SNS COLLEGE OF TECHNOLOGY

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DEPARTMENT OF AUTOMOBILE ENGINEERING

23GET102 – BASIC CIVIL MECHANICAL ENGINEERING

I YEAR / I SEMESTER

UNIT 3 - OVERVIEW OF MECHANICAL ENGINEERING

Topic : Welding

Arc Welding

A comprehensive guide to shielded metal arc welding processes, principles, and applications

What Is Welding?

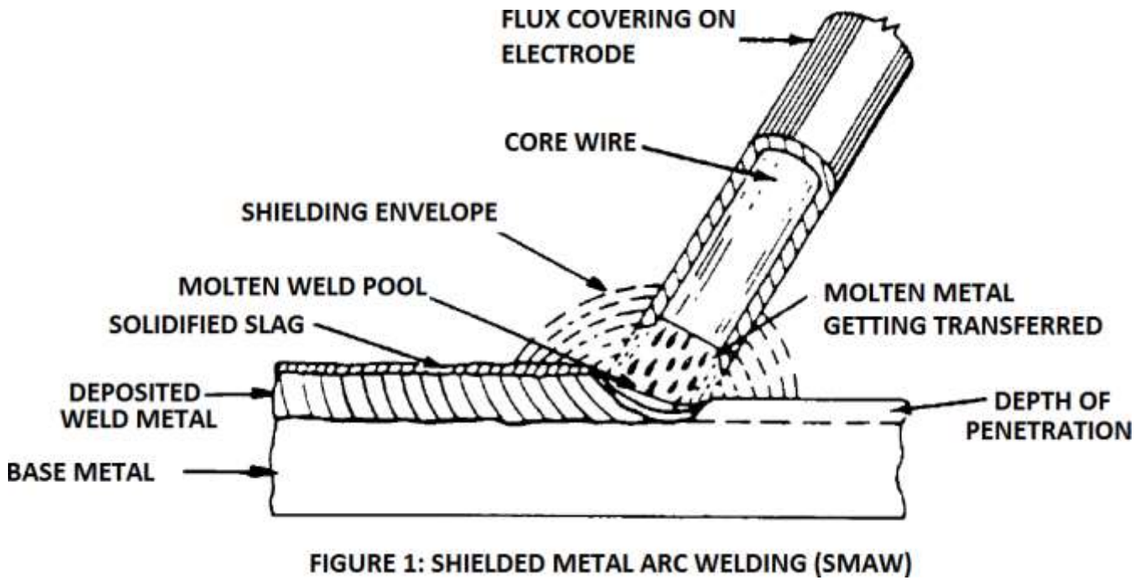


FIGURE 1: SHIELDED METAL ARC WELDING (SMAW)

The AWS definition for a welding process is "A materials joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone and with or without the use of filler material".

Heat-Based Welding

Materials are heated to suitable temperatures to create fusion, with or without filler material added to the joint.

Pressure-Based Welding

Application of pressure alone can create coalescence between materials without requiring heat.

Essential Welding Terminology

Alloy

An element added to a metal to enhance its properties

Arc

The electrical discharge between the electrode and base metal that generates heat through resistance

Bead

Deposited filler metal on the work surface when electrode melts and fuses into the steel

Electrode

Covered with flux or bare wire; called "rod" in stick welding, "wire" for MIG and Flux Cored Arc Welding

Key Welding Components

Electrode Holder

A hand clamp that holds a welding rod and conducts electricity out of the rod in DCEN, or into the rod in DCEP

Filler Metal

Metal added to the weld pool. A weld can be made with or without filler metal. Thin gauge metal is sometimes welded by melting the two base metals together.

Nozzle

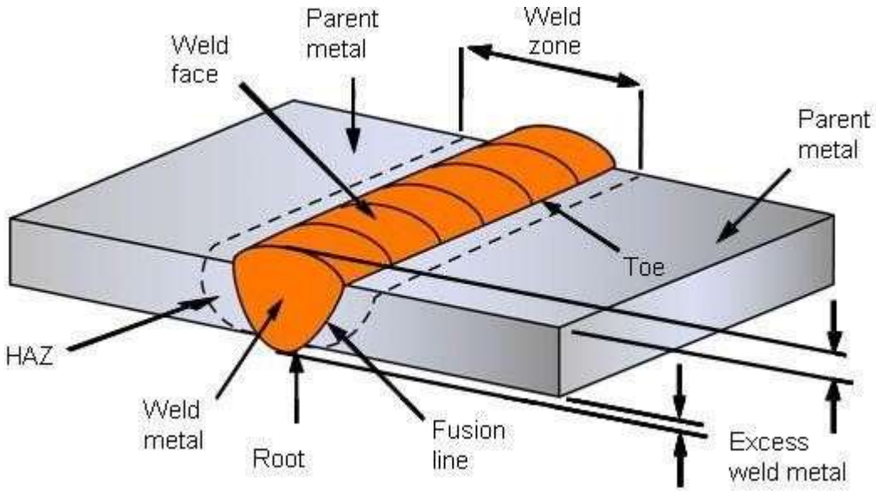
A brass attachment about three inches long, shaped as an open cylinder, placed over an insulator to direct shielding gas over the weld

Penetration

The fusion or depth into the parent metal from its surface, or the amount of fusion through an open faced joint

Shielding Gas

Inert gases like argon or helium that won't combine with other elements, keeping atmospheric contaminants out of the weld pool



Critical Welding Concepts

Depth of Fusion

How deep your filler metal penetrates into the metal from the surface

Flux

Cleans the surface and when burned makes a shielding gas that protects the weld pool from atmospheric contaminants that cause defects

Slag

When flux on a welding rod melts, it produces shielding gas and forms a hardened protective coating over the weld that must be chipped off and cleaned

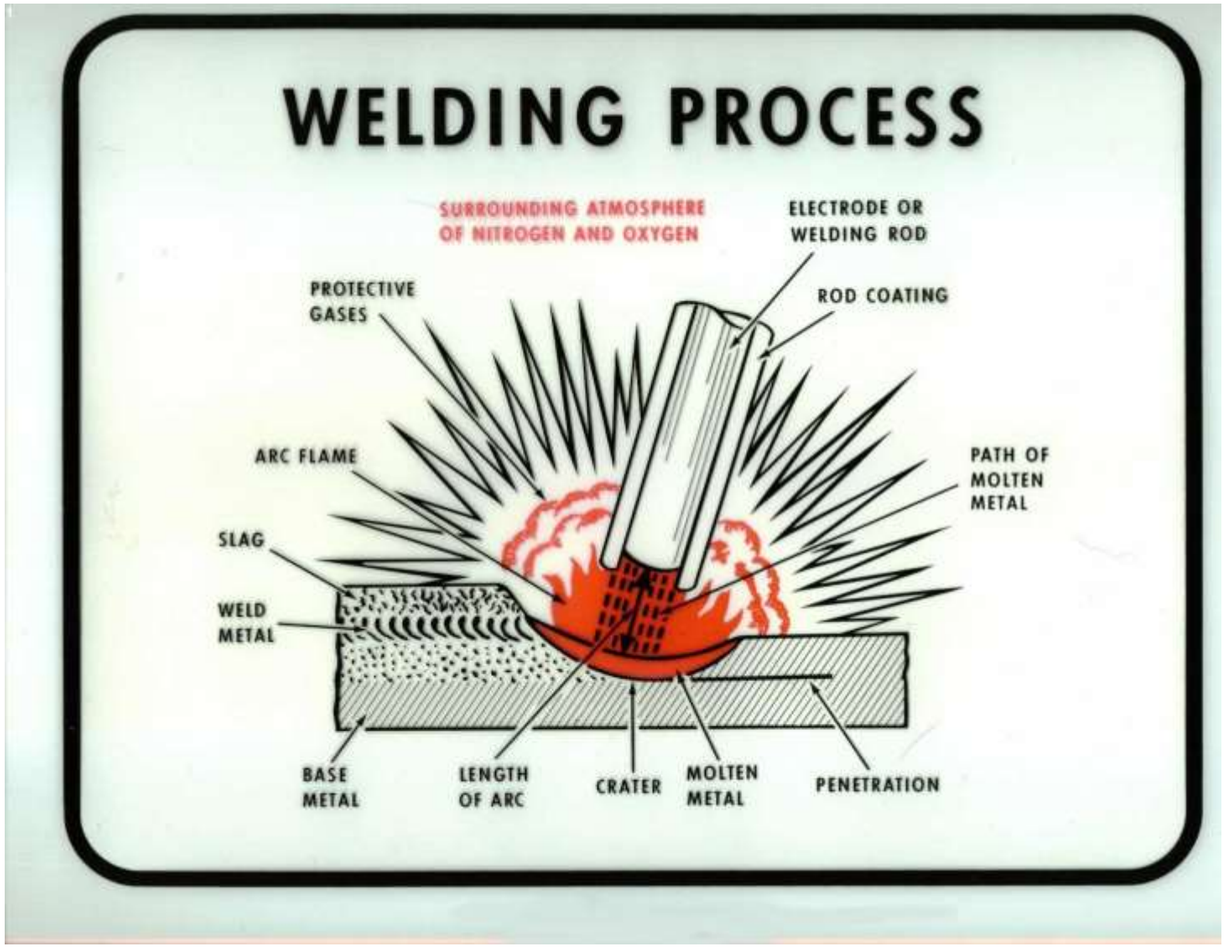
Classification of Welding Processes

Consumable Electrode Welding

- FCAW (Flux Cored Arc Welding)
- GMAW (Gas Metal Arc Welding)
- SMAW (Shielded Metal Arc Welding)
- SAW (Submerged Arc Welding)

Non-Consumable Electrode Welding

- ESW (Electroslag Welding)
- GTAW (Gas Tungsten Arc Welding)
- OAW (Oxyacetylene Welding)
- PAW (Plasma Arc Welding)
- SW (Stud Welding)



Shielded Metal Arc Welding (SMAW)

Shielded metal arc welding (SMAW), also known as manual metal arc (MMA) welding, flux shielded arc welding or stick welding, is an arc welding process where coalescence is produced by heating the workpiece with an electric arc set up between a flux coated electrode and the workpiece.

Current Flow

Current flows through the electrode cable, to the electrode holder, through the electrode, and across the arc. On the work side, current flows through the base material to the work clamp and back to the welding machine.

SMAW Operating Principle

Arc Initiation

The arc is initiated by touching the electrode momentarily to the workpiece

Molten Pool Formation

Heat from the arc melts the surface of the base metal to form a molten pool (weld puddle)

Metal Transfer

Metal melted from the electrode is transferred across the arc into the base metal, becoming deposited weld metal when solidified

Process Control

Control of current and travel speed is important in controlling the weld pool

Slag Formation

The weld metal deposit is covered by slag from the electrode. Almost all electrode metal transfers to the weld pool; a small amount is wasted as spatter

Cleaning

Slag is removed and cleaned after welding

Electrode Components & Shielding

Electrode Structure

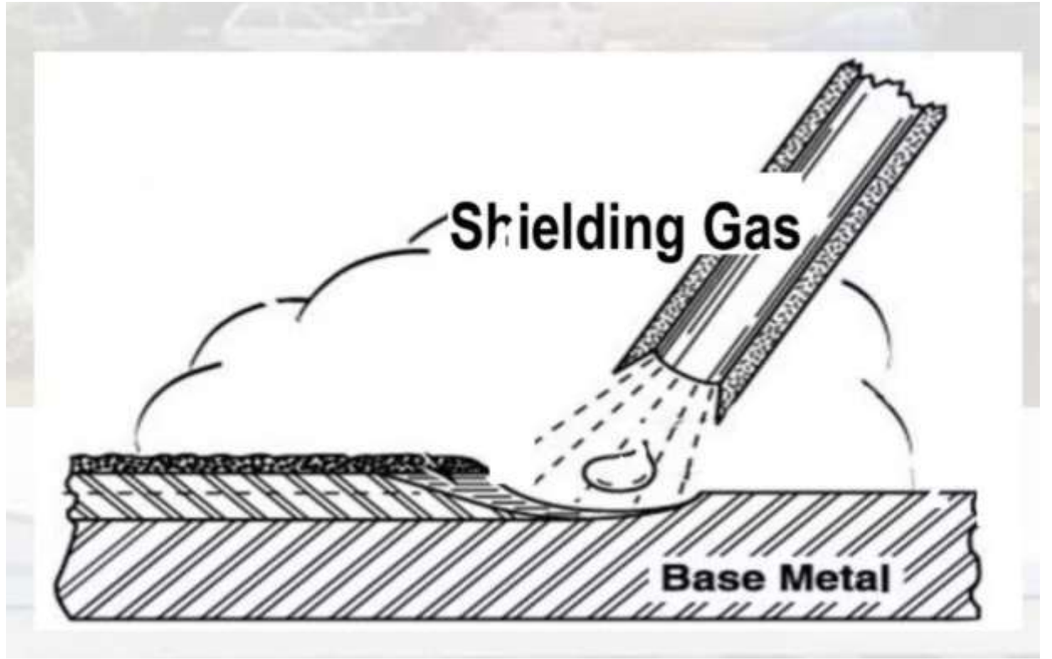
The electrode is consumable and gets melted during welding.
It's composed of two parts:

Core Rod (Metal Filler)
- Carries welding current
- Becomes part of the weld

Flux Coating
- Produces a shielding gas
- Can provide additional filler
- Forms a slag

Shielding Gas & Slag

A shielding gas is formed when the flux coating melts. This protects the weld puddle from the atmosphere, preventing contamination during the molten state while stabilizing the arc.



Slag is a combination of the flux coating and impurities from the base metal that float to the surface. Slag quickly solidifies to form a solid coating that slows the cooling rate. When hard, it can be chipped away and cleaned with a wire brush.

SMAW Advantages & Applications

Equipment Benefits

Equipment is less complex, more portable, and less costly than other welding methods

Versatile Locations

Can be done indoors or outdoors, in any location and any position

Material Compatibility

Electrodes available to match properties and strength of most base metals

Common Applications

SMAW is often used to weld carbon steel, low and high alloy steel, stainless steel, cast iron, and ductile iron. While less popular for nonferrous materials, it can be used on nickel and copper and their alloys and, in rare cases, on aluminum.

Thank You