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**Department of Aerospace Engineering**

**AEC1213 - AIRCRAFT STRUCTURES REPAIR  
LAB MANUAL**

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## Exp. No 1      Welded patch repair by Electric Arc Welding

### Aim:

To perform the welding patch repair on the specified aircraft metal parts using Electric Arc Welding techniques

### Requirement:

- Man-Hour: 3 hours
- Man Power: 1
- Documents: Aircraft Repair Manual

### Required Tools and Materials:

- Steel Ruler
- Scriber
- Fitter's Square
- Smooth file
- Hack saw frame
- Electric arc welding machine
- Mild steel plate
- Hand vice

### Layout Diagram:

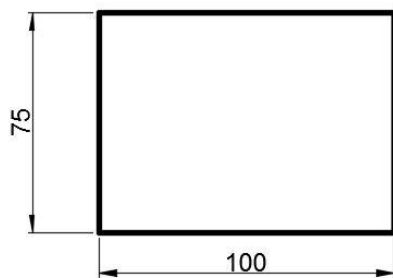


Fig 1

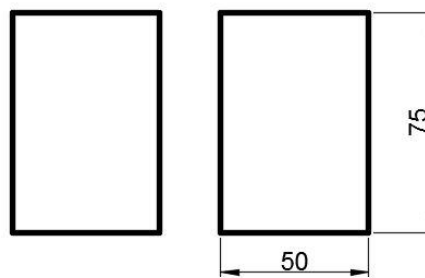
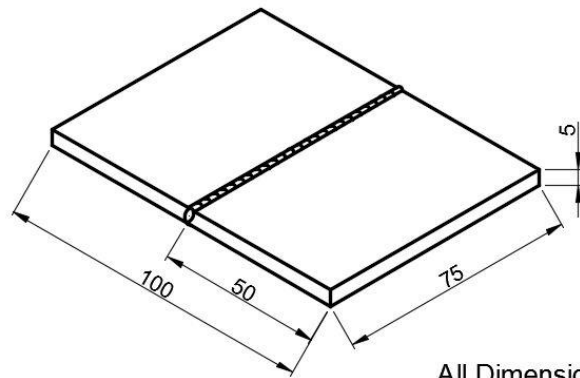


Fig 2



All Dimensions are in mm

### Procedure:

1. Select the thickness of 5mm Mild steel plate and using scribe and steel ruler mark the required dimensions as per given fig 1.
2. With the help of hack saw cut the mild steel plate into two pieces as per the fig 2.
3. Using fitter's Square and smooth file need to check for perfect 90° and file the work piece.
4. Make one of the edges of the plate as 'v' bevel as shown in the diagram
5. Repeat the same procedure for another piece too.
6. Check the condition of the welding machine.
7. Set the welding machine to required setting.
8. Set the two plate like 'v' bevel shown as per the diagram by using hand vice.
9. Make some tack weld on the work piece and remove the hand vice from the work piece.
10. Finally Electric Arc welding has been carried out as per given dimensions.

### Note:

\* Before welding person need to wear gloves, proper shoes, apron, welding helmet.

### Results:

Thus the welding patch repair on the specified aircraft metal parts using Electric Arc welding is carried out.

## Exp. No 2

## Welded patch repair by TIG

### Aim:

To perform the welding patch repair on the specified aircraft metal parts using TIG welding techniques

### Requirement:

- Man-Hour: 3 hours
- Man Power: 1
- Documents: Aircraft Repair Manual

### Required Tools and Materials:

- Steel Ruler
- TIG Welding Machine
- Scriber
- Fitter's Square
- Smooth file
- Pedestal sheet cutting machine
- Aluminium sheet
- Hand vice

### Layout Diagram:

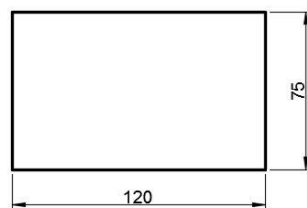


Fig 1

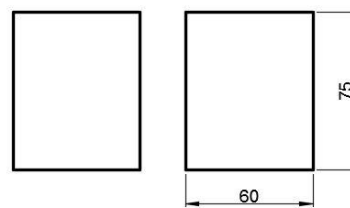
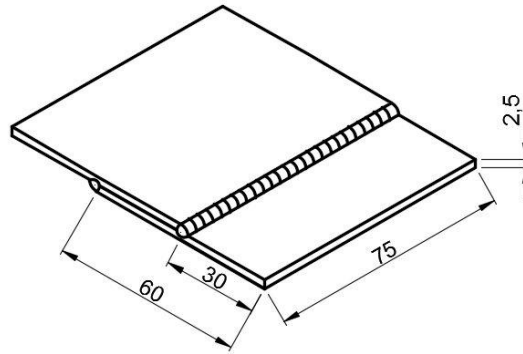


Fig 2



All Dimensions are in mm

### Procedure:

1. Select the thickness of 2.5mm aluminium sheet and using scriber and steel ruler mark the required dimensions as per given diagram.
2. With the help of pedestal sheet cutting machine cut the aluminium sheet into two pieces as per the figure.
3. Using fitter's Square and smooth file need to check for perfect 90° and file the work piece.
4. Take one piece of aluminium sheet and mark a centre line on 60mm side using scriber and steel ruler
5. Take another aluminium sheet and place it exactly on the centre line of the other sheet and hold it using hand vice.
6. Place the work piece on the welding booth and tack the work piece. After tacking remove the hand vice from the work piece.
7. Finally TIG welding has to be carried out as per given dimensions.

### Note:-

\* Before welding person need to wear gloves, proper shoes, apron, welding helmet.

### Results:-

Thus the welding patch repair on the specified aircraft metal parts using TIG welding is carried out.

### Exp. No 3

### Welded patch repair by MIG

#### Aim:

To perform the welding patch repair on the specified aircraft metal parts using MIG welding techniques

#### Requirement:

- Man-Hour: 3 hours
- Man Power: 1
- Documents: Aircraft Repair Manual

#### Required Tools and Materials:

- Steel Ruler
- Scriber
- Fitter's Square
- Smooth file
- MIG Welding machine
- Hack saw frame
- Mild steel sheet

#### Layout Diagram:

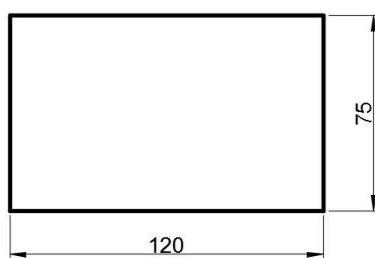


Fig 1

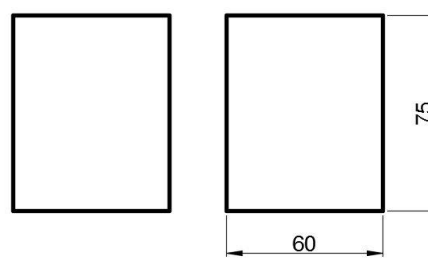
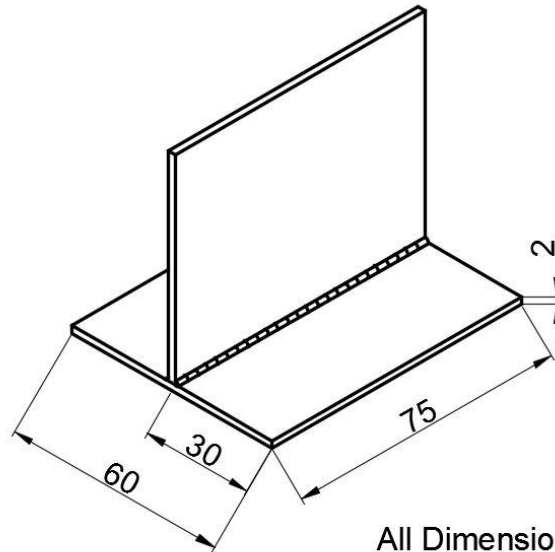


Fig 2



All Dimensions are in mm

### Procedure:

1. Select the thickness of 2mm mild steel sheet and using scribe and steel ruler mark the required dimensions as per given fig 1.
2. With the help of hack saw cut the mild steel sheet into two pieces as per the fig 2.
3. Using fitter's Square and smooth file need to check for perfect 90° and file the work piece.
4. Take one piece of mild steel sheet and mark a centre line on 60 mm side using scribe and steel ruler
5. Take both the work piece to the welding booth and tack it as per the figure.
6. Finally MIG welding has to be carried out as per given dimensions.

### Note:-

\* Before welding person need to wear gloves, proper shoes, apron, welding helmet.

### Results:-

Thus the welding patch repair on the specified aircraft metal parts using MIG welding is carried out.

## Exp. No 4          Welded patch repair by Plasma Arc Cutting

### Aim:

To perform the welding patch repair on the specified aircraft metal parts using Plasma Arc cutting techniques

### Requirement:

- Man-Hour: 3 hours
- Man Power: 1
- Documents: Aircraft Repair Manual

### Required Tools and Materials:

- Steel Ruler
- Scriber
- Divider
- Fitter's Square
- Plasma Arc cutting machine
- Mild steel sheet
- Pedestal sheet cutting machine

### Layout Diagram:

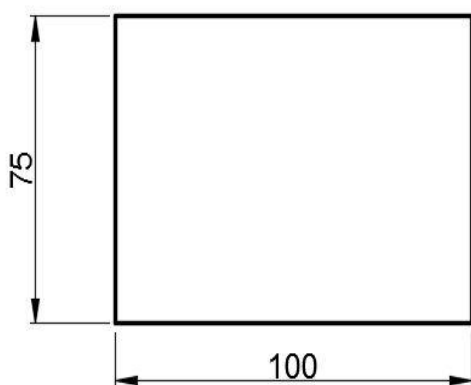


Fig 1

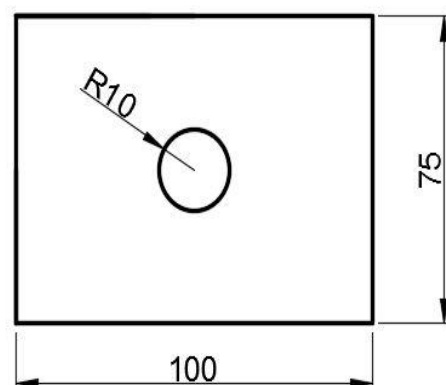


Fig 2

All Dimensions are in mm



**Procedure:**

1. Select the thickness of 1mm Mild steel sheet and using scribe and steel ruler mark the required dimensions.
2. With the help of pedestal sheet cutting machine cut the mild steel sheet as per the fig 1.
3. Draw a circle on the centre of the mild steel sheet using divider as per the fig 2.
4. Check the condition of the cutting machine.
5. Make the required setting in the cutting machine.
6. Using cutting machine cut the circle drawn in the mild steel sheet and remove it from the work piece.
7. Finally Plasma Arc cutting has been carried out as per given dimensions.

**Note:**

\* Before cutting person need to wear gloves, proper shoes, apron, welding helmet.

**Results:-**

Thus the cutting patch repair on the specified aircraft metal parts using plasma arc cutting is carried out.

**Exp.No:5**

## **RIVETED PATCH REPAIR**

### **Aim:**

To carry out a repair on aircraft metal skin by making a butt joint

### **Requirement Tools and Material:**

- Scriber
- Aluminium sheet
- Steel Ruler
- T-Square
- Snap and dolly & straighter
- Ball pan hammer
- Solid rivet and tucker pop rivet
- tucker pop riveting gun- manual/ pneumatic
- rivet cutter

### **Terms Involved in Riveting:**

- **Pitch** :- The distance between the centres of the adjacent rivets in the same row.
- **Space** :- The distance between the rows of the rivets.
- **Land/Margin** :- The distance from the edge of the plate to the nearest rivet centre.
- **Allowance** :- The protruding length of the rivet after the rivet is inserted in the hole of the plate to be attached. Usually it should be 1.5- 1.75 times the diameter of the rivet.
- **Sphere of Influence**:-The area in which the closed rivets maintains the plates in close proximity.

# Layout Diagram

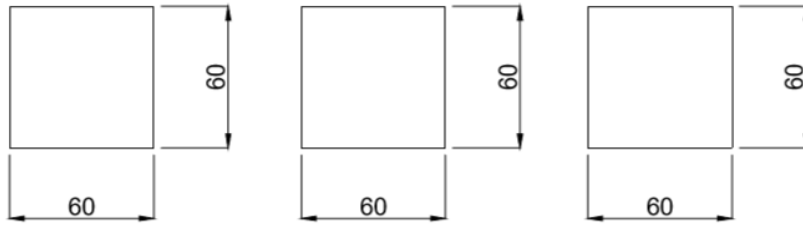


Fig 1

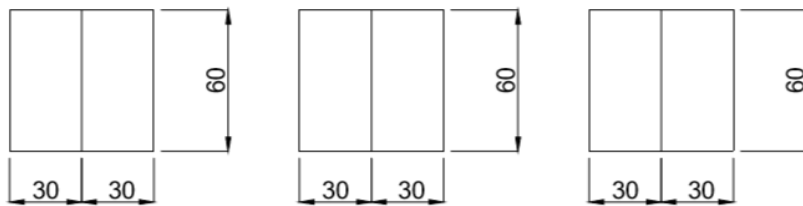


Fig 2

All Dimensions Are in mm

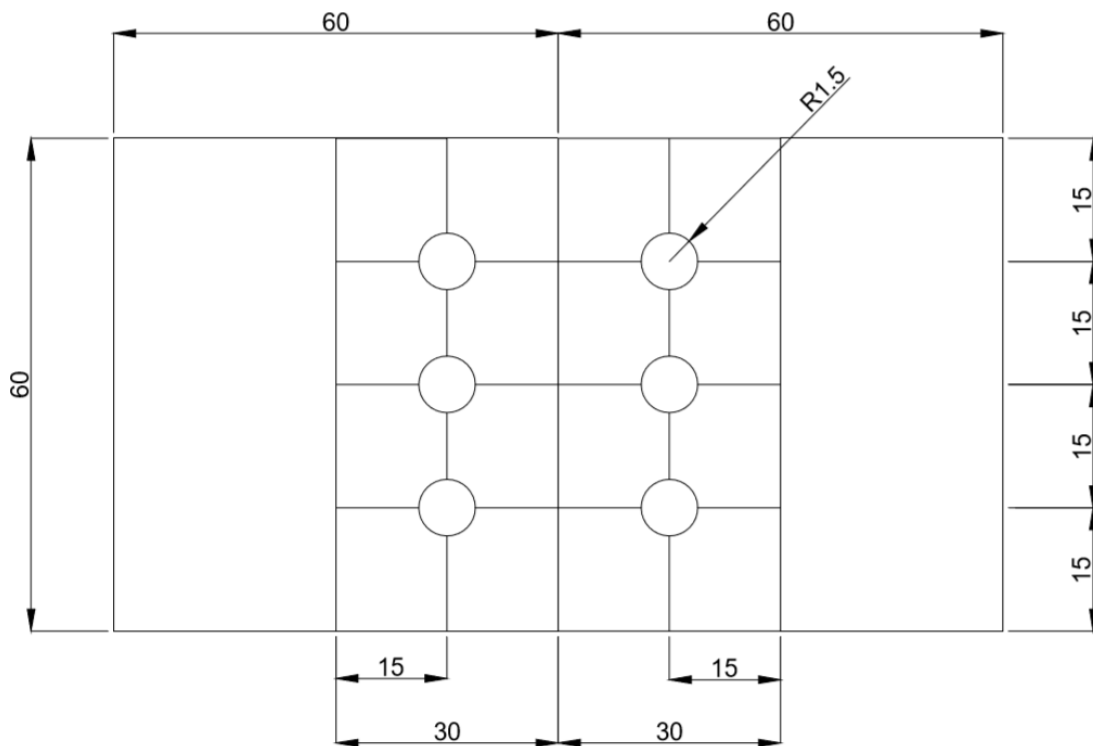


Fig 3

All Dimensions Are in mm

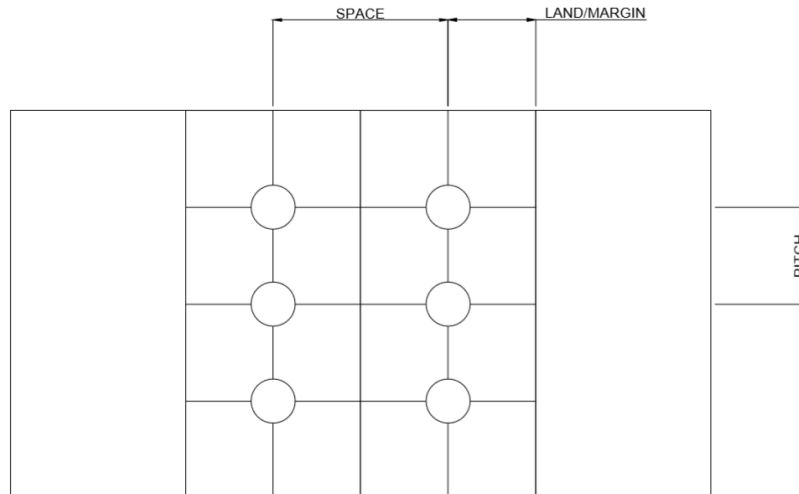


Fig 4

### Procedure:

1. Take a perfectly flattened aluminium sheet and mark the required dimension (60 x 180 mm) with the help of scribe and ruler.
2. Cut the marked sheet (60 x 180 mm) into three equal pieces of 60 x 60mm as shown in fig 1.
3. Mark all the three pieces into 30 x 30mm of dimension as shown in fig 2.
4. Then take one piece and mark a line from left edge at an internal of 15mm of dimensions and again mark a line from top edge at an internal of 15mm of dimensions as shown in fig 3.
5. Mark all the intersection points of 15 x 15mm by centre punch.
6. Now by keeping two pieces butting each other. keep the centre punch marked sheet exactly on top of the butt joint insuring it is perfectly centre and grip both the sides of all the three sheets together and drill on the marked points by centre punch.
7. Now rivet one row with solid rivet with the help of snap and dolly & straightener.
8. Again rivet another row with tucker pop rivet with the help of manual/pneumatic gun.
9. Now we can have the single piece butt joint riveted.

### Results:

Thus the repair on the aircraft skin by riveting is carried out.

## Exp.No:6 (a)

### BENDING OF PIPES

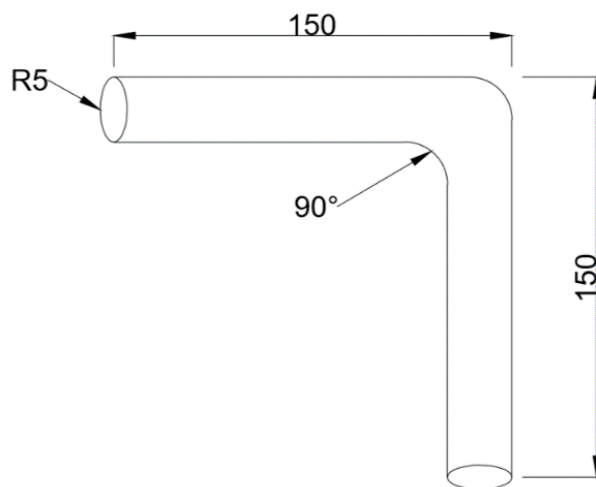
#### Aim:

To learn bending of metallic pipes in aircraft which are necessary to relieve mechanical strain, permit temperature expansion and contraction and absorb vibration.

#### Tools Required and Materials:

- Metal pipes
- Minor hack saw
- Round and smooth files
- Tube bender

#### Layout Diagram



All Dimensions Are in mm

**Procedure:**

1. Select a new piece of tubing with same specification as old tubing.
2. Cut tubing approximately 10% longer than tube being replaced. This will allow for variation in bending.
3. It is important when cutting tubing that the ends are cut square with 30 minutes to the centre line of the tube.
4. De-burr tube end exercise care that all burs are removed and a minimum amount of material is removed.
5. Insert tubing into the machine by raising the slide bar handle as far as it will go.
6. Hook clip over tube and ensure that the full length of the slide bar groove is in contact with the zero mark aligned.
7. Rotate handle until desired bend such as 30°, 45°, 90°, 135° and 180° is obtained.

**Results:**

Thus the given metal piece is bent to correct shape and dimensions

## Exp.No:6 (b)

### FLARING OF PIPES

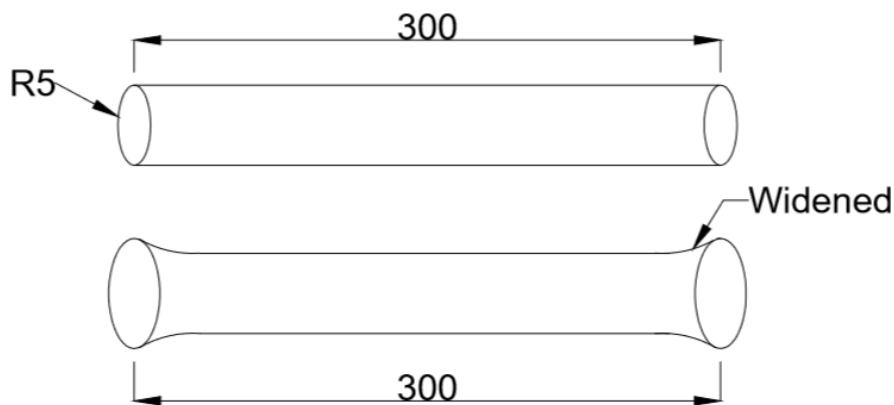
#### Aim:

To learn Flaring of metallic pipes in aircraft which is necessary to ensure that leak proof joints in the system.

#### Tools Required and Materials:

- Metal pipes
- Minor hack saw
- Round and smooth files
- Flaring tool set

#### Layout Diagram:



All Dimensions Are in mm

#### Procedure:

1. Take the pipe and insert inside the flaring tool port which exactly match with the diameter of the tube and tighten the tool on both the sides.
2. Place the flaring knob over the tube protruding knob over the tube visible in the port.
3. Hold it firmly and screw in the flaring knob. So as to get the flaring.
4. Now you will find the tube end will be widened up, i.e flaring.
5. Repeat the same procedure for the other end of the tube.

**Note:**

\* Aviation tube flaring angle is  $37^\circ$  only and the automobile pipe flaring angle is  $45^\circ$ . They should not be interchanged.

**Results:**

Thus the given metal piece is flared to correct shape and dimensions.



**Exp. No :7**

## **FABRICATION OF COMPOSITES**

### **Aim:**

To fabricate the glass fibres laminates using chopped strand mat and glass fibre woven type.

### **Requirement:**

- Man-Hour: 3 hours
- Man Power: 1
- Documents: Aircraft Repair Manual

### **Tools Required and Material:**

- Chopper Strand Mat
- Glass fibre woven type
- Steel Ruler and Scissor
- Polyester resin (General Purpose)
- Wax and Catalyser
- Accelerator
- Roller and Brush
- OHP sheet
- Weighing machine

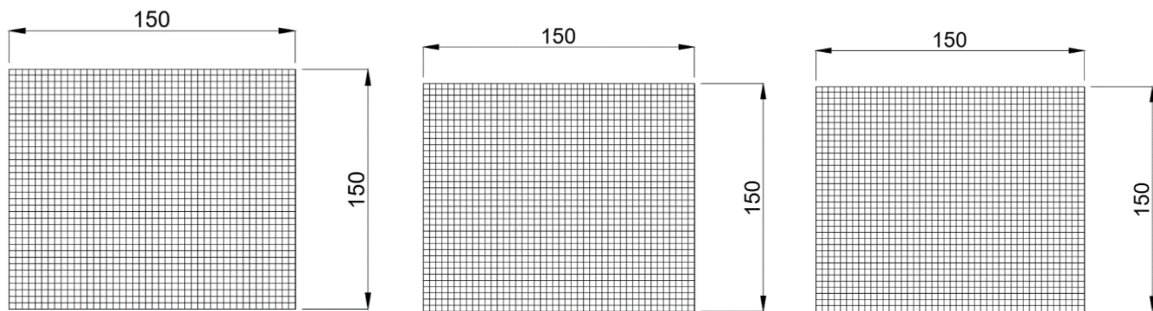
### **Conditions:**

Normal Room Condition.

### **Time Required for Fabrication:**

One hour is sufficient for the fabrication of chopped strand mat and glass fibre woven type. Post curing of about 8 hours is recommended for better finish and strength.

## Layout Diagram:



All Dimensions Are in mm

## Procedure:

1. From the given material.
2. Cut the material into 3 pieces of dimensions 6 x 6 inch using steel ruler and scissor.
3. After cutting the material into 3 pieces. The material is weighted using weighing machine.
4. Take the same weight of the cut material for the polyester resin (GP).
5. From the weight of polyester resin add 2% of Accelerator and 1% of Catalyser. Using brush mix it thoroughly to get equally spread.
6. Take one piece of 2mm aluminium sheet and cut a hollow square hole of 6 x 6inch. The purpose of aluminium sheet is to protect the resin coming out of the composites when is it be being pressed.
7. Take one piece of OHP sheet and apply Wax on the top surface.
8. Take the aluminium sheet with hollow square hole and place it on the centre of wax applied OHP sheet.
9. Apply polyester resin on the hollow square hole and spread it equally.
10. We should keep one piece of Glass Fibre on top of the applied polyester resin.
11. Apply polyester resin on the glass fibre and spread it equally.
12. To remove air bubbles and spread the resin equally make use of roller.
13. Repeat the same procedure from point 10 - 12 for two more layers.
14. Finally keep the wax applied OHP sheet on the top.
15. Apply some load on the whole material to get compressed.

16. After 8 hours of time remove the wax applied OHP sheet to get the final composites material.

**Results:**

Thus the glass fibres laminate using chopped strand mat and glass fibre woven type are fabricated.

## Exp.No:8

### SHEET METAL FORMING

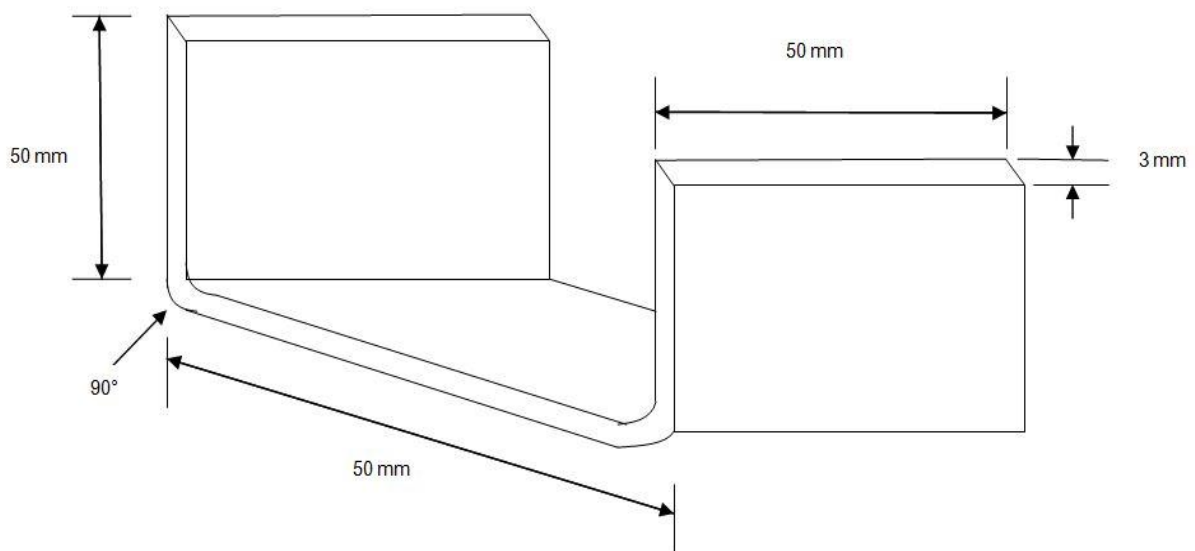
#### Aim:

To perform the shaping operation of the sheet metal as per given dimensions.

#### Required Tools and Materials:-

- Sheet metal
- Bench vice
- Steel rule and smooth file
- Mallet
- Scriber
- V-block
- Pedestal Sheet cutting machine

#### Layout Diagram:



All Dimensions Are in mm

**Procedure:**

1. Take a perfectly flattened sheet metal and mark the required dimension (50 x 150 mm) with the help of scribe and ruler.
2. Cut the marked dimensional sheet metal with the help of pedestal sheet cutting machine.
3. Now blend all the cut edges of the sheet with the help of smooth file.
4. Now mark on the sheet of 50mm equal size in length wise.
5. Fix the sheet on the vice and slowly bend it at 50mm marked line.
6. Keep the bend in a V-block and make 90° bend.
7. Do the other end side bending as earlier steps 4,5 and 6.

**Results:**

Thus the given sheet metal is formed to correct shape and dimensions as given.

**Exp.No:9****Patch Repair of Acrylic Components****Aim:**

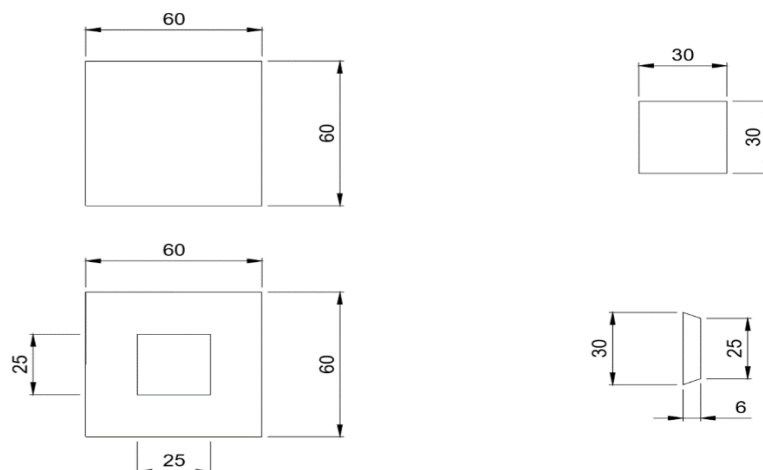
To make a Acrylic patch repair of Acrylic Components in aircraft.

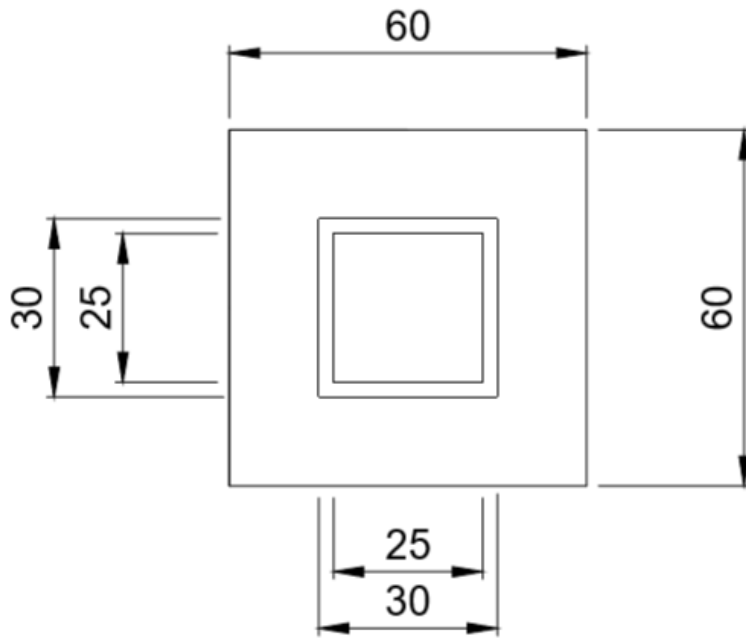
**Tool Required and Material:**

1. Measuring tape
2. Acrylic Sheet
3. Scriber / Marker
4. Minor hacksaw
5. chloroform

**Procedure:**

1. Take the acrylic sheet and mark the required dimensions.
2. Cut the marked sheet with the help of minor hacksaw.
3. File the cut sheet to the required dimensions.
4. Cut the corner piece as per the given diagram.
5. File the faces of the cut surface of the sheet so is to make the proper seating.
6. Keep both the pieces on a smooth surface and place it in such a way both are properly seated
7. Apply chloroform on the joint surface for making them into a single piece.
8. Allow it dry for 5 to 10 minutes.
9. Pick the acrylic sheet and check that it is properly fixed as a single piece.

**Layout Diagram**



All Dimensions Are in mm

**Results:**

Thus the Acrylic patch repair of Acrylic Components is carried out for the given dimensions for the aircraft components.

**Exp. No: 10 (a)**

## **REPAIR OF CRACKS IN WOOD**

### **Aim:**

To learn repair by splicing of wooden spar to an aircraft wooden structure.

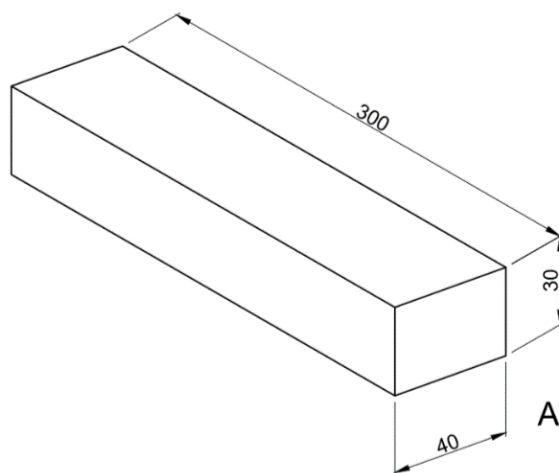
### **Requirements:**

- Man-Hour: 3 hours
- Man Power: 1
- Documents: Aircraft Repair Manual

### **Required Tools and Materials:-**

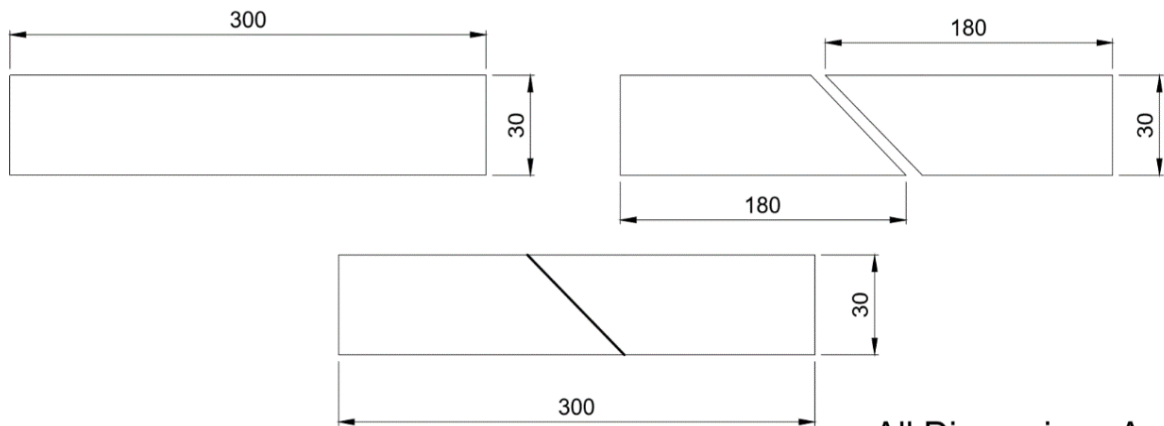
- Carpenter vice
- Pencil and ruler
- Wood saw
- Jack plane
- Rasp file
- Fitter's Square
- Wood piece
- Fevicol

### **Layout Diagram:**



All Dimensions Are in mm





All Dimensions Are in mm

### Procedure:-

1. Select the wood and with the help of wood saw cut 300mm length.
2. Polish the wood on all sides with the help of rasp file and jack plane.
3. Mark the polished wood into equal length.
4. Fix the wood on the carpenter vice and make a slanting cut with the help of wood saw.
5. Apply Fevicol on both the slanting side of the cut section and paste it together as a single piece and allow it for drying.

### Note:-

\*The slanting cut length should be more than the width of the wood for better strength.

### Results:

Thus the given work piece is sliced and repaired and made fit to be introduced into an aircraft wooden structure.

**Exp. No: 10 (b)**

## **REPAIR OF FABRIC STRUCTURE**

**Aim:**

To learn repair work on aircraft fabric structure.

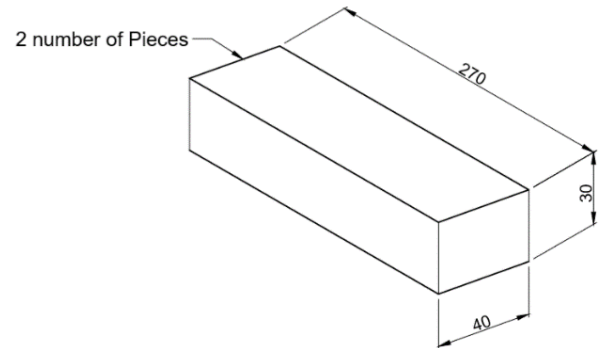
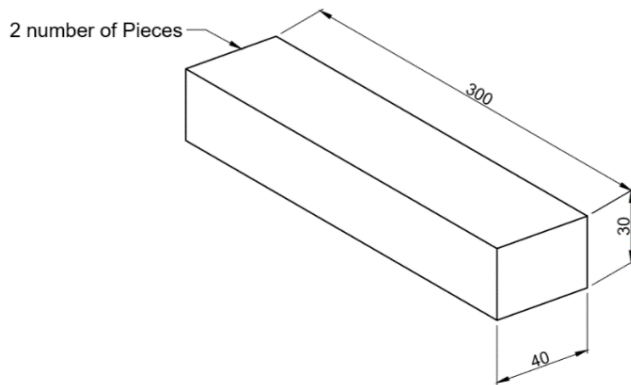
**Requirements:**

- Man-Hour: 3 hours
- Man Power: 1
- Documents: Aircraft Repair Manual

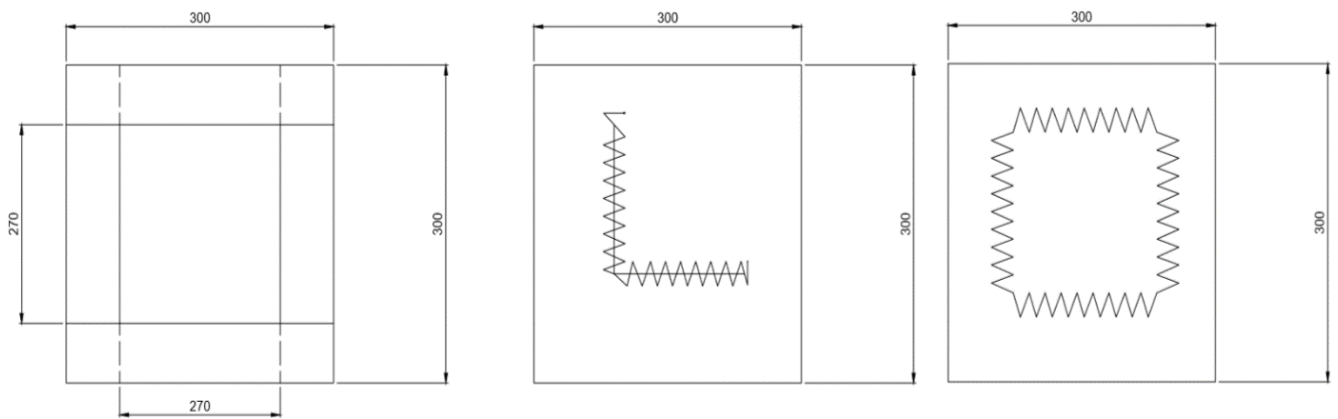
**Required Tools and Materials:**

- Carpenter vice
- Pencil and ruler
- Wood saw
- Jack plane
- Rasp file
- Fitter's Square
- Fevicol
- Cotton clothe
- Bend needle and toin thread
- Scissor and zigzag scissor
- Hammer and Nails

## Layout Diagram:



All Dimensions Are in mm



All Dimensions Are in mm

## Procedure:

1. Select the wood and with the help of wood saw cut two pieces of 300mm length each and two pieces of 270 mm length.
2. Polish all the wood pieces on all sides with the help of rasp file and jack plane.
3. Make a wooden frame with the help of nailing.
4. Polish top/bottom side of the frame with the help of rasp file and jack plane.
5. Apply Fevicol on the polished surface.

6. With the help of Scissor cut the fabric (cotton clothe) which can cover the frame.
7. Paste the cotton clothe on the frame tightly and allow it for drying.
8. With the help of blade tear the fabric as per required shape (L-Shape).
9. With the bend needle and toin thread stitch the town fabric.
10. With the help of blade tear the fabric as per required shape (Zig-Zag Shape)
11. Paste the zig-zag fabric cloth above the stitched fabric using fevicol.

**Results:**

Thus the given work piece is repaired and made fit to be introduced into an aircraft fabric structure.