Safety:

- To avoid injury, the student must take permission from the laboratory staff before handling any machine. Careless handling of machines may result in serious injury.
- Students must ensure that their work areas are clean and dry to avoid slipping.
- A leather apron will be issued to each student during the Welding Exercise. Students not wearing the apron will not be permitted to work in the laboratory.
- Students are required to clear off all tools and materials from the machine/workplace.
- At the end of each experiment, students must clear off all tools and materials from the work area.

Rules:

- Follow the lab timing with proper attire.
- There will be one attendance: Initial attendance (at sharp 8:30 AM) to be taken by TA's at the beginning of lab session.
- Do not use cell phone inside the lab during lab timing.
- Students must come to the laboratory wearing (i) Trousers, (ii) half-sleeve tops, and (iii) Leather shoes. Half pants, loosely hanging garments, and slippers are not allowed.

INTRODUCTION TO WELDING PROCESSES

Objective

To study and observe the welding technique through demonstration and practice of ARC welding and a prepared lap joint by use of Arc welding.

Background

Solid materials need to be joined together in order that they may be fabricated into useful shapes for various applications such as industrial, commercial, domestic, art ware, and other uses. Depending on the material and the application, different joining processes are adopted such as mechanical (bolts, rivets, etc.), chemical (adhesive) or thermal (welding, brazing, or soldering). Thermal processes are extensively used for joining of most common engineering materials, namely, metals. This exercise is designed to demonstrate specifically: gas welding, arc welding, resistance welding, and brazing.

WELDING PROCESSES

Welding is a process in which two materials, usually metals, and is permanently joined together by coalescence, resulting from temperature, pressure, and metallurgical conditions. The particular combination of temperature and pressure can range from high temperature with no pressure to high pressure with any increase in temperature. Thus, welding can be achieved under a wide variety of conditions and numerous welding processes have been developed and are routinely used in manufacturing.

To obtain coalescence between two metals following requirements need to be met: (1) perfectly smooth, flat or matching surfaces, (2) clean surfaces, free from oxides, absorbed gases, grease and other contaminants, (3e) metals with no internal impurities. These are difficult conditions to obtain. Surface roughness is overcome by pressure or by melting two surfaces so that fusion occurs. Contaminants are removed by mechanical or chemical cleaning prior to welding or by causing sufficient metal flow along with the interface so that they are removed away from the weld zone friction welding is a solid-state welding technique. In many processes, the contaminants are removed by fluxing agents.

The production of quality welds requires (1) a satisfactory heat and/or pressure source, (2) a means of protecting or cleaning the metal, and (3) caution to avoid, or compensate for, harmful metallurgical effects.

ARC WELDING

In this process, a joint is established by fusing the material near the region of the joint by means of an electric arc struck between the material to be joined and an electrode. A high current low voltage electric power supply generates an arc of intense heat reaching a temperature of approximately 3800OC. The electrode held externally may act as a filler rod or it is fed independently of the electrode. Due to higher levels of heat input, joints in thicker materials can be obtained by the arc welding process. It is extensively used in a variety of structural applications.

There are so many types of the basic arc welding process such as shielded metal arc welding (SMAW), gas metal arc welding (GMAW), gas tungsten arc welding (GTAW), submerged arc welding

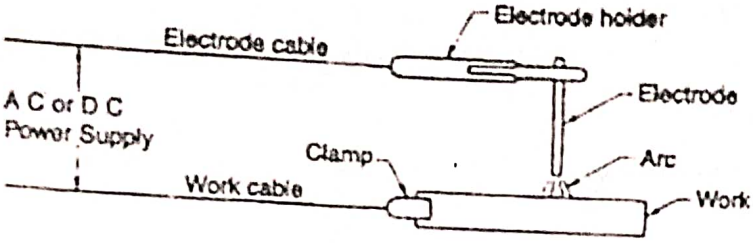


Fig.1 The Basic circuit for arc welding

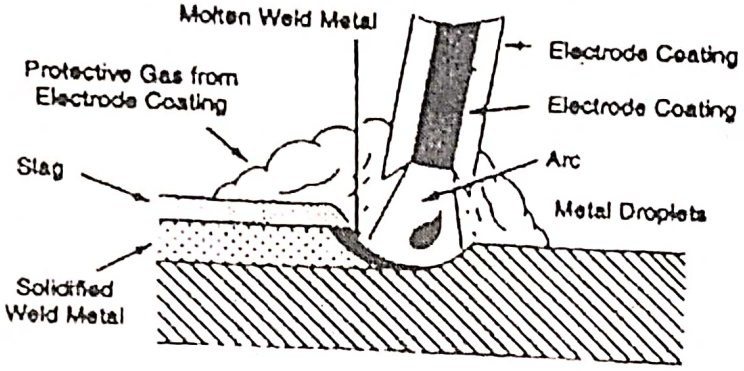


Fig.2 Schematic diagram of shielded metal arc welding (SMAW)

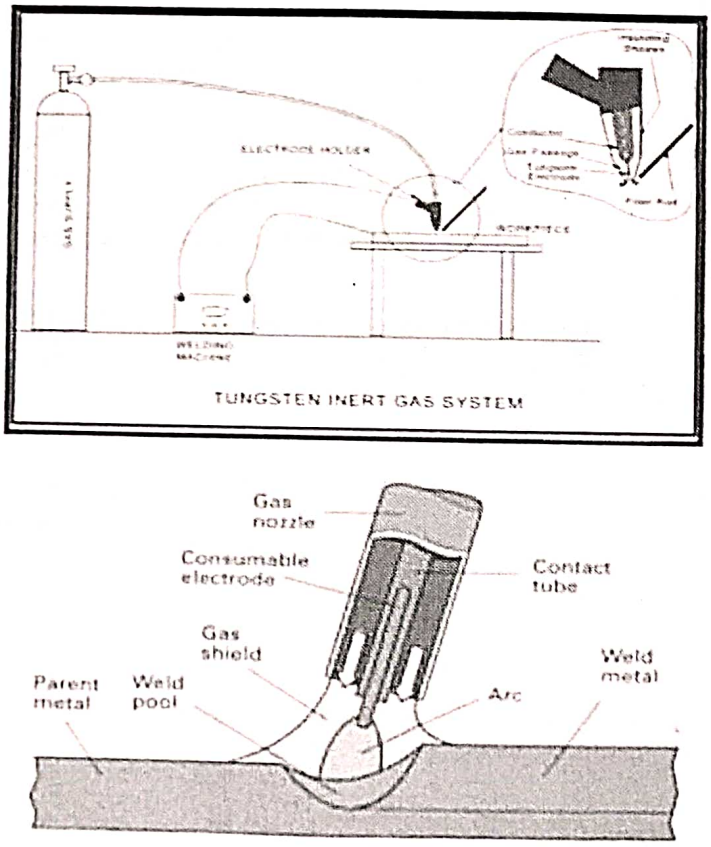


Fig.3 Schematic diagram of gas metal arc welding (GMAW)

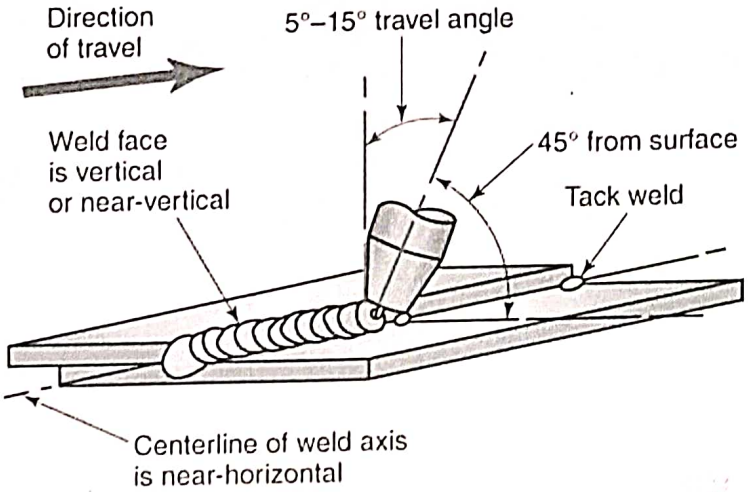
ARC WELDING

Objective

To prepare a butt joint with mild steel strip using MAG& MMAW technique.

Equipment and materials

Welding machine, consumable mild steel wire(electrode), mild steel flats (100 x 25 x 5 mm), Wire Brush, Tongs, etc.



SMAW Filler Metal Classification – A5.1 (Carbon Steel), A5.5 (Low Alloy)

SMAW Number System

E 7 0 1 8 (E7018 example)

Designates "Electrode"

Designates required minimum tensile strength in ksi

Designates Positions of use

1 Flat, Horizontal, Vertical or Overhead
2 Flat & Horizontal only
4 Flat, Horizontal, Vertical Down, Overhead

Designates type of coating and type of current

Digit	Type of Coating	Welding Current
0	Cellulose sodium	DCEP
1	Cellulose potassium	AC, DCEP or DCEN
2	Titania sodium	DCEN or AC
3	Titania potassium	AC or DCEP
4	Iron powder titania	AC, DCEP or DCEN
5	Low Hydrogen sodium	DCEP
6	Low Hydrogen potassium	AC or DCEP
7	Iron powder iron oxide	AC, DCEP or DCEN
8	Low Hydrogen iron powder	AC or DCEP
1.6020	Iron oxide sodium	AC or DCEP

Welding Terminology:

1) Backing: It is the material support provided at the root side of the weld to aid in the control of the penetration.
2) Base Metal: The metal to be joined or cut.
3) Bead or Weld bead: It is the metal added during a single pass of welding. The bead appears as strikers.
4) Crater: In arc welding, a crater is a depression in the weld metal pool where the arc strikers.
5) Deposition Rate: Rate at which weld metal is deposited per unit time and expressed in kg/hr.
6) Fillet Weld: The metal fused into the corner of a joint made of two pieces placed at approximately 90 degrees to each other.
7) Penetration: Depth up to which the weld metal combines with the base metal as measured from the top surface.
8) Puddle: Portion that is melted by the heat of welding.
9) Root: The point at which the 2 pieces to be joined are nearest.
10) Tach weld: A small weld is used to temporarily hold the two pieces together during actual welding.
11) Weld face: The exposed surface of the weld.
12) Weld pass: A single movement of the welding torch or electrode along the length of the joint, which results in beats, is a weld pass

Description:

Principle of Arc welding: An arc is generated below 2 conductor cathode and anode. When they are touched to establish the flow of current. An arc is sustained electric discharge through ionized gas column called plasma b/w 2 electrodes. Electrons liberated from the cathode move towards the anode at a high-speed large amount of heat is generated. To produce potential diff b/w 2 electrodes should be sufficient.

Straight and Reverse Polarity: The positive terminal of the DC supply is connected to the workpiece and the negative terminal to the electrode and known as DCSP. The positive terminal of the DC supply is connected to the electrode and the negative to the workpiece and is known as DCSP.

Procedure:

- Clean the mild steel flats to be joined by a wire brush.
- Arrange the flat pieces properly for full penetration of the lap joint.
- Electrode is fixed to the electrode holder.
- Connections to be given such that electrode- negative and workpiece positive.
- Practice striking of arc, speed, and arc length control
- Set the welding current, and voltage according to the type of metal to be joined.
- Strike the arc and make tacks at both ends to hold the metal pieces together during the welding process
- Lay beads along the joint maintaining proper speed and arc length (Speed 100-150 mm/min).
- Clean the welded zone and submit.

Precautions:

- Edge preparation should be done very carefully.
- Before welding ensure that the surfaces are extremely clean.
- While welding always uses face shields or goggles.