

**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**  
**RAMAPURAM CAMPUS – 600 089**

**FACULTY OF ENGINEERING AND TECHNOLOGY**  
**DEPARTMENT OF MECHANICAL ENGINEERING**

**18MES103L – CIVIL AND MECHANICAL ENGINEERING**  
**WORKSHOP**

**LAB MANUAL**

# **1. RECTANGULAR TRAY**

## **AIM**

To make a Rectangular Tray of given size from a sheet metal piece.

## **APPLICATION**

Cabinets of stabilizer, computer, UPS etc

## **SUPPLIED MATERIAL SPECIFICATION**

Galvanized Iron sheet of dimensions 200mm x 150mm, Thickness 26 gauge

## **TOOLS REQUIRED**

Steel rule

Anvil or Bench plate

Scriber

Stake

Steel square

Mallet

Straight snip

## **SEQUENCE OF OPERATIONS**

- I. Checking
- II. Layout Marking
- III. Shearing
- IV. Folding
- V. Locking and Seaming

## **WORKING STEPS**

### **I. Checking**

1. Check whether the given sheet is having its dimension as 200mm x 150mm. If the dimension is excess trim off using hand shear.
2. Keep one corner of the sheet between body and tongue of Steel Square and check whether the sides exactly coincide with Steel Square.
3. Keep this corner as reference corner and these two sides as reference sides. This corner should be kept at left hand side bottom position.

### **II. Layout Marking**

1. Using steel rule and scribe draw five vertical lines at a distance of 10mm, 35mm, 165mm, 190mm and 200mm from reference vertical edge.
2. Similarly with respect to bottom edge draw five horizontal lines at a distance of 5mm, 30mm, 120mm, 145 mm and 150mm.
3. Shade the unwanted portions as shown in figure. Portions G, H, I and J are called as seam allowances.

### III. Shearing

1. To remove portion A cut along the direction shown by arrows.
2. To remove portion B cut along the direction shown. Use hand gloves to remove the cut portion.

### IV. Folding

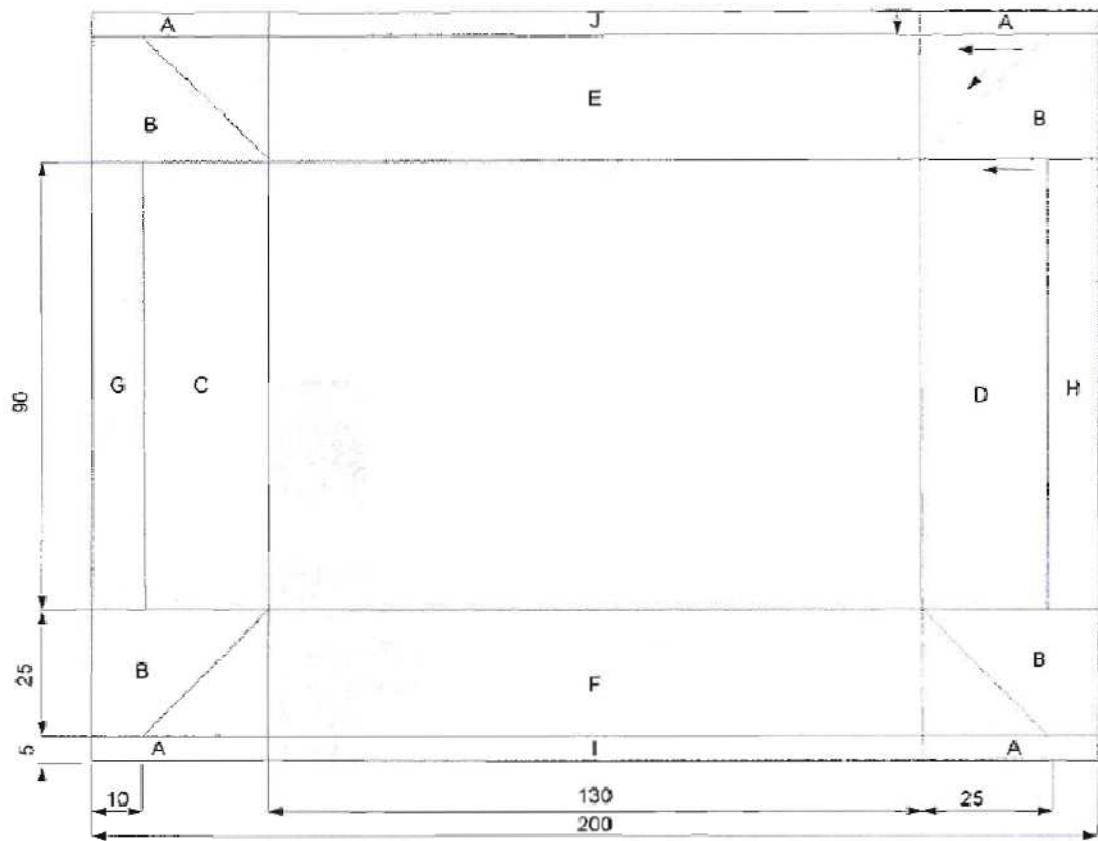
1. Keep the pattern over square stake such that the inner line of hem portion I exactly coincides with the edge of stake.
2. Fold this portion 90° downwards with the help of mallet
3. Remove the sheet, make further 90° fold over the portion I so that it form a hem along the edge. Similarly fold the portion J also.
4. Place the sheet over the stake such that the line 1-2 coincides with the stake edge
5. Bend the portion C, 90° downwards using mallet
6. Similarly bend portions D, E and F in the same order.

### V. Locking and Seaming

1. The incomplete tray is having four corners. Keep one corner in align with the corner of stake. Using mallet fold the projection (Triangular in shape) 90° towards the tray. Repeat this step for all other projections.
2. Fold the remaining portions G and H 180° outwards using stake and mallet to lock the folds.
3. Check for the dimensions.

## RESULT

Thus the required Rectangular tray is made out of the given sheet metal piece.



## **2. SCOOP MAKING**

### **AIM:**

To make a Big Scoop of given size from a sheet metal piece.

### **APPLICATION:**

Cleaning the dust in all industries, maintenance area etc

### **SUPPLIED MATERIAL SPECIFICATION:**

Galvanized Iron sheet of dimension is 350 x 300 mm, Thickness 33 gauge

### **TOOLS REQUIRED:**

- 1) Steel rule. 2) Scriber 3) Steel square 4) Straight snip 5) Anvil or Bench plate
- 6) Stake 7) Mallet.

### **SEQUENCE OF OPERATION:**

- 1) Checking 2) Layout Marking. 3) Shearing. 4) Folding. 5) Locking & Seaming.

### **WORKING STEPS:**

#### **1} CHECKING:**

- a. Check whether the given sheet is having its dimensions as 300mm x 350mm. If the dimension is excess trim off using hand shear.

#### **2} LAYOUT MARKING:**

- a) Using steel rule and scriber mark 5mm point on both sides in vertical axis.
- b) Mark 5mm on one side of the horizontal axis and then again make a point mark after 60mm from first 10mm.
- c) Now from 5mm marking mark 10mm on both end in vertical. axis.
- d) Make two diagonal line attaching on joining 60mm marking on horizontal axis to 10mm marking on vertical axis

#### **3} SHEARING:**

- a) Keep the pattern over square stake such that the line at hem portion I exactly coincides with edge of the stake.
- b) Fold the 5mm marking 180 deg on anvil or both sides of sheet pattern in inner direction..
- c) Now fold 90 deg the horizontal from 60mm marking

#### 4} FOLDING:

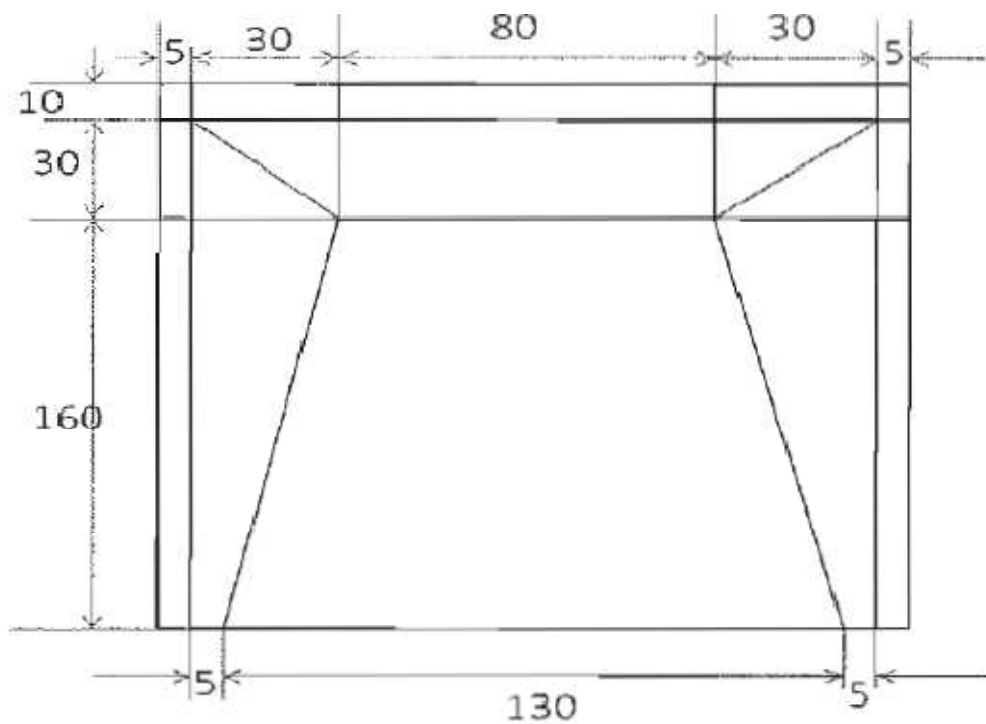
- Make a shape on A shaped part in one square and B in other square.
- Now use a straight snip off unwanted portion ( A & B )
- Now fold the two sides of sheet from the diagonal line 90 deg.

#### 5) LOCKING AND SEAMING:

- Now join the two edge portion A & B from the 60mm 90 deg folded from V horizontal axis and grip and lock them
- Check for the dimensions. of the complete scoop

#### RESULT:

Thus the required Large Scoop is made out of the given sheet metal piece.



### **3. HEXAGONAL HEAD BOLT**

#### **AIM**

To develop the ability to make a hexagonal head bolt from a given rod by hand forging

#### **APPLICATION**

Hexagonal headed bolt is a type of fastener used as means of joining two pieces temporarily.

It is used to join steel structures, machine parts etc.

#### **SUPPLIED MATERIAL SPECIFICATION**

Mild steel rod of diameter 16mm and length 300 mm.

#### **TOOLS REQUIRED**

1. Caliper and Steel rule
2. Anvil
3. Bolt header
4. Tongs
5. Sledge hammer
6. Bottom swage
7. Hand hammer
8. Smoother
9. Hot chisel

#### **SEQUENCE OF OPERATIONS**

- I. Preparing
- II. Upsetting
- III. Swaging
- IV. Finishing
- V. Checking

#### **WORKING STEPS**

##### **I. Preparing**

1. Take a given work piece and check the given dimensions as per requirements using steel rule and caliper.
2. Place the work piece in hearth / forge until it becomes red hot. (Heating the work piece eases the process of upsetting)
3. Take the hot stock out of forge, place it on anvil, measure 280mm from one end of stock using steel rule and cut off with hot chisel.

##### **II. Upsetting**

1. Again heat one end of the stock to a length of 90mm.
2. Grip the hot stock with tongs, Place it vertically on anvil such that the hot portion is at bottom. Strike the top portion with sledge hammer. This will cause increase in diameter of the bottom portion. Keep upsetting until the edge portion becomes slightly larger than the required size of the head.
3. Fix a bolt header over anvil inline with hardie hole in anvil. Upset the head of the bolt with hand hammer.

4. Withdraw bolt from bolt header and with hand hammer round the bolt head on anvil face. This is called as Fullering

### III. Swaging

1. Heat the bolt head in hearth again.
2. Insert bottom swage of required hexagonal bolt head dimension in hardie hole of anvil.
3. Remove bolt from forge; place the head on the bottom swage.
4. Strike with hand hammer to give required shape to the head.
5. Turn the head by 60 degree about its axis and repeat the step 4. Repeat this for all six sides of the hexagon.

### IV Finishing

1. Insert the shank of bolt in bolt header, place stock on anvil so that its shank passes through hardie hole in anvil.
2. Place smoother on bolt head and make top portion of head spherical in shape by striking the smoother with hand hammer
3. Straighten the shank of the bolt by placing it on the face of the anvil.

### V. Checking

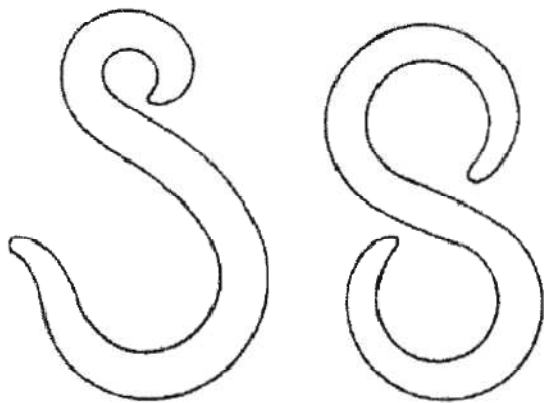
1. Check the length of the shank. If it is more than 200mm long, heat the end and cut off surplus with hot chisel.

## **RESULT**

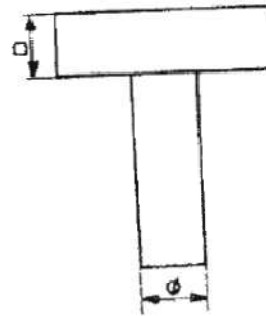
Thus the required Hexagonal Head Bolt is made out of the given stock.



Make the following models from given mild steel rod. Assume suitable dimensions.



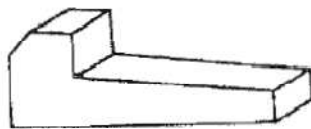
CRANE HOOKS



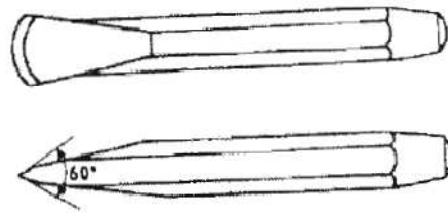
T BOLT



SQUARE BOLT



KEY



CHISEL

## 4. STEP FITTING

### **AIM:**

To construct Step fitting using mild steel work piece.

### **SUPPLIED MATERIAL SPECIFICATION:**

Mild steel metal plates of dimension is (50 x 50 x 6) mm

### **TOOLS REQUIRED:**

- 1) Hack saw frame with blade. 2) Try square. 3) Steel rule. 4) Jenny caliper 5) Files.
- 6) Ball peen hammer. 7) Centre punch. 8) Dot punch

### **SEQUENCE OF OPERATION:**

- 1) Preparation. 2) Marking. 3) Cutting. 4) Filing. 5) Finishing. 6) Fitting

### **WORKING STEPS:**

#### 1) PREPARATION

1. Check the initial dimensions using steel rule.
2. Fix the job on a bench vice and file and two adjacent sides using a flat file to form right angles.
3. Check for the perpendicularity with try square.

#### 2) MARKING:

- a) Apply chalk on the work surface.
- b) Measure the given dimension using jenny caliper from the steel rule.
- c) Transfer the measured dimensions to the work piece
- d) Mark the dimensions on the work piece with one of the filed sides as reference edge.
- e) Repeat the above steps with the next edge as reference edge to mark the dimension.
- f) Scribe lines along the marked dimensions on the work piece.
- g) Make dots along these lines using dot punch which is called as PUNCH LINES.
- h) Draw lines parallel to these punch lines at a distance of 2mm from them, which are called CUTTING LINES ..

#### 3) CUTTING:

a) Fix the work piece in the bench vice in such a way that the cutting line is perpendicular to the jaws of the vice.

b) Cut along the cutting lines.

c) Repeat the steps till cutting is finished along all the cutting lines by rearranging the work piece in the vice..

d) Must ensure that cutting is carried out along all the cutting lines.

#### 4) FILING:

a. Fix the work piece in the bench vice in such a way that the cutting edges (punch lines) are parallel to the jaws.

b. File the cut edges using flat rough file to a distance of 2mm, so that the punch lines are exposed.

c. Remove and refit the work piece in the bench vice to make the next set of cut edges parallel to the jaws.

d. File the cut edges using flat rough file to a distance of 2mm

e. Must ensure that filing is carried out along all the cutting edge punch lines.

#### 5) FINISHING:

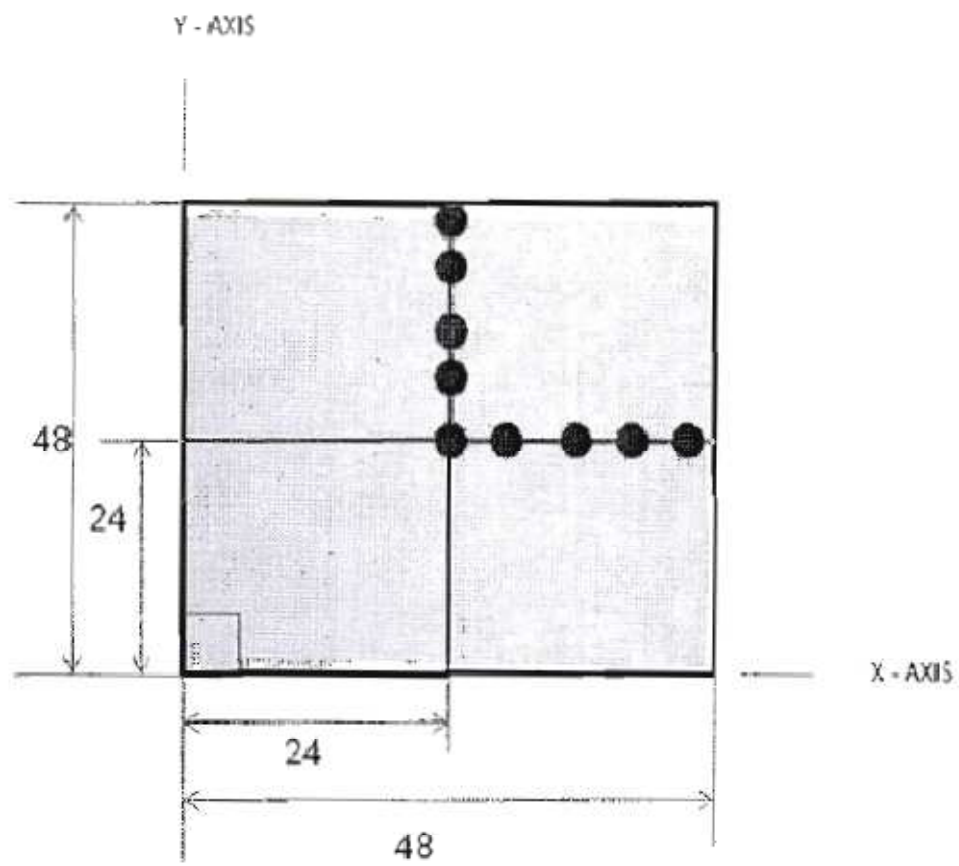
a) Using a flat smooth file to produce a smooth surface finish In all the filed edges.

#### 6) FITTING:

Check for true form with a mating gage and for symmetry about the axis with a Vernier caliper. The fitting accuracy is considered if both contours mate without misalignment and clearances.

#### **RESULT:**

Thus a Step Fitting is obtained out of the given work piece with specified dimensions, shape, finish and accuracy with proper fitting.



## **5. DRILLING AND TAPPING**

### **AIM:**

To make drill and tap on given mild steel work piece.

### **SUPPLIED MATERIAL SPECIFICATION:**

Mild steel metal plates of dimension is (50 x 50 x 6) mm

### **TOOLS REQUIRED:**

1) Hack saw frame with blade. 2) Try square. 3-) Steel rule. 4) Jenny caliper 5) Files.  
6) Drilling M/c. 7) Tapping M/c. 8) Dot punch. 9) Thread pitch gauge

### **SEQUENCE OF OPERATION:**

1) Preparation. 2) Marking. 3) Drilling. 4) Tapping. 5) Finishing.

### **WORKING STEPS:**

#### **1) PREPARATION**

Check the initial dimensions using steel rule.

Fix the job on a bench vice and file and two adjacent sides using a flat file to form right angles. Check for the perpendicularity with try square.

#### **2) MARKING:**

Apply chalk on the work surface. Measure 20mm using jenny caliper from the steel rule. Transfer the measured dimensions to the work piece with edge 12mm. Draw lines along the dimensions on work piece with scribe. Make dots along these lines using dot punch ..

#### **3) DRILLING:**

Place the work piece on the drilling machine platform. Using drilling machine make two holes on the dotted place made by dot punch. Pour some oil for smooth drill and drill the work piece properly by adjusting the pilot. Repeat the steps twice for better finishing. Lastly go to the thread pitch gauge machine & complete the drilling procedure on the work piece.

#### **4) TAPPING:**

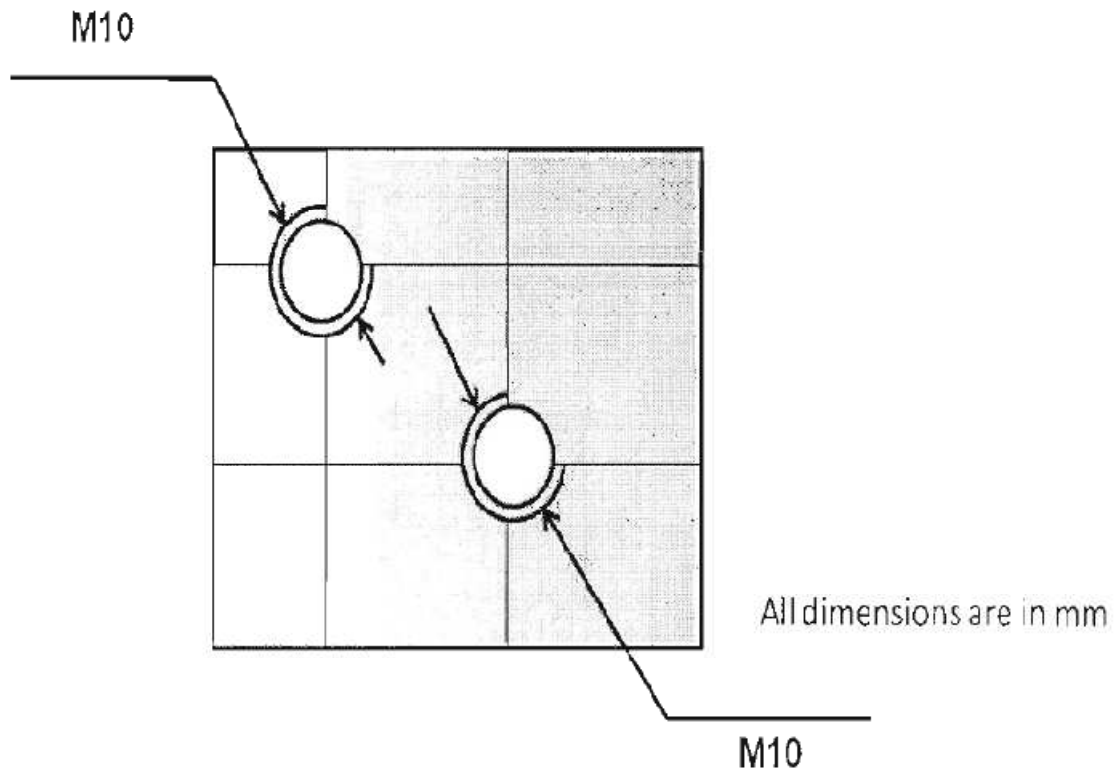
Fix the work piece in the bench vice in such a way that it should not move. Using Tapping tool 1 make threads in the holes. Repeat the procedure for both .holes, then take the tapping tool 2 and use it carefully by rotating in clockwise, simultaneously do this process for both holes..

#### **5) FINISHING:**

Using a 10mm screw, check the accuracy of the finish.

**RESULT:**

The required holes using Drilling & Taping techniques with proper measurements has been obtained.



## **6. PLUMBING**

### **AIM:**

Using the given components completely join the pieces to make the arrangement as shown in figure.

### **APPLICATION:**

Used for house hold purpose..

### **SUPPLIED MATERIAL:**

- 1) 1" x 6" GI pipe 2) 3/4" x 6" GI pipe 3) 1/2" x 6" GI pipe 4) 1/2" x 3" GI pipe  
5) 1/2" PVC pipe tap 6) 1/2" Dummy 7) 3/4" x 1/2" reducer 8) Ball valve  
9) 1/2" Steel plug 10) 1/2" Coupling

### **TOOLS REQUIRED:**

- 1) Adjustable spanner. 2) Pipe Wrench. 3) Pipe Vice. 4) Double end Spanner  
5) Ring Spanner.

### **SEQUENCE OF OPERATION:**

- 1) Setting. 2) Joining. 3) Tightening. 4) Checking

### **WORKING STEPS:**

#### **SETTING:**

Set the given materials as required in the figure

#### **JOINING:**

The given materials are joined as required in the figure

#### **TIGHTENING:**

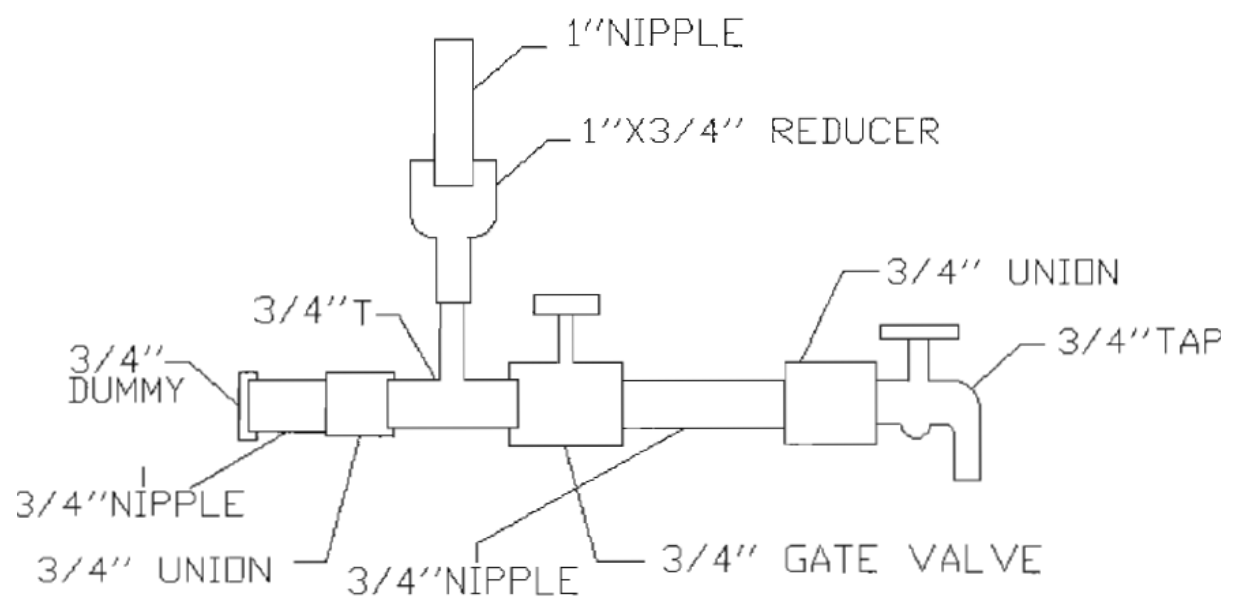
The joints are tightened by using pipe wrench or Adjustable spanner or Double end spanner or all

#### **CHECKING:**

This step is done, only to check whether there is any leakage or not.

### **RESULT:**

The pipe has been joined together as it was shown in the figure.





## **7. BUTT JOINT**

### **Aim:**

To make a butt joint on the given work pieces using arc welding.

### **Apparatus required:**

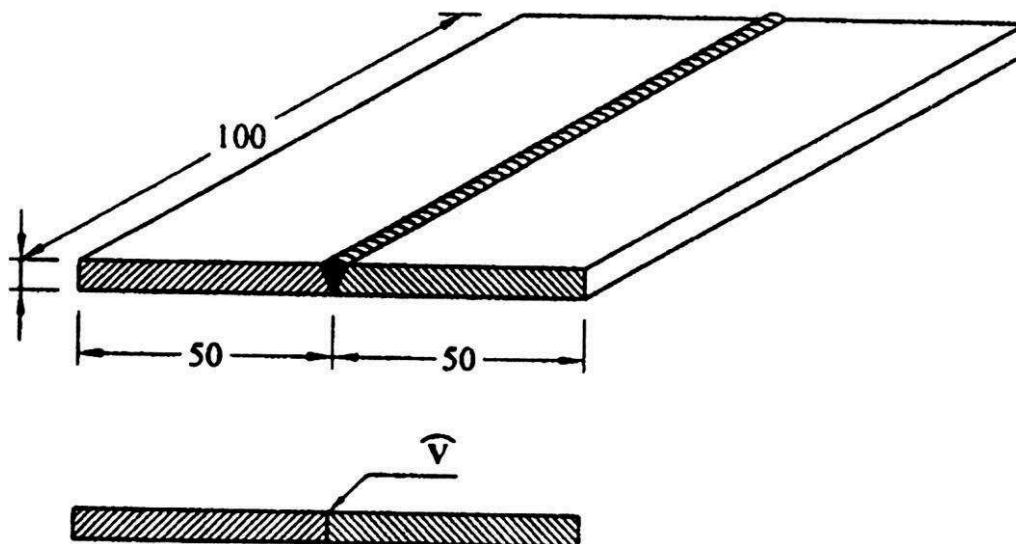
Work pieces, Welding electrodes, Welding machine, Tongs, Wire brush, chipping hammer, Gloves and Goggles.

### **Procedure:**

1. The given work pieces are cleaned with the wire brush to remove the rust, scale and other impurities.
2. Edges are prepared suitably to the given dimension and positioned for the butt joint.
3. Depending upon the thickness of the parent metal, the amperage and correct voltage is selected.
4. With goggles covering the eyes and gloves on hands, an arc is struck on the work piece and tacks are made at the extreme ends.
5. Welding process is progressed along the seam at a constant speed and keeping uniform distance between the electrode and the work piece.
6. Using chipping hammer the flux in the form of slag is chipped off and then cleaned.
7. After welding, the work pieces should be handles only using the tongs.

### **Result:**

Thus the required butt joint is obtained as per the given dimensions.



## **8. LAP JOINT**

### **Aim:**

To make a lap joint on the given work pieces using arc welding.

### **Apparatus required:**

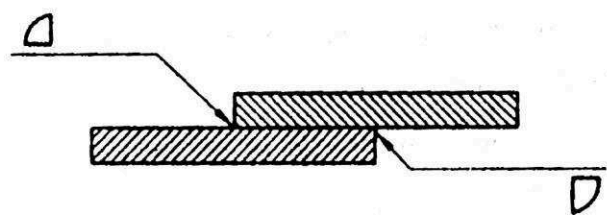
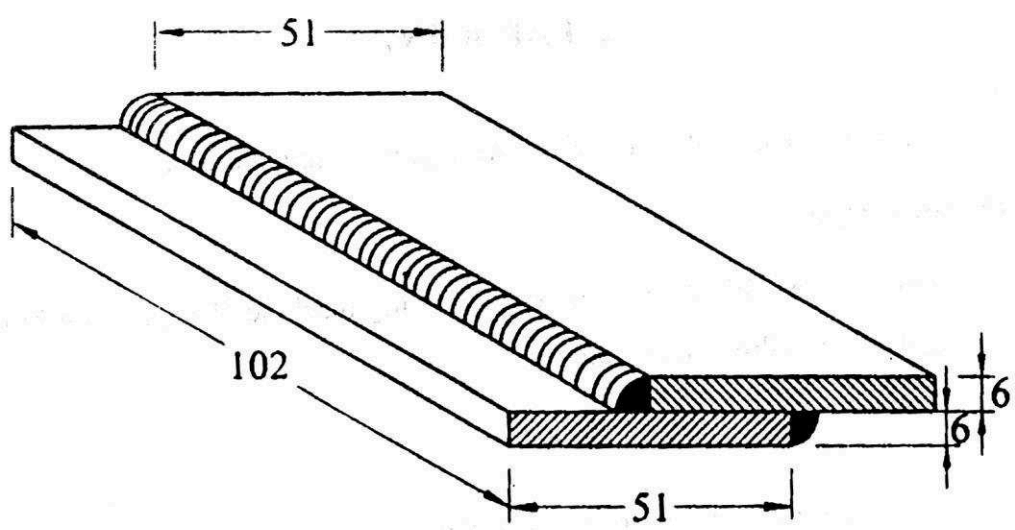
Work pieces, Welding electrodes, Welding machine, Tongs, Wire brush, chipping hammer, Gloves and Goggles.

### **Procedure:**

1. The given work pieces are cleaned with the wire brush to remove the rust, scale and other impurities.
2. Edges are prepared suitably to the given dimension and positioned one over another for the lap joint.
3. Depending upon the thickness of the parent metal, the amperage and correct voltage is selected.
4. With goggles covering the eyes and gloves on hands, an arc is struck on the work piece and tacks are made at the extreme ends.
5. Welding process is progressed along the seam at a constant speed and keeping uniform distance between the electrode and the work piece.
6. Using chipping hammer the flux in the form of slag is chipped off and then cleaned.
7. After welding, the work pieces should be handles only using the tongs.

### **Result:**

Thus the required lap joint is obtained as per the given dimensions.



## **9. T - JOINT**

### **Aim:**

To make a T - joint on the given work pieces using arc welding.

### **Apparatus required:**

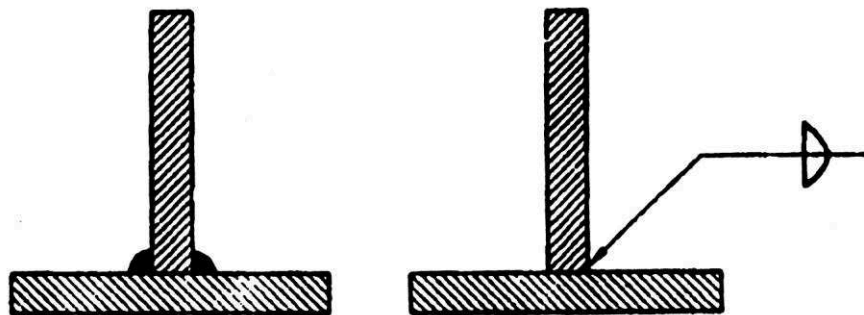
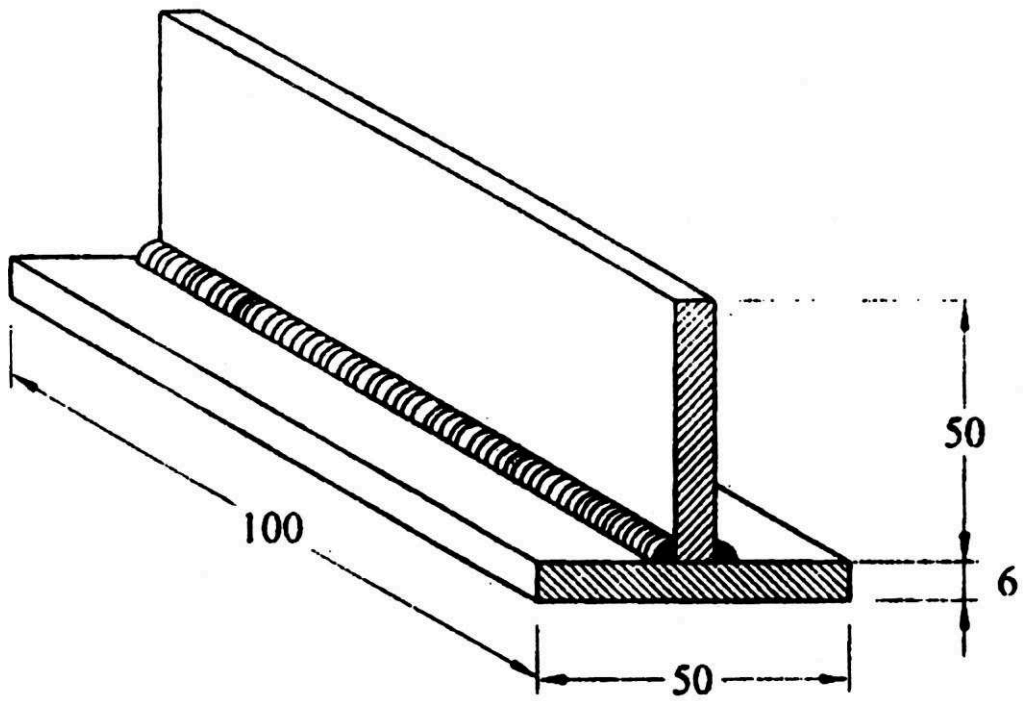
Work pieces, Welding electrodes, Welding machine, Tongs, Wire brush, chipping hammer, Gloves and Goggles.

### **Procedure:**

1. The given work pieces are cleaned with the wire brush to remove the rust, scale and other impurities.
2. Edges are prepared suitably to the given dimension and positioned at right angles for the tee joint.
3. Depending upon the thickness of the parent metal, the amperage and correct voltage is selected.
4. With goggles covering the eyes and gloves on hands, an arc is struck on the work piece and tacks are made at the extreme ends.
5. Welding process is progressed along the seam at a constant speed and keeping uniform distance between the electrode and the work piece.
6. Using chipping hammer the flux in the form of slag is chipped off and then cleaned.
7. After welding, the work pieces should be handles only using the tongs.

### **Result:**

Thus the required T - joint is obtained as per the given dimensions.



**Welded Joint Representation**

## **10. DUSTER MAKING**

### **AIM:**

To construct a duster from the given work piece

### **APPLICATION:**

Cross bars in a cot, shelves.

### **SUPPLIED MATERIAL SPECIFICATION:**

Venteek wood of size 150 x 45 x 30

### **TOOLS REQUIRED:**

- 1) Jack plane. 2) Hand saw. 3) Steel rule. 4) Pencil 5) Marking Gauge. 5) Try square
- 7) Firmer Chisel. 8) Cleaning brush. 9) Wooden mallet

### **SEQUENCE OF OPERATION:**

- 1) Preparing. 2) Marking. 3) Cutting/Sawing. 4) Finishing.

### **WORKING**

#### **1) PREPARING**

Prepare the work piece as described in previous section with a length of 150mm, 45mm and 30mm.

#### **2) MARKING:**

Adjust the marking gauge to 10mm and set out the distance from the same along all the four sides of the piece on the 30mm thick side from both ends b) Again, adjust the marking gauge to 5mm and set out distance along all the four sides of the piece c) Now mark a distance of 5mm perpendicular to these lines on the 30mm x 45mm sides from both ends d) Mark a diagonal line on all the inner square thus formed.

#### **3) CUTTING / SAWING:**

Hold the piece horizontally in a way such that the portion to be cut is just above the jaw. Use a hand saw to cut along the required line markings but slightly inside the line as shown in figure to the required 5mm depth

Now using a firmer chisel take a series of cuts to remove the wood up to this 5mm depth

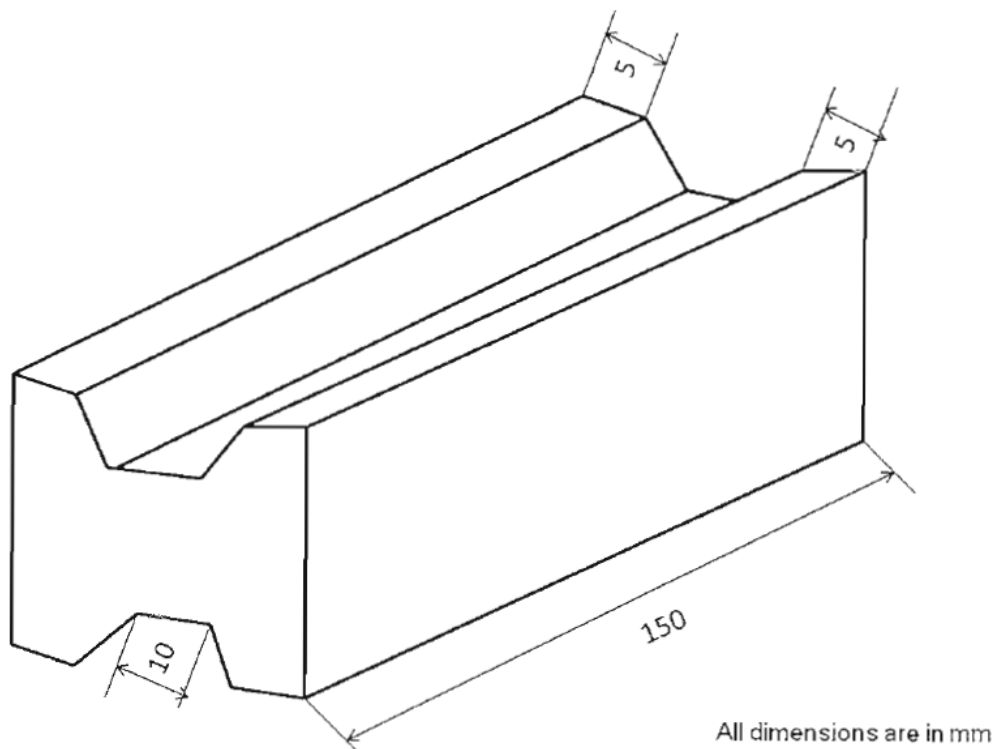
Hold the piece again using a firmer chisel slantly chip off the wood from the along the material diagonal side.

#### **4) FINISHING:**

Take a series of small cuts delicately on both the side pieces to remove the excess wood. Obtain a fine finish of the socket and shoulder assembly joint and clear off the waste by wire brush

#### **RESULT:**

The Duster was produced from the given work piece and assembled joint was submitted for evaluation.





## **11. CROSS HALVING JOINT**

### **AIM:**

To produce a cross halving joint from the given work piece

### **APPLICATION:**

Cross bars in a cot, shelves.

### **SUPPLIED MATERIAL SPECIFICATION:**

Venteek wood of size 150 x 45 x 30

### **TOOLS REQUIRED:**

- 1) Jack plane. 2) Hand saw. 3) Steel rule. 4) Pencil 5) Marking Gauge.  
6) Try square 7) Firmer Chisel. 8) Cleaning brush. 9) Wooden mallet

### **SEQUENCE OF OPERATION:**

- 1) Preparing. 2) Marking. 3) Cutting/Sawing. 4) Finishing.

### **WORKING STEPS:**

#### **1) PREPARING**

Prepare the work piece as described in previous with a length of 150mm, 45mm and 30mm.

#### **2) MARKING:**

Check the dimension of the given work piece. 150mm, 45mm and 30mm. a) First mark from Right side of the piece with distance of 53mm then 45mm. b) Mark again from the left side of the work piece .same distance 53mm then 45mm. c) Then mark the piece from the middle or on 6 inches from the steel rule measurement.. d) Now highlight all & fine marking on all four faces of the given work piece. e) Mark appoint exactly half of the given wooden pieces and mark a groove line from top to bottom by marking gauge on both sides..

#### **3) CUTTING / SAWING:**

Use Firmer chisel to make grive on first & second marking from right side (53mm&45mm) and same on left side..

Now use hand saw to cut till marking on the side that is depth of 15mm

Now we have grove mark on firmer chisel and wooden mallet to cut the grooved part on both side of the wooden piece.

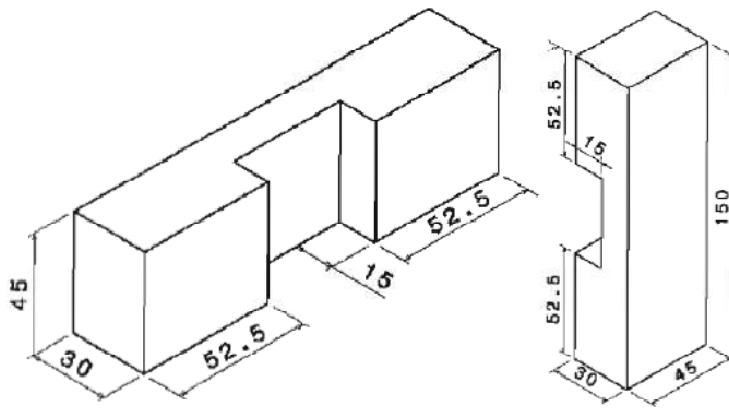
Then clear & level the rough cutting area by Rasp file on both side.

Then cut the wooden piece from the middle, where it was marked at 6 inches from the steel rule.

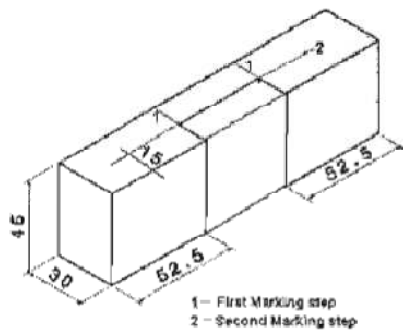
- 4) **FINISHING:** Take a series of small cuts delicately on both the side pieces to remove the excess wood assembly joint in cross shape and clear off the waste by wire brush

**RESULT:**

The cross halving joint was produced from the given work piece and assembled joint was submitted for evaluation.

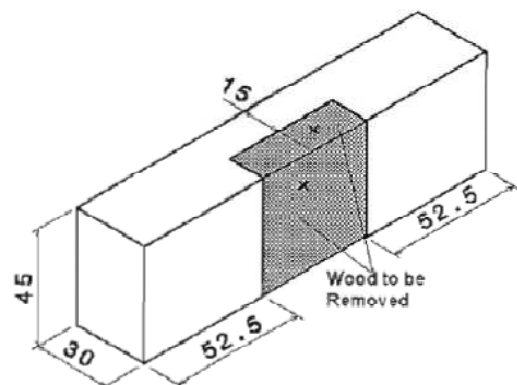


**I. Marking**

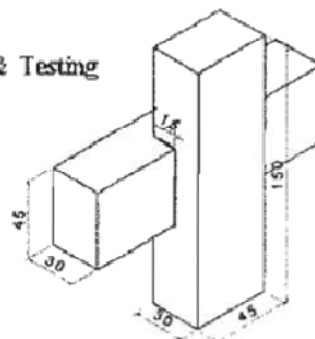


Same Marking on both Piece 1 and Piece 2

**II. Cutting / Sawing**



**III. Finishing & Testing**



## 12. DOVE TAIL JOINT

### **AIM:**

To produce a Dove tail joint from the given work piece

### **APPLICATION:**

Cross bars in a cot, shelves.

### **SUPPLIED MATERIAL SPECIFICATION:**

Venteek wood of size 150 x 45 x 30

### **TOOLS REQUIRED:**

1) Jack plane. 2) Hand saw. 3) Steel rule. 4) Pencil 5) Marking Gauge. 6) Try square  
7) Firmer Chisel. 8) Cleaning brush. 9) Wooden mallet

### **SEQUENCE OF OPERATION:**

1) Preparing. 2) Marking. 3) Cutting/Sawing. 4) Finishing.

### **WORKING STEPS:**

#### 1) PREPARING

a) Prepare the work piece as described in previous with a length of 150mm, 45mm and 30mm.

#### 2) MARKING:

- a) Adjust the marking gauge to 15mm and set out the distance from the face side (A) at one end of the face edges (B)
- b) With try square & scribe check a perpendicular line in the face side (A), from the marked line at a distance of 45mm from the end. This will produce a rectangular of 45 x 15 at the end of the face of the edge (B)
- c) Now on (A) side mark a line on all four side & on (B) side mark first after 53mm second one after 45mm d) Mark a line on 6 inches from the steel rule measurement. e) Now on (A) side mark 45mm after 5mm or up and down side. f) Then on (B) side after 53mm & 45mm in between mark 5mm on top & bottom.

#### 3) CUTTING / SAWING:

- a) First, hand sawing the back part of the (A) side till the marking. b) Then saw the 5mm & 5mm marking on the (B) side and use firmer chisel and wooden mallet to chip off the wood.
- c) Now use Rasp to remove extra 5mm on up & down on (A) side

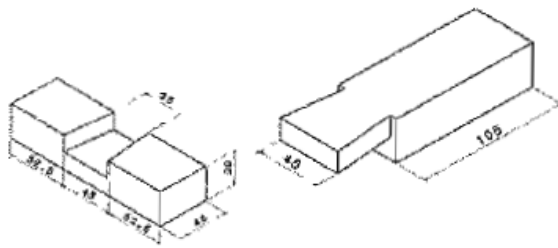
Use Rasp to smooth up the sawed area and the join up two pieces once you cut the piece by and saw from the middle. e) Join the two pices in form of 'T'

#### 4) **FINISHING:**

Take a series of small cuts delicately on both the side pieces to remove the excess wood. Obtain a fine finish of the socket and shoulder assembly joint and clear off the waste by wire brush

#### **RESULT:**

The Dove tail joint was produced from the given work piece and assembled joint was submitted for evaluation.

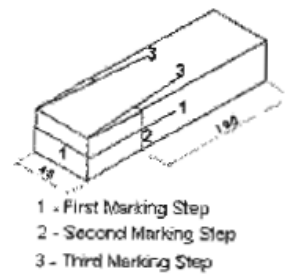


## I. Marking

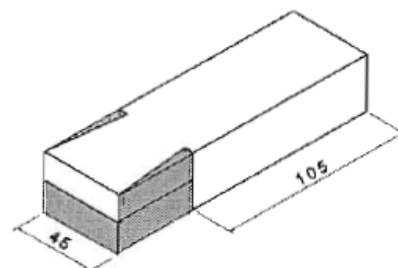
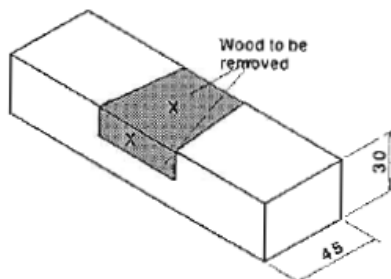
Piece 1



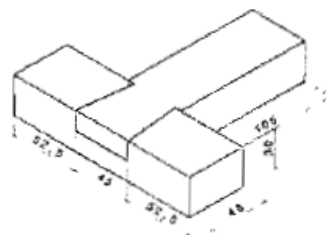
Piece 2



## II. Cutting / Sawing



## III. Finishing & Testing



### **13. STEP TURNING**

**AIM:**

The aim of this exercise is to turn a given work piece to the required dimension..

**SUPPLIED MATERIAL SPECIFICATION:**

Mild steel rod 12 mm diameters

**TOOLS REQUIRED:**

1) Chuck key 2) Turning tool 3) Tool post key 4) Vernier caliper

5) 5/16 Spanner.

**OPERATION:**

Step turning is an operation performed on lathe to produce a cylindrical job of different diameters.

**PROCEDURE:**

1. Chuck the work piece as per the procedure and mount the turning tool on the tool post
2. Face the both ends of the work piece and ensure that ends are perpendicular to the axis of the work piece after facing ..
3. Now set the turning tool perpendicular to the lathe axis.
4. Set the tool to touch the work piece. Measure the diameter of the work piece and set the reading in the reading collar to zero. This reading is the reference point. Subtract the required diameter from the measured diameter. Half of this is the required depth of cut.
5. Start the lathe; divide the depth of cut in steps of 0.5mm.
6. Give roughing cut in steps over a length of 75mm until the diameter is slightly more than 8mm.
7. Finish turn to 70mm over a length of 75mm.
8. Turn the work piece to slightly more than 10mm diameter over a length of 50mm from free end. The reduction in diameter can be done in a number of steps as done previously.
9. Replace the roughing tool with a finish turning tool.
10. Finish turn for 8mm diameter.
11. Check the accuracy of the turned diameters.
12. Chamfer the work piece for the specified dimensions on both ends

**RESULT:**

The given job is TURNED to the required dimensions and finish.

