



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. 15UME029 Semester..... 4th Date.. 18.1.17 Page No.

-: Acknowledgement:-

I would like to express my special thanks of gratitude to Dr Ajoy Biswas Sir & other mentors who gave us the opportunity to learn some of the manufacturing process practically in metal forming lab.

Moreover, I would like to thank my parents & my friends especially Tuhinabha Chaudhuri, Sumik Mog, Angel Chakma who helped me a lot in accomplishing this lab report on time.

I would also like to thank all our instructor Sirs in the workshop especially Nikhil KarmaKar Sir, Debinda Sir & other for enlightening us a lot in the respective fields.

Bidyut Das
18th April '17



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. 15UME029. Semester..... 4th Date..... / / Page No. 1

Job No. D1 :

TITLE: Making of wooden pattern

INTRODUCTION:

(a) Process & its application:

In Casting, a pattern is a replica of the object to be cast, used to prepare the cavity into which molten metal will be poured during the casting process.

Pattern which are used in Sand Casting may be made of wood, metal, plastics & other materials. Patterns are made to exacting standards of construction, so they last for a reasonable length of time, according to quality grade of the pattern being built & so that they repeatedly provide a dimensionally acceptable Casting.

(b) Mechanism:

A pattern prepares a mould cavity for the purpose of making a Casting. A pattern may contain projections known as core prints, if the Casting requires a core & need to be made hollow. Runner, gates & riser used for feeding molten metals in the mould cavity may form a part of the pattern. Patterns properly made & having finished & smooth surface reduce casting defects. A properly constructed pattern minimizes the overall cost of Casting.



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. 15UME029 Semester..... 4th Date..... /..... /..... Page No. 2

② Schematic Diagram:

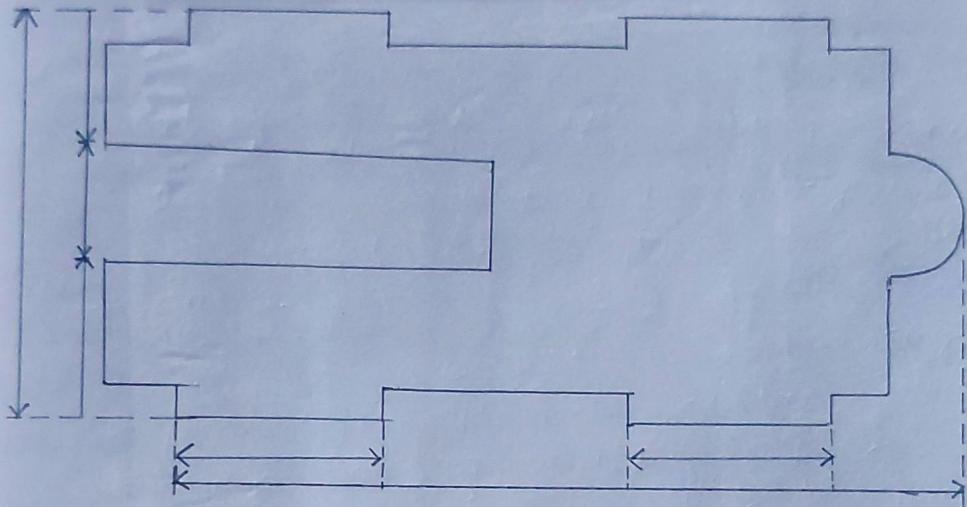


Fig: wooden pattern

TOOLS REQUIRED:

- | | |
|---|---------------------|
| 1) Chisel (half round chisel, flat chisel). | 7) Bench vice. |
| 2) Saw. | 8) Claw hammer |
| 3) Steel Rule. | 9) Grinding Machine |
| 4) File | 10) Tri-Square |
| 5) Sand paper | |
| 6) Drilling Machine | |

MATERIALS REQUIRED:

- 1) Wooden Block
- 2) Wooden nails.



Department of Mechanical Engineering

Roll No. 15VME029 Semester..... 4th Date..... /..... /..... Page No. 3

PROCEDURE:

- 1) First we drew the dimensions on the wooden block using Steel rule & tri-square.
- 2) We gave the required shape & design to the job using saw.
- 3) After that we removed the unwanted material using file.
- 4) Finally, we made the surface smooth using sand paper no space is left between the two surface of the job.
- 5) Then we gave the round shape using half-round chisel.
- 6) Now, to join the surfaces we first drilled at two places & then lastly filled it with wooden nails.

PRECAUTION:

- 1) Always wear shoes.
- 2) Make sure that your hands are not in front of sharp edged tools while using them.

National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. SEMESTER..... 4th Date..... / / Page No. 11

RESULT:

The knuckle joint with required dimension is prepared.

DISCUSSION:

Pattern Allowances:

These are the excess in dimension put in the pattern over the actual mould or casting into mind the later operations required to get a product of proper dimension.

Types of pattern allowances —

- i) Shrinkage allowance ii) Draft allowance
- iii) Machining allowance iv) Distortion allowance
- v) Shake allowance

Types of pattern:

- i) Single piece Pattern ii) Two piece pattern
- iii) Lope & Drug pattern iv) Grated pattern
- v) Match plate pattern vi) Loose piece pattern
- vii) Follow Board pattern viii) Sweep pattern

STATUS OF WORK:

The job has been done by us & later on it was used for sand casting process as a pattern.



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. 15UME029 Semester.....4th..... Date...../...../..... Page No.5.....

Job No. 02

TITLE: Sand Casting of Knuckle Joint model including Finishing.

INTRODUCTION: a) PROCESS & ITS APPLICATION—

Casting is one of the oldest & one of the most popular process converting the materials into final product. Casting process is primarily used for shaping metallic materials although it can be adapted for shaping other materials all such as ceramic, polymeric & glassy materials. In casting a solid is melted treated to proper temperature & then poured into the cavity called mould which contains it in proper shape during Solidification. Any casting process involves three basic steps ie mould making, melting & pouring of metals into mould cavity & removal & finishing of casting under complete solidification.

SAND CASTING PROCESS:

It is one of the cheaper, fairly refractory materials & hence commonly used for making mould cavity. Sand basically contains



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. 15W.M.E.029. Semester..... 4th Date..... /..... /..... Page No. 6

grains of Silica (SiO_2) & some impurities for mould making purposes. Sand is mixed with a binder material such as alloy, clay, molasses, oil, resin etc.

In given Sand moulding process, Clay along with water is used for making the cavity which can be of wood, metal or plastic, wood being the most common.

MELTING & POURING OF METALS:

A melting process must be capable of pouring molten metal not only at proper temperature but also of desired quantity.

FINISHING:

After complete solidification some cleaning & finishing of casting are done so that proper smooth surface is obtained.

(b) MECHANISM:

Castling process is primarily used for shaping metallic materials, although it can be used for shaping other materials, such as ceramic polymeric & glassy material.

In casting a solid is melted



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. 15U.ME019 Semester 4th Date / / Page No. /

reated to proper temperature in proper shape during solidification any casting process involves these basic steps i.e mould making, melting & pouring of metals into mould cavity & removal & finishing of casting after solidification.

② SCHEMATIC DIAGRAM:

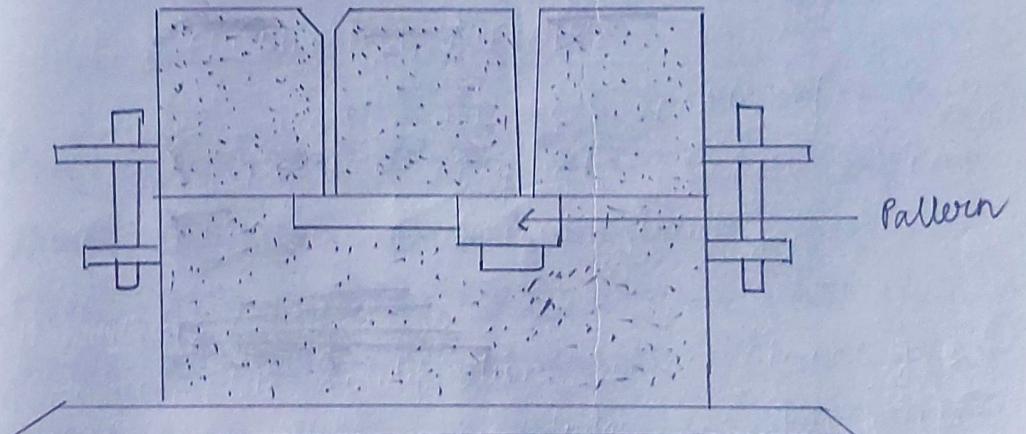


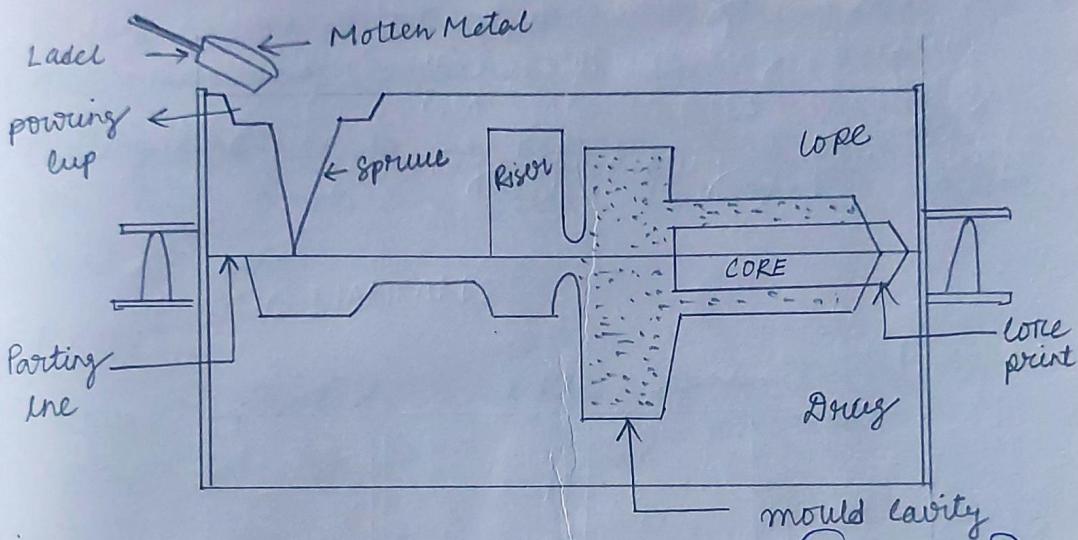
Fig 81



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. 15UME022 Semester..... 4th Date..... /..... /..... Page No. 8

EXPERIMENTAL SET UP:



Core: Upper moulding flask.

Drag: lower or bottom moulding flask.

Flask: A moulding flask is one which holds the sand mould intact.

Core: It is used for making hollow cavities in casting.

Riser: An extra void in the mould that fills with molten material to compensate for shrinkage during solidification.

Pouring cup: The part of the gating system that receives the molten material.



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. 15UME029.. Semester..... 1st Date..... /..... /..... Page No. 9

Sprue: The pouring cup attaches to the sprue which is the vertical part of the gating system. The other ends attaches to the runner.

Parting line: it is the dividing line between the two moulding flasks that makes up the sand mould.

RESULT:

Thus required knuckle joint model is prepared by sand casting process.

PRECAUTION:

- ① Always wear shoes.
- ② Use of hand gloves are necessary because the molten metal temperature is too high.
- ③ Be carefull while working with the tools.

DISCUSSION:

• Possible Defects

Defects	Causes
Unfilled Section	<ul style="list-style-type: none">• Insufficient material• low pouring temperature



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. 15UME029. Semester..... 4th Date..... /..... /..... Page No. 10

Porosity	<ul style="list-style-type: none">Melting temperature is too high.Non uniform cooling rate.Sand has low permeability.
Hot treating	<ul style="list-style-type: none">Non-Uniform cooling rate
Surface Protection	<ul style="list-style-type: none">Erosion of Sand mould interiorA crack in the sand mouldMould halves shift.

MATERIALS USED:

1. Wooden block 2. Wooden nails

TOOLS REQUIRED:

1. Ghonel 2. Moulding Box 3. Rammer
4. Strike off bar 5. Runner 6. Riser

PROCEDURE:

- At first the moulding box, pattern tools are taken & cleared
- Then firstly we fill the drag with sand positioning the pattern on the plate
- Then we sprinkled little bit of river sand on it.
- Then lope is rammed & excess sand is struck off.



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No...15UME029 Semester.....4th..... Date...../...../..... Page No. 17

- 5) The cope is now positioned on the top of drag.
- 6) Positioning of the riser pin is done & then we fill the cope with sand & ramming is done.
- 7) Then using water on the edges of the pattern, we look out the pattern using spike then finish the cavity.
- 8) we melt the metal in furnace
- 9) Using the hand gloves & proper care we pour the molten material into the cavity in a proper manner that the voids are not created.
- 10) Then after sometime the metal gets solidified in the cavity.
- 11) Then we cut off the riser & give finishing to mould cavity.



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. 15UME029. Semester..... 4th Date..... / / Page No. ... 12

Job No 03

TITLE: T joint of mild steel plate by arc welding process.

INTRODUCTION:

(a) PROCESS & ITS APPLICATION:

Arc welding is the welding process in which heat is generated by an electric arc struck between an electrode & a work piece. Electric arc is luminous electrical discharge between the electrodes through ionized gas.

Arc welding is mainly used for repairing all kinds worn or damaged parts. It is extensively used in manufacturing industries, construction, Industries (construction of ships, tanks, locomotives & automobile) & maintenance work replacing, reveting & bellng to greater extent.

(b) MECHANISM:

Electric arc between the electrode & the work piece closes the circuit. The arc temperature may reach (10000°F) which is sufficient for the fusion of the work piece edges & joining them.

When a long join is required the arc is moved along the joint line.



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

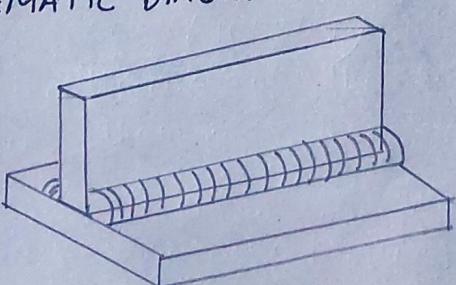
Roll No. ISU-ME029 Semester..... 4th Date..... /..... /..... Page No. 13

The front edge of the weld pool melts the welded surface when the rear edge of the weld pool solidifies forming the joint.

A filler material is required for better bonding. Filling rod (wire) is used either as outside material fed to the arc region or as consumable welding electrode which melts & fills the weld pool. Chemical composition of the filler metal is similar to that of work piece.

Molten metal in the weld pool is chemically active & reacts with the surrounding atmosphere. As a result weld may be contaminated by oxide & nitride inclusion deteriorating its mechanical properties. Shields are supplied to the weld zone in the form of flux coating of the electrode or in other form. Neutral shielding gases such as argon & helium are used for protection of the weld pool from atmospheric contamination.

④ SCHEMATIC DIAGRAM:



FASR



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No... ISU-ME029 Semester..... 4th Date..... /..... /..... Page No. 14

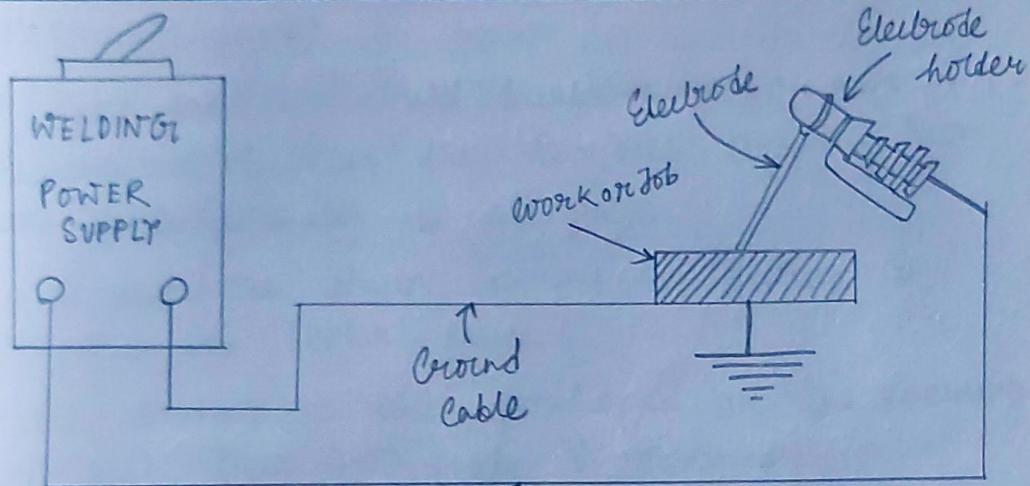


Fig: Experimental Set up

MATERIALS REQUIRED:

Two metal (mild steel) pieces of $100 \times 40 \times 6$ mm

TOOLS REQUIRED:

- | | |
|------------------------|--------------------------|
| 1) Arc welding machine | 2) Mild Steel Electrodes |
| 3) Flat nose tong | 4) Hand gloves. |
| 5) Metallic work table | 6) Bench vice |
| 7) Rough flat file | 8) Steel rule |
| 9) Wire brush | 10) Chipping hammer |
| 11) Face shield. | |



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. 15UME029 Semester..... 4th Date..... /..... /..... Page No. 15

EXPERIMENTATION :

- i) Take the two mild steel pieces of given dimensions & clean the surfaces thoroughly from rusts, dust particles & oil/grease.
- ii) Remove the sharp corners by filing & prepare the work piece.
- iii) The workpiece are positioned on the welding table such that T-shape is formed.
- iv) The electrode filled in the electrode holder & the welding current is set to proper value.
- v) The ground clamp is fastened to the welding table.
- vi) The arc is struck & the work piece are tag welded at both the ends.
- vii) Welding is then carried out throughout the length of T-Join.
- viii) Remove the slag, spallers & clear the joint by wire brush & chipping hammer.
- ix) Remove the slag, then its kept for cooling.



National Institute of Technology, Agartala
GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. 15UME029 Semester..... 4th Date..... /..... /..... Page No. 17

Different types of welding positions:

- i) Flat position welding.
- ii) Horizontal position welding.
- iii) Vertical position welding.
- iv) Over-head position welding

STATUS OF WORK:

The work was completed & T-Joint is established which was later used for etching process to find the different zones of welding process.



Rif -



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No..... Semester..... Date...../...../..... Page No. 18

Job No 4:

TITLE: Study of weld cross-Section

INTRODUCTION:

① Process & its application:

EFFECT OF WELDING ON MICROSTRUCTURE:

The weld metal microstructure of fusion welded joints are greatly influenced by the chemical compositions of filler metal & the heat input of the process. In general, higher heat input leads to slower cooling rates which results in coarse grains in weld metal. However, lower heat input leads to fast cooling rate which results in the coarse grains in weld metal.

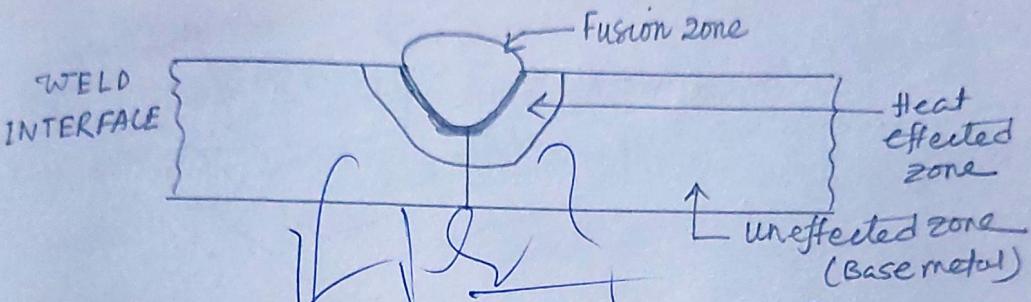
② MECHANISM:

A typical fusion welded joint varies in metallurgical structure from the fusion zone to the base material with consequential variation in mechanical properties.



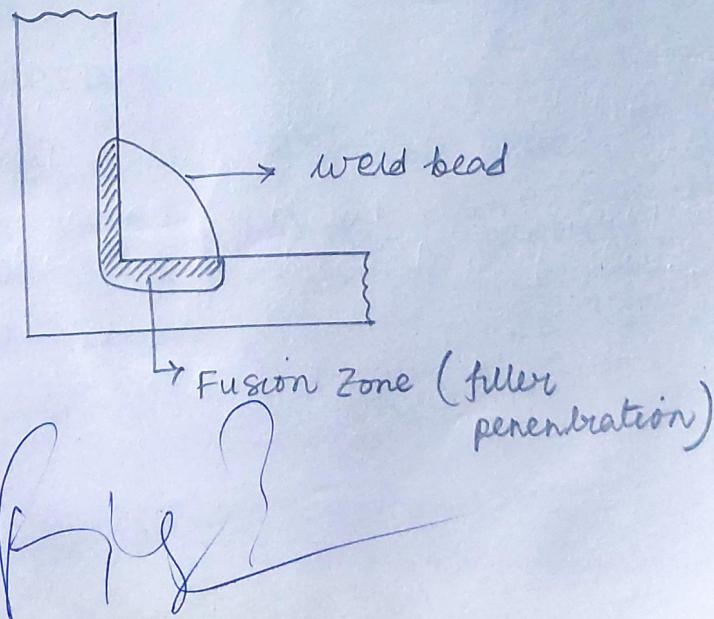
National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. 15UME029 Semester..... 4th Date..... /..... /..... Page No. 19



This is because of the fact that fusion welding process result in melting & solidification with very high temperature gradient. The heat affected zone is the region that experience a peak temperature that is even below the solidus temperature. The weld cross-section is etched with the help of reagent (5% HNO_3 solution)

② SCHEMATIC DIAGRAM:





Department of Mechanical Engineering

Roll No. 15UME029 Semester..... 4th Date..... / / Page No. 21

EXPERIMENTATION:

- i) First we cut the T-Joint sample perpendicular to the weld bead such that the cross-section of weld bead along with metal parts are evolved.
- ii) Then we give the Job mirror finish with different types of sand papers.
- iii) Then we apply 5% HNO_3 which is a reagent. Thus the heat affected zone & other zones are visible clearly under sunlight.

PRECAUTION:

- i) We must always wear shoes while working.
- ii) We should use hand saw carefully and other sharp tools too.

DISCUSSION:

The weld metal is comparatively stronger, & the joint properties are controlled by weld metal chemical composition & microstructure. The strong carbide/vitrile forming elements like Nb, Ti, V etc have very limited solubility in ferrite & austenite, and normally the

National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. 15UME022 Semester..... 4th Date..... /..... /..... Page No. 22

precipitate acts as fine dispersion of Carbides, nitrides &/or Carbonitrides & contribute to strength due to precipitation hardening.

RESULT:

The etching of weld cross-section is done successfully & various zones in cross sections are studied.



STATUS OF WORK:

The job has been done & It was completed as we have done the etching process.



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. / SUME022 Semester..... 4th Date..... / / Page No. 23

Job No 05

TITLE: EXPERIMENTATION OF SUBMERGED ARC WELDING

INTRODUCTION:

(a) PROCESS & ITS APPLICATIONS:

Submerged arc welding (SAW) involves the formation of an arc between a continuously fed electrode & the workpiece. A blanket of powdered flux, which generates a protective gas shield and a slag (& may also be used to add alloying elements to the weld pool), protects the weld zone. A shielding gas is not required. The arc is submerged beneath the flux blanket & isn't normally visible during welding.

MECHANISM:

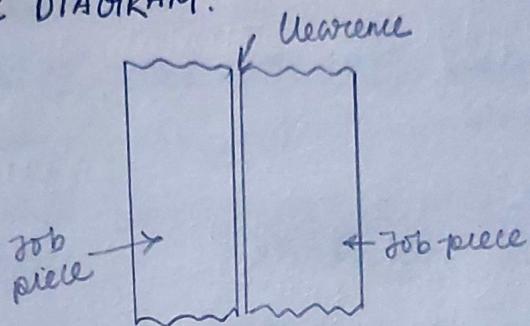
During welding, granular flux is melted using heat generated by arc & forms layer of molten flux layer which in turn avoids spatter tendency & prevents accessibility of atmospheric gases to the arc zone & the weld pool. The molten flux reacts with the impurities in the molten weld metal to form slag which floats over the surface of weld metal.



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. ISU/M/EA29 Semester..... 4th Date..... /..... /..... Page No. 24....

① SCHEMATIC DIAGRAM:



EXPERIMENTAL SET UP:

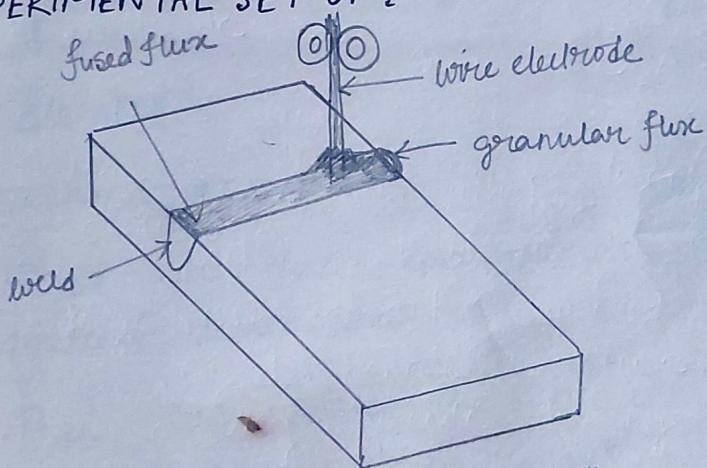
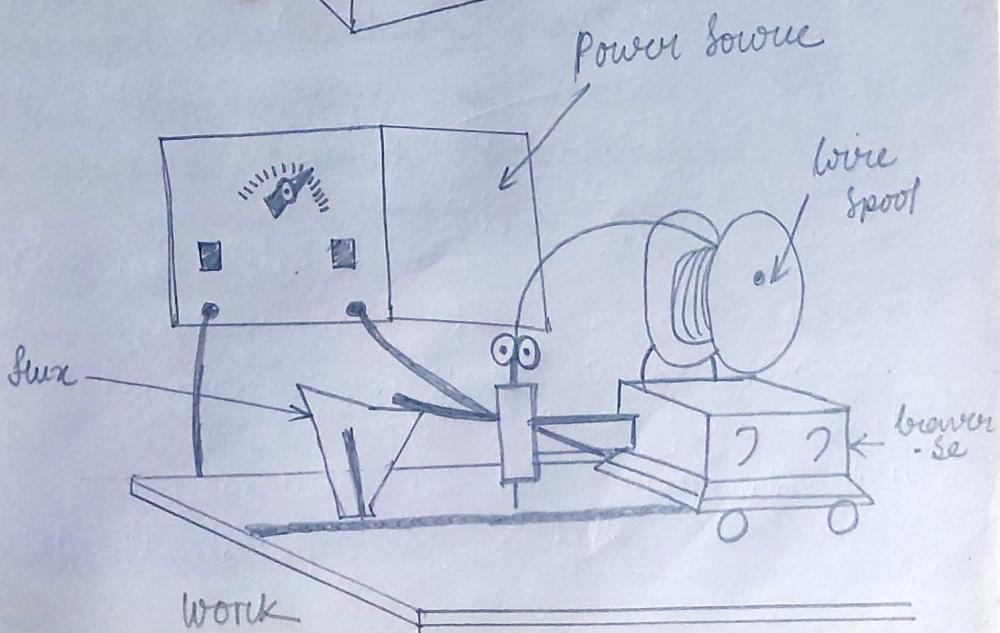


Fig.





National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. 15UME029 Semester..... 4th Date..... / / Page No. 25

MATERIALS REQUIRED:

Two pieces of steel (MS) of definite dimension

TOOLS REQUIRED:

- 1) Hack sawe
- 2) Puller
- 3) Submerged arc welding machine
- 4) Flux
- 5) Electrode

EXPERIMENTATION:

- i) First we cut two pieces of MS of required dimension.
- ii) Then we place the pieces in the submerged arc welding machine.
- iii) Then we adjust the welding setup for proper welding preparation.
- iv) Then the welding is carried out



National Institute of Technology, Agartala

GOVERNMENT OF INDIA

Department of Mechanical Engineering

Roll No. 15DIME022 Semester..... 4th Date..... /..... /..... Page No. 26

PRECAUTION:

- i) We must always wear shoes while working
- ii) Sharp tools must handle properly.
- iii) Proper distance must be maintained from the welding machine during welding operation
- iv) The welding must be done on supervision of a teacher.

DISCUSSION:

Required bead geometry & penetration in a weld zone joint are obtained only with an optimum speed of welding arc during SAW. Selection of a speed higher than optimum one reduces heat input per unit length which in turn results in low deposition rate of weld metal decreases weld reinforcement & shallow penetration. Further too high welding speed increases tendency for under cut in weld owing to reduce heat input. (b) Arc blow due to higher relative undercut welding to reduce heat input (c) Porosity as air pocket are entrapped due to rapid solidification of the weld metal. One other hand low welding speed increases heat input per unit length which may in turn



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. 150M029 Semester..... 4th Date..... /..... /..... Page No. 27

lead to increased tendency of melt through & reductive in tendency for development of porosity & Slag inclusion.

RESULT:

The submerged arc welding (SAW) of two mild steel pieces loads carried out successfully.



Fig ?



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. 15UME029 Semester..... 4th Date..... / / Page No. 28

Job No 05

TITLE: Overlap edge joining on mild steel by using gas welding technique.

INTRODUCTION:

① PROCESS & ITS APPLICATION:

The gas welding or oxyacetylene welding process uses a combination of oxygen & acetylene gas to provide high temperature flame. The gases used in gas welding process are

i) Oxygen:

It is extracted from air & compressed into cylinder at high pressure. Cylinder is black. Oil should never be brought into contact & should not be used in fillings.

ii) Acetylene:

It is fuel gas & can't be compressed directly as it explodes at high pressure. Cylinders are packed with porous material which is filled with acetone. Cylinder absorbs acetylene. It is extremely unstable in pure form at pressure above 15 PSI. Acetone is also present in cylinder to stabilize the acetylene.



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No..ISWME022. Semester.....4th..... Date...../...../..... Page No.29.....

⑥ MECHANISM:

Gas welding is manual process in which the welder must personally control the torch movement & filler rod application. The term oxyfuel gas welding outfit refers to all equipment needed to weld. Cylinder contain oxygen & acetylene gas at extremely high pressure. The temperature generated during the process is 3300°C , when the metal is fused. Oxygen from the atmosphere & the torch combines with molten metal & forms oxides, results defective weld.

SCHEMATIC DIAGRAM:

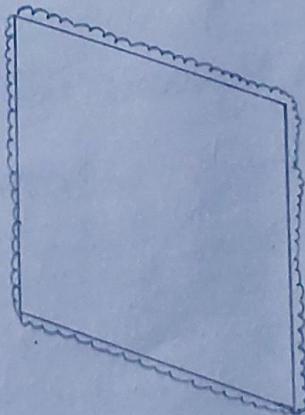
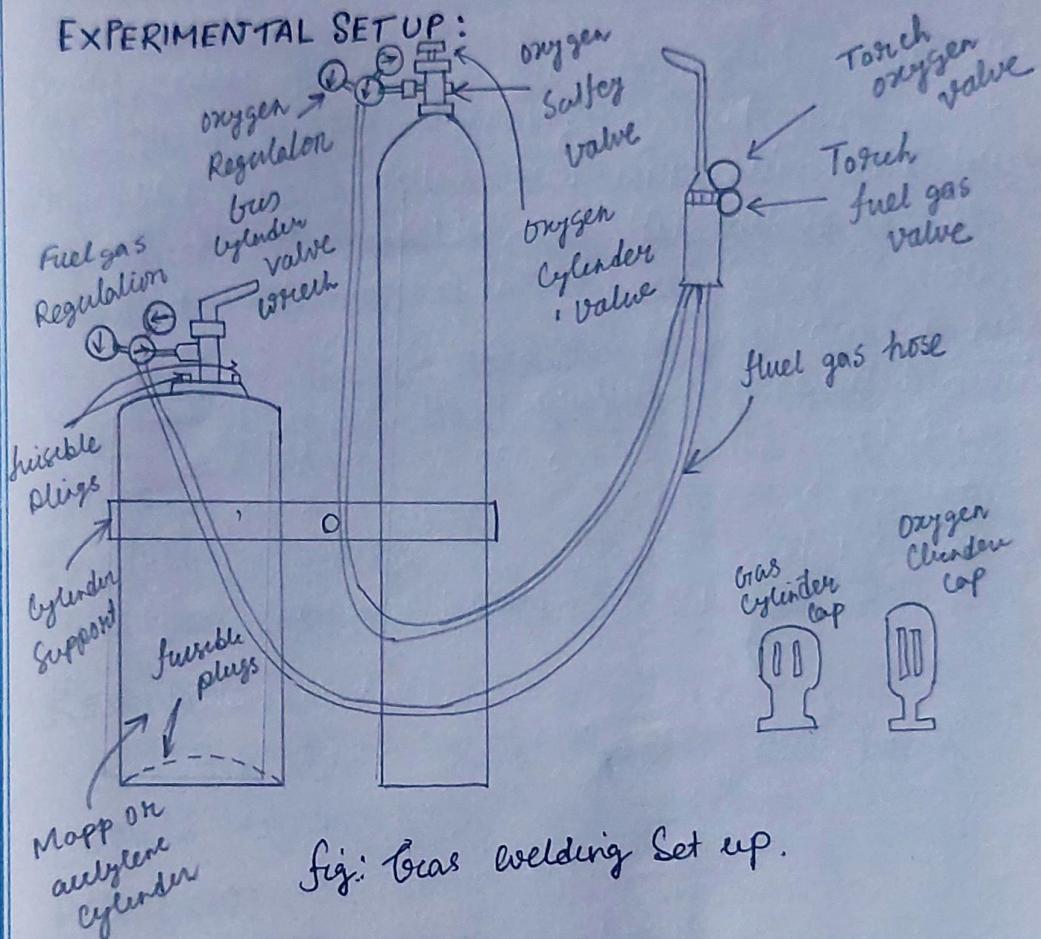


Fig: Overlap Joining of mild steel sheets by gas welding



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. 15UM6222 Semester..... 4th Date..... / / Page No. ... 30



MATERIALS REQUIRED:

- 1) Two metal pieces each of $5\text{ cm} \times 5\text{ cm}$.

TOOLS REQUIRED:

- 1) Snip.
- 2) Steel Rule.
- 3) Rubber mallet.
- 4) Varnish paper.
- 5) Gas welding Machine.



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No. 15UME029 Semester..... Date..... // Page No. 31

PROCEDURE:

- 1) At first we take two mild steel pieces & of the required dimensions we cut it.
- 2) Now using rubber mallet we flatten the surfaces of each of the metal pieces so that no depressions are left.
- 3) Now using varnish paper we remove the rust from the surfaces & make them smooth.
- 4) Now keeping the two pieces together we join them using gas welding.

RESULT:

Thus the two metal pieces are being joined together by gas welding.

DISCUSSION:

Filler rods of gas welding

The function of filler rod is to provide the additional area metal require to weld. It is generally made of some composition & properties as the base metal. It should be free from dust, rust or any other contamination



National Institute of Technology, Agartala
GOVERNMENT OF INDIA
Department of Mechanical Engineering

Roll No...ASVY6022 Semester.....4th..... Date...../...../..... Page No.32....

Advantages

- 1) Portable & most versatile process.
- 2) Better control over the temperature.
- 3) Better control over filler metal composition rate.
- 4) Suitable to weld dissimilar metals.
- 5) Low cost & maintenance.

Disadvantages

- 1) Not suitable for heavy section.
- 2) Less working temperature of gas flame.
- 3) Slow rate of heating.
- 4) Larger heat effected area.
- 5) Problem in shortage & handling of gases.

STATUS OF WORK:

The overlap edge joining on mild steel by using gas welding technique was done on two edges of the pieces & the job was completed.