IM-339
IM339
AC-225-GLM
9012; 9055; 9061
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LINCOLN ELECTRIC®

Weldor's Guide

This manual covers equipment which is obsolete and no longer in production by The Lincoln Electric Co. Specifications and availability of optional features may have changed.

Contents

ARC WELDING SAFETY PRECAUTIONS

PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. READ AND UNDERSTAND BOTH THE SPECIFIC INFORMATION GIVEN IN THE OPERATING MANUAL FOR THE WELDER AND/OR OTHER EQUIPMENT TO BE USED AS WELL AS THE FOLLOWING GENERAL INFORMATION.

1. **HAVE ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR WORK performed only by qualified people**

2. **ELECTRIC SHOCK can kill.**

Protect yourself from possible dangerous electrical shock:

a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Never permit contact between "hot" parts of the circuits and bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.
b. Always insulate yourself from the work and ground by using dry insulation.When welding in damp locations, on metal floors, gratings or scaffolds, and when in positions (such as sitting or lying), make certain the insulation is large enough to cover your full area of physical contact with work and ground.
c. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition.
d. Never dip the electrode holder in water for cooling.
e. Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.
f. If using the welder as a power source for mechanized welding, the above precautions also apply for the automatic electrode, electrode reel, welding head, nozzle or semiautomatic welding gun.
g. When working above floor level, protect yourself from a fall should you get a shock.
h. Ground the work or metal to be welded to a good electrical ground.
i. Also see Item 7.

3. **FUMES AND GASES can be dangerous to your health.**

a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. When welding on galvanized, lead or cadmium plated steel and other metals which produce toxic fumes, even greater care must be taken.
b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.
c. Also see Item 8b.

4. **ARC RAYS can injure eyes and burn skin.**

a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87.1 standards.
b. Use suitable clothing made from durable, flame-resistant material to protect your skin and that of your helpers from the arc rays.
c. Protect other nearby personnel with suitable non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

5. **FIRE OR EXPLOSION can cause death or property damage.**

a. Remove fire hazards well away from the area. If this is not possible cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Have fire extinguisher readily available.
b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.
c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.
d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned." For information purchase "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1-80 from the American Welding Society (see address below).
e. Vent hollow castings or containers before heating, cutting or welding. They may explode.
f. Also see Items 6c and 8c.

Additional Safety Precautions

6. **For Welding in General.**

a. Droplets of molten slag and metal are thrown or fall from the welding arc. Protect yourself with oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses when in a welding area. Use glasses with side shields when near slag chipping operations.
b. Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.
c. Be sure the work cable is connected to the work as close to the welding area as practical. Work cables connected to the building framework or other locations some distance from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

7. **For Electrically Powered Equipment.**

a. Turn off the input power using the disconnect switch at the fuse box before working on the equipment.
b. Make the electrical installation in accordance with the National Electrical Code, all local codes and the manufacturer's recommendations.
c. Properly ground the equipment in accordance with the National Electrical Code and the manufacturer's recommendations.

8. **For Engine Powered Equipment.**

a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.
b. Operate internal combustion engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.
c. Do not add the fuel near an open flame, welding arc or when the engine is running. Stop the engine and, if possible, allow it to cool to prevent spilled fuel from igniting on contact with hot engine parts or electrical sparks. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.
d. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.
e. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.

For more detailed information it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting" — ANSI Standard Z49.1 from the American Welding Society, P.O. Box 351040 Miami, Florida 33135.

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GUARANTEE

The Lincoln Electric Company, the Seller, warrants all new equipment except engines and accessories thereof against defects in workmanship and material for a period of one year from date of shipment, provided the equipment has been properly cared for, and operated under normal conditions. Engines and engine accessories are warranted free from defects for a period of ninety days from the date of shipment.

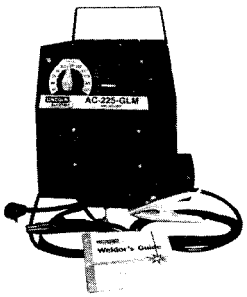
If the Buyer gives the Seller written notice of any defects in equipment, electrode or flux within any period of warranty and the Seller's inspection confirms the existence of such defects, then the Seller shall correct the defect or defects at its option, either by repair or replacement F.O.B. its own factory or other place as designated by the Seller. The remedy provided Buyer herein for breach of Seller's warranty shall be exclusive.

No expense, liability or responsibility will be assumed by the Seller for repairs made outside the Seller's factory without written authority from the Seller.

The Seller shall not be liable for any consequential damages in case of any failure to meet the conditions of any warranty. The liability of the Seller arising out of the supplying of said equipment or electrode or its use by the Buyer, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the equipment or replacing defective electrode in accordance with the above guarantee. Upon the expiration of any period of warranty, all such liability shall terminate.

The foregoing guarantees and remedies are exclusive and except as above set forth there are no guarantees or warranties with respect to engines, accessories, equipment, electrodes, or flux, either express or arising by operation of law or trade usage or otherwise implied, including without limitation the warranty of merchantability, all such warranties being waived by the Buyer.

Operating Instructions



AC-225-GLM

Input Power and Grounding Connections

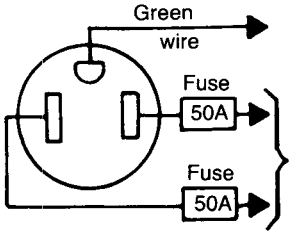
Before starting the installation, check with the power company to be sure your power supply is adequate for the voltage, amperes, phase and frequency specified on the welder nameplate. Also, be sure the planned installation will meet the National Electrical Code and local code requirements. This welder may be operated from a single phase line or from one phase of a two or three phase line.

All models designed to operate on less than 250 volt input lines are shipped with the input cable and attached plug connected to the welder. Exception: 50 Hz units do *not* include the input plug.

Place the welder so there is free circulation of air in through the louvers in the back and sides of the case and out of the bottom on all four sides. Mount the receptacle (if required) in a suitable location. Be sure it can be reached by the plug on the input cable attached to the welder.

WARNING: These installation instructions apply to the input wiring and overload protection installed to supply **one** AC-225-GLM and comply with the National Electrical Code as it applies to electric welders. Other equipment should **not** be connected to this supply without consulting the input power requirements for that equipment, The National Electrical Code, and all local codes.

Using the following instructions, have a qualified electrician connect the receptacle (NEMA 6-5OR Type) to the power lines at the fuse box. Three #10 or larger copper wires are required if conduit is used. For long cable runs over 100′, #8 or larger wire in conduit will be needed to prevent excessive voltage drops. Fuse the two hot lines with 50 ampere super lag type fuses as shown in the following diagram. The center contact in the receptacle is for the grounding connection. A green wire in the input cable connects this contact to the frame of the welder. This insures proper grounding of the welder frame when the welder plug is inserted into the receptacle. If a separate disconnect switch is used, it should have two poles for the two hot lines and both should be fused for 50 amperes.



Connect to a system ground wire. See the National Electrical Code for other details and means for proper grounding.

Connect to hot wires of a three wire, single phase system or to one phase of a two or three phase system.

NOTE: Machines built for power lines over 250 volts are not equipped with an installed input cable. The instructions for wiring these machines are pasted on the inside of the rear panel. Use fuses and input wire sizes suitable for the input amperes specified on the nameplate.

Welders with transformers specially wound for 208 volts are recommended for 208 volt systems.

WARNING: Before attaching the electrode cable to the electrode holder or the work cable to clamp, be certain the welder is turned off or the input power is disconnected.

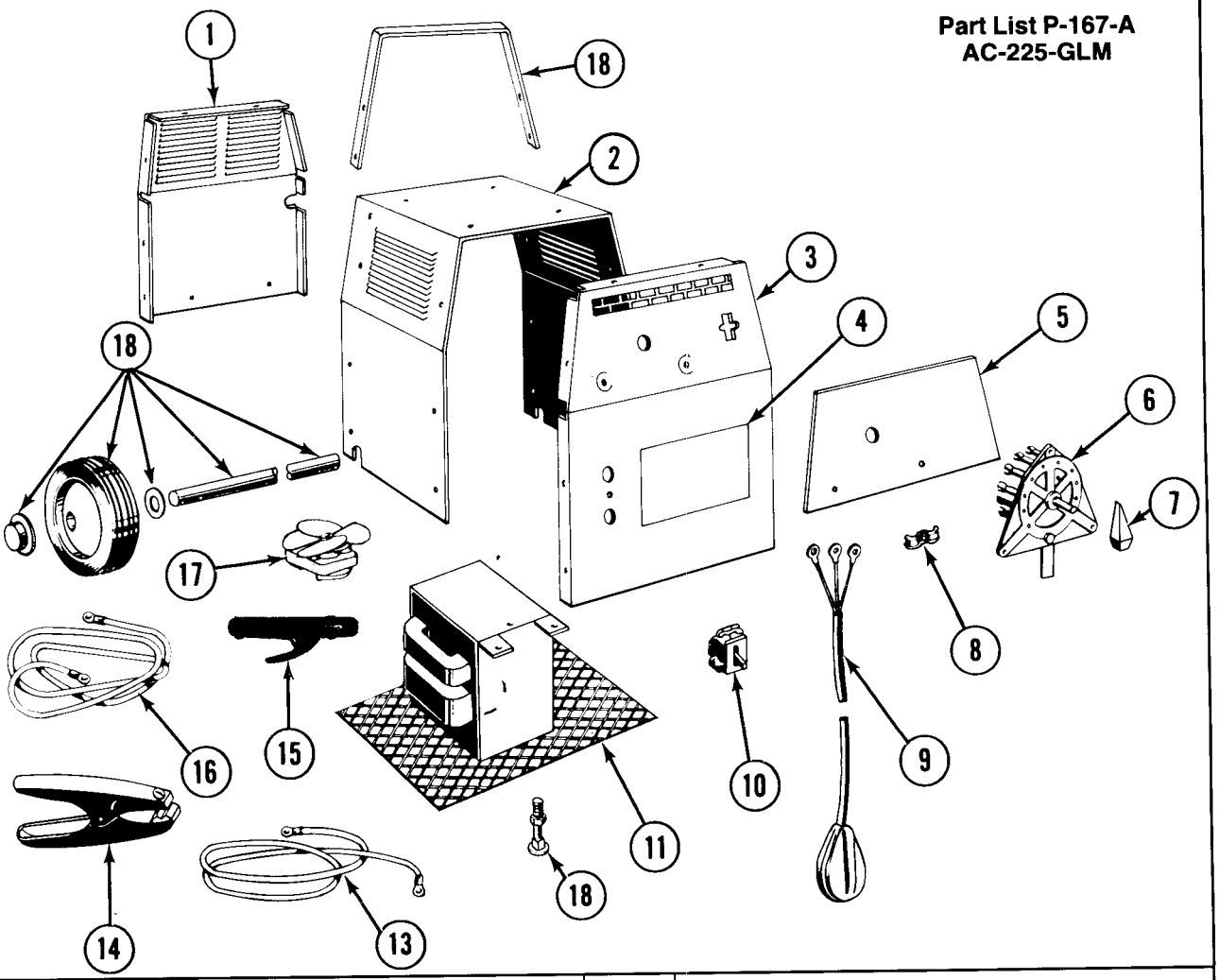
Attaching Electrode Cable to Holder

1. Loosen locking screw and slide handle off holder. Place handle over electrode cable.
2. Remove insulation from electrode cable 1″ ± 1/16″ from end.
3. Back out cable connecting screw until end is flush with inside surface of jaw body.
4. Remove cable connecting clamp from holder jaws. Place clamp over bare end of electrode cable and insert

How To Use Parts List

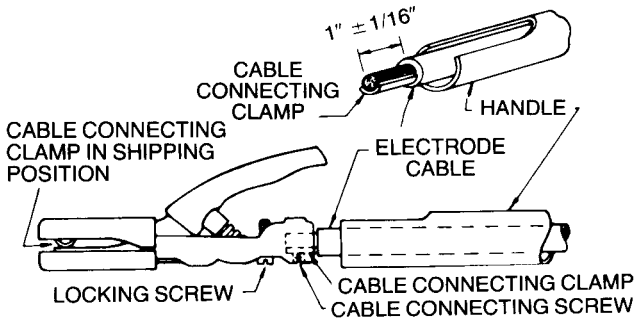
1. Refer to the drawing below.
2. Find the part on the drawing.
3. Using the item number from the drawing, find the part name and description in the table.
4. Get the welding code number found on the nameplate.
5. Order the part from a Lincoln Field Service Shop. Be sure to give the Parts List number, item number, part name and description, number required, the welder name and the welder code number.

Part List P-167-A
AC-225-GLM

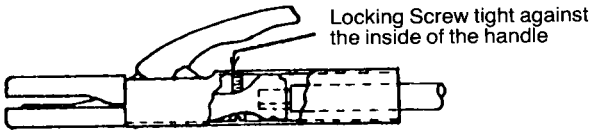


Item	Description	Item	Description
1	Back Case	10	Line Switch
2	Wrap Around	11	Transformer and Base
3	Front Case	13	Work Cable
4	Warning Plate	14	Work Clamp
5	Nameplate	15	Electrode Holder
6	Range Selector Switch	16	Electrode Cable
7	Handle	17	Fan Motor and Blade
8	Output Lead Clamp	18	Undercarriage Kit
9	Input Cable (below 230 V Input)		

into holder with clamp centered against connecting screw.



5. Tighten cable connecting screw securely against clamp.
6. Slide handle into position and secure with locking screw. When installing, turn the locking screw *in* until it is tight. The threaded end of the screw will then press against the inside of the handle and the head of the screw will be *completely inside* the handle.



Attaching Work Cable to Clamp

Insert work cable through strain relief hole in work clamp and fasten securely with bolt and nut provided.

Electrode and Work Cable Replacement

Substitution of cables with larger sizes requiring connections to be made internally is not recommended. Connections for additional lengths or larger sizes should be properly made externally. Lincoln Electric QD (Quick Disconnect) connectors are available for this purpose.

If either cable requires replacement for other reasons, they should be replaced with the appropriate Lincoln parts — and only by qualified personnel.

Welding Current Selection

Each position on the current selector switch is marked with the output amperes for that setting. Turn the switch to the current required for each application.

There is a slight amount of play in each switch position. It is good practice to move the switch back and forth once within this play after switching to a new position. This wiping action keeps the contacts free form dirt and oxides.

CAUTION: Do not turn the selector switch while welding as this will damage the contacts.

Duty Cycle

The 60 Hz welders are rated 18% duty cycle and the 50 Hz welders are rated 14% duty cycle on all switch positions. Duty Cycle is based on a ten minute period. This means that the arc can be drawn for 1.8 minutes out of each ten minute period (with a 18% duty cycle unit) without any danger of overheating. If it is used for more than 1.8 minutes during several successive ten minute periods, it may overheat.

WARNING — Pipe Thawing

Although not specifically designed for the work, the output of arc welding machines is sometimes used to thaw frozen water pipes by electrical resistance heating of the pipe metal. This may involved fire hazards. **Pipe thawing, if not done properly, can result in fire, explosion, damage to wiring which may make it unsafe, damage to pipes, burning up the welder or other hazards. Do not use a welder to thaw pipe before reviewing Lincoln bulletin E695.1 (dated December '76 or later).**

Use only the 75 amp AC setting (on 60 Hz machines) for thawing. It can be operated for 45 minutes continuously (50 Hz units are not recommended for pipe thawing). Cool the welder for 1 hour by running at no load between uses.

Electrode Selection Guide

See Chart on Welder and pages 14-16.

Arc Torch (Optional Accessory)

The arc torch (see page 11) is especially suited for use on these welders for brazing, welding non-ferrous metals and preheating before bending and forming.

Learning to Weld

The serviceability of a product or structure utilizing this type of information is and must be the sole responsibility of the builder/user. Many variables beyond the control of The Lincoln Electric Company affect the results obtained in applying this type of information. These variables include, but are not limited to, welding procedure, plate chemistry and temperature, weldment design, fabrication methods and service requirements.

No one can learn to weld simply by reading about it. Skill comes only with practice. The following pages will help the inexperienced weldor to understand welding and develop his skill. For more detailed information order a copy of "New Lessons in Arc Welding" listed on the back cover.

The Arc-Welding Circuit

The operator's knowledge of arc welding must go beyond the arc itself. He must know how to control the arc, and this requires a knowledge of the welding circuit and the equipment that provides the electric current used in the

arc. Figure 1 is a diagram of the welding circuit. The circuit begins where the electrode cable is attached to the welding machine and ends where the work cable is attached to the welding machine. Current flows through the electrode cable to the electrode holder, through the holder to the electrode and across the arc. On the work side of the arc, the current flows through base metal to the work cable and back to the welding machine. The circuit must be complete for the current to flow. To weld, the work clamp must be tightly connected to clean base metal. Remove paint, rust, etc. as necessary to get a good connection. Connect the work clamp as close as possible to the area you wish to weld. Avoid allowing the welding circuit to pass through hinges, bearings, electronic components or similar devices that can be damaged.

This arc-welding circuit has a voltage output of up to 79 volts which can shock.

WARNING: Electrical shock can KILL. Carefully review Section 2 (Electric Shock) of the ARC WELDING SAFETY PRECAUTIONS on page 2 of this manual.

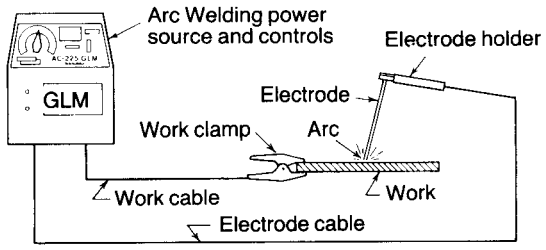


FIGURE 1 — The welding circuit for shielded metal arc welding.

The electric arc is made between the work and the tip end of a small metal wire, the electrode, which is clamped in a holder and the holder is held by the weldor. A gap is made in the welding circuit (see Figure 1) by holding the tip of the electrode 1/16-1/8" away from the work or base metal being welded. The electric arc is established in this gap and is held and moved along the joint to be welded, melting the metal as it is moved.

Arc welding is a manual skill requiring a steady hand, good physical condition, and good eyesight. The operator controls the welding arc and, therefore, the quality of the weld made.

What Happens in the Arc?

Figure 2 illustrates the action that takes place in the electric arc. It closely resembles what is actually seen during welding.

The "arc stream" is seen in the middle of the picture. This is the electric arc created by the electric current flowing through the space between the end of the electrode and the work. The temperature of this arc is about 6000°F, which is more than enough to melt metal. The arc is very bright, as well as hot, and cannot be looked at with the naked eye without risking painful injury. The very dark lens, specifically designed for arc welding, must be used with the hand or face shield whenever viewing the arc.

The arc melts the base metal and actually digs into it, much as the water through a nozzle on a garden hose digs into the earth. The molten metal forms a molten pool or crater and tends to flow away from the arc. As it moves away from the arc, it cools and solidifies. A slag forms on top of the weld to protect it during cooling.

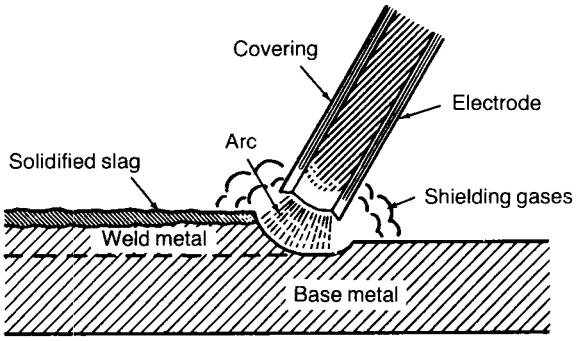


FIGURE 2 — The welding arc.

The function of the covered electrode is much more than simply to carry current to the arc. The electrode is composed of a core of metal wire around which has been extruded and baked a chemical covering. The core wire melts in the arc and tiny droplets of molten metal shoot across the arc into the molten pool. The electrode provides additional filler metal for the joint to fill the groove or gap between the two pieces of the base metal. The covering also melts or burns in the arc. It has several functions. It makes the arc steadier, provides a shield of smoke-like gas around the arc to keep oxygen and nitrogen in the air away from the molten metal, and provides a flux for the molten pool. The flux picks up impurities and forms the protective slag. The principal differences between various types of electrodes are in their coatings. By varying the coating, it is possible to greatly alter the operating characteristics of electrodes. By understanding the differences in the various coatings, you will gain a better understanding of selecting the best electrode for the job you have at hand. In selecting an electrode you should consider:

1. The type of deposit you want, e.g. mild steel, stainless, low alloy, hardsurfacing.
2. The thickness of the plate you want to weld.
3. The position it must be welded in (downhand, out-of-position).
4. The surface condition of the metal to be welded.
5. Your ability to handle and obtain the desired electrode.

Four simple manipulations are of prime importance. **Without** complete mastery of these four, further welding is more or less futile. **With** complete mastery of the four, welding will be easy.

1. The Correct Welding Position

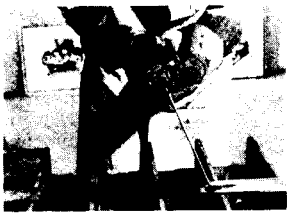
Illustrated below is the correct welding position for right-handed people. (For left-handed it is opposite):

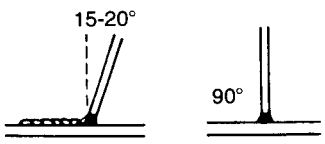
a. Hold the electrode holder in your right hand.

b. Touch left hand to the underside of right hand.

c. Put the left elbow into your left side.

Weld with two hands whenever possible. This gives complete control over the movements of the electrode.





Correct Welding Position

Whenever possible, weld from left to right (if right-handed). This enables you to see clearly what you are doing.

Hold the electrode at a slight angle as shown:

2. The Correct Way to Strike an Arc

Be sure the work clamp makes good electrical contact to the work.

Lower your headshield and scratch the electrode **slowly** over the metal, and you will see sparks flying. While scratching, lift the electrode 1/8″ and the arc is established.

NOTE: If you stop moving the electrode while scratching, the electrode will stick.

NOTE: Most beginners try to strike the arc by a fast jabbing motion down on the plate. Result: They either stick or their motion is so fast that they break the arc immediately.

3. The Correct Arc Length

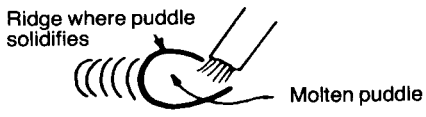
The arc length is the distance from the tip of the electrode core wire to the base metal.

Once the arc has been established, maintaining the correct arc length becomes extremely important. The arc should be short, approximately 1/16 to 1/8″ long. As the electrode burns off the electrode must be fed to the work to maintain correct arc length.

The easiest way to tell whether the arc has the correct length is by listening to its sound. A nice, short arc has a distinctive, "crackling" sound, very much like eggs frying in a pan. The incorrect, long arc has a hollow, blowing or hissing sound.

4. The Correct Welding Speed

The important thing to watch while welding is the puddle of molten metal right behind the arc. **Do NOT watch the arc itself.** It is the appearance of the puddle and the ridge where the molten puddle solidifies that indicate correct welding speed. The ridge should be approximately 3/8″ behind the electrode.



Most beginners tend to weld too fast, resulting in a thin, uneven, "wormy" looking bead. They are not watching the molten metal.

IMPORTANT: For general welding it is not necessary to weave the arc; neither forwards and backwards nor sideways. Weld along at a steady pace. You will find it easier.

NOTE: When welding on thin plate, you will find that you will have to increase the welding speed, whereas when welding on heavy plate, it is necessary to go more slowly in order to get good penetration.

Practice

The best way of getting practice in the four skills that enable you to maintain:

1. Correct Welding Position
2. Correct Way To Strike An Arc
3. Correct Arc Length
4. Correct Welding Speed

is to spend a little more time on the following exercise.

Use the following:

Mild Steel Plate . . . . . 3/16″ or heavier
Electrode . . . . . 1/8″ Fleetweld® 180
Current Setting . . . . . 105 Amps AC

Do the following:

1. Learn to strike the arc by scratching the electrode over the plate. Be sure the angle of the electrode is right and be sure to use both hands.
2. When you can strike an arc without sticking, practice the correct arc length. Learn to distinguish it by its sound.
3. When you are sure that you can hold a short, crackling arc, start moving. Look at the molten puddle constantly, and look for the ridge where the metal solidifies.
4. Run beads on a flat plate. Run them parallel to the top edge (the edge farthest away from you). This gives you practice in running straight welds, and also, it gives you an easy way to check your progress. The 10th weld will look considerably better than the first weld. By constantly checking on your mistakes and your progress, welding will soon be a matter of routine.

Common Metals

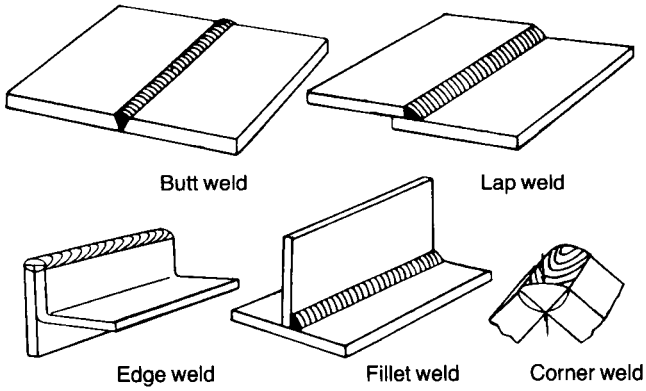
Most metals found around the farm or small shop are low carbon steel, sometimes referred to as mild steel. Typical items made with this type of steel include most sheet metal, plate, pipe and rolled shapes such as channels, angle irons and "I" beams. This type of steel can usually be easily welded without special precautions. Some steel, however, contains higher carbon. Typical applications include wear plates, axles, connecting rods, shafts, plowshares and scraper blades. These higher carbon steels can be welded successfully in most cases; however, care must be taken to follow proper procedures, including preheating the metal to be welded and, in some cases, carefully controlling the temperature during and after the welding process. For further information on identifying various types of steels and other metals, and for proper procedures for welding them, we again suggest you purchase a copy of "New Lessons in Arc Welding" (see the back cover).

Regardless of the type of metal being welded, it is important in order to get a quality weld that it be free of oil, paint, rust or other contaminants.

Types of Welds

Five types of welding joints are: Butt Welds, Fillet Welds, Lap Welds, Edge Welds and Corner Welds.

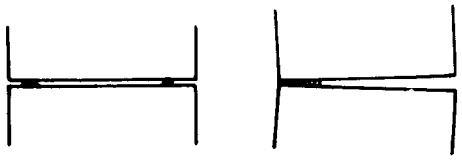
Of these, the Butt Weld and Fillet Weld are the two most common welds.



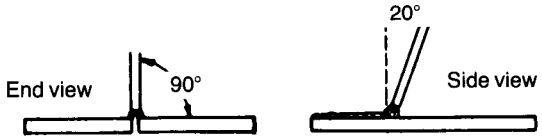
Butt Welds

Butt Welds are the most widely used welds. Place two plates side by side, leaving 1/16" (for thin metal) to 1/8" (for heavy metal) space between them in order to get deep penetration.

Tack the plates at both ends, otherwise the heat will cause the plates to move apart. (See drawing):



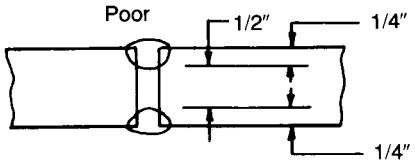
Now weld the two plates together. Weld from left to right (if right-handed). Point the electrode down in the crack between the two plates, keeping the electrode slightly tilted in the direction of travel.



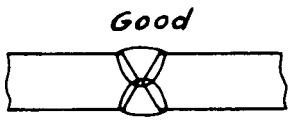
Watch the molten metal to be sure it distributes itself evenly on both edges and in between the plates.

Penetration

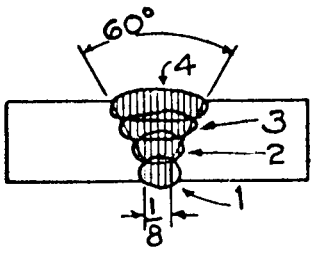
Unless a weld penetrates close to 100%, a butt weld will be weaker than the material welded together.



In this example, the total weld is only 1/2 the thickness of the material; thus the weld is only approximately half as strong as the metal.



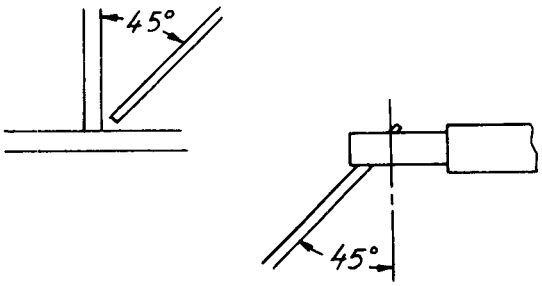
In this example, the joint has been flame beveled or ground prior to welding so that 100% penetration could be achieved. The weld, if properly made, is as strong or stronger than the original metal.



Fillet Welds

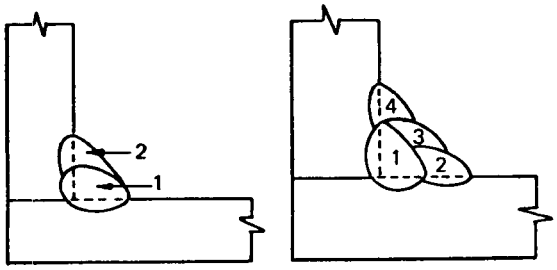
When welding fillet welds, it is very important to hold the electrode at a 45° angle between the two sides, or the metal will not distribute itself evenly.

To make it easy to get the 45° angle, it is best to put the electrode in the holder at a 45° angle, as shown:



Multiple Pass Welds

Make multiple pass horizontal fillets as shown in the sketch. Put the first bead in the corner with fairly high current. Hold the electrode angle needed to deposit the filler beads as shown putting the final bead against the vertical plate.



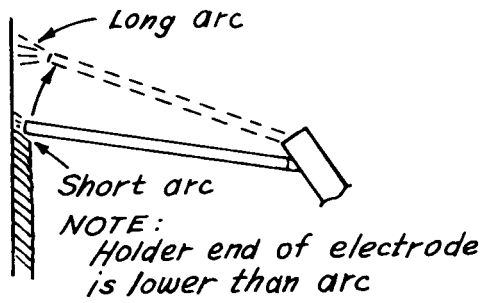
Welding in the Vertical Position

Welding in the vertical position can be done either vertical-up or vertical-down. Vertical-up is used whenever a large, strong weld is desired. Vertical-down is used primarily on sheet metal for fast, low penetrating welds.

Vertical-Up Welding

The problem, when welding vertical-up, is to put the molten metal where it is wanted and make it stay there. If

too much molten metal is deposited, gravity will pull it downwards and make it "drip." Therefore a certain technique has to be followed:

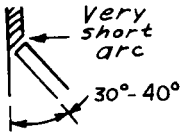


1. Use 1/8" (90-105 amps) or 3/32" (60 amps) Fleetweld 180 electrode.
2. When welding, the electrode should be kept horizontal or pointing slightly upwards. (See drawing.)
3. The arc is struck and metal deposited at the bottom of the two pieces to be welded together.
4. Before too much molten metal is deposited, the arc is SLOWLY moved 1/2-3/4" upwards. This takes the heat away from the molten puddle, which solidifies. (If the arc is not taken away soon enough, too much metal will be deposited, and it will "drip.")
5. The upward motion of the arc is caused by a very slight wrist motion. Most definitely, the arm must not move in and out, as this makes the entire process very complicated and difficult to learn.
6. If the upward motion of the arc is done correctly with a wrist motion, the arc will automatically become a long arc that deposits little or no metal. (See drawing.)
7. During this entire process the ONLY thing to watch is the molten metal. As soon as it has solidified, the arc is SLOWLY brought back, and another few drops of metal are deposited. DO NOT FOLLOW THE UP AND DOWN MOVEMENT OF THE ARC WITH THE EYES. KEEP THEM ON THE MOLTEN METAL.
8. When the arc is brought back to the now solidified puddle, IT MUST BE SHORT, otherwise no metal will be deposited, the puddle will melt again, and it will "drip."
9. It is important to realize that the entire process consists of SLOW, DELIBERATE movements. There are no fast motions.

Vertical-Down Welding

Vertical-down welds are applied at a fast pace. These welds are therefore shallow and narrow, and as such are excellent for sheet metal. Do not use the vertical-down technique on heavy metal. The welds will not be strong enough.

1. Use 1/8 or 3/32" Fleetweld 180 electrode.
2. On thin metal, use 60-75 amps. (14 ga 75 amps — 16 ga 60 amps.)
3. Hold the electrode in a 30-45° angle with the tip of the electrode pointing upwards.
4. Hold a VERY SHORT arc, but do not let the electrode touch the metal.
5. An up and down whipping motion will help prevent burn-through on very thin plate.
6. Watch the molten metal carefully.

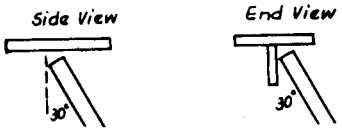


The important thing is to continue lowering the entire arm as the weld is made so the angle of the electrode does not change. Move the electrode so fast that the slag does not catch up with the arc. Vertical-down welding gives thin, shallow welds. It should not be used on heavy material where large welds are required.

Overhead Welding

Various techniques are used for overhead welding. However, in the interest of simplicity for the inexperienced weldor the following technique will probably take care of most of his needs for overhead welding:

1. Use 1/8" (90-105 amps) or 3/32" (60 amps) Fleetweld 180 electrode.
2. Put the electrode in the holder so it sticks straight out.
3. Hold the electrode at an angle approximately 30° off vertical, both seen from the side and seen from the end.



The most important thing is to hold a VERY SHORT arc. (A long arc will result in falling molten metal; a short arc will make the metal stay.)

If necessary — and that is dictated by the looks of the molten puddle — a slight back and forth motion along the seam with the electrode will help prevent "dripping."

Welding Sheet Metal

Welding sheet metal presents an additional problem. The thinness of the metal makes it very easy to burn through. Follow these few simple rules:

1. Hold a **very short** arc. (This prevents burn through, since beginners seem to hold too long an arc.)
2. Use 1/8 or 3/32" Fleetweld 180 electrode.
3. Use low amperage. 75 amps for 1/8" electrode, 40-60 amps for 3/32" electrode.
4. Move fast. Don't keep the heat on any given point too long. Keep going. Whip electrode.
5. Use lap welds whenever possible. This doubles the thickness of the metal.

Hardsurfacing

There are several kinds of wear. The two most often encountered are:

1. *Metal to Ground Wear.*
   (Plowshares, bulldozer blades, buckets, cultivator shares, and other metal parts moving in the soil.)

2. *Metal to Metal Wear.*
   (Trunnions, shafts, rollers and idlers, crane and mine car wheels, etc.)

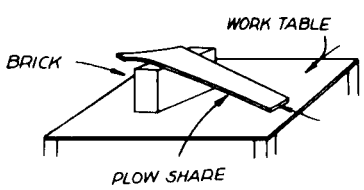
Each of these types of wear demands a different kind of hardsurfacing electrode.

When applying the proper electrode, the service life of the part will in most cases be more than double. For instance, hardsurfacing of plowshares results in 3-5 times more acreage plowed.

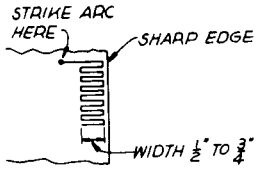
How to Hardsurface the Sharp Edge (Metal to Ground Wear)

1. Grind the share, approximately one inch wide along the edge, so the metal is bright.
2. Place the share on an incline of approximately 20-30°. The easiest way to do this is to put one end of the share on a brick. (See drawing.)

   Most users will want to hardsurface the underside of the share, but some might find that the wear is on the top side. The important thing is to hardsurface the side that wears.
3. Use 1/8″ Abrasoweld™ electrode at 90-105 amps. Strike the arc about one inch from the sharp edge.
4. The bead should be put on with a weaving motion, and it should be 1/2 to 3/4″ wide. Do not let the arc blow over the edge, as that will dull the edge. (See drawing.)

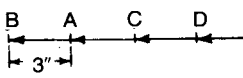


Positioning of Share



Weaving Motion

5. Use the back-stepping method. Begin to weld 3″ from the heel of the share and weld to the heel. The second weld will begin 6″ from the heel, the third weld 9″ from the heel, etc.



First weld from A to B; then from C to A; then from D to C; then from E ot D; and so on.

BACKSTEPPING

Backstepping greatly reduces the chances for cracking of the share, and it also greatly reduces possible warpage.

NOTE: The entire process is rather fast. Many beginners go much too slow when hardsurfacing plow shares, running the risk of burning through the thin metal.

Hardsurfacing of Idlers and Rollers (Metal to Metal Wear)

A very common application of hardsurfacing for **metal to metal** wear is the hardsurfacing of idlers and rollers and the rails that ride on these rollers and idlers.

The reason for hardsurfacing these parts is primarily monetary. A few dollars worth of electrode will completely build up a roller or idler, and the hardsurface will outlast several times the normal life of such rollers and idlers.

If the following procedure is followed, it is not even necessary to remove the grease bearing while welding. This will save a lot of time:

1. The roller (or idler) is inserted on a piece of pipe that is resting on two sawbucks. This enables the operator to turn it while welding.
2. Use Jet-LH® BU-90 electrodes, 5/32″ at 175 amps or 3/16″ at 200 amps.
3. Weld across the wearing surface. Do not weld around.
4. Keep the roller (or idler) cool by quenching with water, and by stopping the welding periodically. This will prevent shrinking of the roller (or idler) on the grease bearing.
5. Build-up to dimension. The weld metal deposited by BU-90 electrode is often so smooth that machining or grinding is not necessary.

NOTE: The quenching of the roller (or idler) has another purpose: It increases the hardness — and thus the service life — of the deposit.

The hardsurfacing of the rails is a lot easier:

1. Place the rails with the side that rides on the rollers and idlers upwards.
2. Use Jet-LH BU-90 electrodes. Same ampere setting as on the idlers and rollers.
3. Build-up to size.
4. **Do not quench.** This will make the deposit slightly softer than the deposit on the idlers and rollers. That means that the wear will primarily be on the rails, which are a lot easier and less time-consuming and cheaper to build-up.

NOTE: The same electrode — BU-90 — will give the operator two desired hardnesses, just by a difference in cooling rate, making it possible to put the hardest deposit on the most expensive parts.

NOTE: The outside of the rails (the side that comes in contact with the gorund) should be surfaced with Abrasoweld, since this side has **Metal to Ground** wear.

Welding Cast Iron

When welding on a piece of cold cast iron, the tremendous heat from the arc will be absorbed and distributed rapidly into the cold mass. This heating and sudden cooling creates WHITE, BRITTLE cast iron in the fusion zone.

This is the reason why welds in cast iron break. Actually, one piece of the broken cast iron has the entire weld on it, and the other piece has no weld on it.

In order to overcome this, the welding operator has two choices:

1. He can preheat the entire casting to 500-1200°F. If the cast iron is hot before welding, there will be no sudden chilling which creates brittle white cast iron. The entire casting will cool slowly.
2. He can weld 1/2" at a time, and not weld at that spot again until the weld is completely cool to the touch.

In this way no large amount of heat is put into the mass.

Most inexperienced weldors will probably use the second method, because they have no way of preheating large castings. Smaller castings can easily (and should) be preheated before welding. A forge, stove, a fire, or the Arc Torch are all excellent means of preheating.

When using the 1/2" at a time method, it is recommended to start 1/2" away from the previous bead and weld into the previous bead (backstepping).

After welding Cast Iron, protect the casting against fast cooling. Put it in a sand (or lime) box.

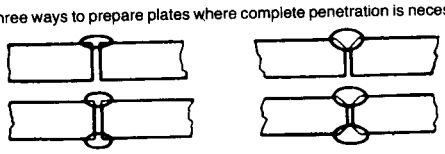
If sand or lime is not available, cover it with sheet metal or any other non-flammable material that will exclude drafts and retain heat.

Cast Iron Plate Preparation

Wherever practical, the joint to be welded should be "veed" out by grinding or filing to give complete penetration. This is especially important on thick castings where maximum strength is required. In some instances a back-up strip may be used and plates may be gapped 1/8" or more.

On sections where only a sealed joint is required and strength is not important, the joint may be welded after slightly veeing out the seam as shown.

Three ways to prepare plates where complete penetration is necessary.



Single and double beads, with and without beveling for tight, partial strength joints.

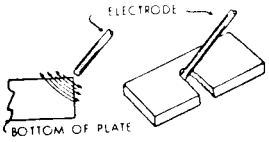
Cutting (Do not exceed the Duty Cycle — See page 12)

The arc welder and the electrode can be used for cutting steel and cast iron. Follow this procedure:

1. Use 1/8 or 5/32" Fleetweld 180 electrode.
2. Set welder on maximum (225 amps).
3. Hold long arc on edge of metal, melting it.
4. Push the arc through the molten metal, forcing it to fall away.
5. Raise the electrode, and start over again.

The important thing is to continue this up-and-down, sawing motion, melting the metal and pushing it away.

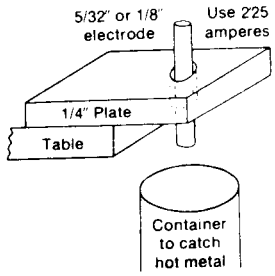
If a lot of cutting is to be done, soak each electrode in water for a minute or two. It keeps them cooler, and the electrodes last longer.



WARNING: When soaking electrode keep your gloves and clothing dry. Never dip an electrode holder in water.

Piercing Holes

1. Welder setting: Maximum (225 amps).
2. Electrode: 1/8 or 5/32" Fleetweld 180.
3. Hold the electrode with a long arc perpendicular over the spot where the hole is to be made.
4. When the metal is molten, push the electrode through the molten puddle.



Making holes with an electrode.

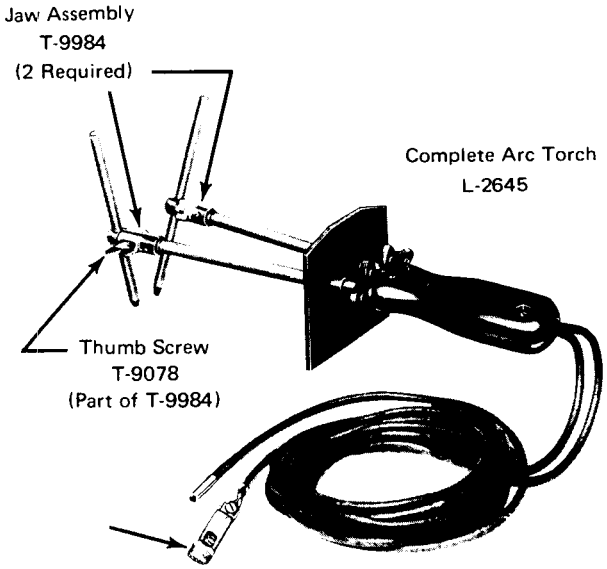
5. Give the molten metal a chance to fall through the hole.
6. Circle with a long arc around the edge of the hole until the desired diameter hole has been made.

If the electrode is pushed through too soon it will stick in the puddle. Be sure the metal is molten before pushing through.

NOTE: On heavy metal 5/16" or thicker), position the plate to be pierced vertically, and the electrode horizontally. This allows the molten metal to drip away freely as you are boring through.

Using The Carbon Arc Torch

. . . Welding Aluminum and Copper Alloys
. . . Brazing and Soldering
. . . Heating, Bending and Straightening

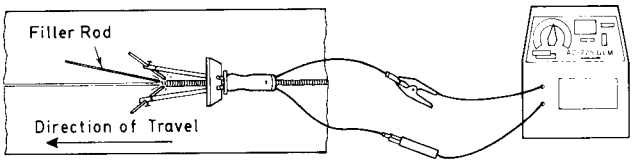


Required Equipment

1. A Lincoln Carbon Arc Torch L-2645; Its rating is 100 amperes.
2. 1/4, 5/16 or 3/8" carbons: Use only copper coated and cored carbons to avoid overheating the holder and provide even burning of the carbons.
3. Any AC or DC welder: Carbons burn much faster on DC than they do on AC. Also the carbon connected to the positive DC output should be larger than the carbon connected to the negative DC output so both carbons burn off at about the same rate.

Torch Connections

Insert the straight ferrule on the end of one arc torch lead into the standard electrode holder. Attach the spring clip on the end of the other lead to either the work clamp or the welding table where the work lead is calmped. If connected to the table, insulate the work from the table. See drawing below.



WARNING: The carbon arc torch rays will cause severe arc burns to exposed skin. Therefore, a pair of work gloves, long sleeved shirt or sleevelets, and an apron are recommended.

Use an arc welding headshield or handshield with No. 11 or No. 12 lens. Oxyacetylene goggles are not sufficient eye and face protection.

When adjusting the length of carbons, be sure the welder is turned off. An arc flash while making this adjustment can burn hands or eyes.

When laying the torch down, avoid touching the carbons to the grounded bench or work. This is best done by turning the welder off. As an alternative, either set the torch on an insulated surface or lay it on its side with the leads hanging down over the bench so the handle rests on the bench top.

DO NOT EXCEED THE OUTPUT DUTY CYCLE OF THE WELDER. Exceeding this duty cycle in successive 10 minute periods can overheat the welder and damage the windings. Cool the welder for 1 hour by running at no load between uses. With the AC-225-GLM, use the (75) amp setting whenever practical because it has a 45 minute continuous rating.

Heat Settings

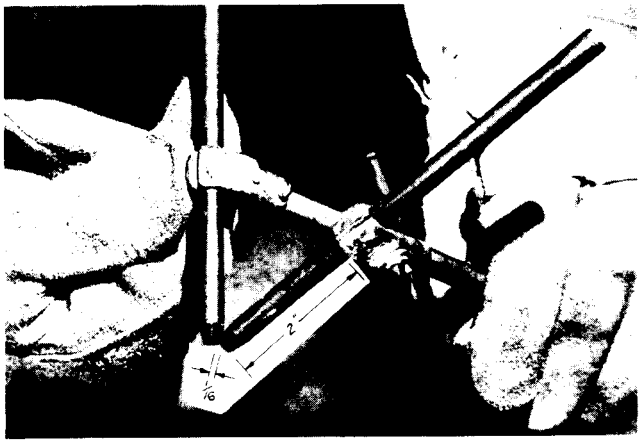
Recommended current settings for different material thicknesses and carbon sizes are given in the table. Generally, use only enough current to cause the filler metal to flow freely on the work. Do not use currents so high that the copper coating burns away more than 1/2" above the arc.

Set the carbons to extend about 2" beyond the copper jaws.

WARNING: Be sure the welder is turned off when making this adjustment.

Thickness of Base Metal	Approximate Current Setting (AC)	Carbon Diameter
1/32"	30-50 amps	1/4 "
1/16"	50-60 amps	1/4 "
1/8 "	70-80 amps	5/16"
1/4 "	90-100 amps	3/8 "

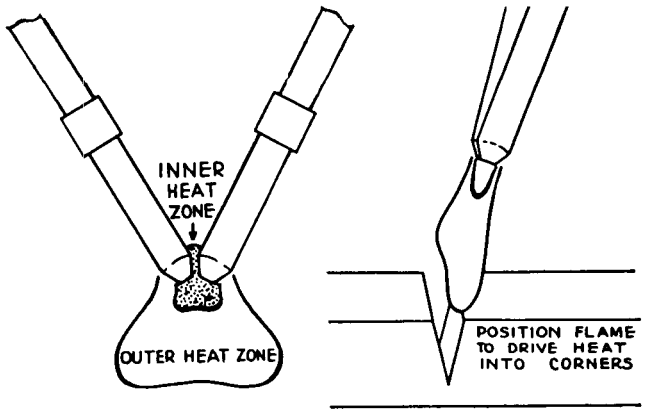
After adjusting the welder current and setting the carbon stickout, start the welder and you are ready to go.



Use the thumb control on the arc torch to rotate the carbons until they touch. Start the arc by reversing the thumb control setting to spread the carbons 1/16 to 3/16" apart. As the carbons burn away use the thumb control to maintain the desired arc. When the proper arc can no longer be maintained, turn the welder off and readjust the carbon stickout.

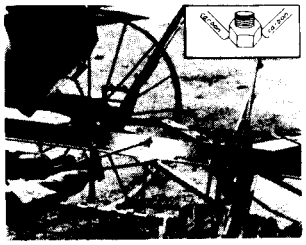
A wide, soft, quiet flame gives the best results for most jobs. When the carbon tips are too close together a small flame accompanied by a hissing or crackling sound results.

The shape of a good flame is illustrated below. The flame fans out to form a "fish tail" shape with inner and outer cone. To heat a crack or a corner, position the flame as illustrated.



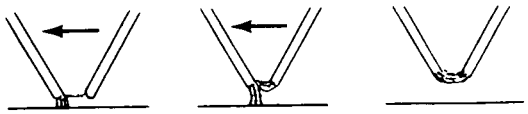
Heat intensity is controlled by changing the current setting, by moving the carbons closer together or farther apart, or by changing the distance between the flame and work. When the work sets on a metal table, the table absorbs some of the heat. To avoid high heat loss, the part can be set of thin metal strips or some insulation.

Removal of Nuts and Bolts: Apply heat with the arc torch for a few seconds and nuts can be easily turned off.



Heating Heavy Parts

Heavy metal can be heated more rapidly by connecting the work lead to the work so the arc is between the carbons and the work as well as between the two carbons. To do this, connect the lead carbon (the carbon which leads the direction of travel) to the electrode holder. Connect both the trail carbon and the work cable to the work or to the welding table. With this connection, raising the torch reduces the amount of the arc going to the work thus reducing the heating. The arc between the carbons and work tends to pit the surface of the work.

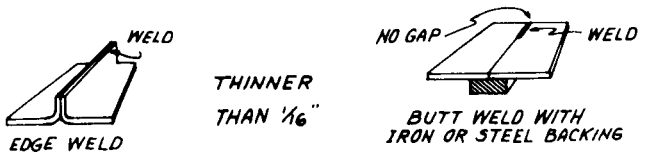


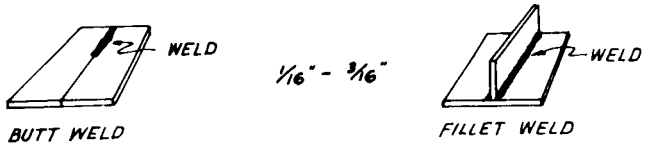
Welding Aluminum Alloys With The Arc Torch

The need to repair aluminum parts continues to grow. These repairs can be simply made with an AC welder using Aluminweld® DC coated electrodes as a filler rod and The Carbon Arc Torch. The arc torch preheats the aluminum plate, assuring good fusion.

Work Preparation

Here are recommended edge preparations and types of joints for different thicknesses of base metal. All welds must be made in the downhand position. Round parts must be rotated.





(EDGES MUST BE BEVELED TO ASSURE PROPER STRENGTH)

Joints

Welding Procedures

1. Use the recommended AC currents and carbon sizes listed in the Table on page 12.
2. Use a 1/8" 'Aluminweld' coated electrode as a filler rod. Hold it in the left hand (for right-handed people).
3. Hold the arc torch in your right hand and start the arc by shorting the carbons together and adjusting them to a 1/16" gap.
4. Hold the arc torch as shown here. Hold your eyes right over the arc torch looking in between the two carbons.
5. Play the 3" to 4" up and down the joint at the start. This preheat helps to give a smoother bead and an easier start when the filler rod is applied.
6. Move the torch to the beginning of the joint (right-handed people should begin at the right and move left.)
7. Place the tip of the electrode in the arc. If the coating melts off and flows easily into the joint, the metal is hot enough to start welding.
8. Let a droplet of the filler rod melt and fuse into the joints.
9. Watch the molten puddle. Add more filler metal by moving the end of the rod in and out of the arc as the right hand moves the arc torch slowly along the joint.

Practice

When you first try to weld with these procedures, you may have a tendency to burn through. Therefore, a few minutes practice before working on the parts to be welded is recommended. Use scrap material about as thick as the part you are going to weld. Practice the technique to get the feel of the arc.

Welding Copper and Brass Alloys

The aluminum welding techniques can also be used on copper and brass alloys. The filler rod recommended for welding these alloys is Lincoln's Aerisweld®. Since this phosphor-bronze electrode has a thick flux coating, some of the flux should be chipped off before using the rod. A little experience wil indicate how much to remove. Chipping off too much flux produces poor weld appearance. Removing too little results in an uncontrollably large molten pool of flux.

Brazing

The techniques for brazing with an arc torch are vey much like the ones used for gas brazing. Only enough heat is needed to melt the filler metal and to raise the parts to be brazed to the melting temperature of the filler metal — usually slightly over 1,000°F. A good brazed joint is assured when the filler metal flows into the joint and adheres evenly to the surfaces. Use only enough filler metal to make a smooth joint. Use standard gas brazing rod and flux.

Heat the end of the brazing rod and dip it into the flux. The flux will stick to the hot rod. Play the arc back and

forth a short distance along the seam when the right temperature is reached. Apply flux as needed and melt off brazing rod to fill the seam. Move along the seam until the job is complete.

If the part being brazed does not get hot enough, increase the current or hold the torch closer to the work. Whenever possible, have the joint horizontal to secure best flow of molten filler rod.

Soldering

The arc torch can be used to solder copper piping and other copper, tinned and galvanized parts. Best results are obtained with over-lapping pieces. Clean the surfaces to be soldered and cover them with soldering flux to prevent oxidation and to speed soldering. Acid core solder also produces good results. Simply play the arc on the area to be soldered and feed solder into the joint as it reaches proper temperature. Never use so much heat that the solder boils.

Heating, Bending and Straightening

Choose the carbon size and current setting depending upon the thickness of the metal to be heated. Play the arc over the section to be heated until the desired temperature is reached. For bending this is usually a dull red color on ordinary mild steels.

Do not hold the carbons too close to the work. Arcing the surface increases the tendency for the base metal to crack when the bending is done.

Carbon Arc Torch Maintenance

The handle is held together with a screw and spring lock washer to give just the right friction on the electrode shafts. If the handle is removed for any reason, the screw at the front of the handle should be turned up snugly and then backed of ½ turn to give the proper friction.

Occasionally the screws in the copper jaws will bind, so it will be advantageous to lubricate the threads with graphite grease and work the grease well into the threaded jaw.

Selecting Electrodes

Which electrode is best for the particular job . . . how do you use it? These are important questions because the cost, quality, and appearance of your work depends on proper electrode selection and application. MILD STEEL ELECTRODES may be classified into the following groups:

Out-of-Position Group (E6011)

This group includes electrodes which have a snappy, deep penetrating arc and fast freezing deposits.

These electrodes are used for general purpose all-position fabrication and repair welding; also the best choice for pipe welding and sheet metal butt, corner and edge welds. They can be used for repair work when dirt, grease, plating or paint cannot be completely cleaned from the steel. Typically used with motions "A" and "B" (below) for the first pass on vertical-up welds.

High-Deposit Group (E6027, E7024)

This group includes the heavy coated, iron powder electrodes with their soft arc and fast deposit rates. These electrodes have a heavy slag and produce exceptionally smooth beads. They are generally used for production welding where all work can be positioned for downhand welding. Stringer beads, with drag technique, are always preferred over weave passes with these electrodes.

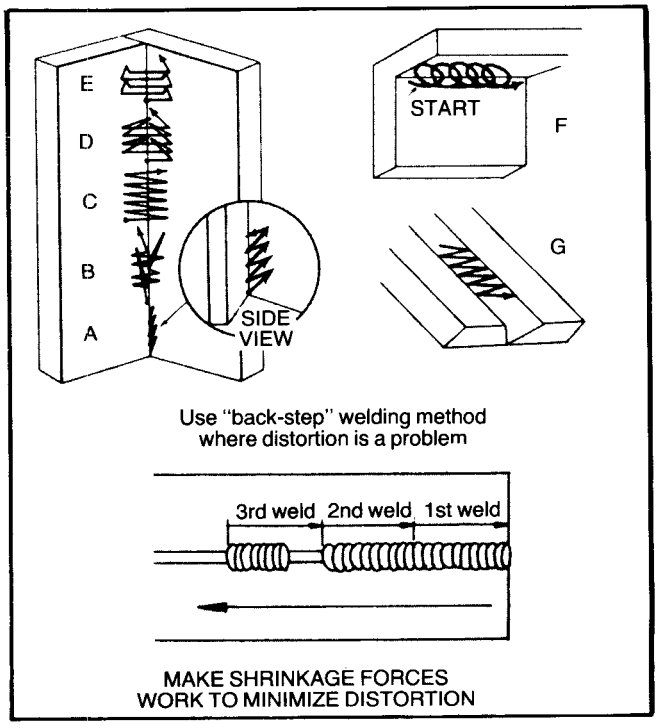
High-Speed Group (E6012, E6013, E7014)

This group includes electrodes which have a moderately forceful arc and deposit rates between those of the out-of-position and high-deposit electrodes. They are primarily general purpose production electrodes especially for downhill fillets and laps or short and irregular welds that change direction or position. Also widely used in maintenance and recommended for sheet metal fillet and lap welds. Motion "D" (below) is generally used for vertical-up welding, but motions "A" and "B" are also suitable.

Low Hydrogen Group (E7018, E7028)

These electrodes are generally called "low hydrogen." The name comes from the fact that their coating contains little hydrogen in either moisture or chemical form. Low hydrogen electrodes offer these benefits: outstanding crack resistance, lowest porosity on sulphur bearing steels, and capable of X-ray quality deposits. Thus, they are the first choice when welding "problem" steels, E7018 can be used in all positions, with Motion "C" recommended for the first pass on vertical-up welds. NEVER use a whipping technique or a long arc with these electrodes. ALWAYS fill craters by drawing electrodes away slowly. ALWAYS keep these electrodes dry. Electrodes not used within a few hours after a container is opened must be stored in heat cabinets. LH-73 is recommended with the AC-225-GLM. Normally, DC(+) is preferred for these electrodes.

Motions



Manipulation depends on the joint. Some of the common motions are shown above.

Motion "A" is a straight whipping motion used with fast-freeze electrodes to make stringer beads in all positions and on all types of joints. It keeps the molten pool small and lets it freeze quckly so the weld metal doesn't spill down or through the joint. Keep arc short when in the crater and longer during whip out from the crater.

Motion "B" is a whipping motion combined with a slight weave in the crater. It is used with fast-freeze electrodes as the first pass on vertical fillets and V-butts.

Motion "C" is a simple side-to-side weave used with all types of electrodes to make fill passes on vertical fillets and V-butts. Also sometimes used with fill-freeze and low hydrogen electrodes to make the first pass on these joints.

Motion "D" is a triangular weave used with fill-freeze and low hydrogen electrodes to make one pass vertical fillets and V-butts. It results in a larger weld than Motion "C".

Motion "E" is a box weave used with all types of electrodes to make fill passes on vertical fillets and V-butts. It is similar to Motion "C," but with a distinct pause and slight upward motion at each edge of the weld to assure complete crater filling and elimination of undercut.

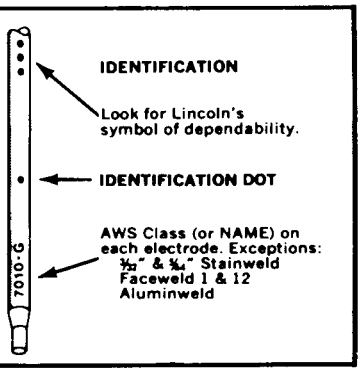
Motion "F" is a circular motion used with all types of electrodes to make overhead welds. Sometimes accompanied by a slight whip after each oscillation in the crater. Always use a series of stringer beads overhead; do not weave.

Motion "G" is a simple side-to-side weave used with all electrodes on wide fillets or butts in the flat position.

ELECTRODE IDENTIFICATION AND OPERATING DATA

COATING COLOR	Conforms to Test Requirements of AWS Class	ELECTRODE BRAND NAME	ELECTRODE POLARITY (+)="REVERSE" (−)="STRAIGHT"	SIZES AND CURRENT RANGES (Amps.) 5/64" SIZE	3/32" SIZE	1/8" SIZE	5/32" SIZE	3/16" SIZE	7/32" SIZE	1/4" SIZE	5/16" SIZE
MILD STEEL											
Brick Red	E6010	Fleetweld 5P	DC (+)		40-75	75-130	90-175	140-225	200-275	220-325	240-400
Tan	E6012	Fleetweld 7	DC (−) AC			80-135 90-150	110-180 120-200	155-250 170-275	225-295 250-325	245-325 275-360	
Gray	E6011	Fleetweld 35	AC DC (+)		50-85 40-75	75-120 70-110	90-160 80-145	120-200 110-180	150-260 135-235	190-300 170-270	
Red Brown	E6011	Fleetweld 35LS	AC DC (±)			80-130 70-120	120-160 110-150				
Gray Tan	E6013	Fleetweld 37	AC DC (±)	50-80 45-75	75-105 70-95	110-150 100-135	160-200 145-180	205-260 190-235			
Gray Brown	E7014	Fleetweld 47	AC DC (−)			110-160 100-145	150-225 135-200	200-280 185-235	260-340 235-305	280-425 260-380	
Gray*	E6013	Fleetweld 57	AC DC (−)			100-150 90-135	150-200 135-180	200-260 180-235			
Brown	E6011	Fleetweld 180	AC DC (±)		40-90 40-80	60-120 55-110	115-150 105-135				
Gray	E7024	Jetweld® 1	AC DC (±)		65-120 60-110	115-175 100-160	180-240 160-215	240-300 220-280	300-380 270-340	340-440 320-400	
Red Brown	E6027	Jetweld 2	AC DC (±)				190-240 175-215	250-300 230-270	300-380 270-340	350-450 315-405	
Gray*	E7024	Jetweld 3(1)	AC DC (±)		65-120 60-110	115-175 100-160	180-240 160-215	240-315 215-285	300-380 270-340	350-450 315-405	380-600 360-600
Gray	E7018	Jetweld LH-70	DC (+) AC		70-100 80-120	90-150 110-170	120-190 135-225	170-280 200-300	210-330 260-380	290-430 325-440	375-500 400-530
Gray*	E7018 (white numbers)	Jetweld LH-73	AC DC (+)		70-90 65-85	95-135 90-125	140-200 130-185				
White	E7018	Jetweld LH-75	DC (+) AC		70-110 80-110	95-160 100-170	120-190 135-225	180-270 210-290	250-330 270-370	300-400 325-420	
Gray	7018 (white numbers)	JET-LH 78	DC (+) AC		85-110	110-160 120-170	130-200 140-230	180-270 210-290	250-330 270-370	300-400 325-420	
Gray Brown	E7028	Jetweld LH-3800	AC DC (+)				180-270 170-240	240-330 210-300	275-410 260-380	360-520	
(1) 5/16" Jetweld 3 does not conform to any AWS/ASME classification.			**LOW ALLOY, HIGH TENSILE STEEL**								
Pink	E7010-A1	Shield Arc® 85	DC (+)		50-90	75-130	90-175	140-225			
Pink*	E7010-A1	Shield Arc 85P	DC (+)					140-225			
Tan	E7010-G	Shield Arc HYP	DC (+)			75-130	90-185	140-225	160-250		
Gray	E8010-G	Shield Arc 70+	DC (+)			75-130	90-185	140-225			
Gray Brown	E8018-C1	Jet-LH® 8018-C1	DC (+) AC			90-150 110-160	120-180 140-200	180-270 200-300		250-350 300-400	
Gray Brown	E8018-C3	Jet-LH 8018-C3	DC (+) AC			110-150 120-170	130-190 140-225	180-270 210-290	250-330 270-370	300-400 325-420	
Gray	E8018-B2	Jetweld LH-90	DC (+) AC			110-150 120-170	130-190 140-225	180-270 210-290			
Gray	E11018-M	Jetweld LH-110M	DC (+) AC		70-100 80-110	85-155 100-170	120-195 135-225	160-280 200-310	190-310 240-350	230-360 290-410	
STAINLESS STEEL											
Pale Green	E308-15	Stainweld® 308-15	DC (+)		30-70	50-100	75-130	95-165		150-225	
Gray	E308-16	Stainweld 308-16	DC (+); AC	20-45	30-60	55-95	80-135	115-185		200-275	
Gray	E308L-16	Stainweld 308L-16	DC (+); AC		30-65	55-100	80-140	115-190			
Gray	E309-16	Stainweld 309-16	DC (+); AC		30-60	55-95	80-135	115-185		200-275	
Gray	E310-16	Stainweld 310-16	DC (+); AC		30-65	55-100	80-140	120-185		200-275	
Gray	E316L-16	Stainweld 316L-16	DC (+); AC		30-65	55-100	80-140	115-190			
Pale Green	E347-15	Stainweld 347-15	DC (+)		30-70	50-100	75-130	95-165			
Gray	E347-16	Stainweld 347-16	DC (+); AC		30-60	55-95	80-135	115-185			
ALUMINUM											
White		Aluminweld®	DC (+)		20-55	45-125	60-170	85-235			

				1/8" SIZE	5/32" SIZE	3/16" SIZE	1/4" SIZE
CAST IRON							
Light Tan	ESt	Ferroweld®	DC (+); AC	80-100			
Black	ENi-CI	Softweld®	DC (±) AC	60-110 65-120	100-135 110-150		
HARDSURFACING							
Black		Abrasoweld	DC (±) AC	40-150 50-165	75-200 80-220	110-250 120-275	150-375 165-410
Black		Faceweld® 1	DC (+); AC			60-150	
Black		Faceweld 12	DC (+); AC			60-150	
Dark Gray		Jet-LH BU-90	DC (±) AC		145-210 155-225	180-280 200-290	230-360 255-375
Dark Gray		Mangjet®	DC (±) AC		120-180 135-230	160-260 165-285	200-350 220-385
Dark Gray		Wearweld®	DC (+) AC			110-275 125-275	150-400 00-400



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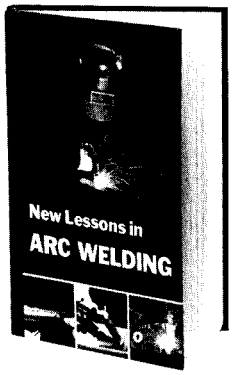
The electrodes under the shaded portions of this chart will operate on the AC-225-GLM Arc Welder. Be careful of abusing the duty cycle with large electrodes which will overheat and damage the machine.



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