

# SMAW



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# Introduction

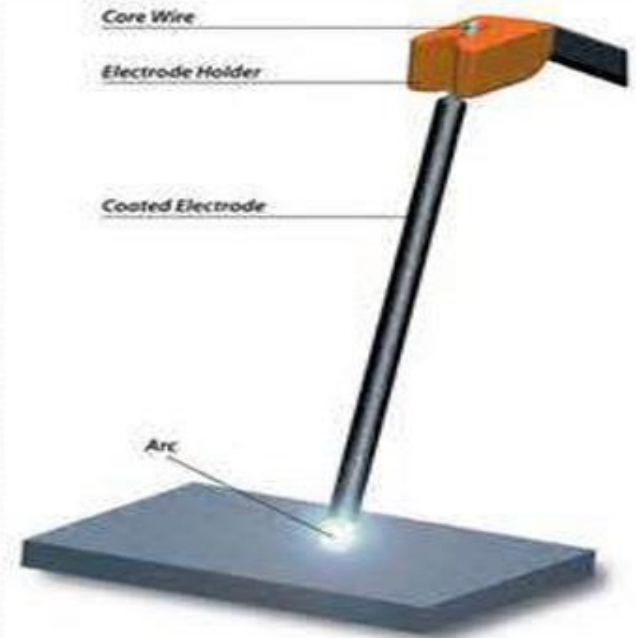


- This is one of the arc welding processes that is commonly used in construction/fabrication processes. It is also known with several names such as; MMA or MMAW, flux shielded arc welding or informally known as stick welding.
- The electrode used in this process is consumable (a rod covered with flux).
- The flux burns to form the protective layer/cover for the weld.
- The current type used in this process can either be AC or DC depending on the design of the weld.

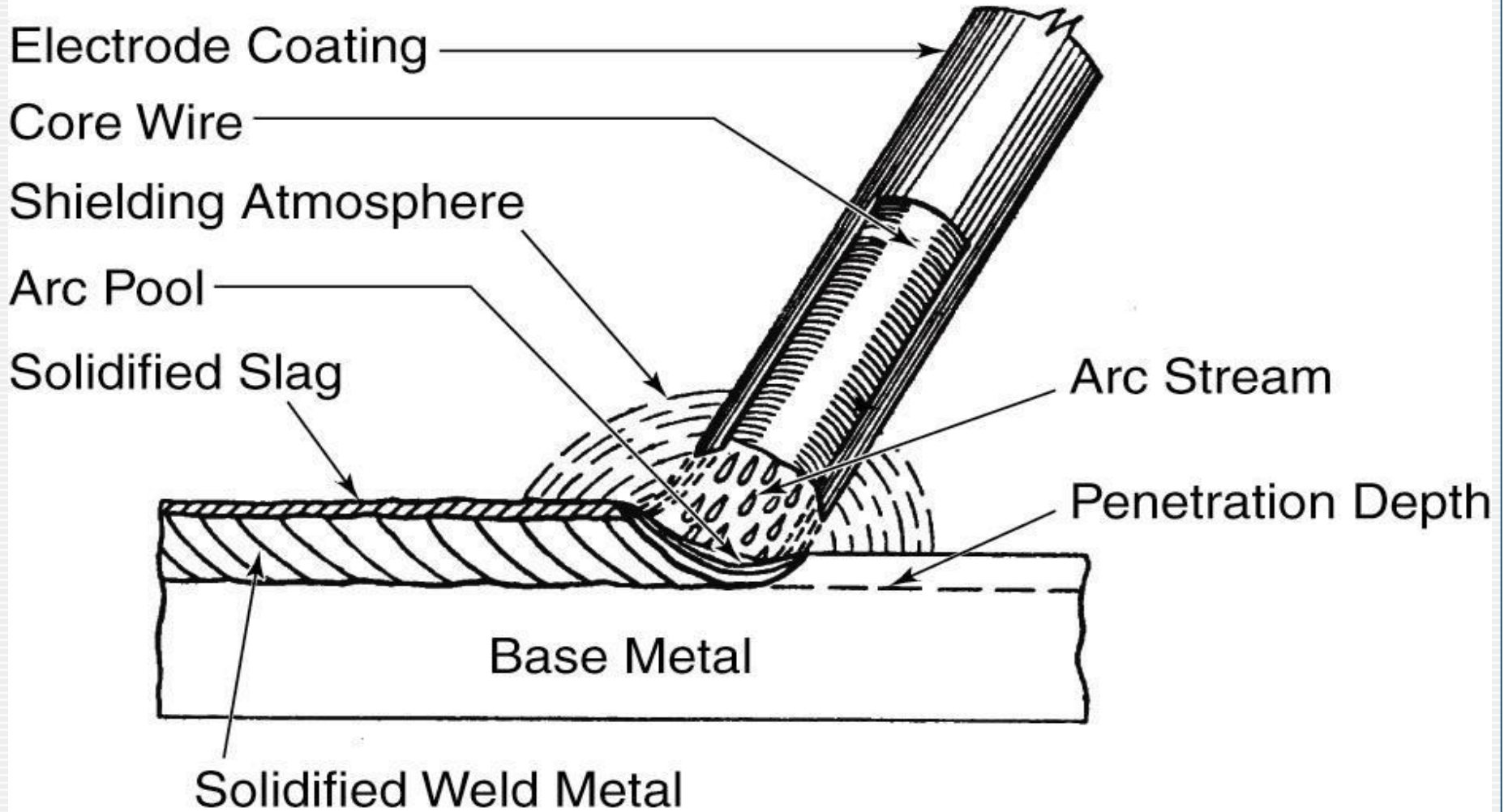
# Introduction Cont...



- Because of the versatility and simplicity of this process, it is most generally and widely used across the world, it is mostly used for repair and maintenance in the heavy steel industry.



# SMAW



# SMAW Operating Principles



- Sets up electric circuit
  - Includes welding machine, work, electric cables, electrode holder and electrodes, and a work clamp
- Heat of electric arc brings work to be welded and consumable electrode to molten state
  - Heat intense: as high at 9,000°F at center

# Equipments Used For SMAW



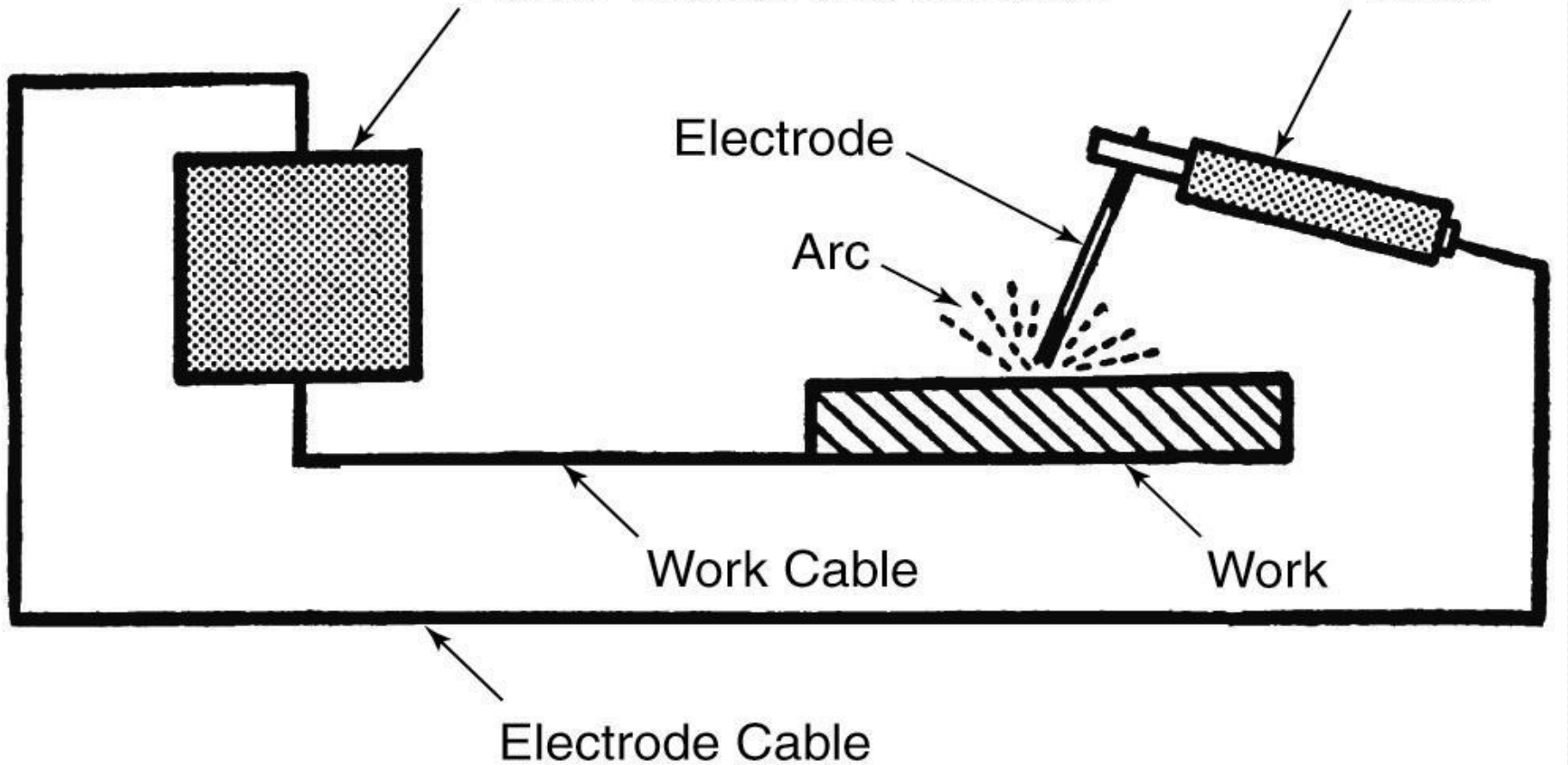
- Some key equipments used when carrying out SMAW process may include the following;
  - I. Power source or power supply (AC or DC)
  - II. Cables (ground cable and ht cable)
  - III. Electrode holder also known as welding tong
  - IV. Welding table (for workshop)
  - V. Clamps
  - VI. Electrodes

# Equipments



Welding Machine AC or DC  
Power Source and Controls

Electrode  
Holder





# Welding Process



- Electric arc started by striking work with electrode.
- Heat of arc melts electrode and surface of base metal.
- Tiny globules of molten metal form on tip of electrode and transferred by arc into molten pool on work surface.
- After weld started, arc moved along work.

# Shielding Of Arc



- At high temperatures in Arc Welding, metals are chemically reactive to oxygen, nitrogen, and hydrogen in air
  - Mechanical properties of joint can be degraded by these reactions
  - To protect operation, arc must be shielded from surrounding air in Arc Welding processes.
- Arc shielding is accomplished by:
  - Shielding gases, e.g., argon, helium, CO<sub>2</sub>
  - Flux

# Welding Power Sources



- Power source type:-
  - Transformer
  - Transformer-rectifier
  - Inverter
  - Generator

# Welding Power Sources Cont...



- **Engine-driven generators**
  - Powered by gas or diesel combustion engine
  - Can be found with A.C. or D.C. electric motor
    - ✦ No longer being manufactured and rarely found
- **Transformer-rectifiers**
  - Use basic electrical transformer to step down A.C. line power voltage to A.C. welding voltage
  - Welding voltage then passed through rectifier to convert A.C. output to D.C. welding current
  - May be either D.C. or A.C.-D.C. machines

# Welding Power Sources Cont...



- **A.C. transformers**
  - Used to step down A.C. line power voltage to A.C. welding voltage
- **Inverters**
  - Increases frequency of incoming primary power
  - Constant current, constant voltage, or both
  - Produce A.C. or D.C. welding current

# Facts About SMAW

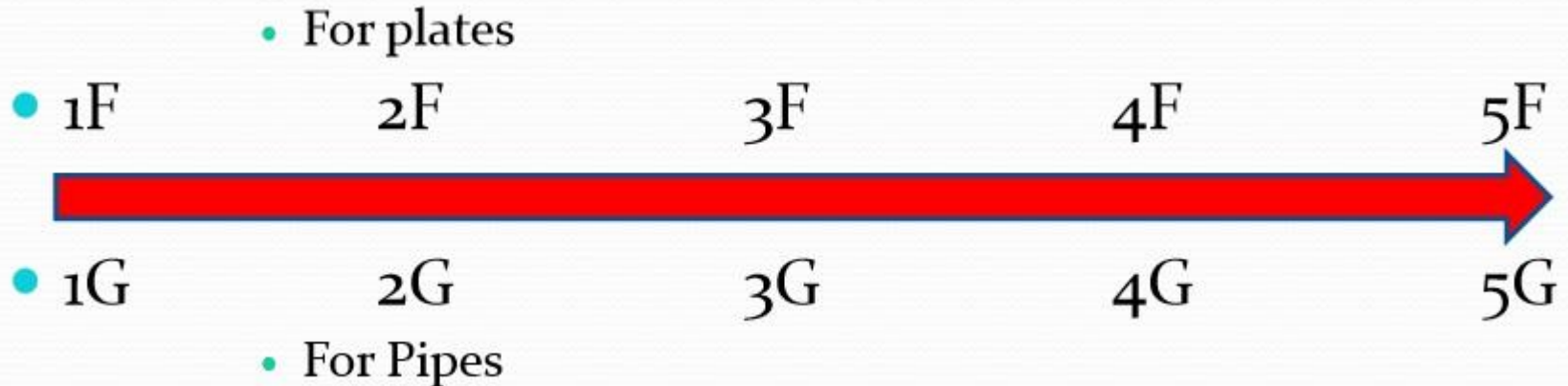


- **SMAW** is considered as one of the least efficient welding process because the operator's factor of chipping away slag and changing of worn-out electrodes during the process.
- Actual welding technique utilized depends on the electrode, composition of the work piece, and the position of the joint to be welded.
- The choice of electrode and welding position also determines the speed of the weld.

# Welding Technique



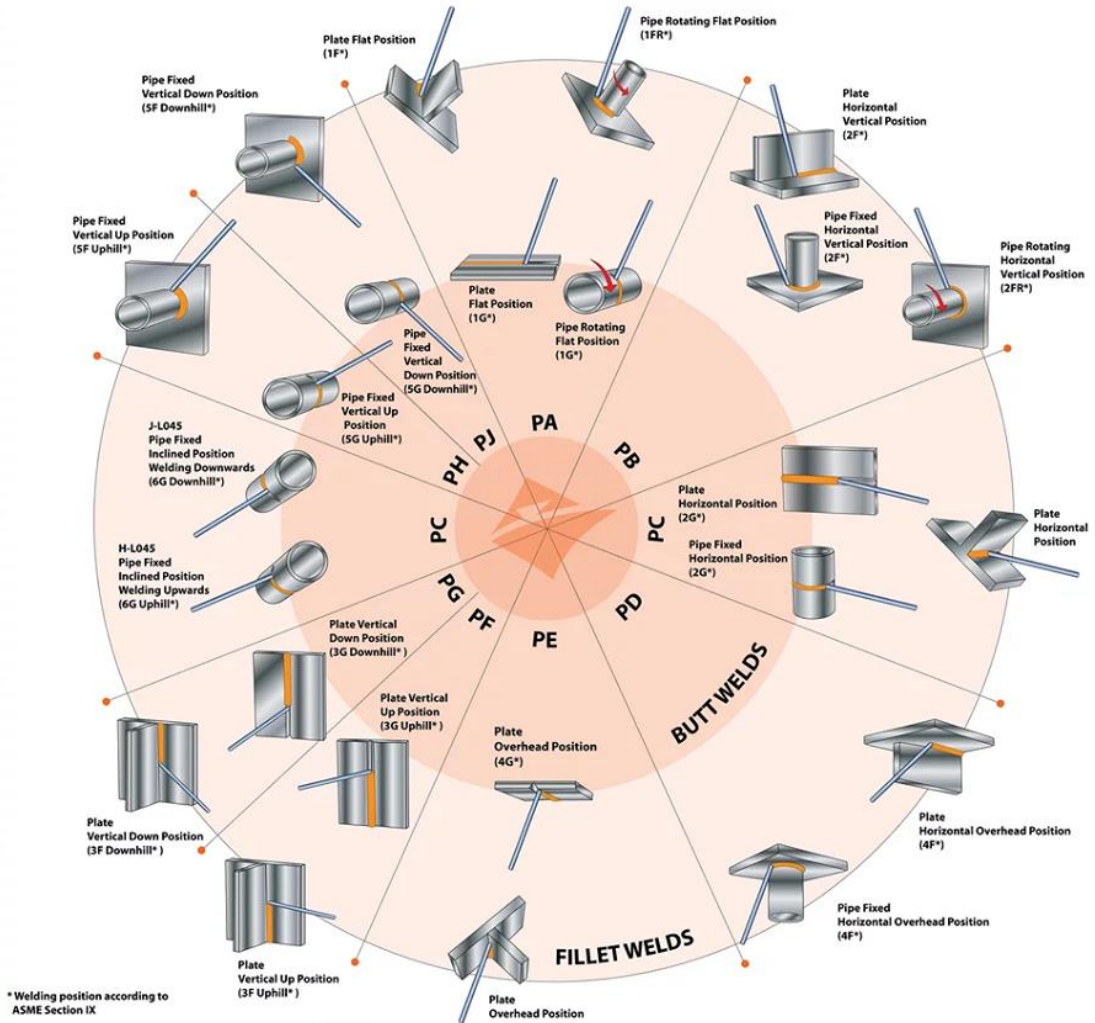
- For the purpose of this presentation; we shall only highlight the level of difficulties in carry out this welding process in different position.



Increasing order of difficulty....

**NOTE:** There are other varying welding positions in addition to the above mentioned.

# Various Welding Positions Both On Plate, Fillet And Pipe



\* Welding position according to ASME Section IX



# Electrode



- The choice of electrode for SMAW depends on a number of factors, including the weld material, welding position and the desired weld properties. The electrode is coated in a metal mixture called flux, which gives off gases as it decomposes to prevent weld contamination, introduces deoxidizers to purify the weld, causes weld-protecting slag to form, improves the arc stability, and provides alloying elements to improve the weld quality.

# Electrode Classification



- Electrodes can be divided into three groups:
  - Fast-fill - designed to melt quickly
  - Fast-freeze - designed to solidify quickly
  - Fill-freeze/fast-follow - intermediate electrodes

# Electrode Classification Cont...



- Electrodes can be classified into the following as seen in the table below:

**CLASSIFICATION TABLE**

<b>Class</b>	<b>Electrode Coating</b>	<b>Penetration</b>	<b>Current Type</b>
Exxx0	Cellulose, Sodium	Deep	DCEP
Exxx1	Cellulose, Potassium	Deep	AC, DCEP
Exxx2	Rutile, Sodium	Medium	AC, DCEN
Exxx3	Rutile, Potassium	Light	AC, DCEP, DCEN
Exxx4	Rutile, Iron Powder	Medium	AC, DCEP, DCEN
Exxx5	Low Hydrogen, Sodium	Medium	DCEP
Exxx6	Low Hydrogen, Potassium	Medium	AC, DCEP
Exxx7	Iron Powder, Iron Oxide	Medium	AC, DCEN
Exxx8	Low Hydrogen, Iron Powder	Medium	AC, DCEP
Exxx9	Iron Oxide, Rutile, Potassium	Medium	AC, DCEP, DCEN

# SMAW Electrode Classification Example



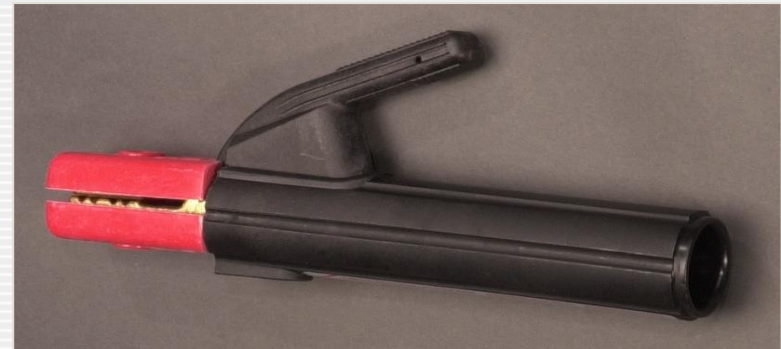
# E7018

- E indicates electrode
- 70 indicates 70,000 psi tensile strength
- 1 indicates use for welding in all positions
- 8 indicates low hydrogen

# Electrode Holder



- Device used for holding electrode mechanically
- Conveys electric current from welding cable to electrode
- Insulated handle protects hand from heat
- Jaws of holder grip electrode at any angle
- Should be well insulated & have a strong spring to hold the electrodes.
- Made of metal with high electrical conductivity and ability to withstand high temperatures



# Ground Clamps



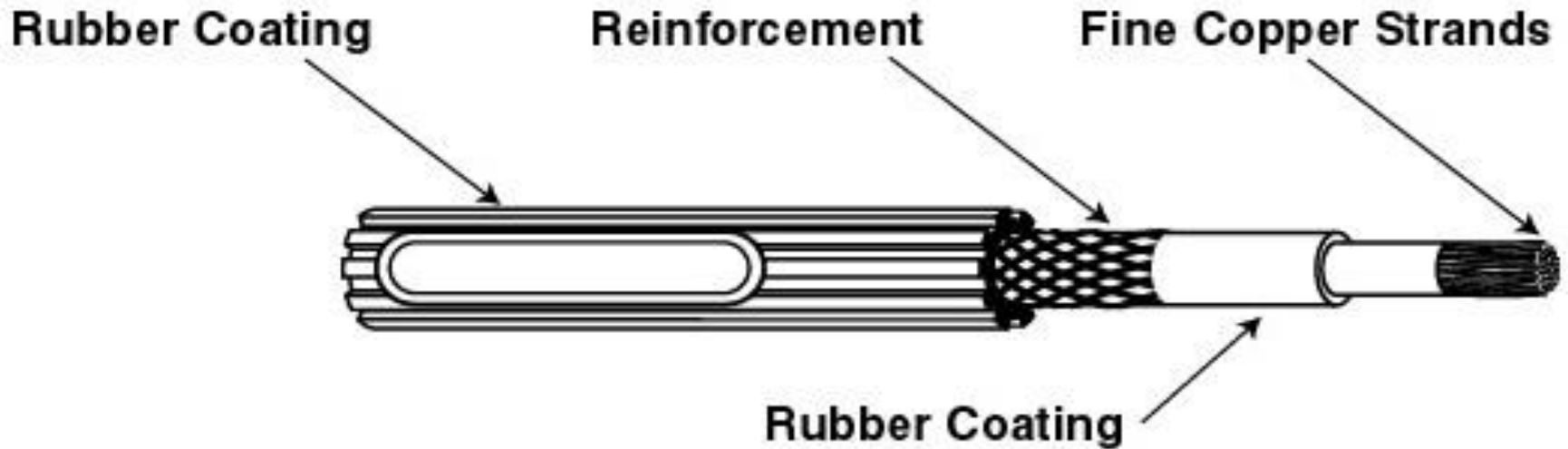
- Completes the full electrical circuit.
- Must be fastened securely to the base metal or to the bench (metal) you are working on.
- A bad connection will result in resistance build-up in the cables and connections.
- Resistance generates heat which can damage and/or melt parts.



# Cables



- Allows the ground clamp and stinger to be mobile.
- Should be well insulated and protected from heat.



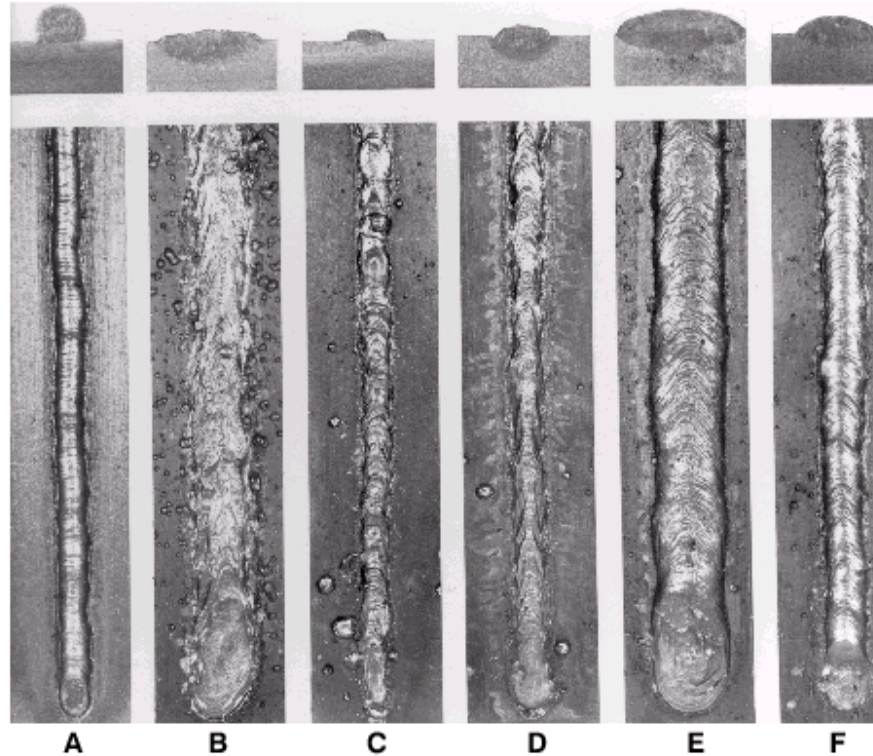
# Defects associated with SMAW



- Below are some of the common defects that are associated with the SMAW process;
  - A. Spatters
  - B. Porosity
  - C. Incomplete penetration
  - D. Cracks
  - E. Under cuts
  - F. Poor fusion
  - G. Poor weld profile, and so on...



# Bead Comparison



- A. Welding current too low.
- B. Welding current too high.
- C. Arc too long.

- D. Welding speed too fast.
- E. Welding speed too slow.
- F. Proper amperage, voltage, and speed.

# SMAW Advantages



- Easily implemented
- Inexpensive
- Flexible
- Not as sensitive to part fit-up variances
- Equipment relatively easy to use
- Portable
- Less sensitive to drafts, dirty parts, poor fit-up



# Limitations



- Low Deposition Rates
- Low Productivity
- Operator Dependent
- Heat of welding too high for lead, tin, zinc, and their alloys

Thank  
you

