

**ELECTRIC ARC**

**WELDING**

**UNIT**

# Electric Arc Welding

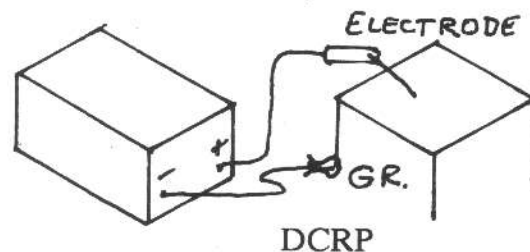
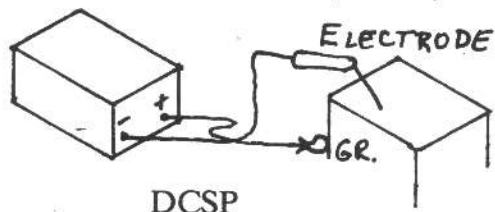
## Introduction

### Definition of Electricity:

**Electricity is the movement of electrons along a conductor.** A conductor is a material that allows electrical current to easily pass through it. Examples of a conductor are aluminum, brass, copper, gold, silver. A resistor is a material that will allow some electrical current to pass through it. A good example of this is steel. An insulator is a material that will not allow electrical current to pass through it. Examples of insulators are glass, plastic, lead, etc.

### Arc Welders:

Over the century there have been many welder designs. Welders have been manufactured that produce **Alternating Current (AC)** and **Direct Current (DC)**. (There are also AC/DC combination welders.) Alternating current pulsates at a rate of 60 cycles per second in the United States, 50 elsewhere in the world. Direct current is used for welders as **Direct Current Straight Polarity (DCSP)** and **Direct Current Reverse Polarity (DCRP)**.



Welding machines get their power from 110 or 220 volt wall plugs. **Be very careful** about owning a 110 volt arc welder, as many of them are very hazardous - this instructor doesn't recommend purchase or ownership of 110 volt arc welders. Welding machines also are powered by gasoline or diesel which give them great portability.

Often students ask about recommendations for purchasing arc welding equipment. The simplest arc welder recommended for purchase by this instructor is an alternating current 220 volt machine. This is a transformer type arc welder that will transform incoming high voltage, low amperage electricity into high amperage, low voltage welding current. An arc welder should be on a separate circuit of its own with a 50 amp. breaker and #8 wire providing the power. Be sure to purchase the correct the correct receptacle plug as their shape or configuration determines the maximum amperage for which they are designed.

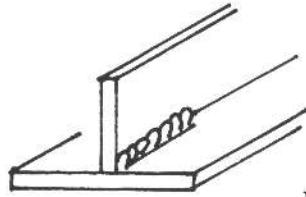
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Examples

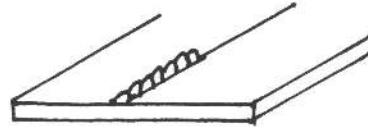
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50 AMP.

Sizes of Metal for Welding: Over 1/8" - seriously consider Arc Welding, under 1/8" use Oxyacetylene.

Proper Bead:

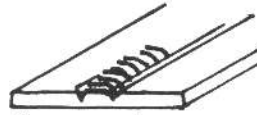
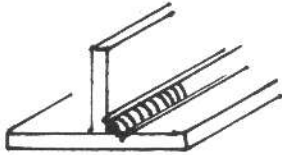


Incorrect



Reasons:

1. Speed forward too fast.
2. Amperage too low.
3. Lead angle of electrode too near horizontal.
4. Electrode too close to metal.



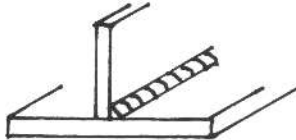
Incorrect



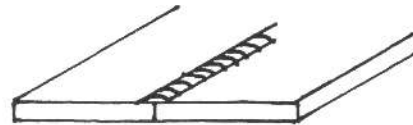
Undercutting

Reasons:

1. Amperage too high.
2. Lead angle of electrode too near vertical.



Correct



Reasons:

All factors indicated above have been corrected.

Position of Electrode:

Bisect the angle of the two metal surfaces. (Split the angle.)

Lead Angle of Electrode:

Lead 10 degrees in the direction of travel. (Lead 10)

Distance of Electrode off Metal Surface - Arc Gap:

Equal to the core diameter of the electrode.

Amperage:

- 1/16" - 20 to 40 amps
- 3/32" - 30 to 80 amps
- 1/8" - 80 to 130 amps
- 5/32" - 150 to 180 amps

Defects:

1. Pits - cause -
  - moving too fast forward
  - no filling motion
  - arc gap too high
  
2. Spatter - cause -
  - electrode too far from metal surface
  - too much amperage
  
3. Uneven Slag Coating - cause -
  - type of electrode - could be if E-6011; however, you are being trained on E-6013 so this is not a good reason.
  - excessive heat - base metal too hot from previous welds or too much amperage for the electrode.
  - uneven motion
  
4. Uneven ripple (jumpy) - cause -
  - distance from electrode to metal is not being maintained constant - changing the arc gap.
  - travel speed not maintained constant - shaking of the hand while welding.

**Warning:** Always wait until slag turns black before chipping slag.  
Always wear EYE SAFETY protection when chipping slag.

Appearance of a Good Weld:

Same as Oxyacetylene Welding with one addition:

1. **Smooth** surface weld after slag removal.
2. **Even** ripple
3. **Gloss** or sheen to the surface after slag removal.
4. **Penetration**
5. **Smooth Slag Coating** on E-6013 and E-7024

**Reminder:** Always remove little beads of spatter or "berries" from surface before applying finish.)

A.W.S.

American Welding Society - standardization organization that develops **welding** symbols on working drawings, compositions of welding electrodes and specifications regarding their use. The American Welding Society also has the numbering system as mentioned here and shown in more detail on the next page:

- E = **Electrode** (for Electric Arc Welding only)
- 60 = **Thousands of Pounds per square inch Tensile Strength** when in a weld deposit.
- 1 = **Position** the welding electrode will be successful.
- 3 = **Flux Coating** and therefore the type of **Welding Current** to be used with the electrode.

Purposes of an Electrode Flux:

1. Helps **establish the arc**.
2. Produces a **slag coating** to shield weld while cooling.
3. **Protects metal under arc** from atmosphere.
4. **Produces a fluxing gas** - Hydrogen or carbon dioxide.

STANDARD AMERICAN WELDING SOCIETY  
CODE FOR WELDING ELECTRODE DESIGNATION

"ELECTRODE"

WELDING POSITION IN WHICH ELECTRODE IS CAPABLE OF PRODUCING SATISFACTORY WELDS

- 1 = All positions; Flat, Vertical, Horizontal or Overhead.
- 2 = Flat Position or Horizontal Fillets Only
- 3 = Flat Only

TYPE OF COATING AND WELDING CURRENT

- 0 = not low hydrogen, d-c reverse polarity
- 1, 2, or 3 = not low hydrogen, a-c or d-c rev. polarity
- 4, 7 = not low hydrogen, iron powder coating, a-c or d-c reverse polarity
- 5 = low hydrogen, d-c reverse polarity
- 6 = low hydrogen, a-c or d-c rev. polarity
- 8 = low hydrogen, iron powder coating a-c or d-c reverse polarity

**E-8018-B2**

Example:

CHEMICAL COMPOSITION OF WELD DEPOSIT (ALLOY)

MINIMUM TENSILE STRENGTH OF WELD DEPOSIT

- 60 = 60,000 lb. per sq. inch
- 70 = 70,000
- 80 = 80,000
- 90 = 90,000
- 100 = 100,000
- 110 = 110,000
- 120 = 120,000

- None = Mild Steel or Alloy not Designated
- A 1 = Carbon Moly
- B 1 = 1/2% Chrome, 1/2% Moly
- B 2 = 1 1/4% Chrome, 1/2% Moly
- B 3 = 2 1/4% Chrome, 1% Moly
- C 1 = 2 1/2% Nickel
- C 2 = 3 1/2% Nickel
- C 3 = 1% Nickel
- D 1 = 1 1/2% Manganese, 1/4% Moly
- D 2 = 1 3/4% Manganese, 1/4% Moly
- G = Alloy not designated
- M = Conforms to alloy designated by Military Spec.

## ELECTRIC ARC WELDING

Ventilation must be provided when using this area. Helmet, jacket, and gloves must all be worn when welding to protect eyes and skin from being burnt by the ultraviolet rays. Cracks in lens found in welding helmets must be immediately replaced because of the dangerous ultraviolet rays. Weld in the booth only. Use eye protection when chipping slag. Hot cables should be reported to the instructor. If hot metal is to be left out in the lab. after welding, label it "hot" with soapstone. Do not weld on galvanized steel!!! (It is dangerous to health because of the toxic zinc fumes.) Do not weld near flammables. When through and leaving the booth, turn the power off. Suspend electrode holders so they do not touch any metal when not in use.