

CENTRAL WORKSHOP

DEPARTMENT OF MECHANICAL ENGINEERING

LAB MANUAL FOR WELDING SHOP

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SYLLABUS

- Welding types
- Accessories
- Weldments
- Safety precautions

OBJECTIVES

- To demonstrate different techniques of welding
- To practice arc initiation, fabrication and testing of weld joint.

OUTCOMES

The expected outcomes of welding shop is that students will be able :

- To practically relate concepts discussed in manufacturing process course.
- To understand the operating principles of different welding techniques.
- To apply these learning to improve the performance of welded joint.

TUTORIAL ASSIGNMENTS

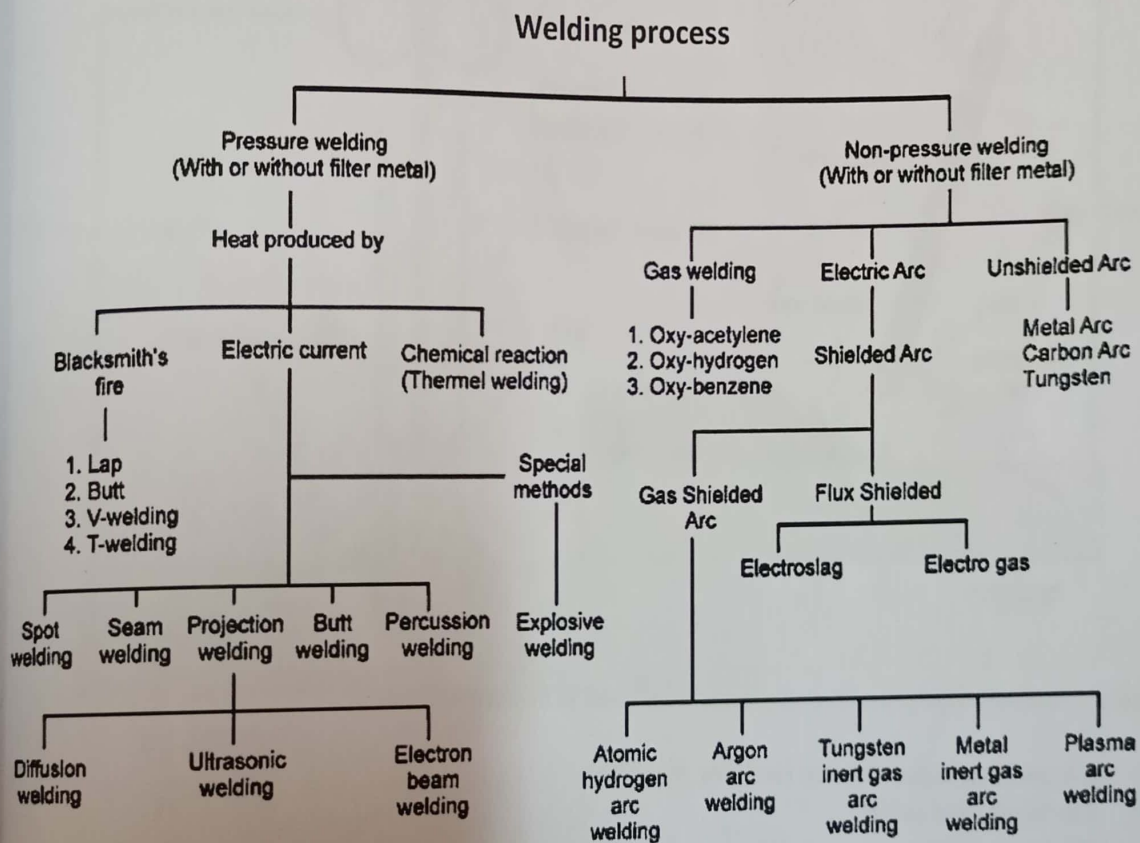
- To prepare a Butt Joint using Shielded Metal Arc Welding (SMAW).
- To prepare a corner joint using Oxy-acetylene gas welding.
- To prepare a job using Metal Inert Gas welding(MIG).
- To prepare a job using Tungsten Inert Gas (TIG)welding.

INTRODUCTION

Welding:

Welding is one of the manufacturing process by which two or more similar or dissimilar materials can be joined permanently by fusion process with or without the applications of external pressure, filler material. The heat may be obtained by blacksmith fire, electric arc, electrical resistance or by chemical reaction.

It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

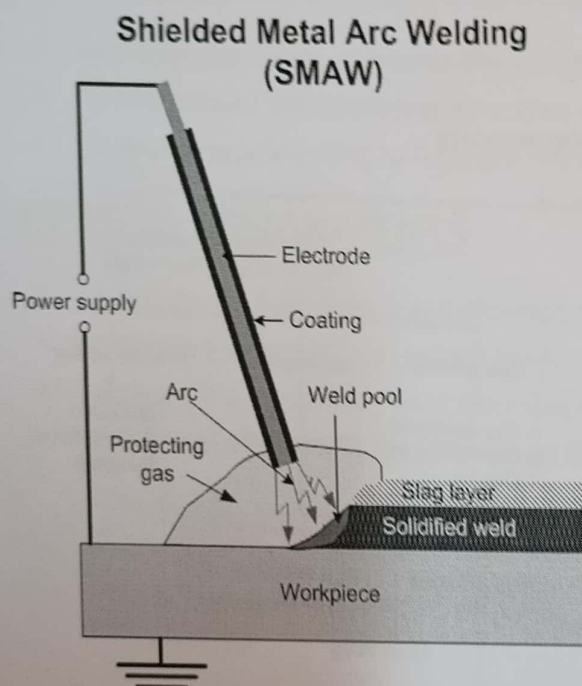


SHIELDED METAL ARC WELDING (SMAW)

Shielded metal arc welding (Stick welding, Manual metal arc welding) uses a metallic consumable electrode of a proper composition for generating arc between itself and the parent work piece. The molten electrode metal fills the weld gap and joins the work pieces.

This is the most popular welding process capable to produce a great variety of welds.

The electrodes are coated with a shielding flux of a suitable composition. The flux melts together with the electrode metallic core, forming a gas and a slag, shielding the arc and the weld pool. The flux cleans the metal surface, supplies some alloying elements to the weld, protect the molten metal from oxidation and stabilizes the arc. The slag is removed after Solidification.



Some of the basic equipments and accessories used in SMAW welding :

- Arc welding power source (welding machine)
- Electrode lead cable
- Electrode holder
- Connectors
- Cables
- Ground clamp
- Safety Gloves
- Chipping hammer
- Hand shield, safety goggles , Auto darkening helmet.
- Wire brush

METAL INERT GAS (MIG) WELDING

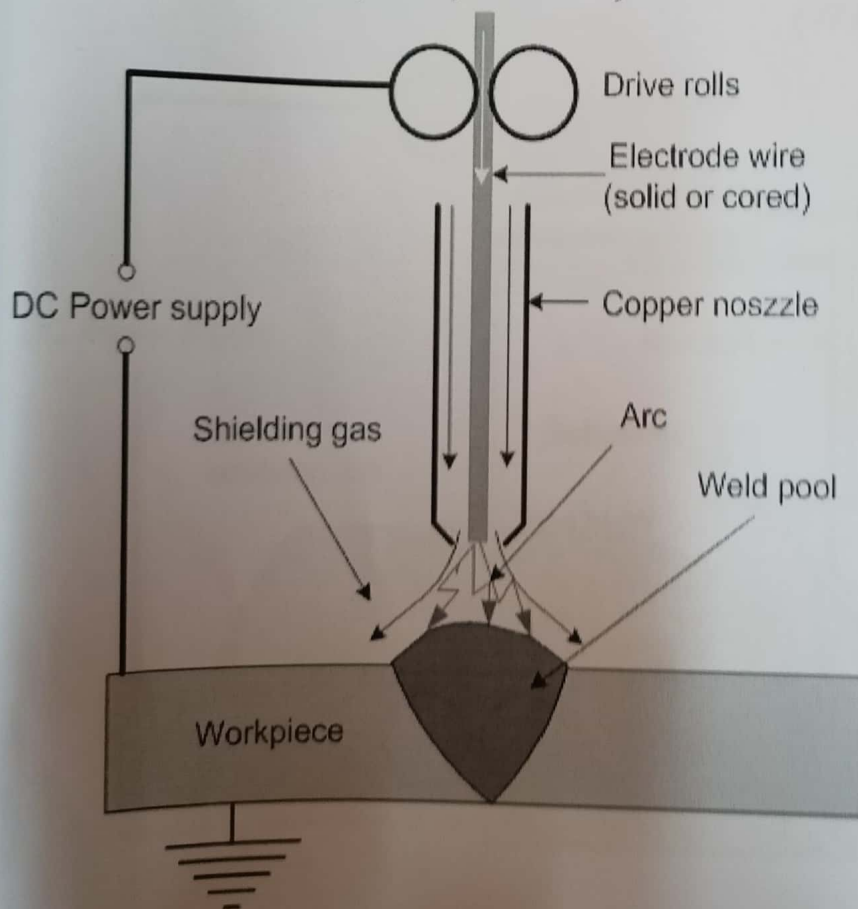
Metal Inert Gas Welding (Gas Metal Arc Welding) is a arc welding process, in which the weld is shielded by an external gas (Argon, helium, CO_2 ,).

Consumable electrode wire, having chemical composition similar to that of the parent material, is continuously fed from a spool to the arc zone. The arc heats and melts both the work pieces edges and the electrode wire. The fused electrode material is supplied to the surfaces of the work pieces, fills the weld pool and forms joint.

Due to automatic feeding of the filling wire (electrode) the process is referred to as a semi-automatic. The operator controls only the torch positioning and speed.

Metal inert gas welding

(MIG, GMAW)



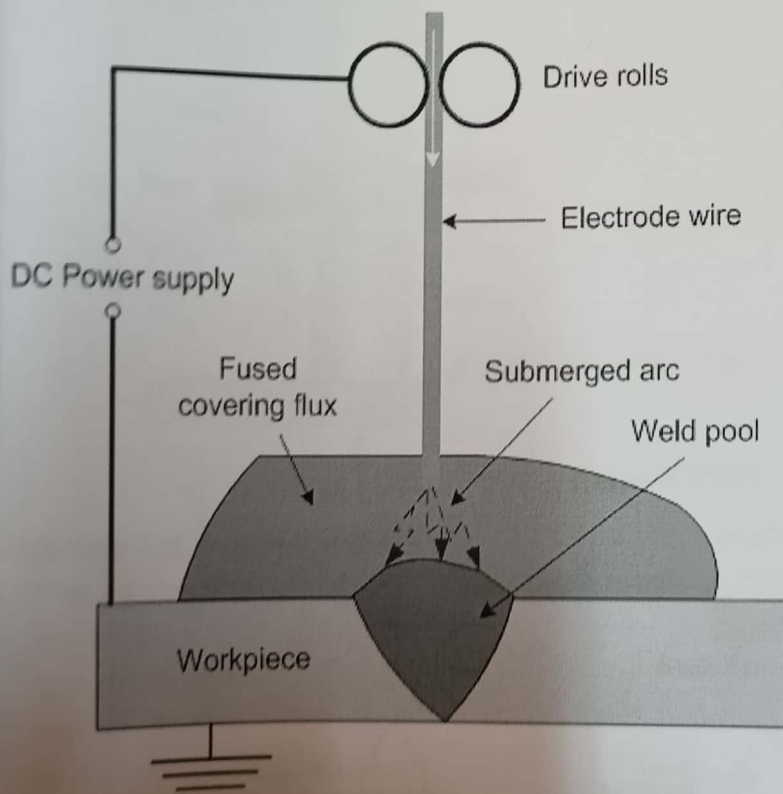
SUBMERGED ARC WELDING(SMAW)

Submerged Arc Welding is a welding process, which utilizes a bare consumable metallic electrode producing an arc between itself and the work piece within a granular shielding flux applied around the weld.

The arc heats and melts both the work pieces edges and the electrode wire. The molten electrode material is supplied to the surfaces of the welded pieces, fills the weld pool and joins the work pieces.

Since the electrode is submerged into the flux, the arc is invisible. The flux is partially melts and forms a slag protecting the weld pool from oxidation and other atmospheric contaminations.

Submerged Arc Welding (SAW)



OXY-ACETYLENE GAS WELDING

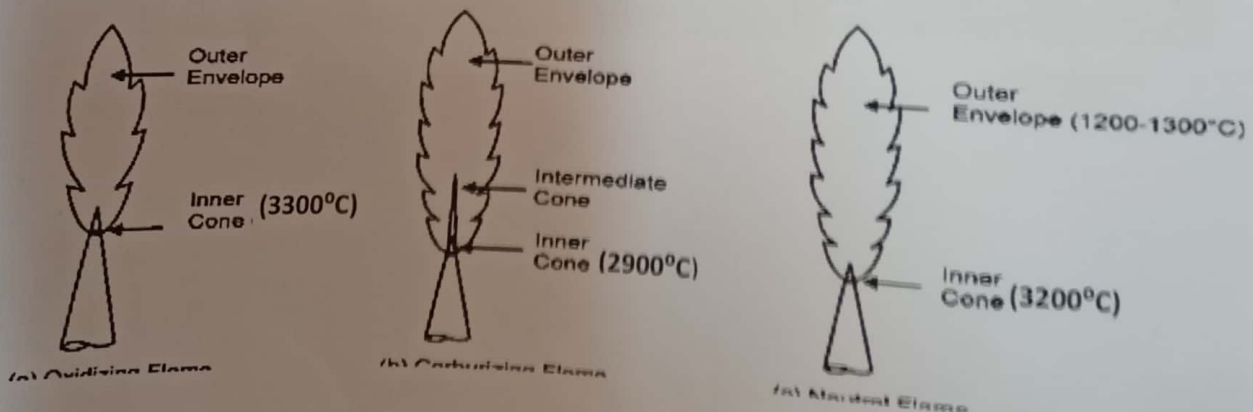
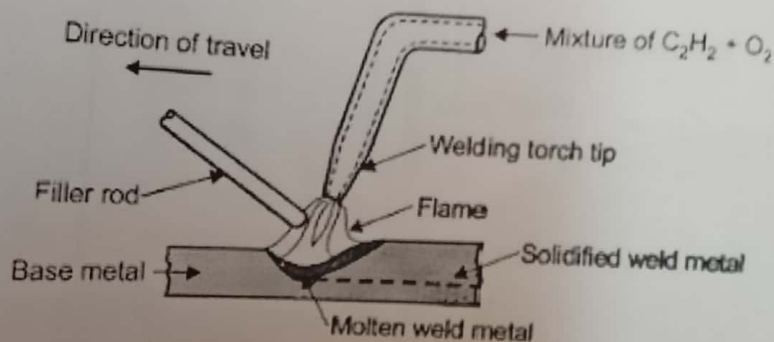
Gas Welding is a welding process utilizing heat of the flame from a welding torch. The torch mixes a fuel gas with Oxygen in the proper ratio and flow rate providing combustion process at a required temperature. The hot flame fuses the edges of the welded parts, which are joined together forming a weld after Solidification.

The flame temperature is determined by a type of the fuel gas and proportion of oxygen in the combustion mixture: $4500^{\circ}\text{F} - 6300^{\circ}\text{F}$ ($2500^{\circ}\text{C} - 3500^{\circ}\text{C}$). Depending on the proportion of the fuel gas and oxygen in the combustion mixture, the flame may be chemically neutral (stoichiometric content of the gases), oxidizing (excess of oxygen), carburizing (excess of fuel gas).

Filler rod is used when an additional supply of metal to weld is required. Shielding flux may be used if protection of weld pool is necessary.

Gas Welding equipment:

- Fuel gas cylinder with pressure regulator;
- Oxygen cylinder with pressure regulator;
- Welding torch;
- Blue oxygen hose;
- Red fuel gas hose;
- Trolley for transportation of the gas cylinders.

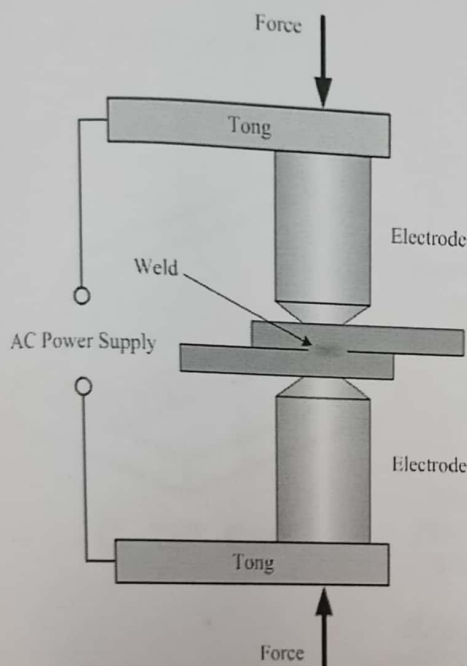


RESISTANCE WELDING

Resistance Welding is a welding process, in which work pieces are welded due to a combination of a pressure applied to them and a localized heat generated by a high electric current flowing through the contact area of the weld.

Heat produced by the current is sufficient for local melting of the work piece at the contact point and formation of small weld pool ("nugget"). The molten metal is then solidifies under a pressure and joins the pieces. Time of the process and values of the pressure and flowing current, required for formation of reliable joint, are determined by dimensions of the electrodes and the work piece metal type.

Resistance Spot Welding (RSW)



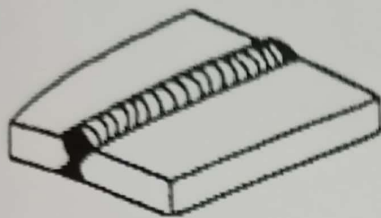
Advantages of Resistance Welding:

- High welding rates;
- Low fumes;
- Cost effectiveness;
- Easy automation;
- No filler materials are required;
- Low distortions.

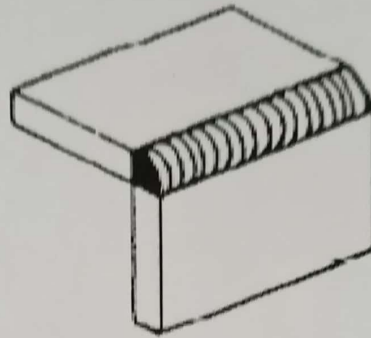
Disadvantages of Resistance Welding:

- High equipment cost;
- Low strength of discontinuous welds;
- Thickness of welded sheets is limited - up to 1/4" (6 mm);

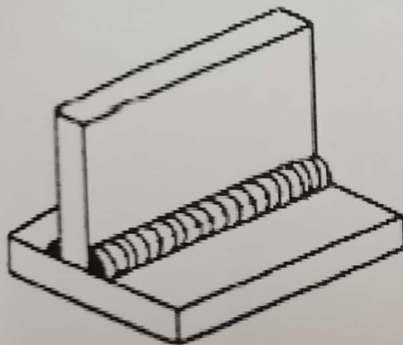
TUTORIAL ASSIGNMENTS



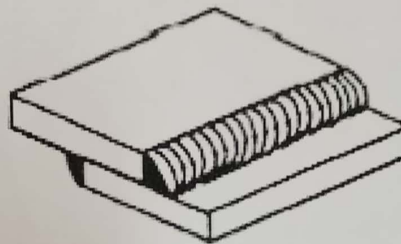
A. BUTT JOINT



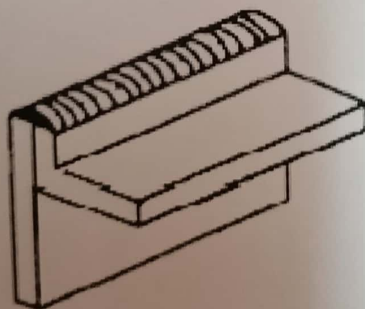
B. CORNER JOINT



C. TEE JOINT



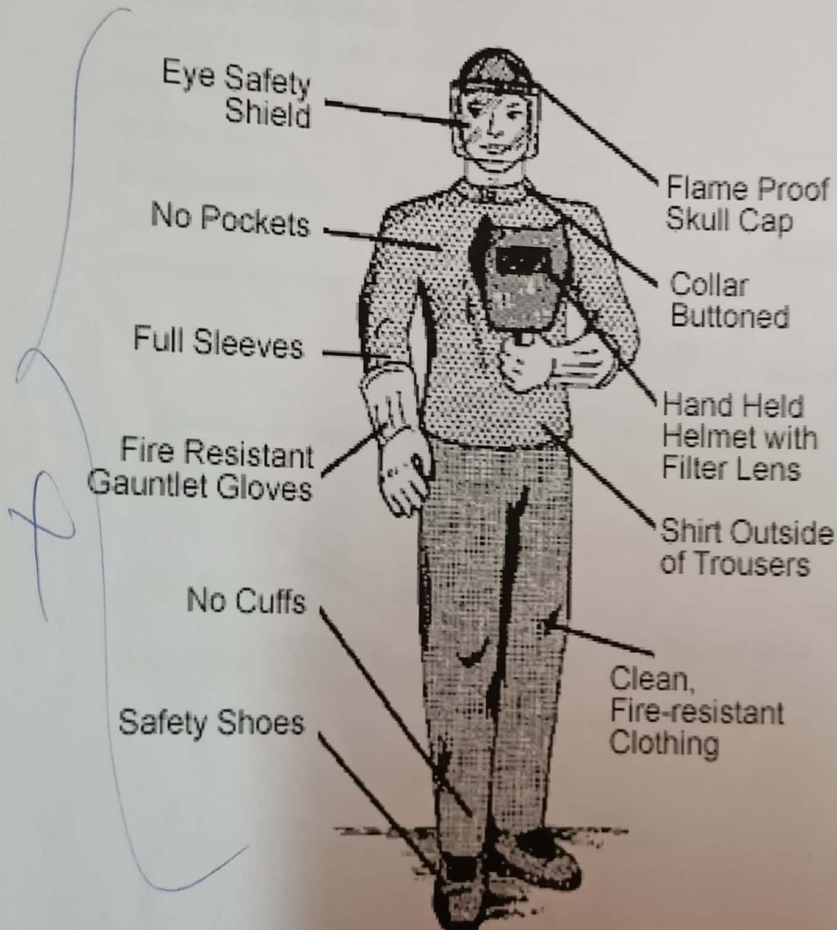
D. LAP JOINT



E. EDGE

SAFETY PRECAUTIONS FOR WELDING

- Be sure the welder is properly installed and grounded.
- Never weld without adequate ventilation.
- Take proper precautions to prevent fires.
- Protect your entire body with fire retardant clothing, shoes, and gloves.
- Wear eye protection at all times.
- Weld only in a firesafe area.
- Never do any welding, cutting, or hot work on used drums, barrels, tanks, or other containers.
- Mark metal "HOT" with a soapstone.
- Keep a well stocked first aid kit handy.



7

TUNGSTEN INERT GAS (TIG) WELDING

Tungsten Inert Gas Arc Welding (Gas Tungsten Arc Welding) is a welding process, in which heat is generated by an electric arc struck between a tungsten non-consumable electrode and the work piece. The weld pool is shielded by an inert gas (Argon, helium, Nitrogen) protecting the molten metal from atmospheric contamination.

The heat produced by the arc melts the work pieces edges and joins them. Filler rod may be used, if required.

Tungsten Inert Gas Arc Welding produces a high quality weld of most of metals. Flux is not used in the process.

Tungsten inert gas arc welding (TIG, GTAW)

