Practical Workbook

MY-304: Metallurgy of Welding

Name____________________________

Roll No__________________________

Batch___________________________

Year ___________________________

Department of Metallurgical Engineering

NED University of Engineering and Technology

Karachi-75270, Pakistan

Practical Workbook

MY-304: Metallurgy of Welding

PREPARED BY

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(Assistant Professor MYD)

This is to certify that this practical book contains ___________pages.

Approved by

Chairman, MYD

Department of Metallurgical Engineering

NED University of Engineering and Technology

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CERTIFICATE

It is certified that Mr. / Miss ____________________Student of class _____________ Batch_________________ Bearing Roll No. ____________has completed his/her coursework in the subject of ____________________________________ as prescribed and approved by the Board of Review of the Department of Metallurgical Engineering.

His/her performance is reflected by index/contents of his/her practical workbook. This overall performance of the student is Excellent/Very Good/Good (satisfactory)/Not Satisfactory

____

Course Teacher

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PRACTICAL 1

Aim of the Experiment

To demonstrate the safety involved in the joining of materials.

Guidelines and Safety Rule

1. Walk way should be marked ad kept clear such as free from holes, slippery substances and water to avoid slips, trips ad falls.
2. Trip hazards can be avoided by careful sitting of leads ad hoses and not putting tools down where people may walk.
3. Oily waste should be placed in metal bin, and all bins should be emptied regularly to avoid an accumulation of combustible waste.
4. Ensure that work area is free from combustible materials. Sparks can ignite materials 10m away or more.
5. Fire extinguisher should be placed close to the working area ad easier to reach every one.
6. Avoid to wear rings, watches or jewelry, keep your hear short or wear a cap or welding helmet, or welding goggles, welding gloves, welding shoes, wear an apron or proper clothing, do not wear loose clothes,
7. Never ever work alone, and immediately report of any accident/incident even if it is small.
8. Do not eat or drink in lab.
9. Do not touch live electrical part.
10. Check that all equipment all of correct type , rated to the correct pressure ad and of suitable materials
11. Always provide adequate ventilation during welding and cutting operations;
12. Store gas cylinders outside whenever possible or in a well-ventilated place;
13. The main hazards are from fire and explosion. These are caused by:
    - ✴ careless handling of a lighted blowpipe resulting in burns to the user or others;
    - ✴ using the blowpipe too close to combustible material;
    - ✴ cutting up or repairing tanks or drums which contain or may have contained flammable materials;
    - ✴ gas leaking from hoses, valves and other equipment;
    - ✴ misuse of oxygen;
    - ✴ backfires and flashbacks.
14. Shut off the blowpipe when not in use. Do not leave a lighted blowpipe on a bench or the floor as the force of the flame may cause it to move;
15. Clamp the work piece, do not hold it by hand;
16. Keep hoses away from the working area to prevent contact with flames, heat, sparks or hot spatter;
17. keep hoses clear of sharp edges and abrasive surfaces or where vehicles can run over them;
18. Do not allow hot metal or spatter to fall on hoses;
19. Handle cylinders carefully. Keep them in an upright position and fasten them to prevent them from falling or being knocked over. For example, chain them in a wheeled trolley or against a wall;

20. Always turn the gas supply off at the cylinder when the job is finished;
21. Maintain all equipment and keep in good condition;
22. Regularly check all connections and equipment for faults and leaks.
23. If a backfire does occur:
    ✳ shut off the blowpipe valves, oxygen first and then the fuel gas;

    ✳ shut off the oxygen and fuel gas cylinder valves;

    ✳ cool the blowpipe with water, if necessary;

    ✳ check the equipment for damage or faults, particularly the nozzle.
24. The following precautions will help to prevent flashbacks:
    ✳ use the correct lighting up procedure. Purge the hoses before lighting the blowpipe to remove any potentially explosive gas mixtures. Use a spark igniter and ignite the gas quickly after turning it on;

    ✳ ensure the blowpipe is fitted with spring-loaded no return valves to prevent a backflow of gas into the hoses;

    ✳ use the correct gas pressures and nozzle size for the job. In particular, the acetylene pressure must not exceed 0.62 bar (9 psi);

    ✳ maintain the equipment in good condition. These measures will reduce the risk of a flashback but will not completely eliminate it. Non-return valves will not stop a flashback once it has occurred. As the consequences of a flashback are potentially very serious, cylinders should be protected.
25. If a flashback does occur:
    ✳ immediately close the cylinder valves, both fuel gas and oxygen, if it is safe to do so. The flame should go out when the fuel gas is shut off. If the fire cannot be put out at once, evacuate the area and call the emergency fire services;

    ✳ the blowpipe, hoses, regulators, flashback arresters and other components may have been damaged. Check carefully and replace if necessary before reuse. If in doubt, consult the supplier
26. The light generated by MIG welding is extremely bright. Looking directly at a welding arc even for a short time causes arc eye when the bright flash from the arc burns the cornea. The cornea is very sensitive to sun burn. Expect to be awake all night with the sensation that someone is sticking pins in your eye. So wear a full face welding mask it tends to be the reflected light that causes arc eye.
27. The light from MIG welding has a strong ultraviolet content and causes sunburn Full covering of arms and legs is essential. If it's hot wear thin clothes in preference to stripping to exposed skin.

EXERCISE

Q1. Which color coding is used for acetylene and oxygen gas?

Q2. How fire extinguisher used?

Q3. What will you do in case of emergency? (i) if you were doing gas welding. (ii) if you were doing electric arc welding.

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PRACTICAL 2

Aim of the Experiment

Demonstrate the joining process by GMAW.

Equipment and Materials

(1) Welding torch,
(2) Workpiece,
(3) Power source,
(4) Wire feed unit,
(5) Electrode source,
(6) Shielding gas supply.

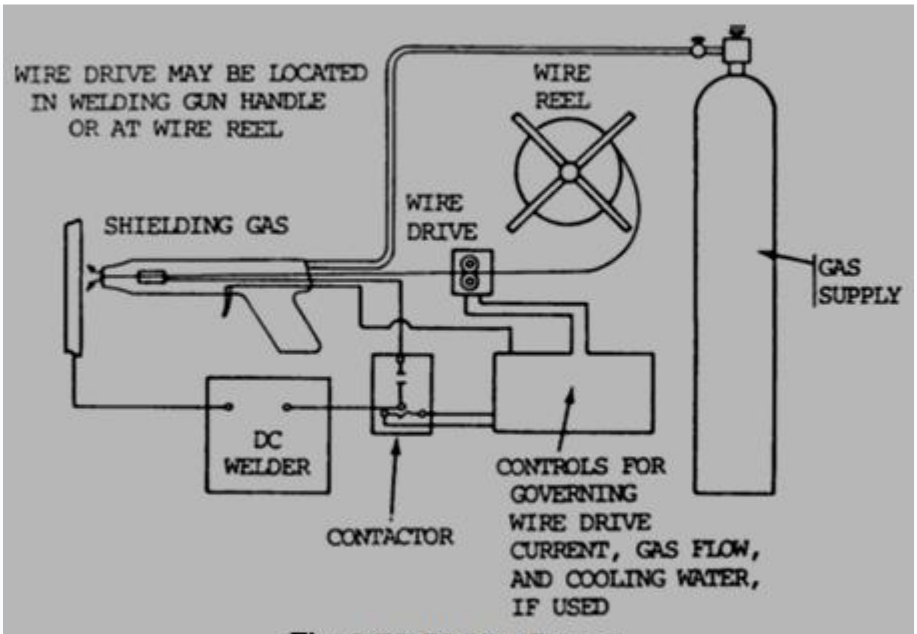

Fig: MIG Welding Process

Theory

Gas Metal Arc Welding is a commonly used high deposition rate welding process. Alternative names are Metal active-gas (MAG); Metal arc gas-shielded (MAGS); Semi-automatic welding and CO_2 welding. sometimes referred to by its subtypes metal inert gas (MIG) welding or metal active gas (MAG) welding, is a semi-automatic or automatic arc welding process in which a continuous and consumable wire electrode and a shielding gas are fed through a welding gun. A constant voltage, direct current power source is most commonly used with GMAW, but constant current systems, as well as alternating current, can be used. There are four primary methods of metal transfer in GMAW, called globular, short-circuiting, spray, and pulsed-spray, each of which has distinct properties and corresponding advantages and limitations. Wire is continuously fed from a spool. Current ranges 60 to 500A with heat input 1 to 25 kj/s.

Procedure

1. Press the trigger on the gun, and allow the wire to projects about 6mm
2. Use the scratch method to strike the arc and form a puddle
3. Once the puddle established, move the gun along the metal at a uniform speed
4. The gun should inclined at 5 to 10 degree from vertical position
5. Proceed to form a welding bead as with other welding methods

Observation

EXERCISE

Q1. Which type of electrode is used in GMAW Welding?

Q2. Enlist the name of the gases used for providing shielding atmosphere in GMAW Welding?

Q3. Which power source is used in GMAW Welding and of what polarity?

Q4. How we change the current in GMAW Welding?

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PRACTICAL 3

Aim of the Experiment

Carry out macroscopic examination of weldment under supervision.

Apparatus

Welding:	Electric Arc Welding
Weld Joint:	Butt V-Groove joint.
Material and Equipment:	Mild Steel welded Plate, Emery paper (180,220,320,400,600 mesh size), pipit, beaker, cotton.
Machines:	Abrasive cut off machine, Grinding Machine, Polishing Machine.
Etchant:	15mL HNO3 + 85mL H2O + 5mL methanol or ethanol
Microscope:	Stereo Microscope (5X).

Theory

Metallography

Metallography consists of the structural characteristic of metal and alloy is related to its physical and mechanical properties. Experience has indicated that success in metallographic study depends largely upon the care taken in preparation of the specimen. The most expensive microscope will not reveal the structure of a specimen that has been poorly prepared.

Specimen Preparation

1) Sampling

The transverse section is most often used to observe welded joint macrostructure and microstructure may be supplemented by additional viewing and sectioning technique, including top-view photograph, the longitudinal section and the normal section. For studies of solidification effects, a section normal to the solidification direction may be useful. The summery of welded joint section and their uses is shown in table. This section may be obtained by use of an abrasive cut off wheel or by sawing. The specimen should be kept cool during cutting operation.

Table: Summary of welded joint section and their uses:

SECTION	USES
Transverse	Bead Geometry Joint characterization Microstructural characterization Defect Documentation Solidification shrinkage cracks Under bead cracks Toe cracks Hydrogen cracks Weld metal longitudinal cracks Weld metal root cracks Slag entrapment Incomplete fusion Inadequate joint penetration Pile-up Undercut Porosity
Longitudinal	Solidification structure Defect Documentation Transverse heat-affected zone Base metal cracks
Normal to Solidification direction	Solidification cell or dendrite characterization
Normal Section	Solidification structure Defect Documentation Solidification shrinkage cracks Hydrogen cracks
Top surface	Appearance of the joint Defect Documentation Arc strike Spatter Porosity (blow hole) Weld metal crater cracks Transverse heat-affected zone Base metal cracks Transverse weld metal cracks Weld metal longitudinal cracks Toe cracks

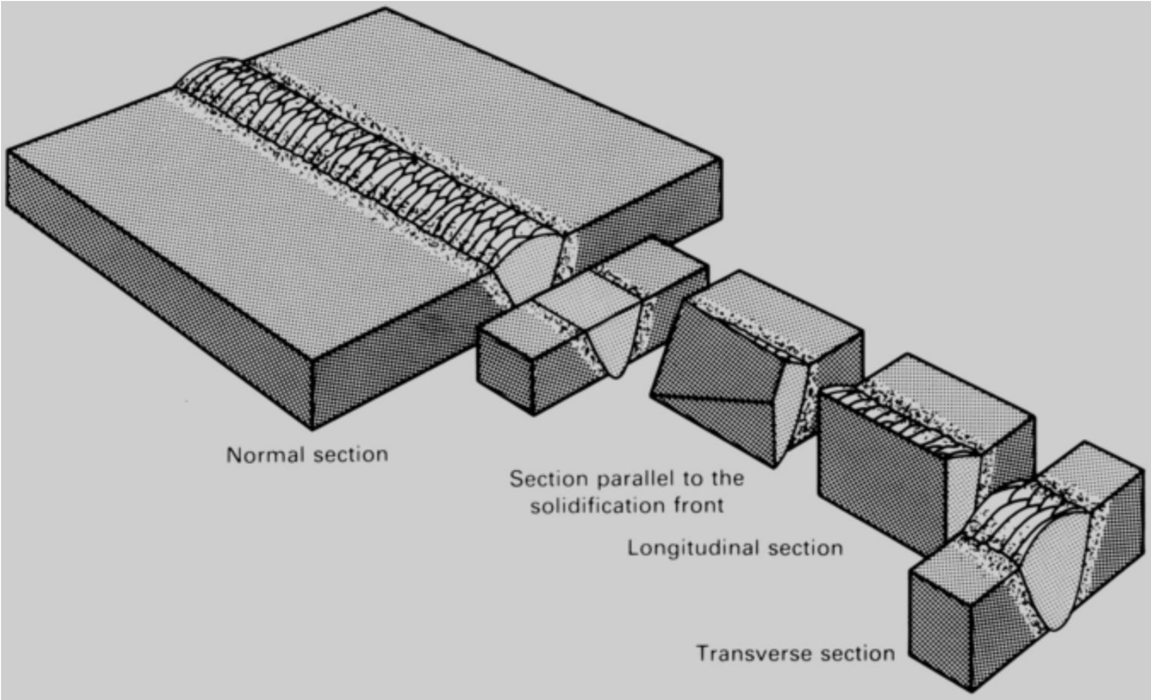

Fig: Sections used in the metallographic examination of welded joints.

2) Grinding

Surface layers damaged by cutting must be removed by grinding. It is very important phase of the sample preparation sequence because damage introduced by sectioning must be removed at this phase.

In the grinding operation the specimen should be moved perpendicular to the existing scratch. This will facilitates recognition of the stage when the deeper scratches have been replaced by shallower ones characteristic of the finer abrasive. The grinding is continued until the surface is flat and free of nicks, burrs etc, which is done by starting with the coarse paper and the continuing with the fine paper usually for macroscopic examination up to 400 or 600. The sample should be kept cool during operation and washed thoroughly to remove coarse silicon carbide partials or material burrs before proceeding to a finer paper.

3) Polishing

It is done polishing machine, a rotating wheel covered by a special cloth. The choice of the proper polishing cloth depends upon the particular materials being polished and the purpose of the metallographic study. Alumina is employed for ferrous and copper based materials. Polishing is also classified as coarse polishing uses abrasive in the range of 30 μm to 3μm while fine polishing uses abrasives 1μm and smaller. After polishing the surface should like mirror surface.

4) Macroetching

Macroetching is the procedure for revealing the large-scale structure of a metallic specimen, that is the structure visible with the unaided eye or low-power microscope or binocular, usually under 10X.

The application of Macroetching in the fabrication of metals are the study of weld structure, weld penetration, dilution of filler metal by base metal entrapment of flux, porosity and cracks in the weld and heat affected zone (HAZ).

(With reference to ASTM E 340-00, "Standard Test Method for Macroetching of metal and alloy" and ASM HANDBOOK Vol: 9 "Metallography and Microstructure" chapter Macroetching.)
Room-temperature macroetches used for the characterization of welded joints for carbon and low alloy steels are. (ASM HANDBOOK Vol: 9 "Metallography and Microstructure" chapter "Metallography and Microstructure of weldment page #1052 table 3)

Etching Solution	**Surface Preparation**	**Comments**
$10g(NH_3)_2S_2O_8$ (ammonium persulphate) + 100mL H_2O	Polish	**Swab,** macro etch brings out fusion line, HAZ, reheated zone, columnar zone (Time,1-10 min)
15mL HNO_3 + 85mL H_2O + 5mL methanol or ethanol	Finish grind or polish	**Swab**, macroetch brings out fusion line, HAZ, reheated zone, and columnar zone; scrub gently under running water to remove any black residue.
8mL HNO_3 + 2g picric acid + $10g(NH_3)_2S_2O_8$ + 10g citric acid + 10drops (0.5mL benzalkonium chloride + 1500mL H_2O	Polish	**Immerse;** highlight partially transformed region in reheat and HAZ.

Procedure

EXERCISE

Q1. Why sample preparation is important in metallography?

Q2. What is swab or swabbing?

Q3. What do you find out by examining the welded section?

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PRACTICAL 4

Aim of the Experiment

Duplicate the soldering process to join given samples and compare the microstructures of welded and soldered samples.

Safety
1. Protective shoes
2. Lab coat
3. Goggles and Gloves

Equipment and Materials
1. Soldering Iron
2. Solder
3. Flux

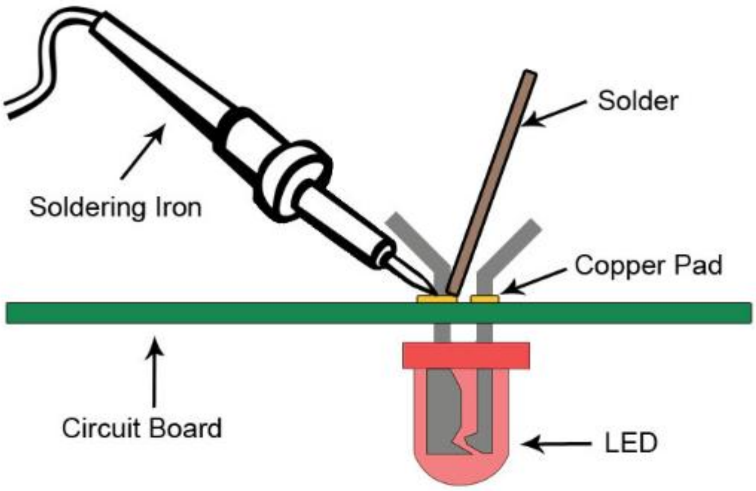

FIG: Soldering Process

Theory

Soldering is defined as a joining process in which coalescence is produced by heating generally to a temperature below 426 ^{0}C and using a nonferrous filler metal solder that has a melting point below that of the base metal. The filler metal is distributed between the properly fitted joints by capillary action. Solder joints have low strength and are not suitable for structural applications or for exposure to temperatures over 100 ^{0}C.

Heating Methods: Heat may be applied in one of several ways, depending upon the application.
1. Soldering irons.
2. Dip soldering.
3. Induction heating.

4. Resistance heating.
5. Oven heating.
6. spray gun heating, and
7. Flame heating.

Soldering Filler Metals:
Selection of the proper materials is an important preliminary step in the soldering of metal joints. Selection depends on the metals to be joined, the expected service, operational temperatures, expansion and contraction and vibration expected during service. Tin-lead and tin-lead-other alloy solders are the most widely used solders. Other types of solders are tin-antimony-lead solders, tin-antimony solders, tin-zinc solders etc.

Forms of Solders:
Solders are available in the forms of solid wire, pigs, slabs, bars, paste, tape, powder foil and sheet.

Fluxes:
A soldering flux is a liquid, solid, or gaseous material which, when heated, prevents the formation of oxides and increase the wetting action of the solder. Fluxes are classified into three general groups: highly corrosive, intermediate, and noncorrosive. The types of flux to use depends upon the metal being soldered, the oxidation rate of the metal, and the resistance of the oxide to removal.

Pre cleaning and Surface Preparation:
Care in cleaning the surface of the material to be soldered is essential. A dirty surface impairs the wetting and alloying action because it prevents the solder from flowing as a thin film. All foreign materials such as oil, paint, pencil markings, lubricants, general atmospheric dirt, and oxide films must be removed before soldering. The strength and adherence of the solder is a function of the surface contact area of the solder to the base metal. Contact may be improved by roughening the surface of the base metal.

Surface Cleaning Methods:
Two methods of surface cleaning are employed: mechanical and chemical. Emery cloth is the most widely used method of mechanical cleaning for copper, brass and the softer metals. Chemical cleaning is usually done for production operations. Either solvent or alkaline degreasing is recommended. Acid cleaning, also called pickling, removes rust, scale, oxides and sulfides. The inorganic acids-hydrochloric, sulfuric, phosphoric, nitric, and hydrofluoric are used singly or mixed. Hydrochloric and sulfuric acid are the most frequently used.

Procedure

1. Clean the surfaces thoroughly.
2. Apply flux on surfaces to be joined as soon as possible after cleaning.
3. Adjust the surfaces for flat position lap joint.
4. Make sure the soldering iron has warmed up. If necessary use a brass soldering iron cleaner or damp sponge to clean the tip.
5. Pick up the Soldering Iron in one hand, and the solder in the other hand.
6. Place soldering iron tip on the pad.
7. Feed a small amount of solder into the joint. The solder should melt on the pad and flow around the component leg.

8. Remove the solder, then remove the soldering iron.
9. Leave the joint to cool for a few seconds, then using a pair of cutters trim the excess component lead.

Observations

EXERCISE

Q1. What are the disadvantages of using lead silver solder?

Q2.Write some Industrial Applications of the soldering process.

Q3. What are the application of different solder such as solid wire, pigs, slabs, bars, paste, tape, powder foil and sheet?

Q4.Which solder and flux we used during soldering and why we select this.

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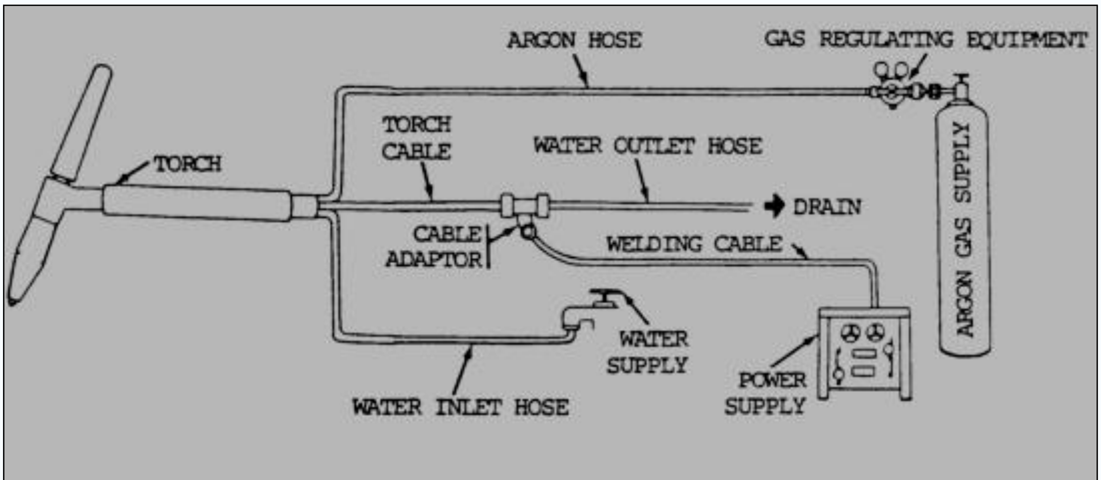
PRACTICAL 5

Aim of the Experiment

To demonstate GTAW/TIG under supervision and join given sample

Apparatus

(1) Welding torch,
(2) Work piece,
(3) Power source,
(4) Electrode source,
(6) Shielding gas supply.



TIG Process

Theory

Gas tungsten arc welding (GTAW), also known as tungsten inert gas (TIG) welding, is an arc welding process that uses a no consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by a shielding gas (usually an inert gas such as argon), and a filler metal is normally used, though some welds, known as autogenously welds, do not require it. A constant-current welding power supply produces energy which is conducted across the arc through a column of highly ionized gas and metal vapors known as plasma. Current range 10 to 300 with heat input 0.2 to 8 KJ/s. TIG is most commonly used to weld thin sections of stainless steel and light metals such as aluminum, magnesium, and copper alloy

Procedure

1. Adjust the current, gas and cooling by thickness and process specification
2. Strike the arc, and obtain a molten puddle
3. When the puddle becomes bright and fluid, move the torch along the base metal at a slow and steady speed
4. Hold the torch at approximately 75 to 80 degrees.
5. Run the bead with the same weaving motion as in oxy-acetylene welding.

Observation

EXERCISE

Q1. Enlist the materials names which are commonly welded by TIG welding?

Q2. Which power source used in TIG welding?

Q3. What polarity used in TIG welding?

PRACTICAL 06

Aim of the Experiment

Operate SMAW under supervision to produce T joint and Lap joint.

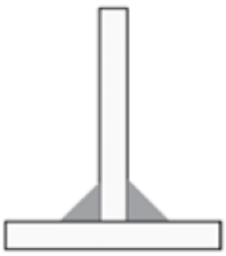
Apparatus

Welding Type: Electric Arc Welding
Weld joint: T Joint, Lap joint
Material: Mild Steel Plates, Welding Electrodes

Theory

The selection of a proper weld joint and weld type is an important aspect of arc welding. Some very common arc welding joints and weld types are shown in Figure. The joint refers to how the two work pieces or parts that are being welded are arranged relative to each other. Weld type refers to how the weld is formed in the joint. Specifically in arc welding, there are numerous joint types, but only two weld types, namely, a fillet and a groove weld. A fillet weld (top two in the figure) offers the advantage of requiring no special joint preparation because the parts to be welded come together at an angle to form the necessary features to contain the weld. The strength of a fillet weld is a function of its size, as measured from the surface of the weld to the root of the weld where the parts meet.

Groove welds (bottom of figure) facilitate the creation of full penetration welds in thicker materials, which are usually necessary in order to generate maximum joint strength. The choice of weld and joint type is often dictated by the design details of the component being welded, and both often play a major role in the mechanical properties of the welded joint. The thickness of the parts being welded, as well as the material and type of welding process being used also affects the choice of weld or joint type. Economics always plays a roll relative to the amount of preparation that is required to create the joint, the cost of filler metal, and how fast the weld can be deposited. Joints such as T and edge joints only require the edges of the parts to be brought together. In the case of groove welds, the edges where the parts meet usually must be machined, ground, or thermally cut to produce the proper groove (although the figure shows a tight butt joint configuration in which special preparation may not be required).



Lap joint with fillet welds

T joint with fillet welds

Butt joint with a groove weld

Procedure

Observation

EXERCISE

1. Draw the appearance of external corner joint

2. Joint type and Position of Welding are same or different? If different then explain the different welding positions.

3 Tack welding is also performed in Corner Joint welding or it was only related to Butt joint?

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PRACTICAL 07

Aim of the Experiment

Operate SMAW **under supervision** to produce butt joints.

Apparatus

Welding: Electric Arc Welding
Weld Joint: Butt Joint
Material and Equipment: Mild Steel Plates, Welding Electrodes

Theory
Shielded Metal Arc Welding
Shielded Metal Arc Welding (SMAW) or Stick welding is a process which melts and joins metals by heating them with an arc between a coated metal electrode and the workpiece. The electrode outer coating, called flux, assists in creating the arc and provides the shielding gas and slag covering to protect the weld from contamination. The electrode core provides most of the weld filler metal.

When the electrode is moved along the workpiece at the correct speed the metal deposits in a uniform layer called a bead. The Stick welding power source provides constant current (CC) and may be either alternating current (AC) or direct current (DC), depending on the electrode being used. The best welding characteristics are usually obtained using DC power sources.

The power in a welding circuit is measured in voltage and current. The voltage (Volts) is governed by the arc length between the electrode and the workpiece and is influenced by electrode diameter. Current is a more practical measure of the power in a weld circuit and is measured in amperes (Amps). The amperage needed to weld depends on electrode diameter, the size and thickness of the pieces to be welded, and the position of the welding. Generally, a smaller electrode and lower amperage is needed to weld a small piece than a large piece of the same thickness. Thin metals require less current than thick metals, and a small electrode requires less amperage than a large one.
It is preferable to weld on work in the flat or horizontal position. However, when forced to weld in vertical or overhead positions it is helpful to reduce the amperage from that used when welding horizontally. Best welding results are achieved by maintaining a short arc, moving the electrode at a uniform speed, and feeding the electrode downward at a constant speed as it melts.

Procedure

Observations

EXERCISE

Q) How the current and voltage can affect the quality of weld.

Q) Identify different type of joint?

Q) What is the main reason for performing Tack Weld?

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PRACTICAL 8

Aim of the Experiment

Operated electrical resistant welding (Spot welding) under supervision and studied the microstructure of nuggets.

Theory

Spot welding is one of the oldest welding processes. It is used in a wide range of industries but notably for the assembly of sheet steel vehicle bodies. This is a type of resistance welding where the spot welds are made at regular intervals on overlapping sheets of metal. Spot welding is primarily used for joining parts that are normally up to 3 mm in thickness. Thickness of the parts to be welded should be equal or the ratio of thickness should be less than 3:1. The strength of the joint depends on the number and size of the welds. Spot-weld diameters range from 3 mm to 12.5 mm.

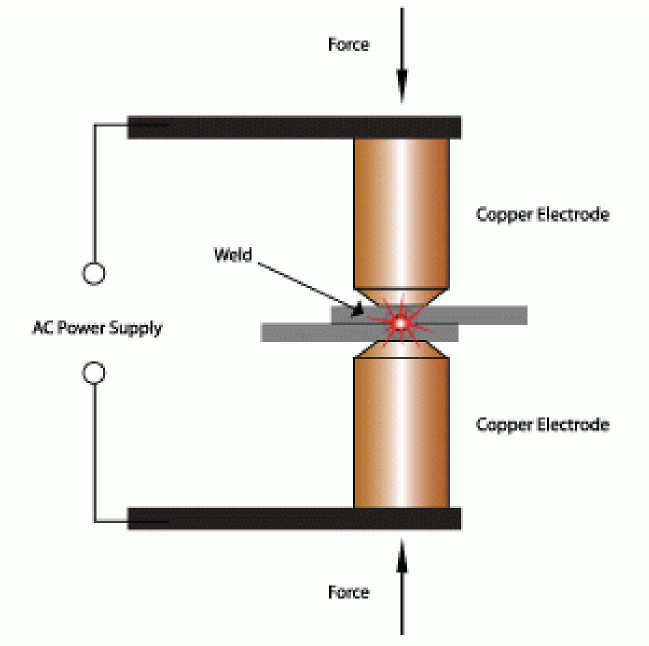


Fig Spot Welding

Working principle

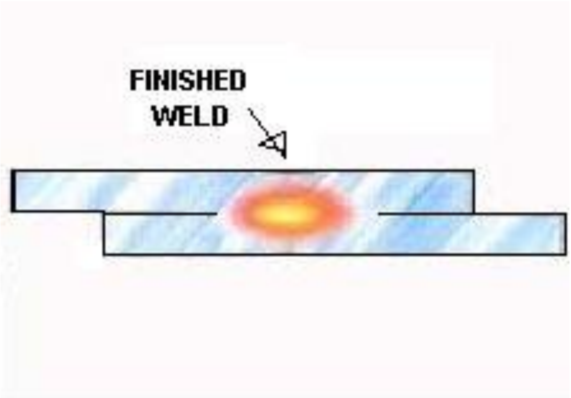
Spot welding is one form of resistance welding, which is a method of welding two or more metal sheets together without using any filler material by applying pressure and heat to the area to be welded. The process is used for joining sheet materials and uses shaped copper alloy electrodes to apply pressure and convey the electrical current through the workpieces. In all forms of resistance welding, the parts are locally heated. The material between the electrodes yields and is squeezed together. It then melts, destroying the interface between the parts. The current is switched off and the "nugget" of molten materials solidifies forming the joint

To create heat, copper electrodes pass an electric current through the workpieces. The heat generated depends on the electrical resistance and thermal conductivity of the metal, and the time that the current is applied. The heat generated is expressed by the equation:

$$E=I^2*R*t$$

where E is the heat energy, I is the current, R is the electrical resistance and t is the time that the current is applied.

Copper is used for electrodes because it has a low resistance and high thermal conductivity compared to most metals. This ensures that the heat is generated in the workpieces instead of the electrodes.



Materials suitable for spot welding

Steel has a higher electrical resistivity and lower thermal conductivity than copper electrodes, making welding relatively easy. Low-carbon steel is most suitable for spot welding. Higher carbon content or alloy steel tend to form hard welds that are brittle and could crack. Aluminium has an electrical resistivity and thermal conductivity that is closer to that of copper. However, aluminium's melting point is much lower than that of copper, making welding possible. Higher current levels must be used for welding aluminium because of its low resistivity.

Galvanized steel (i.e. steel coated with zinc to prevent corrosion) requires a different welding approach than uncoated steel. The zinc coating must first be melted off before the steel is joined. Zinc has a low melting point, so a pulse of current before welding will accomplish this. During the weld, the zinc can combine with the steel and lower its resistivity. Therefore, higher levels of current are required to weld galvanized steel.

Procedure

Observations

EXERCISE

1. Write down differences between Spot welding and Tack welding

2. Write down some application of Spot welding

3. Describe what kind of metals can be welded through Spot Welding

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PRACTICAL 9

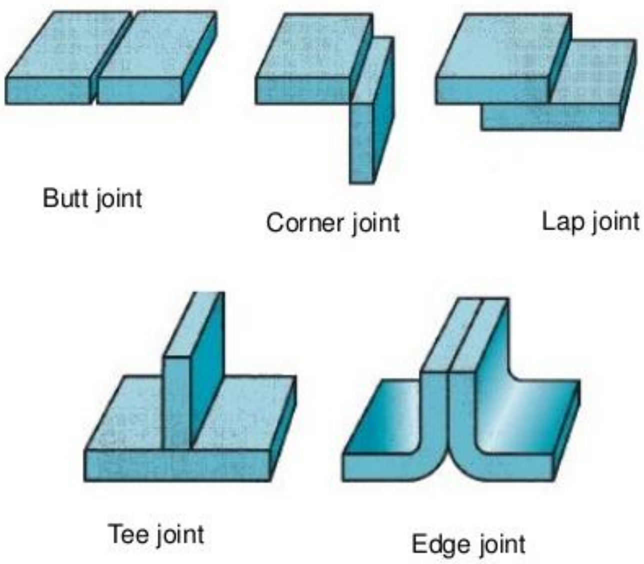
Aim of the Experiment

Operate under the supervision welding expert for the Inspection of weldments

Introduction:

Critical appraisal involving examination, measurement, testing, gauging, and comparison of materials or items are called inspection. An inspection determines if the material or item is in proper quantity and condition, and if it conforms to the applicable or specified requirements. Weldment is a unit formed by welding together an assembly of pieces.

Different types of weld joints



Fusion zone:

The **fusion zone (referred to as FZ)** can be characterized as a mixture of completely molten base metal (and filler metal if consumable electrodes are in use) with high degree of homogeneity where the mixing is primarily motivated by convection in the molten weld pool. The microstructure in the weld fusion zone is expected to change significantly due to remelting and solidification of metal at the temperature beyond the effective liquidus temperature.

Weld bead:

A weld deposit resulting from a pass is called weld bead. The more peaked and narrow the weld bead, the greater the chance that poor fusion may occur. The weld bead characteristics may be altered via both size and shape. Welding current and travel speed are the welding parameters primarily used to control weld bead size. For instance, when the current is decreased, the weld bead will become smaller. The converse is also true. Weld bead size can also be changed by varying the arc travel speed, bead size and travel speed are inversely related. A decrease in travel speed will result in an increase in the weld bead height and width and vice versa.

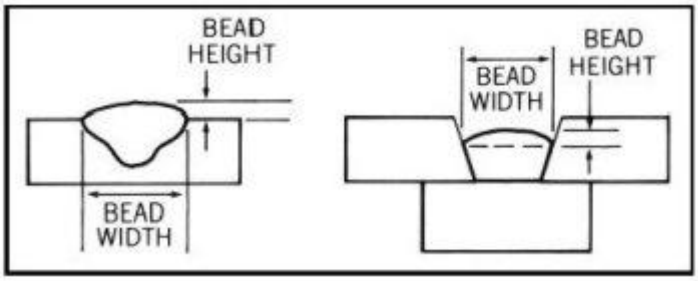


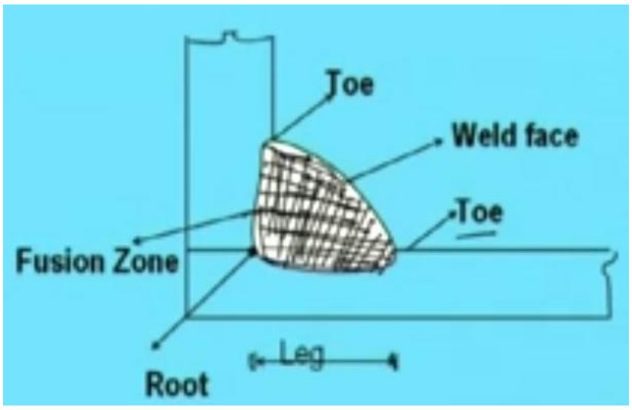
Figure – Weld Bead Characteristics

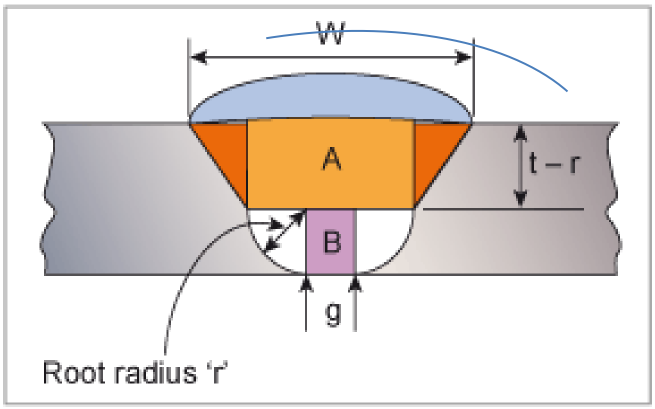
Heat affected zone (HAZ)

The HAZ is a region of base metal surrounding the fusion zone in which melting has not occurred, but temperatures from welding were high enough to cause solid state microstructural changes.

Weld Leg length

It is defined from the point of intersection of the joint to the end of the weld.





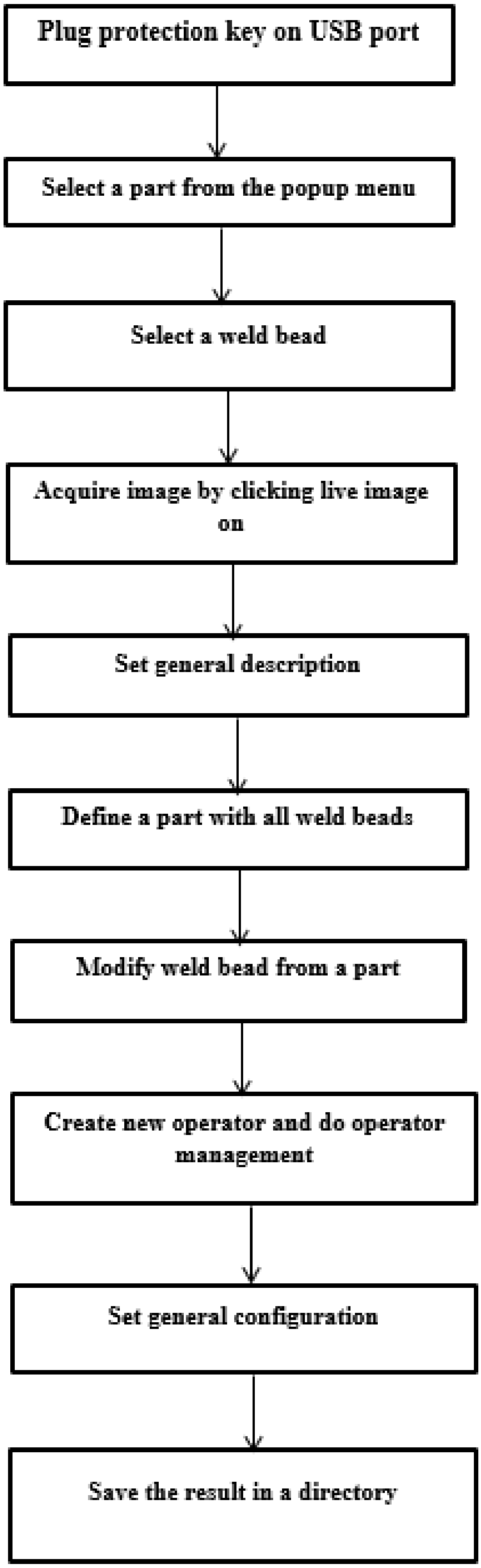
W =Width

A = Fusion Zone

B = Gap B/W Metals

Procedure:

This practical is based on software **"welding expert".** The following are the basic steps to be followed.


Plug protection key on USB port
Select a part from the popup menu
Select a weld bead
Acquire image by clicking live image on
Set general description
Define a part with all weld beads
Modify weld bead from a part
Create new operator and do operator management
Set general configuration
Save the result in a directory

Observations:

S #	Material	Types Of Joint	Fusion Zone of Weld Bead	Radius Of Weld Bead	Gap B/W Metals	HAZ Area	Thickness Of Metal 1	Thickness Of Metal 2	Width Of Weld Bead	Leg length

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