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Materials required for the job-

M/S Flat Bar- 2pcs

M/S Electrode- size 3.15mm = 10 SWG

Tools and Equipments Required for Job-

1. Steel foot rule 2. Try square 3. Scriber
Hammer 7. Ball Peen Hammer 8. Electrode
and Helmet 11. Chisel 12. Tongs etc.
4. Hacksaw Blade with frame 5. File 6. Chipping
9. Leather Apron and Hand Gloves 10. Welding Screen

Sequence of the Job

① HOLDING

1. Measuring 2. Marking 3. Cutting 4. Filling 5. Squaring 6. Welding 7. Cleaning

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Description of the work performed-

1st Day-

1. Introduction about Arc Welding. Classifications of Welding.
2. Safety precautions for Arc Welding.
3. Study about various Tools and Equipments used in Arc Welding shop.
4. Discussion of Arc Welding Machine. Types of welding machines and their uses. (AC Transformer, DC Motor Generator, Rectifier etc)
5. Discuss about the terms of Arc Welding. Brazing soldering , current, arc length, arc blow, electrode, flux, bead, deposit, electrode holder, earth clamp, slag, root run, root gap, tack weld, spatter, undercut, porosity, blow hole or gas pockets etc.
6. Electrode- types of electrode, flux coating, size, current carrying capacity etc.
7. Engineering process of metal joining, Types of metal joining, welding position etc.
8. Edge preparation, importance of edge preparations.
9. TIG Welding, MIG Welding, Gas Welding etc.

2nd Day-

1. Discuss about Gas Welding.
2. Safety precautions used in Gas Welding.
3. Discuss about gas welding related tools and equipments. Oxygen cylinder, acetylene cylinder, blow pipe or hose , torch, regulator, purifier, back pressure valve, cylinder key, etc
4. Discuss about gas welding terms, backfire, false back, filler road, nozzle, over heat etc.
5. Discuss about colour code of cylinder.

3rd Day

Received practical material for welding job hence measuring, cutting, filling, squiring practice are done.

4th Day

Free hand Arc Welding practice is done. Use M/S Electrode- size 3.15mm = 10SWG. Position is flat or down hand position. Current setting – 130 in amps. Rectifier Machine is used.

5th Day

Final welding bead or run have made. Use M/S Electrode- size 3.15mm = 10SWG. Position is flat or down hand position. Current setting – 130 in amps. Rectifier Machine is used.

What is Welding?

Welding is technique of metal joining process in between two pieces of similar or dissimilar metals, by the permanent way with the help of a suitable heat. The welding may be done with or without the application of pressure and with or without the use of filler metal.

Classification of welding process on methods-

Welding process may be broadly classified under two main headings-

1. Fusion or non pressure welding-

For example- a) Arc Welding- metallic Arc welding, Carbon arc welding

b) Gas Welding – Oxy-acetylene, Oxy-hydrogen

2. Pressure welding or non-fusion welding-

For example- a) Resistance welding

b) Forge welding

Safety precautions for Arc Welding-

1. Don't make welding without cleaning nicely the work pieces.
2. Do not touch the hot job with naked hand.
3. Do not see the Arc rays through naked eye.
4. Don't weld continuously on the side of white washed wall because Arc rays reflect from the white washed wall.
5. Keep dry sand and water to put off the fire in welding shop.
6. Do not run the machine, if there is no work.
7. Rubbing the electrode from right hand to left hand when the electrode stick (touch) the job.
8. Don't weld without final preparation of the job.
9. While chipping the welding bead, use chipping goggles.
10. Don't keep the coated electrode in damp place, otherwise the flux coating may be damaged.
11. Don't weld or join any kind of work or job without knowing the metal character.

Name of the various tools and equipments required in Arc welding shop-

1. Arc welding machine – AC Transformer, Rectifier, DC Motor Generator etc.
2. Two cable- (one is connected with electrode holder and another is connected with earth clamp.)
3. One eye shield or welding helmet.
4. Leather apron and hand gloves.
5. Electrode.
6. Electrode holder.
7. Earth clamp.
8. Chipping hammer and Goggles.
9. Welding Table (metallic).
10. Tongs.
11. Steel foot rule.
12. Try square **Try square**
13. Sand bucket
14. Ball pin hammer **Ball peen hammer**
15. File (Rough and smooth)
16. Hacksaw frame with blade
17. Center punch

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18. Divider.
19. Caliper (out & inside)
20. Scriber etc.

Welding Transformer- The voltage range that is employed in arc welding with AC supply is normally from 80 to 100 volt, but the main supply of power in the factories is at 220 to 440 volts. A device is therefore used to change the higher voltage of main supply to lower voltage for welding. Such a device is called transformer. The AC welding transformer never be operated without AC main supply. The transformer is two types.

1. Step up transformer:- The transformer used for raising the voltage is called step up transformer.
2. Step down transformer:- The transformer is used to lower the voltage. So it is called step down transformer.

Generator- Generator is a source of electrical energy supply. Generator gives electricity when it is run with a prime mover like turbine, engine or motor. A generator may be an AC or DC generator to give AC or DC type of electricity respectively. The in-put to a generator is mechanical torque and its out-put is electric current.

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Motor- Motor is just reverse of generator in the sense that it is fed with electricity and converts the electrical energy into the mechanical energy. Its out-put is mechanical torque. Motor may be AC or DC type.

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- DC Welding Motor Generator:- That device, which works with the help of a motor in electric arc welding is called DC generator. In DC generator, there is a set of motor and generator which are fitted on the same shaft. The motor of this set can be easily operated by AC supply. In this set, the arc voltage is kept in between 15 volt to 45 volts, while in open circuit to make the arc easily the voltage is kept in between 60 to 100 volts. In DC generator, we can get the current of voltage from 20 to 1000 amps according to requirement.
- AC/DC welding Rectifier:- It is a device of electric arc welding, in which both type of AC and DC current are used. It is a step-down transformer, out-put is connected with the rectifier unit, which changes the AC supply to DC supply. The out-put of DC supply is connected with the negative and positive terminals. The supply for welding process is taken from here by the welding cables. It can be designed specially to provide the AC welding supply or DC welding supply with the help of a operating switch, which is fitted on rectifier machine.

Current Carrying Capacity of Different Size of Electrodes

Electrode size (in mm)	Electrode size (in swg)	Current for Light Works(in amps)	Current for Heavy Works(in amps)	Current for Normal Works(in amps)
6mm	4 swg	220	320	260
5mm	6 swg	180	240	210
4mm	8 swg	140	180	165
3.15mm	10 swg	90	130	110
2.5mm	12 swg	55	85	70
2mm	14 swg	40	60	60
1mm	16 swg	25	40	30

Different types of tools used in welding shop:-

1. Measuring tools:-
 - a. Steel foot rule
 - b. Measuring tap
 - c. Try square
 - d. Caliper
 - e. Divider
2. Marking tools:-
 - a. Scriber
 - b. Punch(center, dot, prick, number, figure)
3. Cutting tools:-
 - a. Hacksaw frame with blade
 - b. Chisel
 - c. Power saw
 - d. File
 - e. Drill
4. Holding tools:-
 - a. Table vice
 - b. Tongs
5. Hand tools:-
 - a. Hammer
 - b. Wrench
 - c. Screw driver

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Edge preparation for welding:- The edge preparation is called "Beveling" or "Veering" or "Grooving". The edge can be prepared by machining or by Oxy-acetylene flame cutting or by grinding or by filing.

Purpose of edge preparation:- The main purpose of edge preparation is to get complete penetration while depositing the weld metal and to get the more strength of the welding joint.

As per metal thickness, the edge preparation is performed. The angle of bevel which is kept normally to 40°.

Gap:- Basically it is known as "root gap". A gap of 1 to 3 mm is usually kept between the two edges of a butt joint to get full penetration of the weld metal.

Type of welding joint:- There are five types of welding joints which are in general use.

1. Butt joints
2. Lap joints
3. T joints
4. Corner joints
5. Edge joints

Welding positions:- There are five types of welding positions.

1. Flat position
2. Inclined position
3. Horizontal position
4. Vertical position
5. Over head position

Electrode Size:- The size of an electrode is measured and designated by the diameter of the core wire.

- Electric Arc was first Discovered by Sri Humphry Deny.

Arc welding electrode:- An electrode is made of a metallic wire called core wire coated uniformly with "flux", while fluxing the electrode, about 20mm of its length is left bare at one end for inserting it into the electrode holder. Being bare at this end, the metallic core wire also helps transmitting full current from electrode holder to the tip of the electrode. The electrode manufactured in two different standard lengths, 350 and 450mm.

Types of electrode:- There are three types of electrode.

1. Bare electrode
2. Coated or covered electrode
3. Carbon electrode (generally use of carbon electrode is rear in welding)

Types of Coated Electrode:- There are four types of coated electrode.

1. Light coated electrode- the coating factor for light coated electrode is 1.25 to 1.3
2. Medium coated electrode- the coating factor for medium coated electrode is 1.4 to 1.5
3. Heavy coated electrode- the coating factor for heavy coated electrode is 1.6 to 2.2
4. Super heavy coated electrode- the coating factor for super heavy coated electrode is above 2.2

Weld Defect:- There are many types of welding defects.

a. External defect-

1. Incorrect profile
2. Cracks
3. Craters
4. Spatter
5. Edge or plate melted off
6. Undercut

7. Lack of penetration etc

b. Internal defects-

1. Porosity
2. Blow hole or gas pockets
3. Lack of fusion
4. Internal cracks
5. Slag inclusion etc.

Terms related in Arc Welding

Electric Arc: The current flows in continuously between positive and negative terminal is known as Electric Arc.

Arc Length: The distance between electrode and the job remaining once Arc formed is known as Arc Length.

Electrode Holder: It is a holding device, using to hold the electrode during arc welding is known as Electrode Holder.

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Filter Lance: To protection of eyes from the harmful rays produce during arc welding, the coloured glass using at eye shield is known as Filter Lance.

Cavity- Blow Holes- Gas Pockets: The holes formed in welding bead in welding are the Cavity or Blow Holes or Gas Pockets. **Cavity/Blow Holes/Gas Pockets**

Porosity: The gaseous holes formed by gas entrapment during solidification are known as porosity.

Crater: The ending portion of a welding bead of a job becomes down it is called Crater.

Slag: The non metallic layer formed on weld metal is known as Slag.

Tacking: The small welding spots to be done for the parts of the welding metals for joining. It is called Tacking.

Cast Iron Welding By Arc:- Cast Iron is a ferrous metal. The shapes of these jobs are cooked and such jobs are made by cast iron, which is prepared mixing pig iron, **Silicon Manganese, Sulphur Phosphorous and Iron.** The metal made is cast iron, its temperature is approximately 1150°C and oxidize temperature is 1350°C .

silicon, manganese, sulphur, phosphorous and iron

1. AC Motor Generator:- In this, a generator is driven by a suitable AC motor. The average voltage of the generator is **25 volt.** The current ranges from 25 to 100 amperes. The voltage can be set to the desired value with the help of rheostat

2. Diesel Engine Generator Set:- In this set, the drive is given by a diesel engine. Rest of the system is same as in case of AC motor generator. Diesel engine generator sets are used in the areas where electricity is not available.

3. Transformer Rectifier Set:- It allows the current flows through it only in one direction because it has a one way valve or solid rectifier installed on the electrode side of the secondary coil. The set can supply straight polarity and reverse polarity power supply. The rectifier is two types.

- a. Silicon diode
- b. Selenium plate.

4. Welding Transformer Set:- It is used to step down the voltage supply. It consists of a primary and secondary circuit. The input is given to primary winding. By electromagnetic induction the current flows through the secondary coil. The output can be controlled as per requirement.