Safety

You are going to be creating extreme amounts of heat in a concentrated area to fuse 2 materials together.

IT WILL BE HOT!!!!!
Long sleeves and pants

Prevent flash burn and spatter burn
Gloves

Prevent contact with hot metal
Eye Protection

If you look at an arc while welding it will burn your retinas
Additional Eye Protection

Prevent weld spatter from entering the welding helmet and burning your eyes.
Hat

Wearing a hat is encouraged to prevent spatter from falling on your head
Shoes

Close toed leather shoes
Intro To Welding

GMA Welding Processes
Fusion-Welding Concepts:

- Different heat sources used to melt base material
- Shielding gases
- Filler material
- Heat-affected zone and weld metallurgy
- Variety of welding equipment
  - Pros
  - Cons
- Criteria for selection of welding process
Introduction

• **Definition**: Fusion-Welding involves the melting together and coalescing of materials by means of heat.

• **Common Processes**:
  1. Oxyfuel gas welding (OFW)
  2. Shielded metal-arc welding (SMAW)
  3. Submerged arc welding (SAW)
  4. Gas metal-arc welding (GMAW)
  5. Flux-cored arc welding (FCAW)
  6. Gas tungsten-arc welding (GTAW)
  7. Plasma-Arc welding (PAW)
  8. Electron-Beam welding (EBW)
  9. Laser-Beam welding (LBW)
Heat Affected Zone

- Weld Metal
- HAZ
- Base Metal
Consumable-Electrode Arc Welding Processes
Shielded Metal-Arc Welding

**SMAW** – is one of the oldest welding process and was developed in the mid-1800’s. The heat required is generated from an electrical arc (~50,000 F). This process is also referred to as stick welding because of the shape of the electrode.
Gas Metal-Arc Welding (GMAW)

GMAW – A process where the heat required is generated by electrical energy (the arc) between the consumable electrode and the work piece. First developed in the 1950’s, it is commonly referred to as Metal Inert Gas welding or MIG welding. This process has three different forms of metal transfer spray, globular, and short-circuiting.
Gas Metal-Arc Welding (GMAW)

Process Advantages

• Higher deposition rate (efficiency) than SMAW - (Shielded Metal-Arc Welding)
• Reduction of smoke and fumes
• Can be easily automated
• Operator skill level less than SMAW
• All-position welding
• Wide variety of Alloys are weldable including Aluminum
GMAW (Gas Metal-Arc Welding)

**Process Limitations**

- Inaccessible areas are difficult to weld
- Feeding wire over long distances is difficult
- Feeding soft and small diameter wire
- Higher equipment and maintenance costs
- Incomplete shielding in drafts and wind
Spray Transfer
Gas Metal-Arc Welding

- Small droplets of molten metal from the electrode are transferred to the weld area at a rate of several hundred droplets per second.
- Argon or Argon-rich gas must be used with this process.
- Generally used in the flat and horizontal positions but can be used in all positions.
- Spray transfer is spatter-free and very stable.
Spray Transfer
Gas Metal-Arc Welding

Electrode Holder
Consumable Electrode
Shielding Gas
Droplets
Weld Puddle
Base Metal
Globular Transfer
Gas Metal-Arc Welding

• At lower current densities, transfer occurs by the formation of a single large drop at the end of the electrode wire.

• The drop grows in size until the force of gravity overcomes surface tension of the liquid and the drop is transferred by gravity across the arc gap; considerable spatter occurs.

• High voltage used giving more weld penetration and higher welding speeds than by spray transfer; good for larger sections.

• Must be used in the horizontal position due to gravity and may be used with all welding gases, but normally CO₂.
Globular Transfer
Gas Metal-Arc Welding
Electrode Comparisons
(Typical welding situations)

**SMAW**
1/4” – Diameter Thin-covered electrode
Submerged Arc Welding

**FCAW**
3/32” – Diameter Flux-Cored electrode
Flux-Cored Arc Welding

**GMAW**
1/16” – Diameter Solid electrode
Gas Metal Arc Welding
Electrode Coatings:

- Stabilize the arc
- Generate shielding gases - keep surrounding air away
- Control the rate that the electrode melts
- Acts as a flux: first to protect the weld from $O_2$ and second to protect the molten weld pool with a slag cover
- Add alloys to the weld zone to improve mechanical properties - including deoxidizers to prevent brittle weld joints
Nonconsumable-Electrode Arc-Welding Processes

TIG Welding
Gas Tungsten-Arc Welding

• AKA TIG welding (for Tungsten inert gas welding)
• Uses a constant current power source with both AC and DC capabilities
• Arc is maintained between non-consumable electrode and base metal
• Only fully inert gases or gas mixtures can be used
• Filler metal is fed in manually
• Used for a wide variety of metals
• Cleanest of the welding forms
Examples:
Great Weld
Kudos to


Hannah Uhlenhake
Sialas Bernardoni