GAS METAL ARC WELDING (GMAW)

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What is Welding?

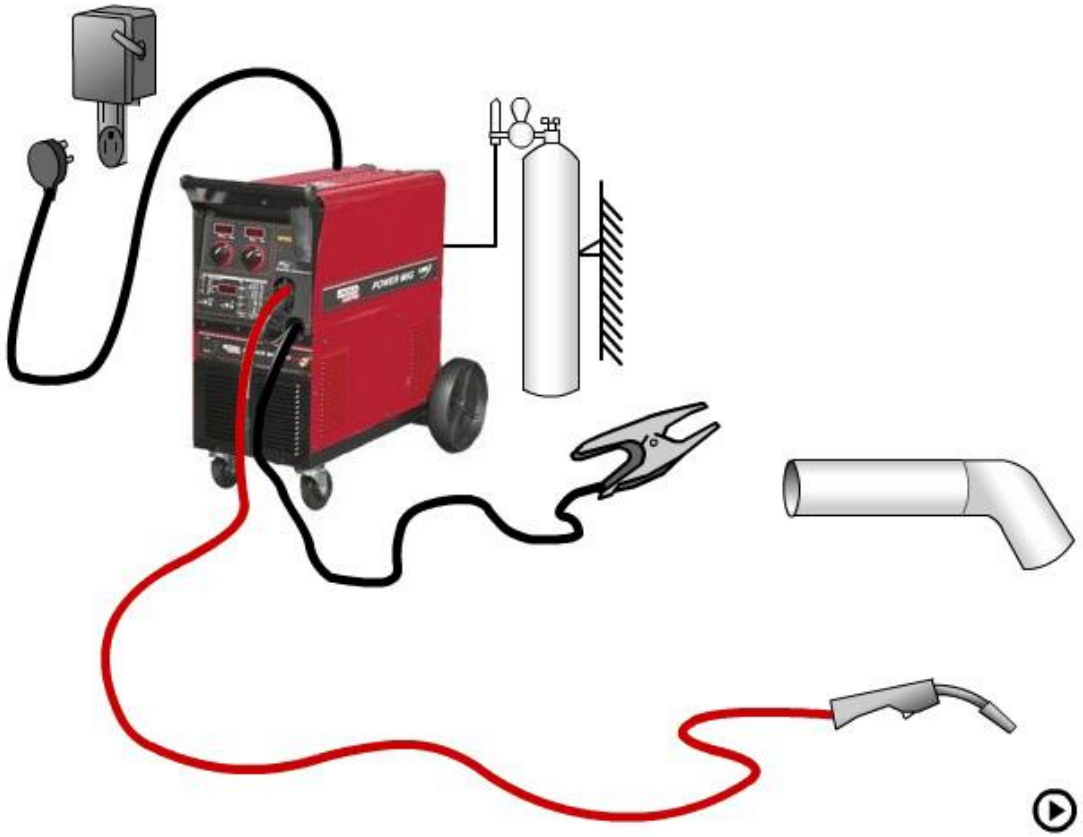
- A fabrication process that joins materials, usually metals, permanently through localized coalescence to become one.
- Coalescence of materials is achieved by :
  - heating them to suitable temperatures with or without the application of pressure
  - by the application of pressure alone, and
  - with or without the use of filler material.

MAG (CO_2) Welding

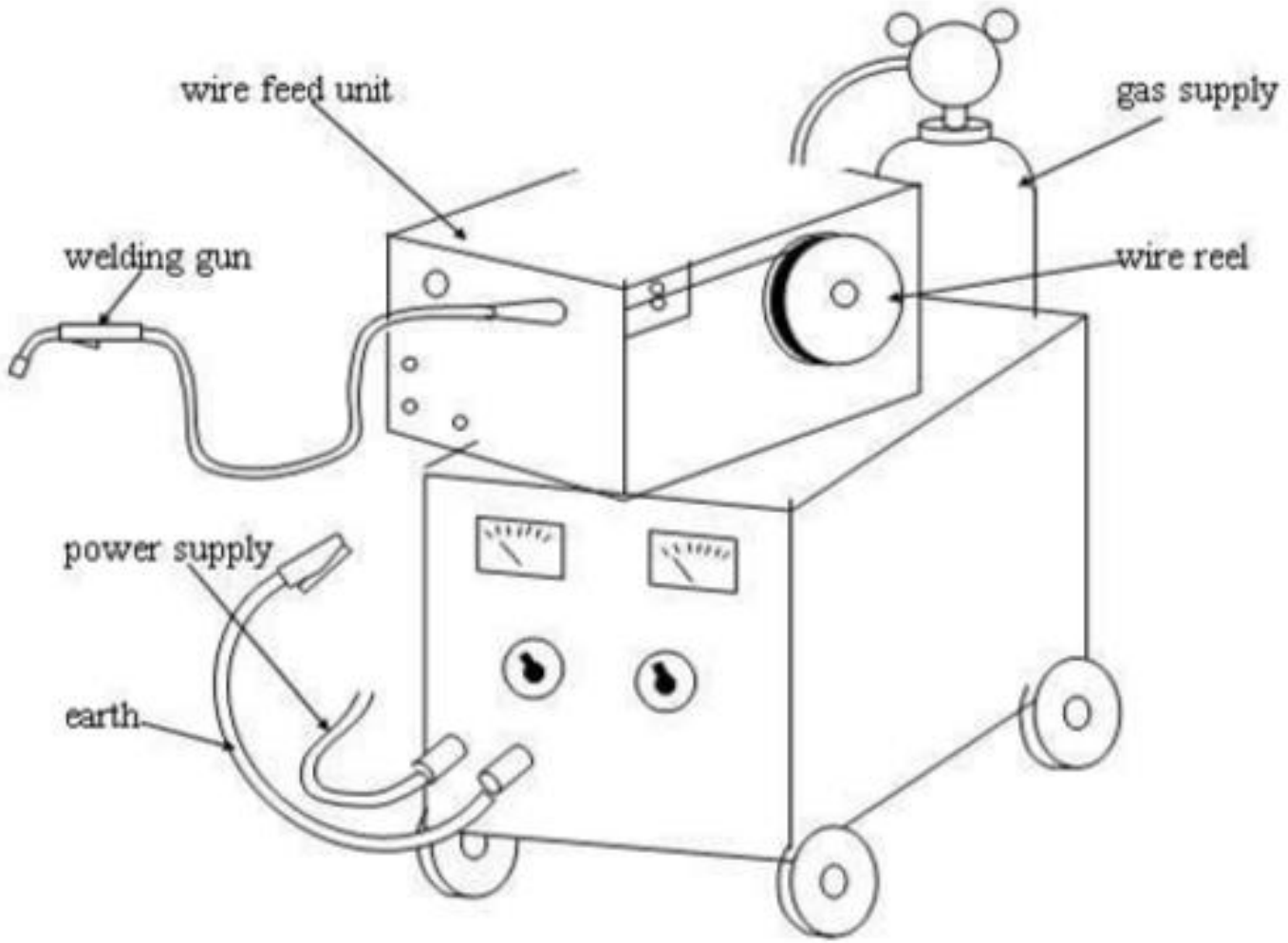
- MAG (CO_2) welding is a variation of the standard MIG process. In MIG process, generally argon, helium or their mixture are used for shielding the molten weld pool whereas in CO_2 welding process, CO_2 is used as the shielding gas.
- CO_2 being an active gas, this process is known as MAG process.
- CO_2 welding is used for welding of carbon and low carbon sheets from 16 gauge (0 to 0.54 inch) to ¼ inch.
- It produces deeper penetration than argon.
- CO_2 is basically a semi automatic process, ion which the arc length and the feeding of electrode wire into the arc automatically controlled.
- CO_2 may also be used in mechanized and automatic forms where productivity is to be increased and consistent quality in weld object is demanded.

MIG Welding

- Metal inert gas (MIG) welding also known as MAG and GMAW.
- It is a semi-automatic or automatic arc welding process in which a continuous and consumable wire electrode and a shielding gas are fed through a weldinggun.
- An electric arc forms between the consumable wire electrode and the work piece metal(s), which heats the work piece metal(s), causing them to melt and join.

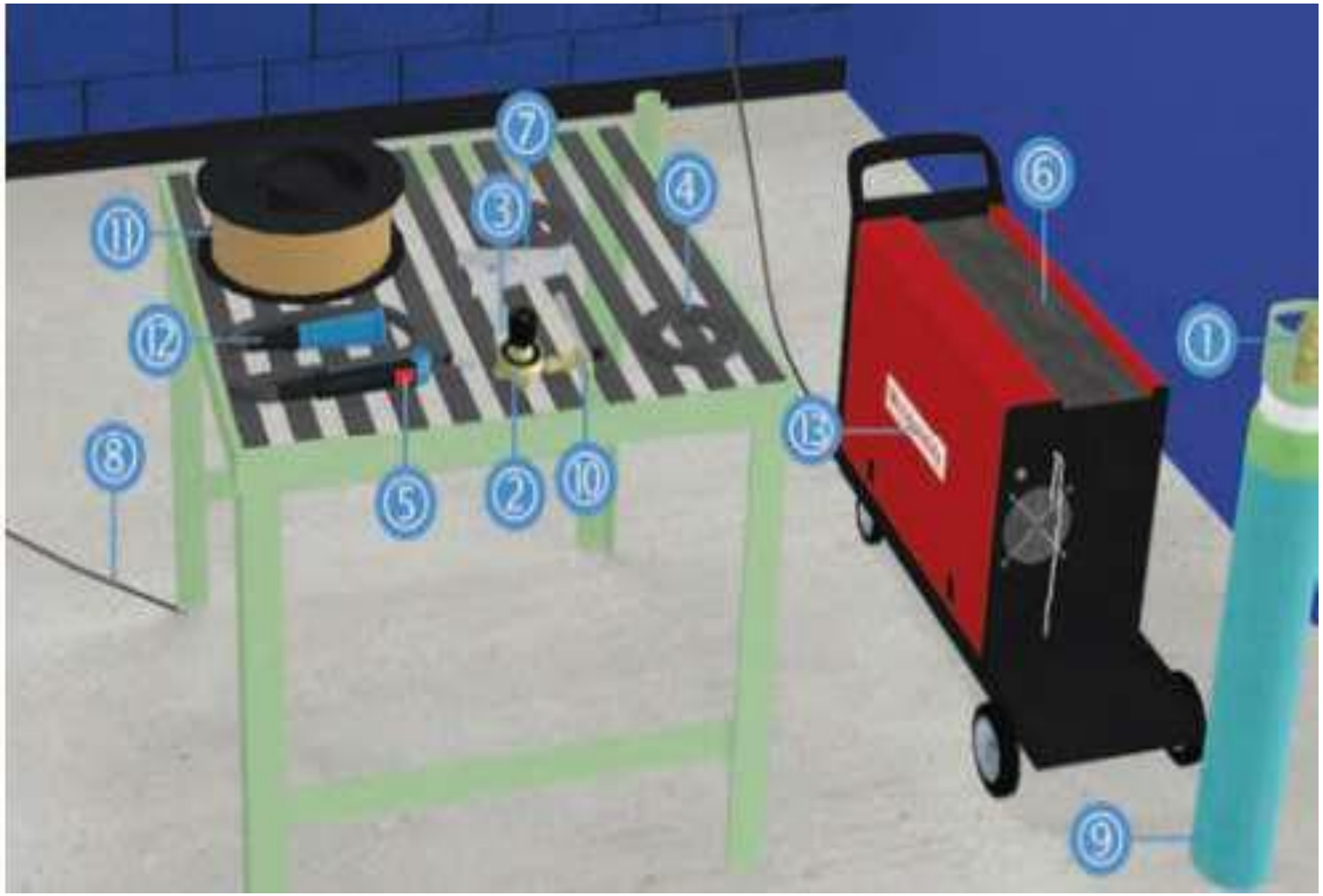


Basic MIG Welding Circuit



Equipment and Set-Up

1. Cylinder
2. Pressure regulator
3. Pressure gauge
4. Flexible hose
5. Welding gun
6. Power source
7. Welding return lead and clamp
8. Earth connection
9. Shielding gas cylinder
10. Flow meter
11. Wire feed
12. Welding cable assembly
13. Cooling system



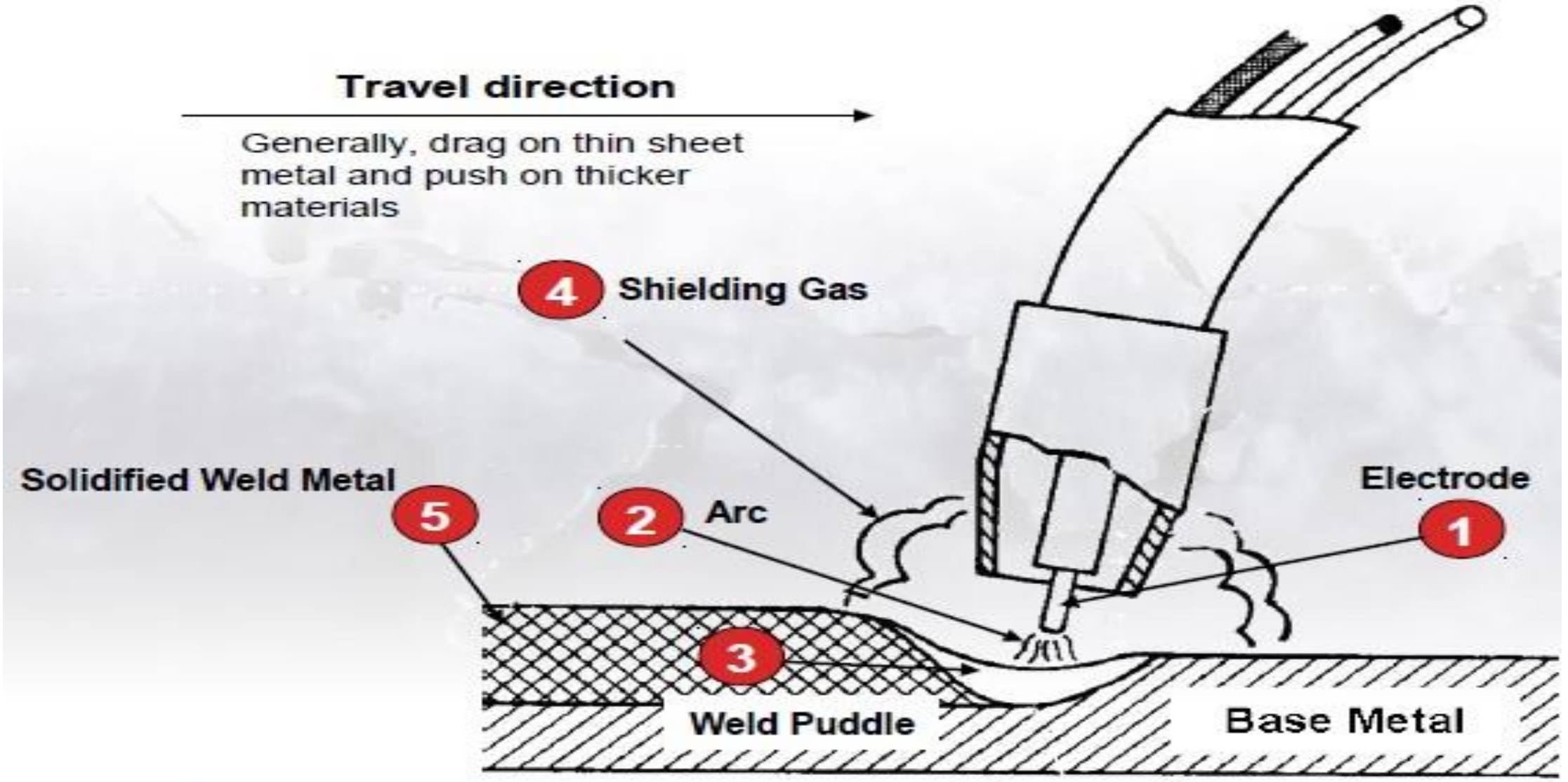
MIG Principle

METAL INERT GAS WELDING (MIG)

GMAW Principle

- Gas metal arc welding is generally used due to the high efficiency of filler metal that can be deposited per hour.
- GMAW is approximately 92% - 98%efficient.
- GMAW requires a shielding gas.
- The GMAW process is performed using DCEP (Direct Current Electrode Positive).
- Alternating current is never used for GMAW.
- DCEN is used only for a specialized process using emissive electrodes.

GMAW Components



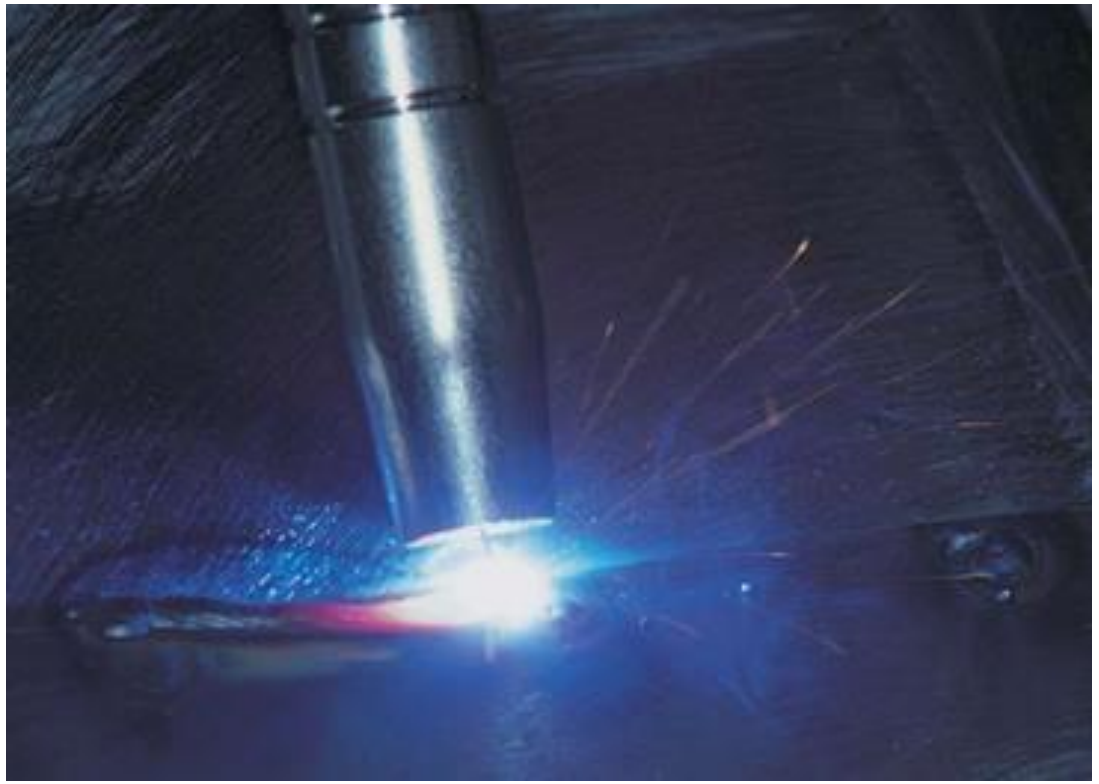
1 - Electrode

- A GMAW electrode is:
  - A metal wire
  - Fed through the gun bythe wire feeder
  - Measured by its diameter

GMAW electrodes are commonly packaged on spools, reels and coils

2 - Arc

- An electric arc occurs in the gas filled space between the electrode wire and the work piece.



Electric arcs can generate temperatures up to 10,000°F

3 - Weld Puddle

- As the wire electrode and work piece heat up and melt, they form a pool of molten material called a weld Puddle.
- This is what the welder watches and manipulates while welding.

28.5 Volts with a 90% Argon / 10% CO2 shielding gas

4 - Shielding Gas

- GMAW welding requires a shielding gas to protect the weld puddle.
- Shielding gas is usually CO2, argon, or a mixture of both.

The gauges on the regulator show gas flow rate and bottle pressure

5 - Solidified Weld Metal

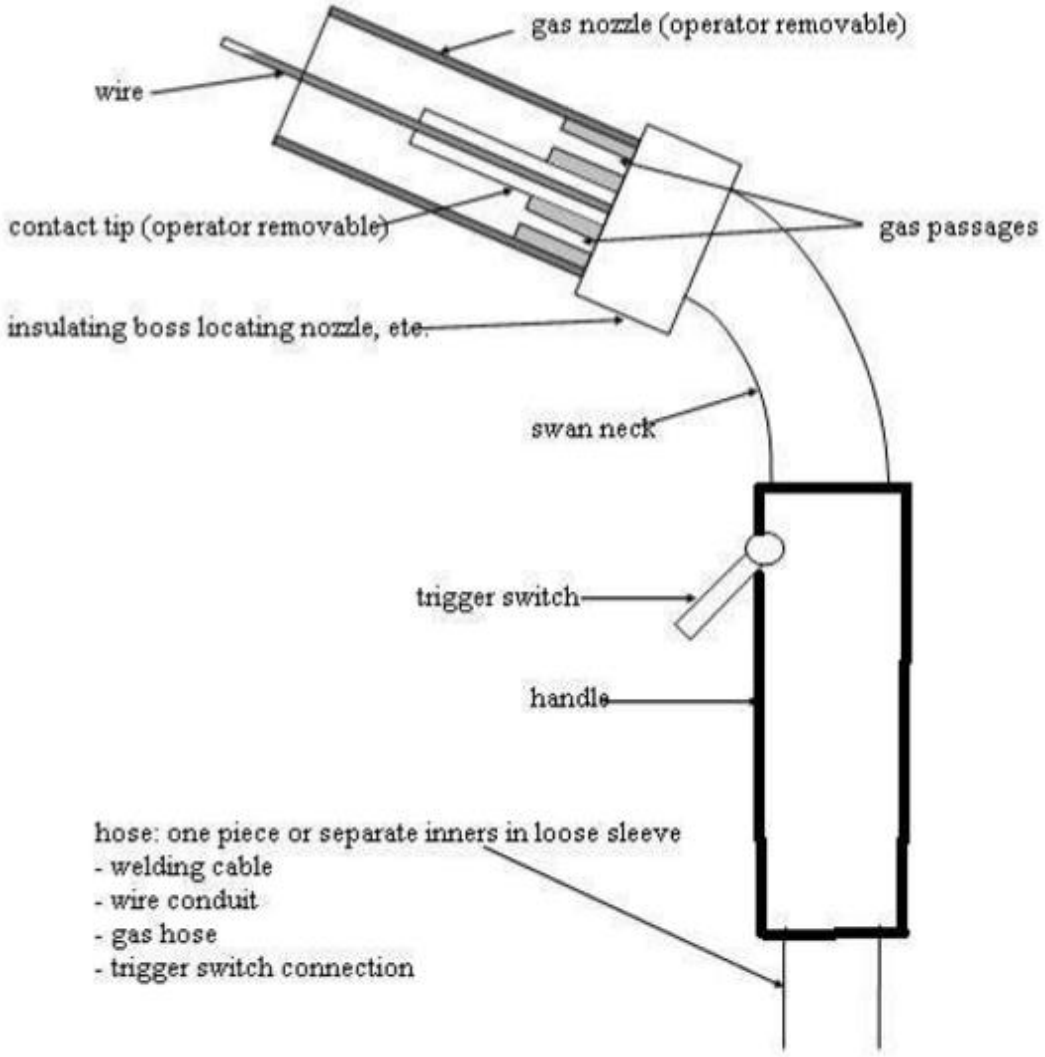
- The welder “lays a bead” of molten metal that quickly solidifies into a weld.
- The resulting weld is slag free.

An aluminium weld done with the GMAW process

Welding Procedure

- Correct edge preparation and joint fit up.
- Joint surface to be cleaned of rust, scale, grease or any other foreign matter.
- Assembling the weld equipments and setting the welding parameters.
- Selecting correct gun nozzle size.
- Setting electric extension on the bases whether short circulating or spray type welding is to be done.
- Passing on the CO2 gas supply to remove air from the holes and then setting CO2 flow rate as per base metal and joint design.
- Fillet, vertical, horizontal and over head welds can also be made using CO2 welding.
- After the weld is complete the end crater should be filled.

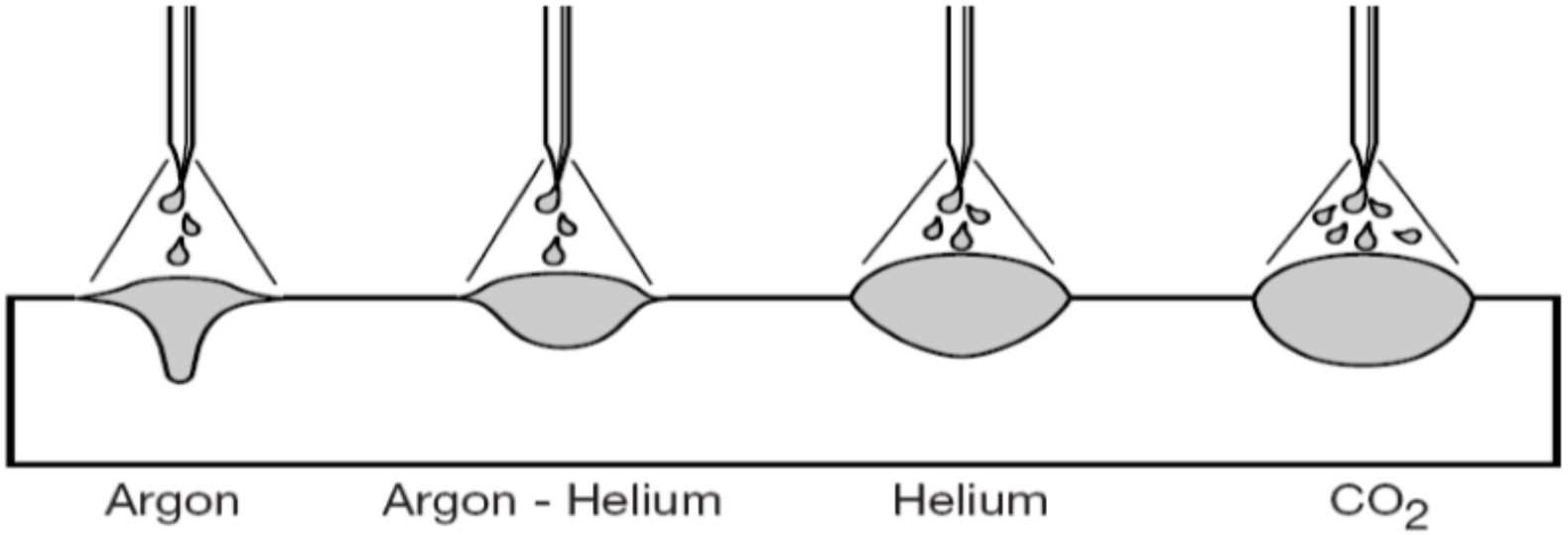
Welding Torch



Shielding Gases

- MAG welding + Reactive shielding gasses (oxygen, nitrogen, carbon dioxide & hydrogen)
- MIG welding + Inert shielding gasses (Argon & Helium)

PENETRATION PATTERN FOR VARIOUS SHIELDING GASSES

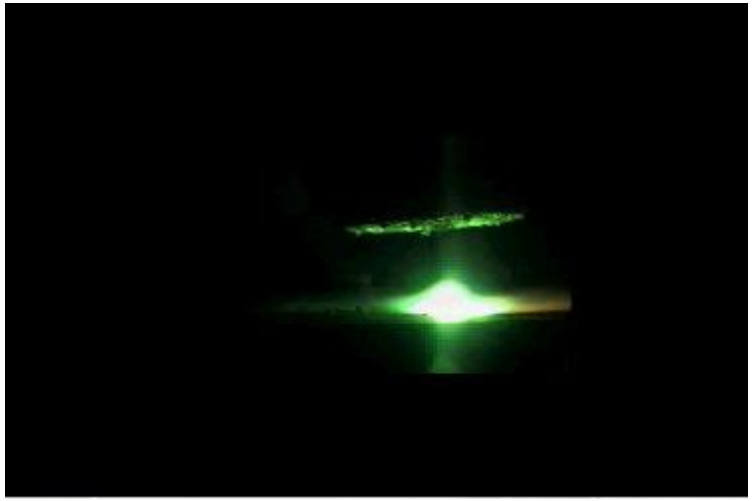


Modes of Metal Transfer

- Two common conventional modes of metal transfer are:
  - Short arc
  - Axial spray arc
- The application, joint design, base material thickness, and properties determine the appropriate mode to use.

Short Arc Transfer

- In short arc transfer…
  - The arc is initiated and a droplet is formed on the end of the wire.
  - The wire touches the work piece and produces a short circuit.
  - The droplet is then transferred to the weld puddle



Application of short arc transfer

Axial Spray Arc Transfer

- In axial spray arc transfer …
  - Very high currents are used.
  - A point forms at the end of the electrode and the fine droplets.
  - The puddle is very fluid making out of position welding difficult.

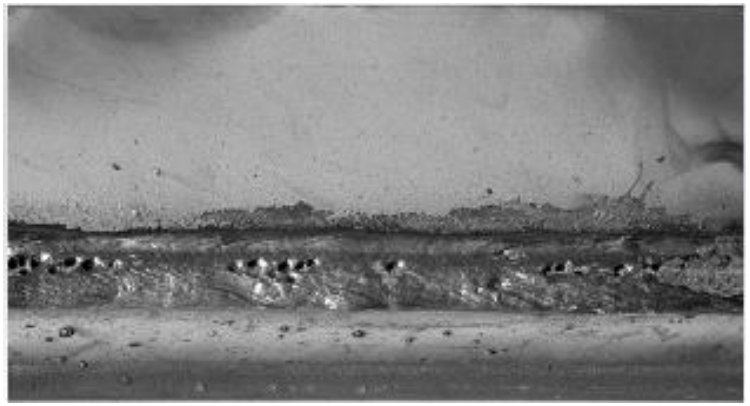
Application of axial spray arc transfer

Troubleshooting Welds

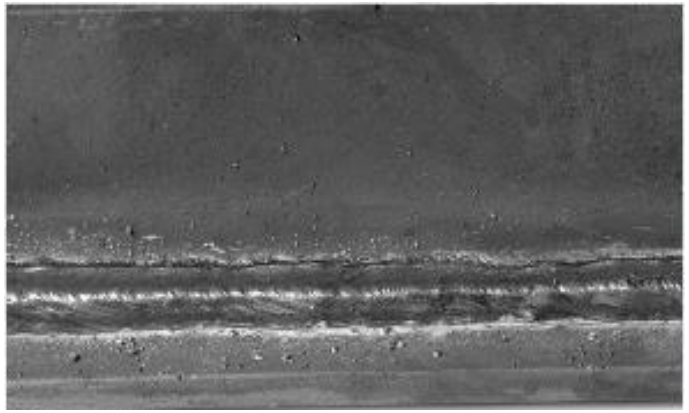
GOAL - Make Good Welds

Eliminate Ropey Convex bead

Eliminate Porosity



Eliminate Excessive Spatter



Advantages of GMAW

- High operating factor
- Easy to learn
- Limited cleanup
- Use on many different metals: stainless steel, mild (carbon) steel, aluminium and more
- All position
- Great for home use with 115V and 230V unit

Disadvantages of GMAW

- Less portable with shorter gun lengths (15 foot guns)
- GMAW equipment is more expensive than SMAW equipment
- External shielding gas can be blown away by winds
- High radiated heat
- Difficult to use in out of position joints

GMAW Lesson #1

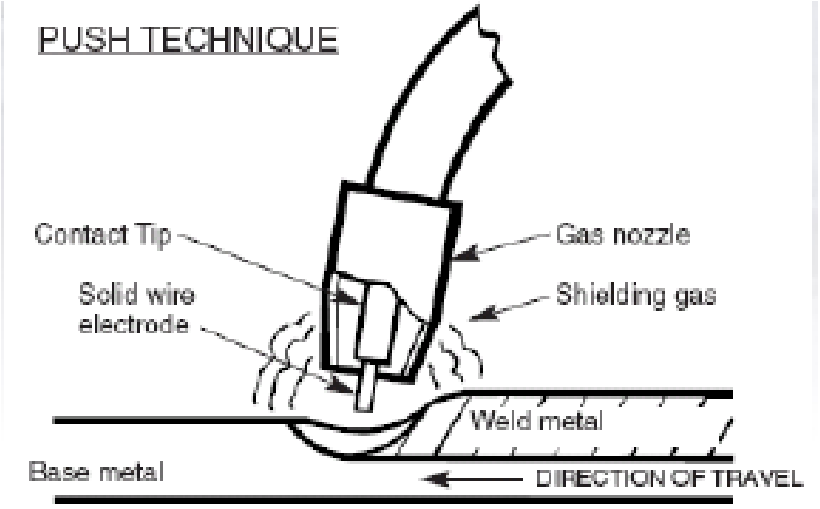
Objective: To run a stringer (straight) bead using short arc transfer and to fill the crater

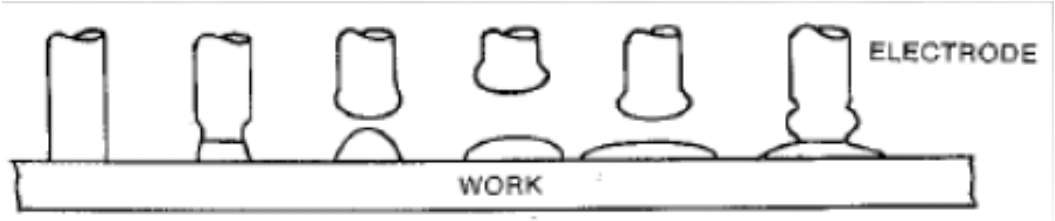
Equipment:

- Single Process - Constant Voltage Power Source & Wire Feeder
  - Power MIG 215 or Power MIG 255C
- Multi-Process
  - Composite: Power MIG 350 MP
  - Combination: V-350/ LF-72 package

Material:

- Mild Steel Plate – 3/16" or thicker
  - .035" SuperArc L-56 (ER70S-6)
  - 100% CO2 or 25% CO2/ 75% Argon blend shielding gas





GMAW Lesson #2

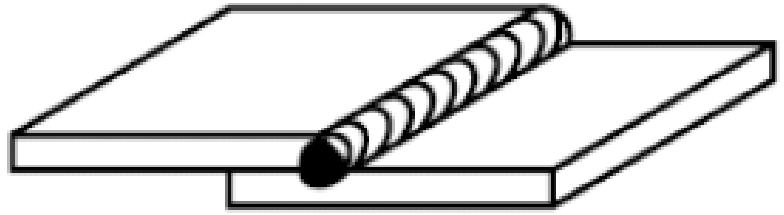
Objective: To make a fillet weld on a lap joint in the horizontal position (AWS position 2F)

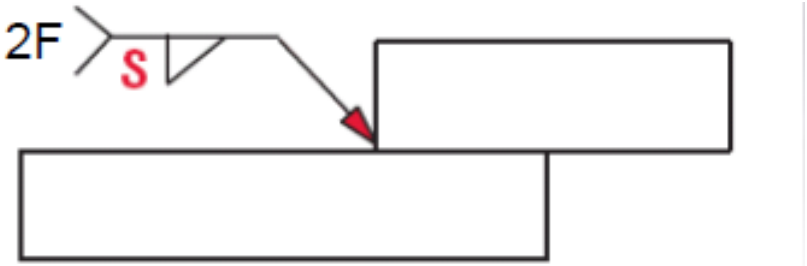
Equipment:

- Single Process - Constant Voltage Power Source & Wire Feeder
  - Power MIG 215 or Power MIG 255C
- Multi-Process
  - Composite: Power MIG 350 MP
  - Combination: V-350/ LF-72 package

Material:

- Mild Steel Plate – 10 gauge
  - .035" SuperArc L-56 (ER70S-6)
  - 100% CO2 or 25% CO2/ 75% Argon blend shielding gas



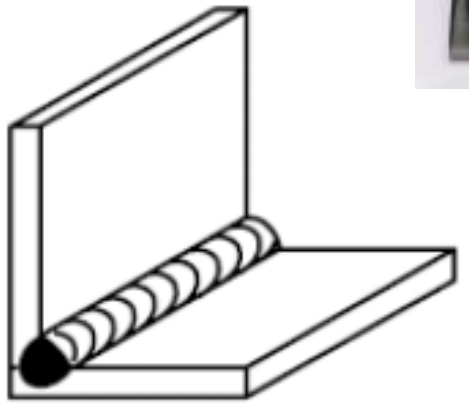


GMAW Lesson #3

Objective: To make a fillet weld on a tee joint in the horizontal position (AWS position 2F)

Equipment:

- Single Process - Constant Voltage Power Source & Wire Feeder
  - Power MIG 215 or Power MIG 255C
- Multi-Process –
  - Composite: Power MIG 350 MP
  - Combination: V-350/ LF-72 package



Material:

- Mild Steel Plate – 10 gauge
  - .035” SuperArc L-56 (ER70S-6)
  - 100% CO2 or 25% CO2/ 75% Argon blend shielding gas

GMAW Lesson #4

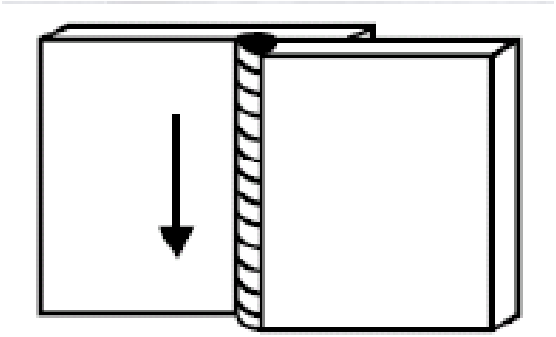
Objective: To make a fillet weld on a lap joint in the vertical position welding down (AWS position 3FD)

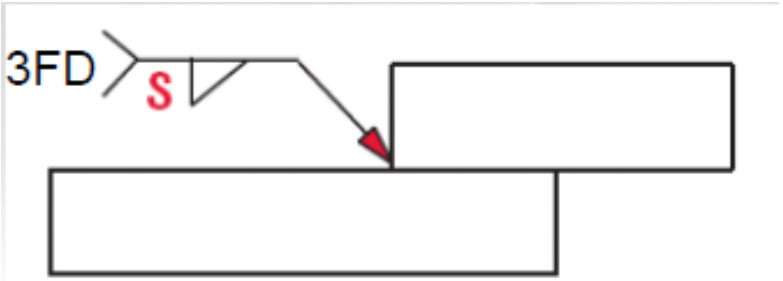
Equipment:

- Single Process - Constant Voltage Power Source & Wire Feeder
  - Power MIG 215 or Power MIG 255C
- Multi-Process –
  - Composite: Power MIG 350 MP
  - Combination: V-350/ LF-72 package

Material:

- Mild Steel Plate – 10 gauge
  - .035” SuperArc L-56 (ER70S-6)
  - 100% CO2 or 25% CO2/ 75% Argon blend shielding gas





GMAW Lesson #5

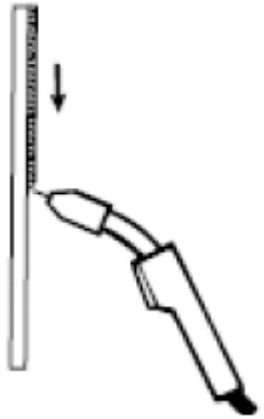
Objective: To make a fillet weld on a tee joint in the vertical position welding down (AWS position 3FD)

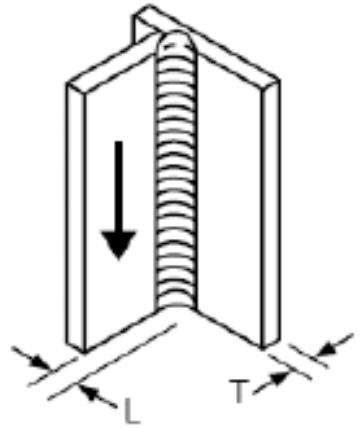
Equipment:

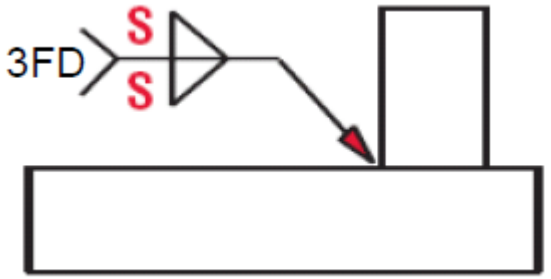
- Single Process - Constant Voltage Power Source & Wire Feeder
  - Power MIG 215 or Power MIG 255C
- Multi-Process –
  - Composite: Power MIG 350 MP
  - Combination: V-350/ LF-72 package

Material:

- Mild Steel Plate – 10 gauge
  - .035” SuperArc L-56 (ER70S-6)
  - 100% CO2 or 25% CO2/ 75% Argon blend shielding gas







GMAW Lesson #6

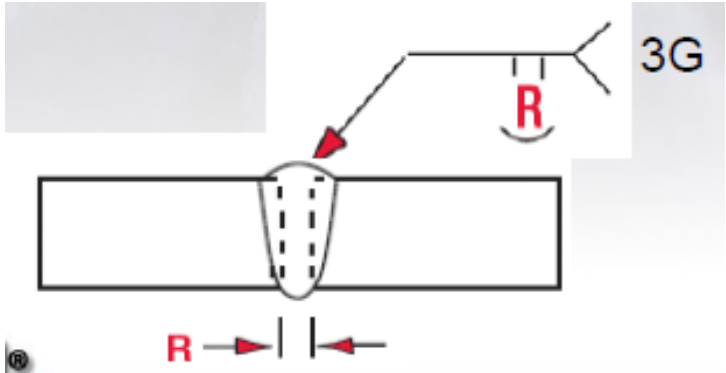
Objective: To make a butt weld with a gap in the vertical position welding down

Equipment:

- Single Process - Constant Voltage Power Source & Wire Feeder
  - Power MIG 215 or Power MIG 255C
- Multi-Process –
  - Composite: Power MIG 350 MP
  - Combination: V-350/ LF-72 package

Material:

- Mild Steel Plate – 10 gauge
  - .035” SuperArc L-56 (ER70S-6)
  - 100% CO2 or 25% CO2/ 75% Argon blend shielding gas



GMAW Lesson #7

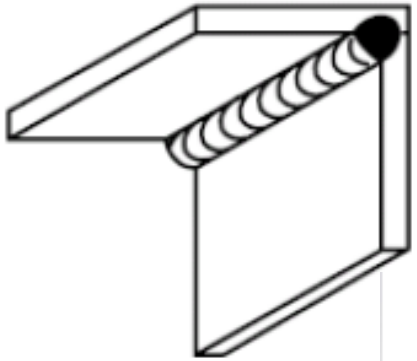
Objective: To make a fillet weld on a tee joint in the overhead position (AWS position 4F)

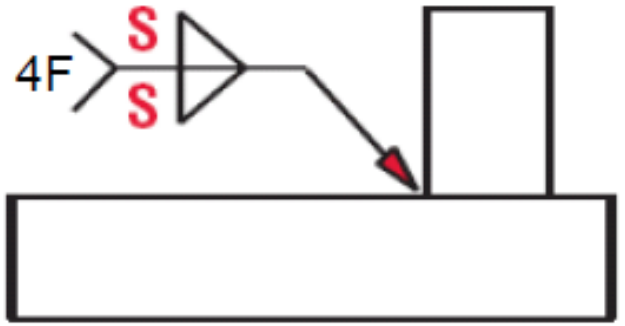
Equipment:

- Single Process - Constant Voltage Power Source & Wire Feeder
  - Power MIG 215 or Power MIG 255C
- Multi-Process –
  - Composite: Power MIG 350 MP
  - Combination: V-350/ LF-72 package

Material:

- Mild Steel Plate – 10 gauge
  - .035” SuperArc L-56 (ER70S-6)
  - 100% CO2 or 25% CO2/ 75% Argon blend shielding gas



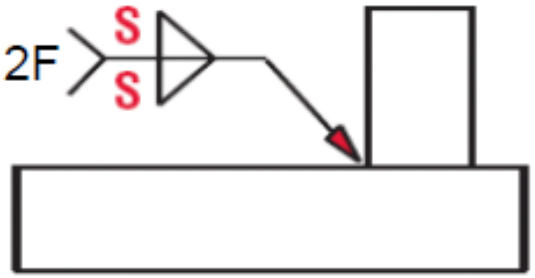


GMAW Lesson #8

Objective: To make a three pass fillet weld on a tee joint in the horizontal position (AWS position 2F)

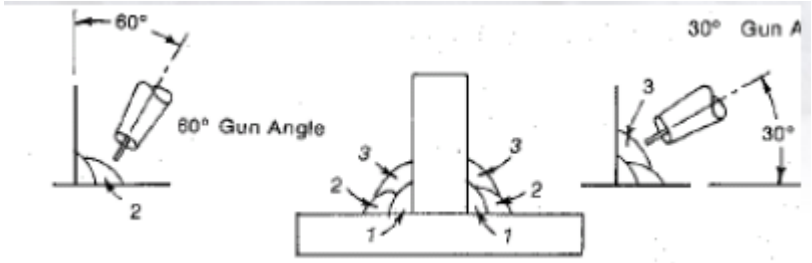
Equipment:

- Single Process - Constant Voltage Power Source & Wire Feeder
  - Power MIG 215 or Power MIG 255C
- Multi-Process –
  - Composite: Power MIG 350 MP
  - Combination: V-350/ LF-72 package



Material:

- Mild Steel Plate – ¼”
  - .035” SuperArc L-56 (ER70S-6)
  - 100% CO2 or 25% CO2/ 75% Argon blend shielding gas



GMAW Lesson #9

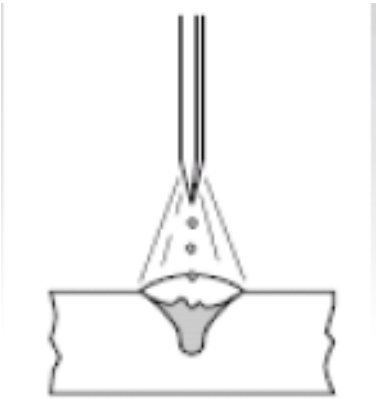
Objective: To run a horizontal fillet weld on a tee joint using axial spray transfer (AWS position 2F)

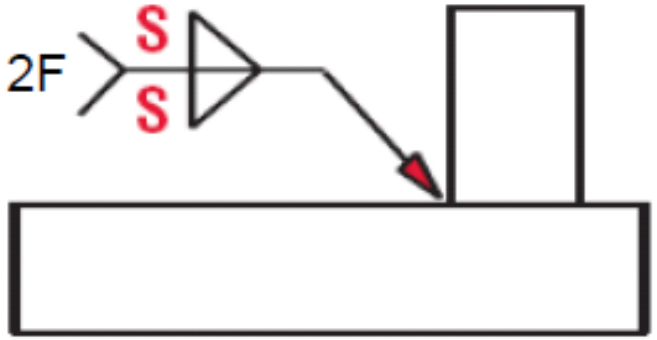
Equipment:

- Single Process - Constant Voltage Power Source & Wire Feeder
  - Power MIG 225C
- Multi-Process –
  - Composite: Power MIG 350 MP
  - Combination: V-350/ LF-72 package

Material:

- Mild Steel Plate – ¼”
  - .045” SuperArc L-56 (ER70S-6)
  - 90% Argon/ 10% CO2 blend shielding gas



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