INDIAN INSTITUTE OF TECHNOLOGY PATNA

ME110 : MECHANICAL WORKSHOP

Welding

3.5

subjects
Types of Joints
Work layout
Precautions.

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Contents

INTRODUCTION

Welding is a process of joining similar metals by application of heat with or without application of pressure and addition of filler material. The result is a continuity of homogeneous material, of the composition and characteristics of two parts which are being joined together. Weldability of a material depends on one or more of five major factors: (1) melting point, (2) thermal conductivity, (3) thermal expansion, (4) surface condition, and (5) change in microstructure.

TYPES OF WELDING

1. Plastic or pressure welding: The pieces of metal to be joined are heated to a plastic state and then forced together by external pressure.
   Eg:- Forge welding, Resistance welding, Thermit welding, Gas welding (where pressure is required).
2. Fusion or non-pressure welding: The material at the joint is heated to a molten state and allowed to solidify.
   Eg:- Gas welding, arc welding, thermit welding.

ARC WELDING

Arc welding is a type of welding that uses a power supply to create an electric current flow through the electrode and the base material which leads to melting of material at the welding point.

→ Arc welding is limited to welding ferrous materials.
→ With special electrodes cast iron, nickel, aluminium, copper and other metals can also be welded.
→ This process is versatile, portable and cheap.

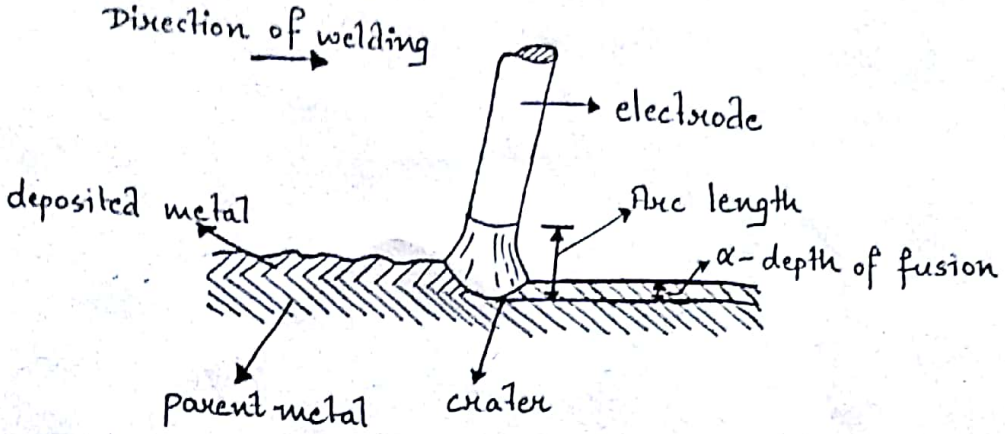


Fig: Arc Welding

PRINCIPLE OF ARC WELDING

The arc column is generated between the two conductors of electricity, cathode and anode. When these two conductors of an electric circuit are brought together and separated for a small distance (2 to 4 mm) such that the current continues to flow through a path of ionized particles (gaseous medium), called plasma, an electric arc is formed. This ionized gas column acts as a high-resistance conductor that enables more ions to flow from the anode to the cathode. Heat is generated as the ions strike the cathode. Electrical energy is converted to heat energy.

The heat of the arc raises the temperature of the parent metal which is melted forming a pool of molten metal. The

electrode metal is also melted and is transferred into the metal in the form of globules of molten metal. The deposited metal serves to fill and bond the joint or to fuse and build up the parent metal surface.

ADVANTAGES OF ARC WELDING

1. Most efficient way to join metals.
2. Lowest-cost joining method.
3. It affords lighter weight through better utilization of materials.
4. Joins all commercial metals.
5. It also provides design flexibility.

LIMITATIONS OF ARC WELDING

1. It is manually done, therefore requires high labour cost.
2. Needs high energy, causing danger.
3. Not convenient for disassembling.
4. Defects are hard to detect at joints.
5. Limited to welding ferrous materials.

JOB PERFORMED

OBJECTIVE

To weld two pieces of ferrous metal in the form of V-butt joint by arc welding process.

EQUIPMENTS AND TOOLS

1. Arc Welding Power Source: Both DC and AC sources are used for electric arc welding process. DC welding supply is usually obtained from generators driven by electric motor or, if no electricity is available, by internal combustion engine. For AC welding supply, transformers are predominantly used.

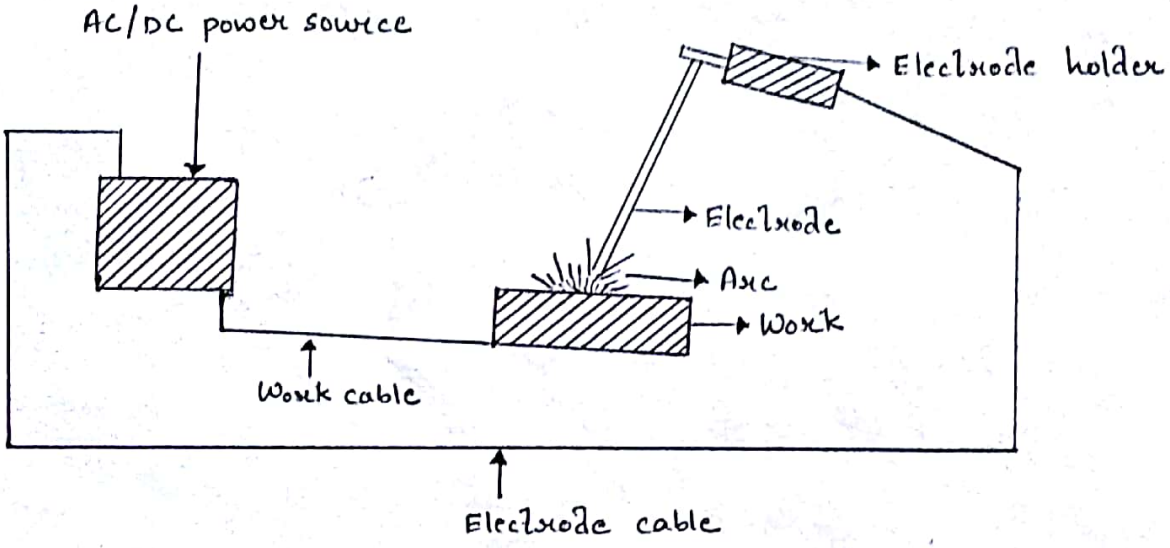


Fig: Arc Welding Equipments

2. Welding Cables: These are insulated copper or aluminium cables required for conduction of current from the power source through the electrode holder, the arc, the workpiece and back to the welding power source.

3. Electrode holder: Electrode holder is used for holding the electrode manually and conducting current through it.

4. Welding electrodes: An electrode is a piece of wire or a rod of a metal or alloy, with or without coating. An arc is set up between electrode and workpiece. They are either consumable or non-consumable.

5. Chipping hammer: Chipping hammer is used to remove the slag, formed after the welding process, by striking.

6. Wire brush: Wire brush is used to clean the surface to be weld before welding and also after it has been welded.

7. Hand Screen: It is used for the protection of eyes from the harmful radiation emmitted during process and it also suppresses weld beads.

8. Protective Clothing: This prevents exposure to direct heat and hot weld beads of body. It includes:

i) Helmet
ii) Apron
iii) Safety gogles
iv) Hand gloves


Apron

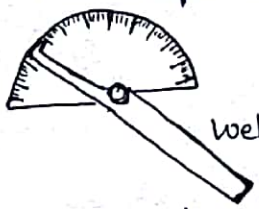

Safety gogles


Hand gloves

9. Marking / Measuring Tools: Steel rulers, tri-squares, welding protractor, etc.


Ruler


Tri-Square


welding protractor

10. Cutting Tools: These are used to remove metal from workpiece before welding. Eg:- Files, hacksaws.


File

OPERATIONS PERFORMED

1. Filing: Filing is done using file tool. It is necessary for making the job of proper shape to be operated upon.
2. Marking: Marking is done before filing to make the work piece proper in shape, to be operated upon.
3. Edge Preparation: For making the job ready to be operated upon, we need to prepare edges in proper shape which in this job is single V. Other types of edges are :- square edge, double V, Single U, Double U.
1. Joint Preparation: Joint is prepared by welding the job by using TiO_2 electrodes.

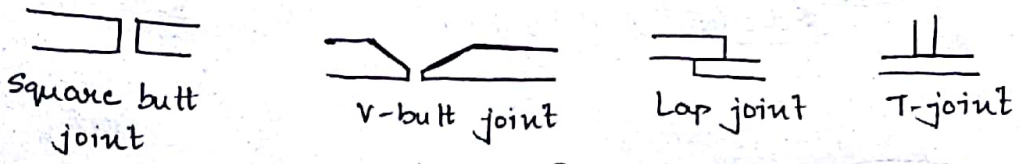
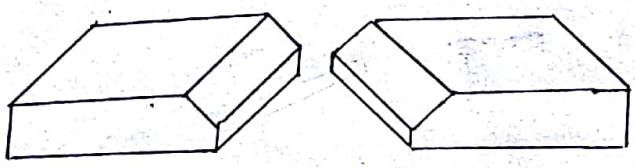


Fig: Common welding joints

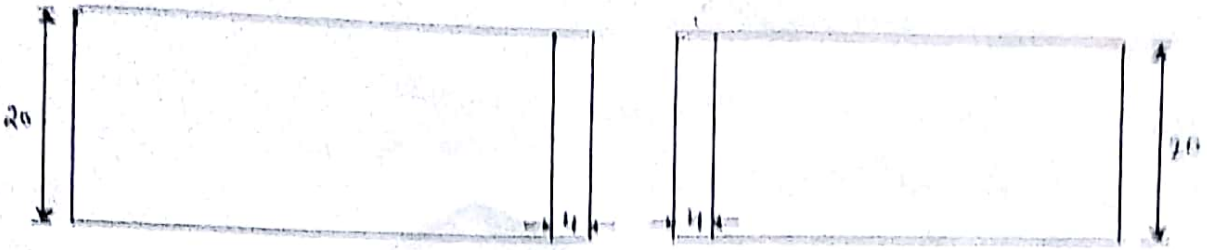
5. Surface Cleaning Process: Surface is cleaned before and after welding process using tools like wire brush, chipping hammer and file.
6. Weld Bead testing process: Welded bead is tested for welding defects.

LAYOUT / DIAGRAM

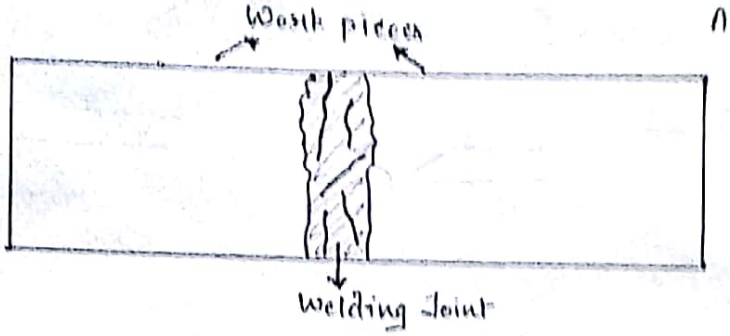


Side View

Front View



Top View



ALL DIMENSIONS ARE IN MM.

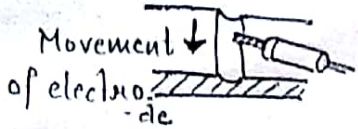
Final Job

PROCEDURE

Preparing test specimen as per size: Prepare the test specimen as per measurement keeping the surfaces plain, mutually orthogonal (where required) and rust free to ensure defect free welding. Files are used for this process.

Preparing edges: The surfaces to be welded are prepared using files into required weld joint shape. Here, we are making a V-butt joint.

Preparation of joints: After the preparation of edges of test specimen, joints are weld. Proper safety should be maintained at all times. For this job leading movement of electrode is used.



Penetration: shallow
Reinforcements: Minimum
Tendency to undercut: Minimum

4. Material Testing: After the completion of joint, testing the job for welding defects is important. Any slag is chipped away using chipping hammer and wire brush.

RESULT

Overall the experience of welding workshop was quite good and knowledgeable. We got the required V-butt joint of fair quality.

SAFETY PRECAUTIONS

- Wear protective clothing to cover all exposed areas of the body so as to get protection from sparks, hot spatter and radiation.
- Wear flame proof gauntlet gloves, leather and high top shoes to provide good protection from sparks and spatter.
- Wear specifically design helmets equipped with filter plates to protect yourself from harmful ultraviolet radiation.
1. Never look at the flash from naked eyes, even for an instant.
5. Proper gap should be maintained for the formation of arc such that the molten puddle is protected from contaminents. Trailing should be done slowly.