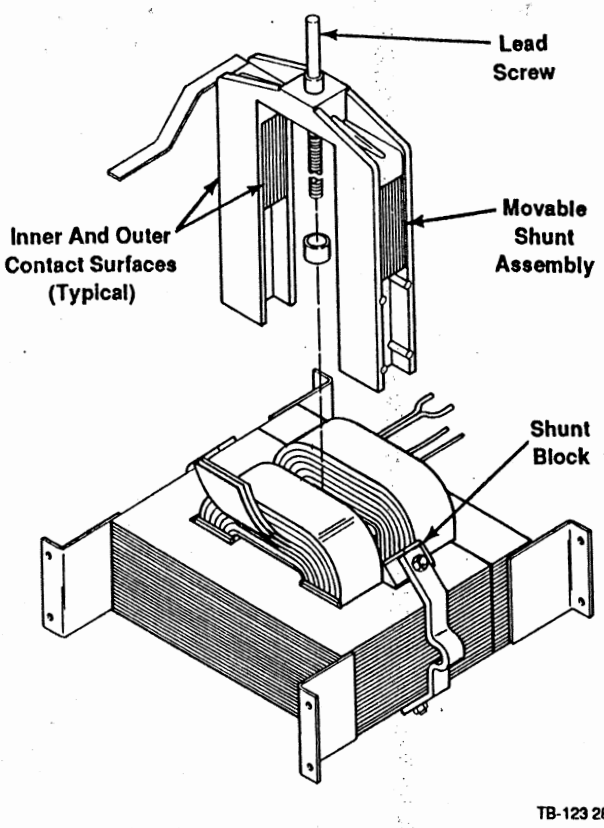


Figure 6-1. Movable Shunt Assembly

Annually lubricate the movable shunt as follows:

1. Remove wrapper.
2. Locate movable shunt assembly.
3. Wipe off contact surfaces on shunt block.
4. Apply a light coat of high temperature grease to the lead screw and contact surfaces of the shunt block.
5. Work movable shunt back and forth to spread grease evenly on parts.

IMPORTANT: *When lubricating lead screw and shunt block, be sure not to get grease on any other part of welding power source.*

6. Reinstall wrapper.

6-3. ANTI-NOISE BLOCK ADJUSTMENT (Figure 6-1)

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 removing plug from receptacle, padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

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

This adjustment is provided to compensate for vibration noises should they arise. This adjustment eliminates vibration noises by applying pressure against the movable shunt.

If it should become necessary to perform an anti-noise block adjustment, proceed as follows:

1. Remove the locking pin from the Amperage Control handle (pry up; slide out).
2. Remove the Amperage Control handle from shaft (slide off upward).
3. Remove screws, and lift wrapper off from unit.
4. Place Amperage Control handle back on shaft. (Handle needs to be in place to rotate the shaft when cleaning and lubricating the shunt.)
5. Slide locking pin into Amperage Control handle, and snap pin forward to lock it in place.

IMPORTANT: *Clean and lubricate the shunt before performing the following adjustment. (See Section 6-2).*

6. Locate the adjustment screws, and loosen locking nuts on each screw.

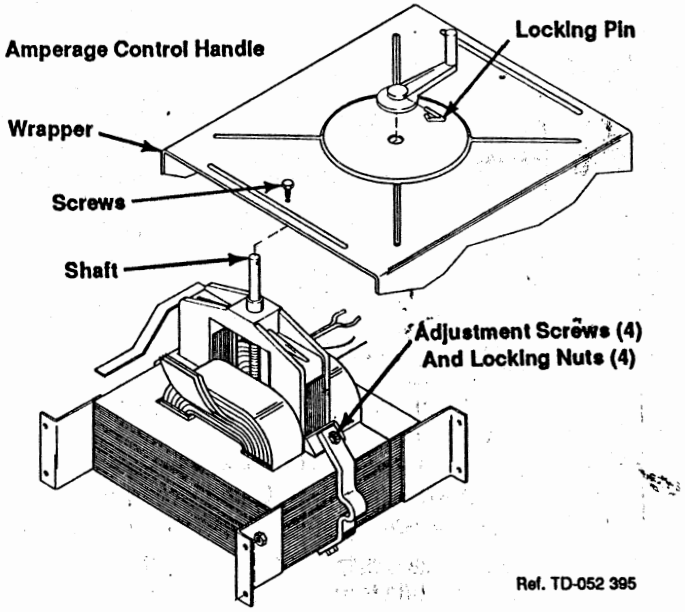


Figure 6-2. Location Of Anti-Noise Block Adjustment Screws

7. Use a screwdriver to tighten adjustment screws 1/4 turn.
8. Tighten locking nuts on screws.
9. Remove Amperage Control handle; install and secure wrapper; reinstall Amperage Control handle. Energize unit, and check for shunt noise.
10. If shunt noise is still present, repeat procedure, turning adjustment screws in 1/4 turn increments until the noise stops.

IMPORTANT: *Do not overtighten shunt. Overtightening the shunt can produce a hard cranking situation when the Amperage Control is rotated. If vibration noise*

cannot be eliminated without overtightening the shunt, call a serviceperson.

6-4. TROUBLESHOOTING (Table 6-2)

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 removing plug from receptacle, 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.*

Troubleshooting to be performed only by qualified persons.

It is assumed that the unit was properly installed according to Section 3 of this manual, the operator is familiar with the function of controls, the welding power source was working properly, and that the trouble is not related to the welding process.

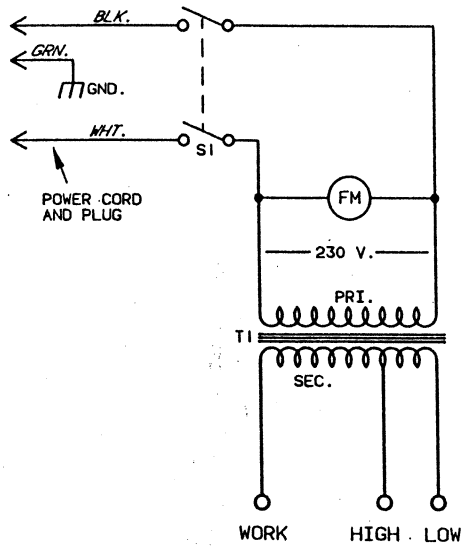
The following table is designed to diagnose and provide remedies for some of the troubles that may develop in this welding power source.

Use this table in conjunction with the circuit diagram while performing toubleshooting 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 6-2. Troubleshooting

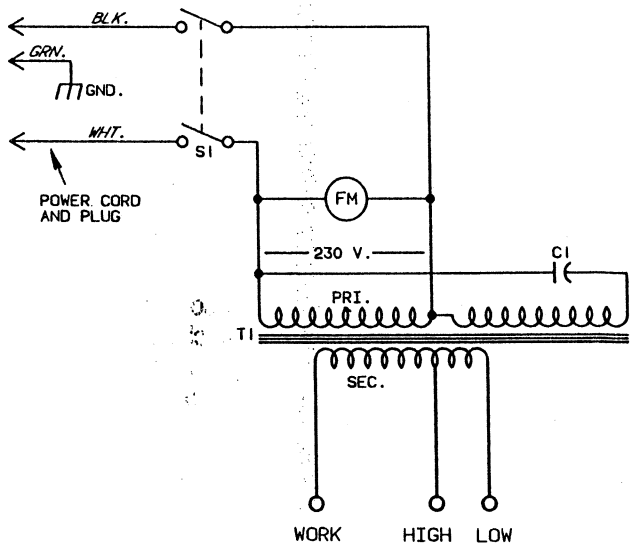
TROUBLE	PROBABLE CAUSE	REMEDY
No weld output; fan does not run.	Open line fuse.	Check line fuses and replace if open.
	POWER switch S1.	Replace S1.
Erratic weld current.	Loose welding connections.	Check welding connections. Make sure plugs fit properly into the WORK and ELECTRODE receptacles.
	Bad or damp electrodes.	Try different electrodes.
Fan does not run; weld output okay.	Fan motor FM	Check FM leads. If okay and fan motor turns freely, replace FM.
Arc hard to start; erratic arc.	Using wrong ELECTRODE receptacle.	The ELECTRODE 30-150 receptacle will provide better arc starting for some electrodes. Try both ELECTRODE receptacles.

SECTION 7 – ELECTRICAL DIAGRAMS



Circuit Diagram No. A-108 072

Diagram 7 -1. Circuit Diagram For Models Without Power Factor Correction



Circuit Diagram No. A-108 071

Diagram 7 -2. Circuit Diagram For Models With Power Factor Correction

SECTION 8 – PRINCIPLES OF SHIELDED METAL ARC WELDING

8-1 GENERAL

Shielded Metal Arc welding with a transformer welding machine depends upon the fundamental fact that when one side of the secondary welding circuit is attached to a piece of steel and the other side of the circuit is connected to an electrode, an arc will be established when the electrode touches the steel. If the arc is properly controlled, the metal from the electrode will pass through the arc and be deposited on the steel. When the electrode is moved along the steel at the correct speed, the metal will deposit a uniform layer called a bead. The electrodes used in welding are carefully manufactured to produce strong, sound welds. They consist of a core of steel wire, usually called mild since it contains a low (0.10-0.14) percentage of carbon. Around this core is applied a special coating which assists in creating the arc and at the same time protects the molten steel as it transfers across the arc.

In order to utilize these principles in shielded metal arc welding, some means of controlling the power is essential. The power in a welding circuit is determined by the voltage and current. The arc voltage is governed by the arc length and the electrode diameter. Therefore, the practical measure of the power or heat is in terms of the current, measured in amperes. A small electrode requires less current than a large one. To simplify operation, the scale on the front of the welding machine is marked off for the various current values.

The exact current required for a job depends upon the size of the pieces to be welded and the position of welding. Generally, a lower current will be sufficient for welding on a small part than would be necessary to weld on a large piece of the same thickness. Similarly, with a given size of electrode, a lower current should be used on thin metals than on the thicker sections. Most manufacturers of electrodes have ampere recommendation charts available.

Table 8-1. Current Requirements For Mild Steel Electrodes

Current Requirements For Mild Steel Electrodes

Electrode Diameter	Amperage	
	Min.	Max.
5/64	20	50
3/32	40	80
1/8	65	125
5/32	90	160
3/16	120	180

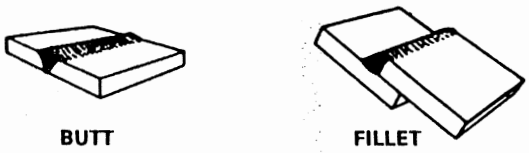


Figure 8-1. Flat Position Welds

While it is always easier to weld on work in the flat position, as shown in Figure 8-1, occasionally, it is necessary to weld in a horizontal, vertical, or overhead position as shown in Figure 8-2, Figure 8-3, and Figure 8-4, respectively. Generally, under these conditions it is helpful to reduce the current from the value used on welding in the flat position.

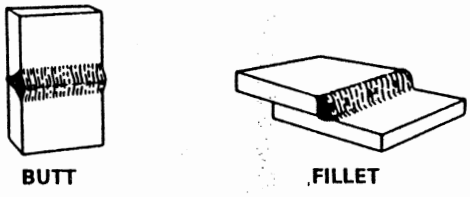


Figure 8-2. Horizontal Position Welds

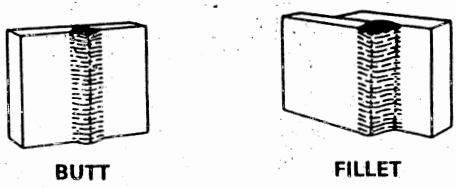


Figure 8-3. Vertical Position Welds

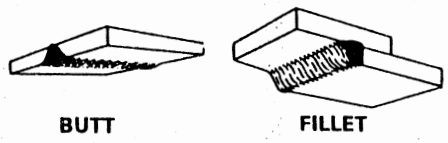


Figure 8-4. Overhead Position Welds

8-2. STRIKING THE ARC-RUNNING BEADS

In learning to weld there are certain fundamental steps which must be mastered before one can attempt to weld on actual work. Prior to striking an arc, insert the electrode in the holder as shown in Figure 8-5. To strike an arc, Figure 8-6 illustrates what is commonly known as the "scratch start technique". In this method the striking end of the electrode is dragged across the work in a manner much the same as striking a match. When the electrode touches the work, the welding current starts. If held in this position, the electrode would "freeze" or weld itself to the work. To overcome this, the electrode should be slightly withdrawn from the work immediately after contact has been made. The distance that the electrode is withdrawn is small and depends upon the diameter of the electrode; this distance is known as the arc length. If in striking an arc, the electrode freezes, it may be freed by a quick twist of the wrist.

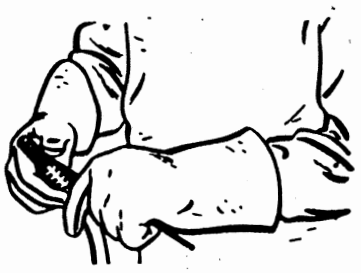


Figure 8-5. Electrode Insertion

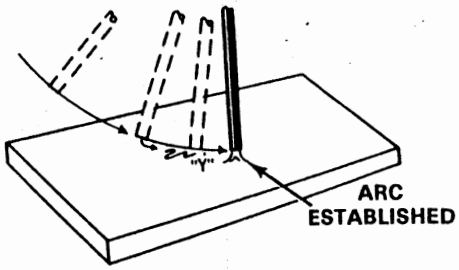


Figure 8-6. Arc Initiation – Scratch Start Technique

Another method of establishing the arc is known as the "tapping method" as shown in Figure 8-7. The electrode is brought straight down on the work and immediately after contact, is withdrawn to the proper arc length.

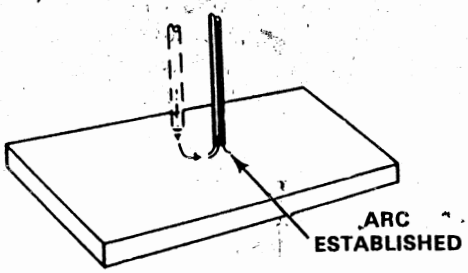


Figure 8-7. Arc Initiation – Tapping Technique

Practice striking the arc using both methods. Generally the scratch method is preferred for arc welding.

Determination of the correct arc length is difficult since there is no ready means of measuring it. As a preliminary guide, use about 1/16" arc length on 1/16" and 3/32" electrodes; for 1/8" and 5/32" electrodes use about 1/8" arc length. As skill is acquired, the sound of the arc will be a good guide. A short arc with correct current will give a sharp, crackling sound.

A portion of the electrode coating forms a protective coating called slag over the deposited weld metal. To examine the weld, remove the slag from the weld with a chipping hammer.

Once the knack of establishing and holding an arc has been learned, the next step is learning to run a good weld bead. In the beginning it is best to run beads of weld metal on flat plates using a full electrode. Practice moving from left to right and from right to left. The electrode should be held less than perpendicular to the work, tilting it in the direction of travel. The correct position is shown in Figure 8-8.

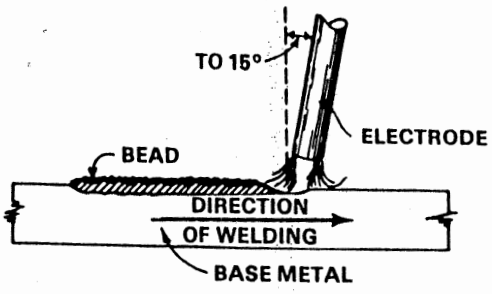


Figure 8-8. Electrode Position

A proper weld bead is illustrated in Figure 8-9. This shows a cross-section through the bead and identifies the various terms used in describing a weld. To produce these results it is necessary to hold a short arc, travel at a uniform speed, and feed the electrode downward at a constant rate as it melts.

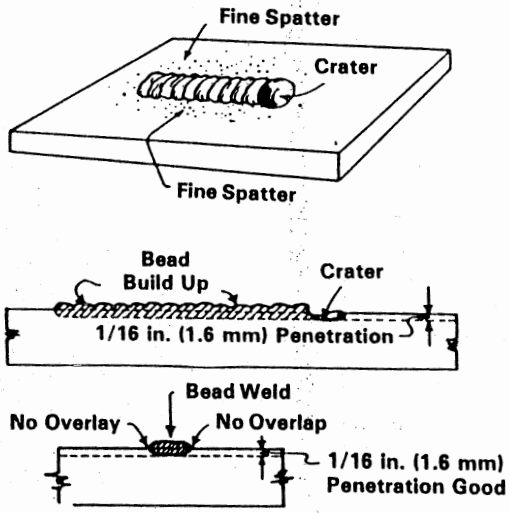


Figure 8-9. Proper Weld Bead

Probably the first attempts in the practice will fall short of the results shown. Too long an arc will be held or the travel speed will vary from slow to fast and the welds will look as illustrated in Figure 8-10 showing a cross section through a poor weld bead. In addition, the weld will probably be spongy (porous) and of low strength.

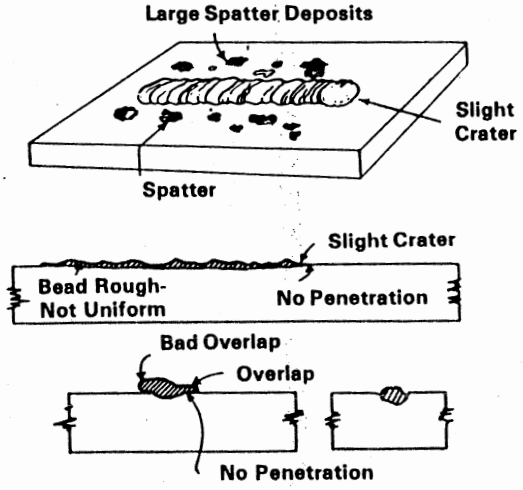


Figure 8-10. Poor Weld Bead

Continue practicing until uniform beads as shown in Figure 8-9 can be produced. A good method of practicing is to deposit a series of beads, one next to the other until the plate is covered. The slag must be thoroughly removed between each pass. Then deposit another series of beads at right angles to the first, thus binding up the plate to a greater thickness.

8-3. WEAVING

When it is necessary to cover a wider area in one pass of the electrode, a method known as weaving is employed. In this the electrode is moved or oscillated from side to side in a set pattern. In order to be sure of uniform deposits, it is necessary to use a definite pattern such as those illustrated in Figure 8-11. While weaving is helpful, particularly when building up metal, it should be limited to weaves not exceeding 2-1/2 times the diameter of the electrode.

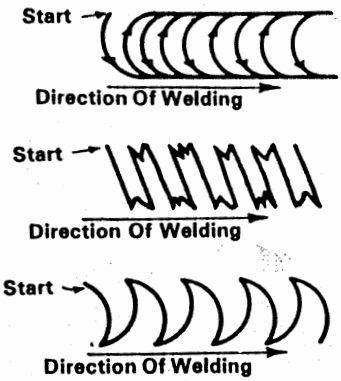


Figure 8-11. Weave Patterns

8-4. BUTT JOINTS

Up to this point the discussion has covered only the deposit of beads on flat plate. Such operations are helpful in building up worn parts or applying hardfacing materials. The next step is learning to weld two pieces of metal together. For this purpose, other types of welds are illustrated in Figure 8-12.

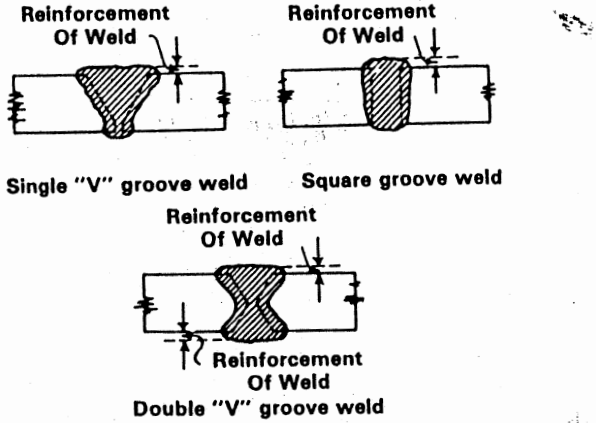


Figure 8-12. Butt Joint Welds

In making weld beads previously described, it was probably noted that depositing weld metal on one side of the plate, caused it to "curl" up towards the weld; this is called distortion and will almost always be found when heat is applied locally to a metal plate. Similarly in making a butt weld, distortion will cause the edges of the

plate to draw together ahead of the electrode travel. This is caused by the contraction of the deposited weld metal on cooling. This may be overcome by spreading the edges of the joint apart on a taper of about 1/8" per foot.

Another procedure to avoid metal movement caused by weld heat is to make short welds, tying the two pieces together at spaced intervals. This is known as tack welding and holds the metal in position for welding.

In making welds in a butt joint, preparation of the edges may be necessary to insure good results. In shielded metal arc welding it is a common practice to weld thin materials up to 3/16" thick without any special preparation using the square groove butt joint. For thickness of 3/16" and over, either the single or double "V" groove is employed. Generally the single "V" groove will be satisfactory on thicknesses up to 3/4", regardless of thickness, where one can work on the weld from one side only.

One method for beveling steel for "V" groove welding is by means of using an oxyacetylene cutting torch. The work may be done with a hand guided torch or special oxyacetylene cutting machine. However, in performing this cutting, a scale will develop on the plates. This must be removed by grinding or chipping before welding as it is likely to become entrapped in the weld bead and produce an unsound weld. Where oxyacetylene cutting equipment is not available, grinding will probably be the best means of preparing bevels. The angles of these bevels should be about 30 degrees and the bottom edge may be left square for a distance of about 1/16". See Figure 8-13.

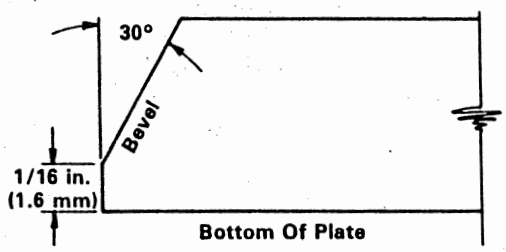


Figure 8-13. Single Bevel

Practice making butt welds starting on thin material about 1/8" thick (avoid very thin material, around 1/16" thick, in the beginning as this requires a fair degree of skill). Separate the squared edges of the 1/8" material about 1/16" and make a butt weld all the way through with a 1/8" electrode. Probably the first attempt will either fail to penetrate the sheet or burn through it. Keep trying, adjusting the current within the recommended range; also vary the electrode travel speed to give the desired weld. Having mastered 1/8" thick metal, proceed to a similar exercise on 1/4" thick metal. This time, however, deposit a bead on each side of the joint and try to fuse one to the other. Since the weld from one side is in effect an 1/8" thickness, no bevel is needed.

Next make a single "V" groove on 1/4" plate beveled .30 degrees. Start with a 1/8" electrode at the bottom of the groove and finish over that with a 5/32" electrode. Be sure to penetrate about 1/32" beyond the bottom of the "V" (called the root). When skill has been acquired on the 1/4" material, proceed to 3/8" and then to 1/2", also make the double "V" groove butt joints. Generally speaking, it will be necessary to deposit a bead or layer for each 1/8" thickness. On the heavier plates, weaving the top layers may be necessary to fill the groove completely.

When making practice butt welds it is wise to check the results occasionally. Where elaborate testing equipment is not available, this may be done with a hammer and vise.

Caution should be observed in handling welded pieces of metal, since heat absorbed by the metal is intense and can cause serious burns.

Grip a short, welded piece with the weld just above the jaws of the vise. Hammer it in a direction than tends to open the bottom root side of the weld, in the manner shown in Figure 8-14. A good weld will not break under this test, but will bend over. If the weld breaks, examine it to determine the cause. If there are a large number of holes (the weld looks spongy) it is porous. This is probably due to holding too long an arc. If there are bits of slag in the weld perhaps the arc was too short or the electrode was manipulated incorrectly thus permitting molten slag from the electrode coating to be trapped. This is quite likely to happen on a "V" joint made in several layers and calls for thorough cleaning between layers. Perhaps on breaking it will be found that the original surface of the bevel is still evident. That means that is was not melted and the cause is quite likely to be found in too fast a travel speed or insufficient heat.

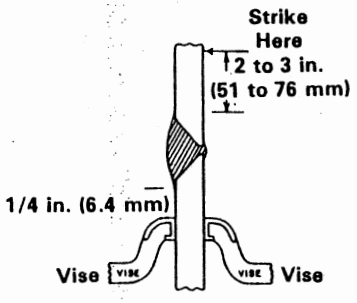


Figure 8-14. Weld Test

8-5. TEE AND LAP JOINTS

The other basic type of weld, the fillet weld, is used for making tee and lap joints. For this type of welding, no special preparation, other than squared edges, is necessary. Typical welded tee and lap joints are pictured in Figure 8-15 and Figure 8-16 respectively.

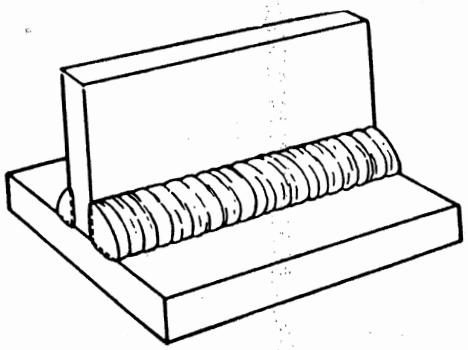


Figure 8-15. Tee Joint

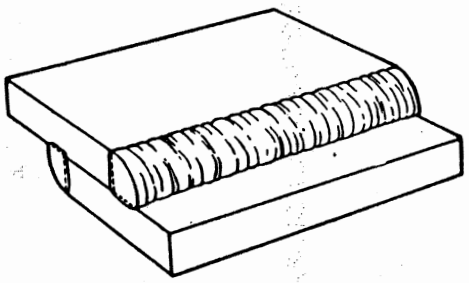


Figure 8-16. Lap Joint

Considering the tee joint first, it will be seen immediately that the position of the pieces requires a different method of electrode manipulation than for a butt weld. The method of holding the electrode for butt welds will not be satisfactory.

To deposit a single pass fillet weld, hold the electrode as shown in Figure 8-17. This will provide fusion into the corner and a fillet, the side of which will be approximately equal. For maximum strength a fillet weld should be deposited on each side of the upright section. When a heavier fillet is needed, deposit a second layer as indicated in Figure 8-18, using any of the weaving patterns shown in Figure 8-19.

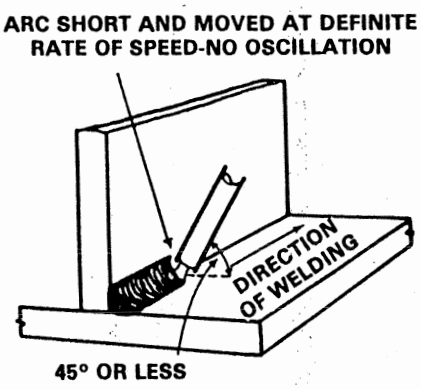


Figure 8-17. Tee Joint Fillet Weld

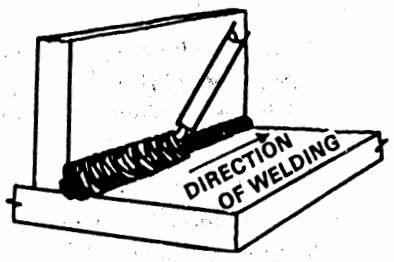


Figure 8-18. Multi-Layer Deposits – Tee Joint

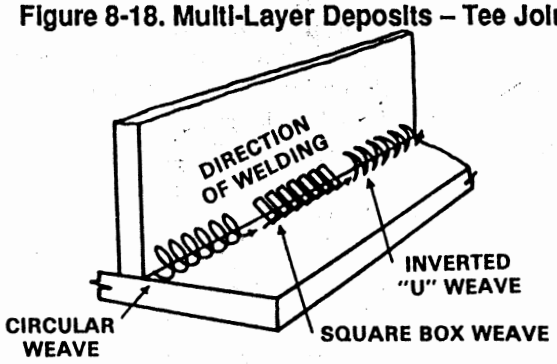


Figure 8-19. Tee Joint Fillet Weld Weave Patterns

The lap joint, while involving the same fundamental weld type, the fillet, has metal distributed differently and therefore requires still another technique. The details of the application are given in Figure 8-20, for a single pass weld. For a two pass weld, Figure 8-21 provides the details.

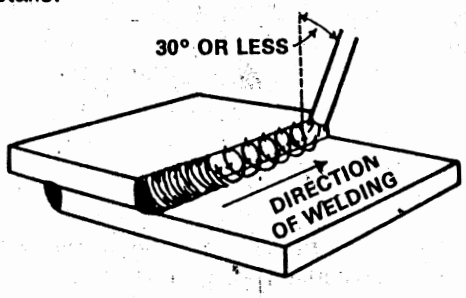


Figure 8-20. Lap Joint Fillet Weld

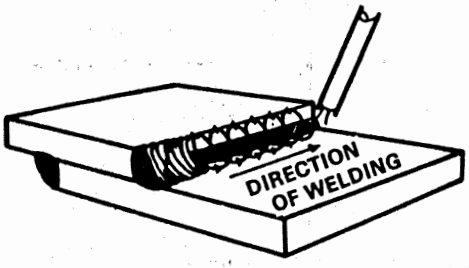


Figure 8-21. Multi-Layer Deposit Lay Joint

8-6. WELDING VERTICALLY, HORIZONTALLY, AND OVERHEAD

The importance of welding in the flat position, whenever possible, cannot be stressed too strongly. The quality of the weld is better, the operation easier and faster. However, occasions will arise when it is necessary to work on parts in a position in which welds must be deposited horizontally, vertically and overhead. It must be realized at the very beginning that welding in these positions is difficult and will require constant practice to develop skill.

As is the case of welding in the flat position, it is best to start practicing by first running weld beads in the various positions. Then as proficiency is gained on these operations, practice may be continued on butt and fillet welds (tee and lap joints) in these positions.

One of the first facts to be noted when welding in these positions is that the force of gravity tends to cause the molted metal to drip (fall) down. The technique used, therefore, must be acquired to overcome this. Start by making horizontal weld beads on plates inclined at 45 degrees as shown in Figure 8-22. When this has been mastered so that uniform beads can be made consistently, practice on welding vertically may be started. Again begin with an easy operation such as running beads vertically on plates set at 45 degrees. (See Figure 8-23.)

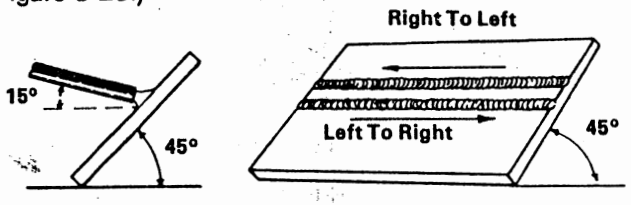


Figure 8-22. Horizontal Weld Beads – Inclined Plate

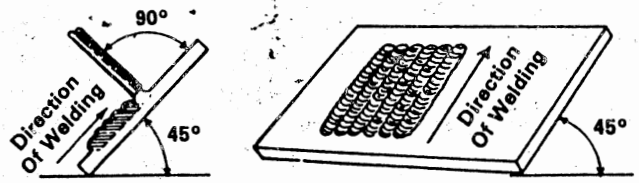


Figure 8-23. Vertical Weld Beads – Inclined Plate

To progress with this practice it is necessary now to move the plates into vertical position. The details of horizontal weld beads are given in Figure 8-24.

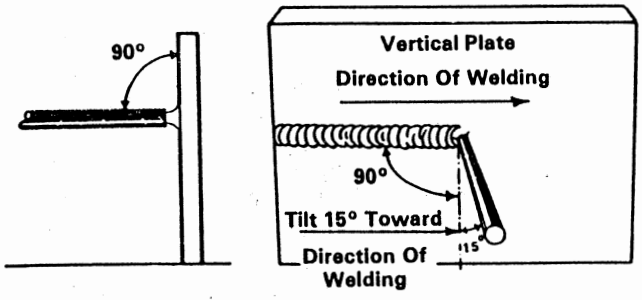


Figure 8-24. Horizontal Weld Beads – Vertical Plate

Welding vertically may be performed either by welding upward or starting from the top and welding down. It is generally conceded that working upward is easier and therefore, weld beads in this manner should be practiced. A method for making weave weld beads is illustrated in Figure 8-25.

Since single weld beads are of limited value, weaving weld beads must be practiced on butt welds in the vertical and horizontal positions.

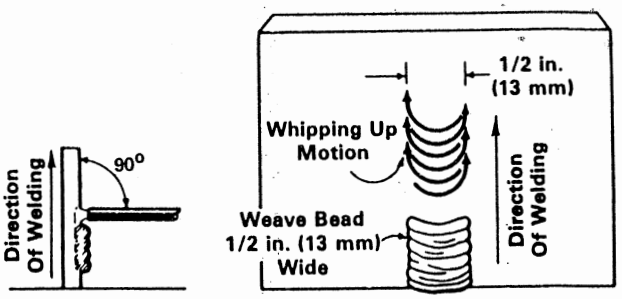


Figure 8-25. Weave Pattern – Vertical Plate

Figure 8-26 provides information suitable for single pass vertical butt weld or the first pass of a multiple layer deposit. Two methods of depositing the subsequent layers are given in Figure 8-27.

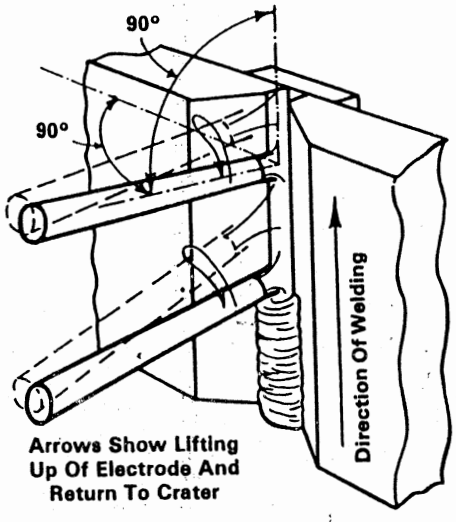


Figure 8-26. Single Pass Vertical Butt Weld

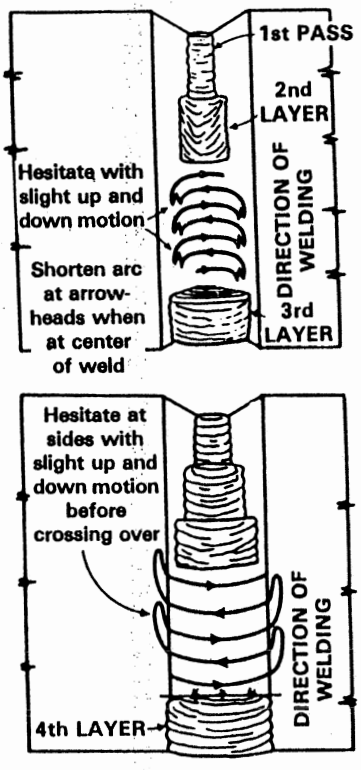


Figure 8-27. Multi-Layer Deposit Vertical Butt Weld

The details for horizontal welds are shown in Figure 8-28 and Figure 8-29. Note that a strip of metal is shown at the foot of the weld. This is known as the backing strip. Its use permits securing a sound root pass without great difficulty. In use, the beveled plate edges should be centered on the backing strip and the strip tack welded to the plates on the reverse side.

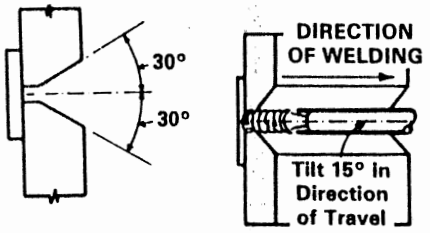


Figure 8-28. Root Pass

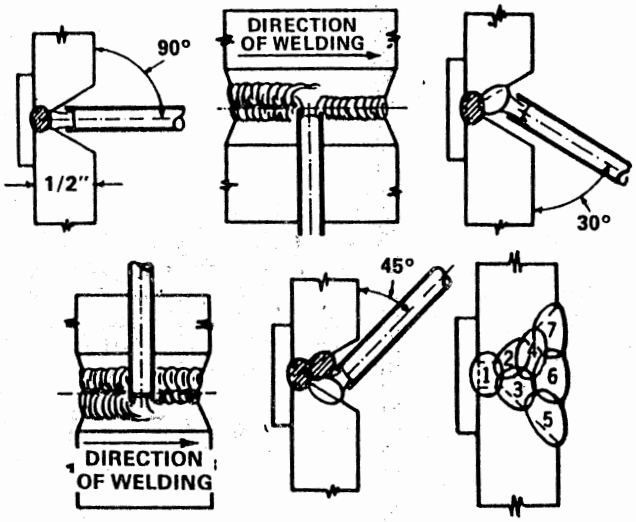


Figure 8-29. Multi-Layer Deposit – Horizontal Butt Weld

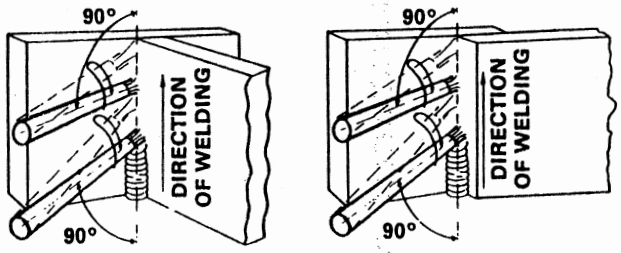


Figure 8-30. Fillet Weld – Vertical Tee Joint

For fillet welds on tee and lap joints the technique is shown in Figure 8-30. When depositing a multilayer fillet weld, the same method would be used to deposit the first layer on both lap and tee joints. For depositing subsequent layers on tee joints two means are used and are shown in Figure 8-31. For additional layers on lap joints a somewhat similar weave may be seen in Figure 8-32.

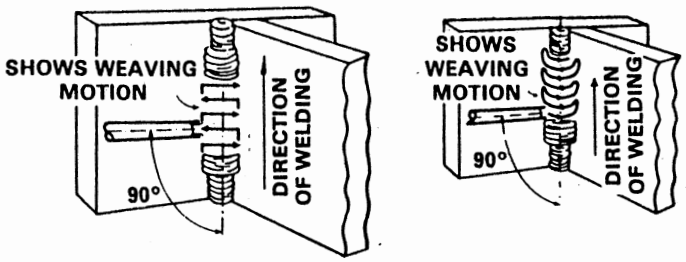


Figure 8-31. Multi-Layer Deposit – Tee Joint

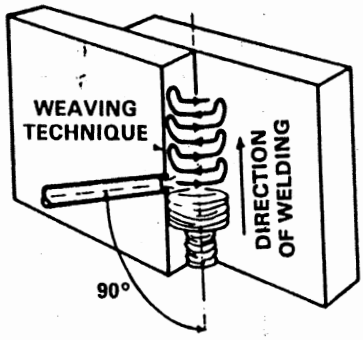


Figure 8-32. Multi-Layer Deposit – Lap Joint

Welding in the overhead position is the final problem to master. Again proceed through the steps of making weld beads, the making of butt welds and finally the making of fillet welds. For the electrode position of overhead welding Figure 8-33 will prove helpful. When weaving is necessary, the pattern in Figure 8-34 may be used. The technique for overhead butt welds is illustrated in Figure 8-35; this covers single pass welds or the first pass of multilayer welds. Subsequent beads may be deposited as shown in Figure 8-36. For depositing single layer fillets or the first layer of multiple fillets in the overhead position the technique in Figure 8-37 should be employed. The sequence for depositing beads on a multilayer fillet weld is provided in Figure 8-38. Note that single beads are recommended and for that reason use the same technique shown in Figure 8-37. Again the technique for fillet welds may be employed for welding lap joints.

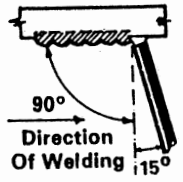


Figure 8-33. Electrode Position – Overhead Weld

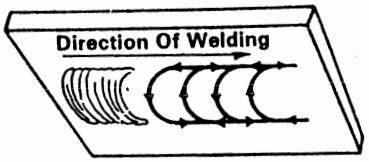


Figure 8-34. Weave Pattern – Overhead Weld

Figure 8-35. Overhead Butt Weld – Root Pass

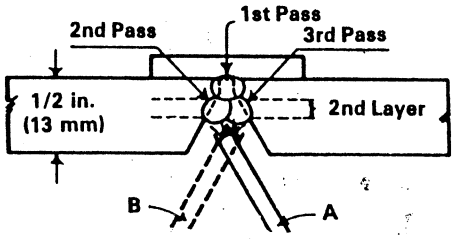


Figure 8-36. Multi-Layer Deposit – Overhead Butt Weld

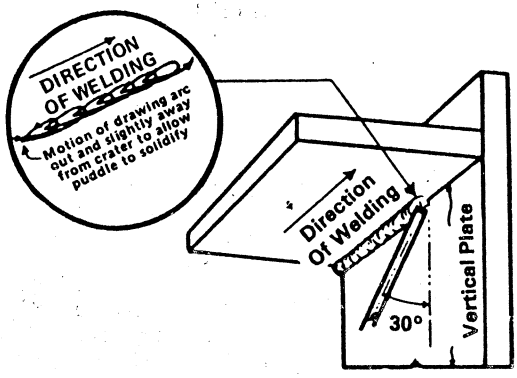


Figure 8-37. Overhead Weld Tee Joint – Single Pass

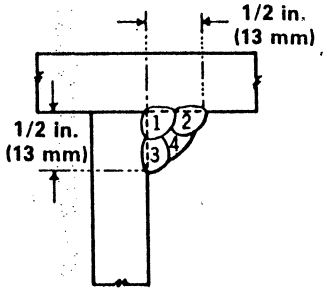


Figure 8-38. Multi-Layer Deposit – Overhead Tee Joint

8-7. CONCLUSION

It may be appreciated that no printed instruction can impart to the beginner all the skill necessary for successful welding. Personal instruction by an experienced welding operator is the best means for accomplishing this end. Therefore, an effort should be made to secure some facility for instruction and practice under competent supervision. In any event the beginner should at least secure the benefit of criticism of finished welds by a qualified welding operator.

SECTION 9 – PARTS LIST

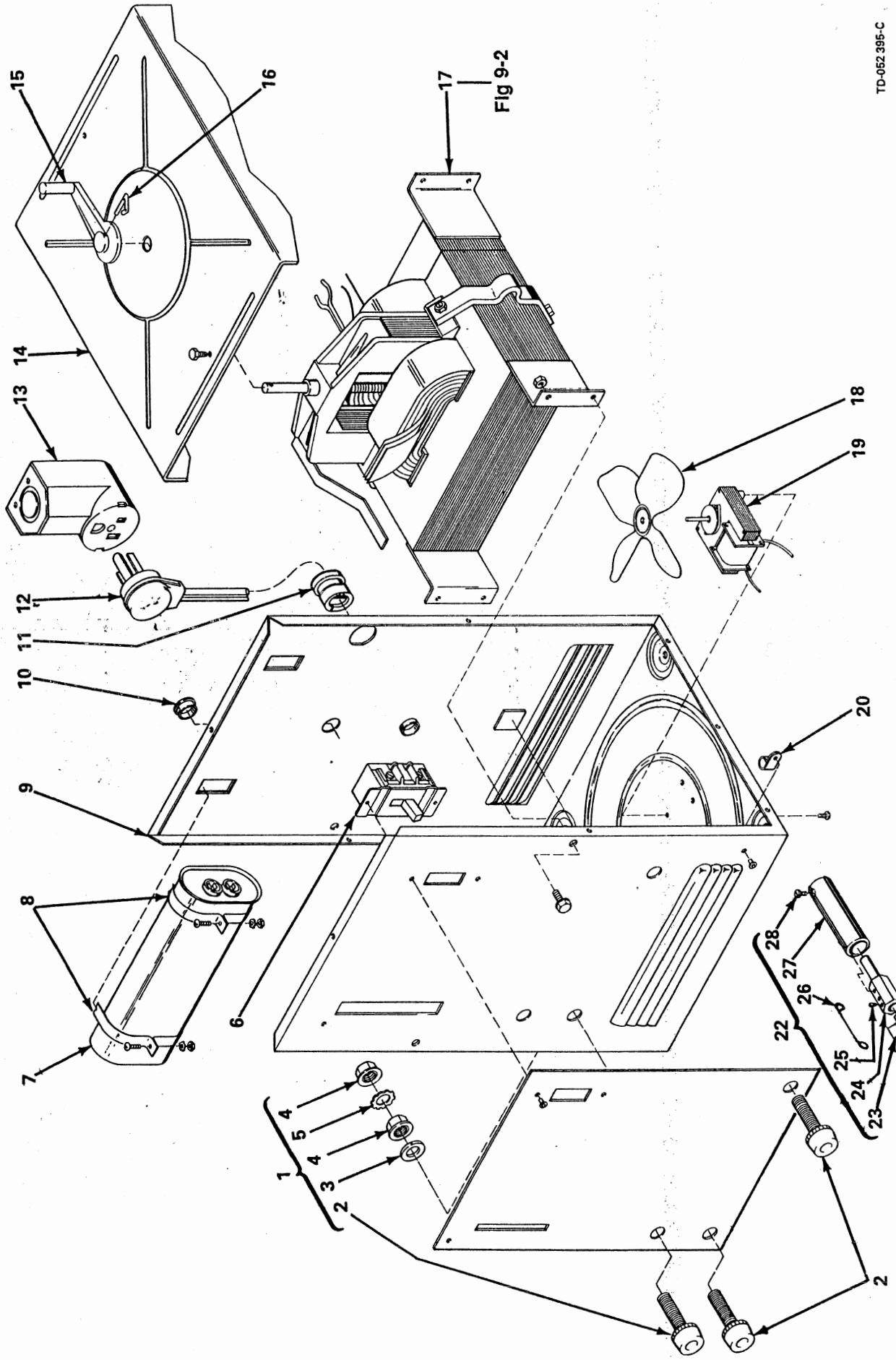


Figure 9-1. Main Assembly

Item No.	Dia. Mkgs.	Part No.	Description	Quantity Model Without PFC	Quantity Model With PFC
Figure 9-1			**Main Assembly**		
1		039 800	RECEPTACLE, jack-plug (consisting of)	3	3
2		091 541	· RECEPTACLE & NUT, red	1	1
3		010 291	· WASHER, flat - 5/8 ID x 1-1/4 OD x 1/8	1	1
4		604 668	· NUT, self-locking - hex 1/2-20	2	2
5		605 787	· WASHER, lock-internal tooth	1	1
6	S1	*090 328	SWITCH, toggle SPST 40 amp 600 volts (units over 250 volts) or		
6	S1	*025 864	SWITCH, toggle SPST 40 amp 250 volts (units 250 volts or under)	1	1
7	C1	059 417	CAPACITOR, paper oil 30 uf 460 volts ac		1
8		017 125	CLAMP, mtg-capacitor		2
9		088 372	CASE SECTION, base/front/rear	1	1
10		024 103	BLANK, snap-in 3/4 mtg hole	2	2
11		088 299	CONNECTOR, clamp-cable 1-1/8 mtg hole (115/230 volt units)	1	1
11		111 443	BUSHING, strain relief 7/8 mtg hole (200/230 volt units)	1	1
11		010 325	BUSHING, strain relief 3/4 x 840 mtg hole (units over 230 volts)	1	1
12		023 898	CORD SET, power 230 volts 10 ga 3C 6 ft (115/230 volt units)	1	1
12		088 297	CORD SET, power 300 volts 12 ga 3C 6 ft (200/230 volt units)	1	1
12		088 298	CORD, power 600 volts 14 ga 3/c 6 ft (units over 230 volts)	1	1
13		039 778	RECEPTACLE, straight 3P3W 50 amp 250 volts	1	1
14		+082 272	WRAPPER	1	1
		123 154	LABEL, general precautionary	1	1
15		009 433	HANDLE, control-current	1	1
16		009 926	PIN, handle-control current	1	1
17	T1	117 668	TRANSFORMER & SHUNT (230 volts) (Fig 9-2)	1	
17	T1	117 666	TRANSFORMER & SHUNT (380 volts) (Fig 9-2)	1	
17	T1	117 672	TRANSFORMER & SHUNT (460 volts) (Fig 9-2)	1	1
17	T1	117 667	TRANSFORMER & SHUNT (575 volts) (Fig 9-2)	1	
17	T1	117 664	TRANSFORMER & SHUNT (230 volts) (Fig 9-2)		1
17	T1	117 671	TRANSFORMER & SHUNT (380 volts) (Fig 9-2)		1
17	T1	117 673	TRANSFORMER & SHUNT (575 volts) (Fig 9-2)		1
18		005 656	BLADE, fan 6 inch 4 wing 30 deg	1	1
19	FM	008 825	MOTOR, fan 240 volts 50/60 hz 3000 rpm	1	1
20		010 142	CLAMP, 5/16 dia	2	2
21			NAMEPLATE (order by model & serial number)	1	1
22		039 608	PLUG ASSEMBLY, jack (consisting of)	2	2
23		019 833	· STRIP, copper	1	1
24		101 219	· PLUG, jack	1	1
25		602 178	· SCREW, set 1/4-20 x 3/8	2	2
26		010 521	· WIRE, tie	1	1
27		602 814	· INSULATOR, red	1	1
28		602 160	· SCREW, self tapping-fillister hd 8-32 x 1/4	1	1

*Recommended Spare Parts.
+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 Model Without PFC	Quantity Model With PFC
Figure 9-2			**Transformer & Shunt (Fig 9-1 Item 17)**		
1		080 522	BLOCK, anti-noise-shunt	4	4
2		604 992	NUT, hex double chamfer 5/16-18	4	4
3		080 425	SCREW, set-headless 5/16-18 x 1-1/2	4	4
4		112 569	INSULATION, coil-secondary	2	2
5	SEC	112 488	COIL, secondary	1	1
6		119 962	SHUNT, transformer (Fig 9-3)	1	1
7	PR1	112 498	COIL, pri (230 volts)	1	
7	PR1	112 499	COIL, pri (380 volts)	1	
7	PR1	112 500	COIL, pri (460 volts)	1	1
7	PR1	112 945	COIL, pri (575 volts)	1	
7	PR1	112 492	COIL, pri (230 volts)		1
7	PR1	112 503	COIL, pri (380 volts)		1
7	PR1	112 491	COIL, pri (575 volts)		1
8		112 573	INSULATION, coil-primary	2	2
9		605 129	SCREW, cap-hex hd 1/4-20 x 7	1	1
10		602 241	WASHER, flat-SAE 1/4	2	2
11		020 300	WEDGE, rear-removable	2	2
12		020 301*	GUIDE, wedge-rear	1	1
13		089 800	NUT, flange locking-hex 1/4-20	1	1

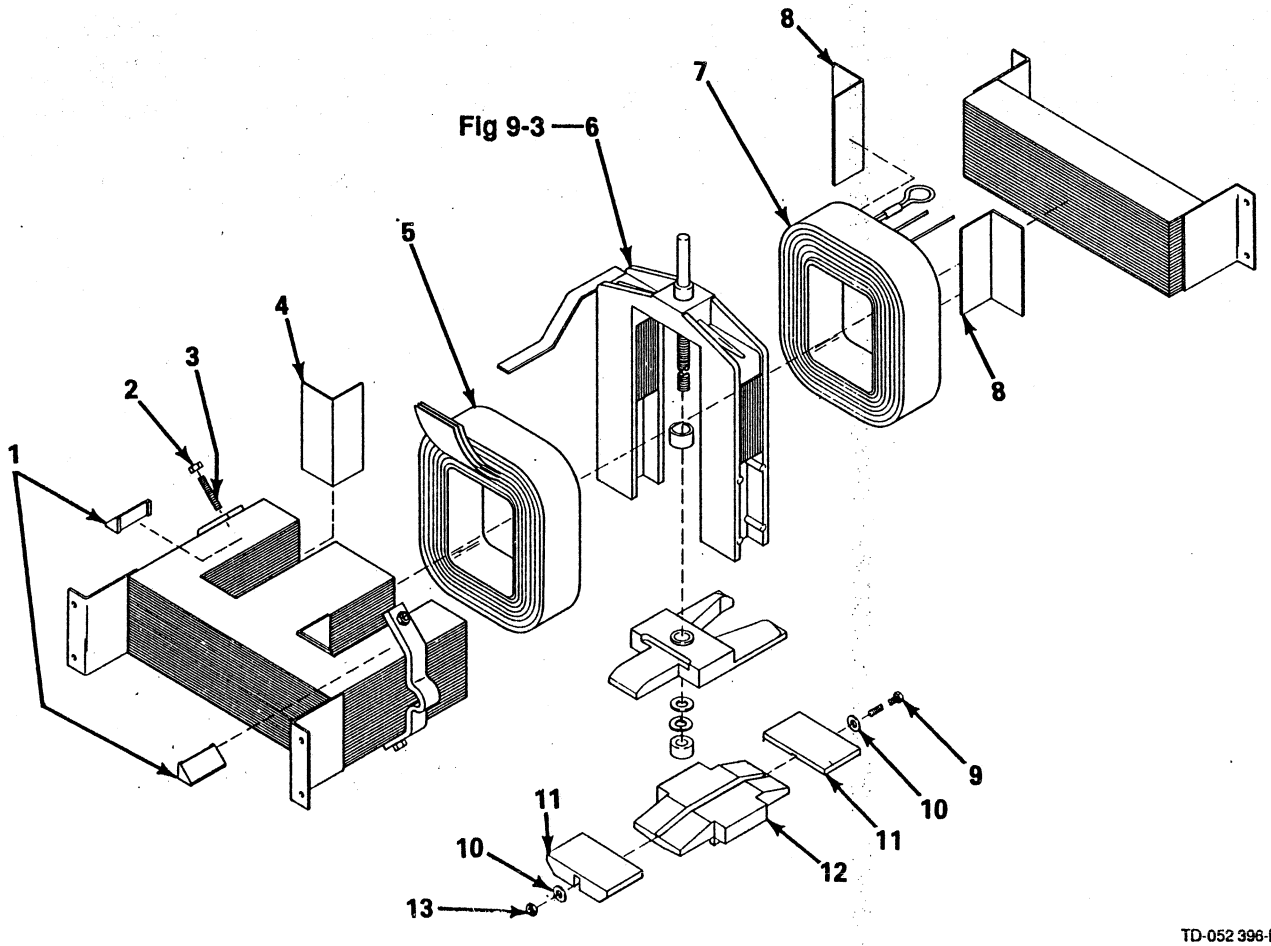
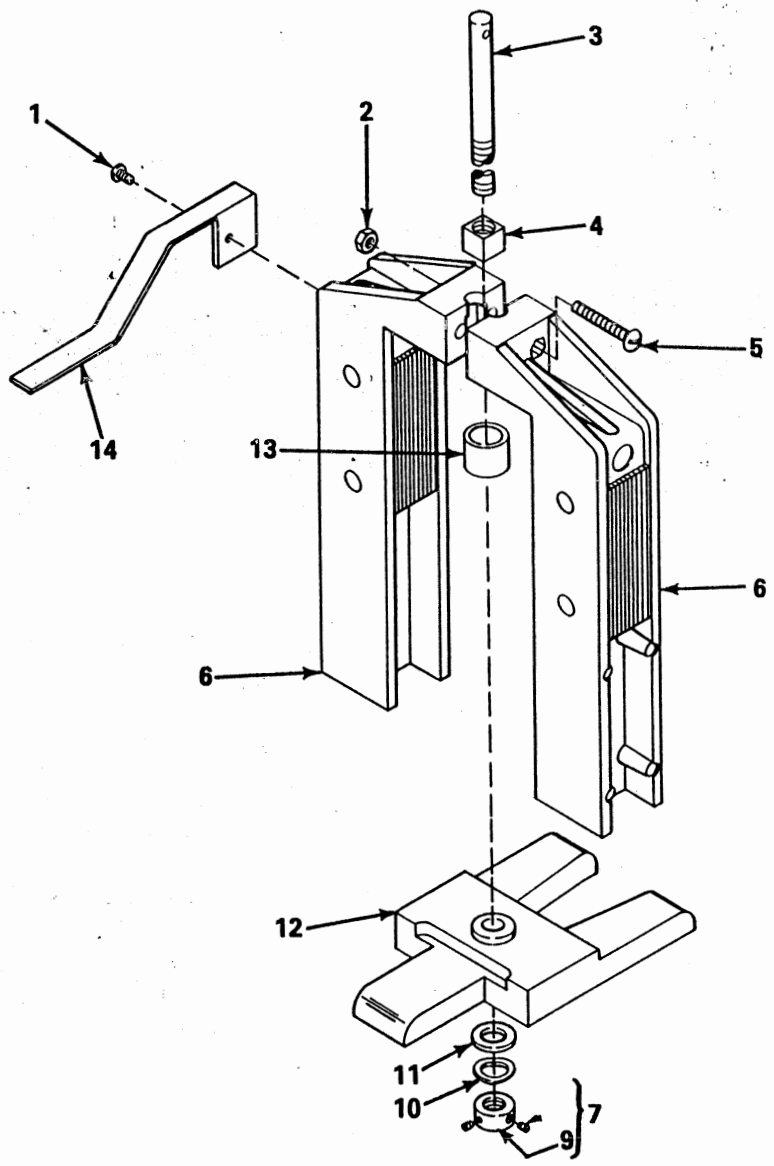


Figure 9-2. Transformer & Shunt

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

Item No.	Part No.	Description	Quantity
Figure 9-3	**119 962**	**Shunt (Fig 9-3 Item 6)**	
1	+081 821	SCREW, self-tapping fillister hd 8-11 x 1/2	1
2	601 860	NUT, hex 8-32	2
3	009 428	SCREW, lead-shunt	1
4	021 100	NUT, lead-screw	1
5	602 087	SCREW, round-hd 8-32 x 1-1/4	2
6	036 356	BLOCK, shunt	2
7	024 869	COLLAR, set-w/screws (consisting of)	1
8	602 176	· SCREW, set-socket hd 1/4-20 x 3/16	2
9	024 612	· COLLAR	1
10	010 929	WASHER, flat-spring 3/8	1
11	010 653	BEARING, thrust 3/8 ID x 3/4 OD x 1/16	1
12	020 284	WEDGE, coil	1
13	119 963	TUBING, 17/32 ID x 7/8 OD x 1/2	1
14	+009 312	INDICATOR	1



TB-052 397-A

Figure 9-3. Shunt

+Not part of Shunt Assembly

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

⚠ WARNING

ARC WELDING can be hazardous.

PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS KEEP AWAY UNTIL CONSULTING YOUR DOCTOR.

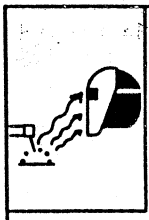
In welding, as in most jobs, exposure to certain hazards occurs. Welding is safe when precautions are taken. The safety information given below is only a summary of the more complete safety information that will be found in the Safety Standards listed on the next page. Read and follow all Safety Standards.

HAVE ALL INSTALLATION, OPERATION, MAINTENANCE, AND REPAIR WORK PERFORMED ONLY BY QUALIFIED PEOPLE.

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.

⚠ WARNING

ENGINES can be hazardous.

ENGINE EXHAUST GASES can kill.

Engines produce harmful exhaust gases.

1. Use equipment outside in open, well-ventilated areas.
2. If used in a closed area, vent engine exhaust outside and away from any building air intakes.

ENGINE FUEL can cause fire or explosion.

Engine fuel is highly flammable.

1. Stop engine and let it cool off before checking or adding fuel.
2. Do not add fuel while smoking or if unit is near any sparks or open flames.
3. Do not overfill tank – allow room for fuel to expand.
4. Do not spill fuel. If fuel is spilled, clean up before starting engine.

MOVING PARTS can cause injury.

Moving parts, such as fans, rotors, and belts can cut fingers and hands and catch loose clothing.

1. Keep all doors, panels, covers, and guards closed and securely in place.
2. Stop engine before installing or connecting unit.
3. Have only qualified people remove guards or covers for maintenance and troubleshooting as necessary.
4. To prevent accidental starting during servicing, disconnect negative (–) battery cable from battery.
5. Keep hands, hair, loose clothing, and tools away from moving parts.
6. Reinstall panels or guards and close doors when servicing is finished and before starting engine.

SPARKS can cause BATTERY GASES TO EXPLODE; BATTERY ACID can burn eyes and skin.

Batteries contain acid and generate explosive gases.

1. Always wear a face shield when working on a battery.
2. Stop engine before disconnecting or connecting battery cables.
3. Do not allow tools to cause sparks when working on a battery.
4. Do not use welder to charge batteries or jump start vehicles.
5. Observe correct polarity (+ and –) on batteries.

STEAM AND PRESSURIZED HOT COOLANT can burn face, eyes, and skin.

It is best to check coolant level when engine is cold to avoid scalding.

1. If the engine is warm and checking is needed, follow steps 2 and 3.
2. Wear safety glasses and gloves and put a rag over cap.
3. Turn cap slightly and let pressure escape slowly before completely removing cap.

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.