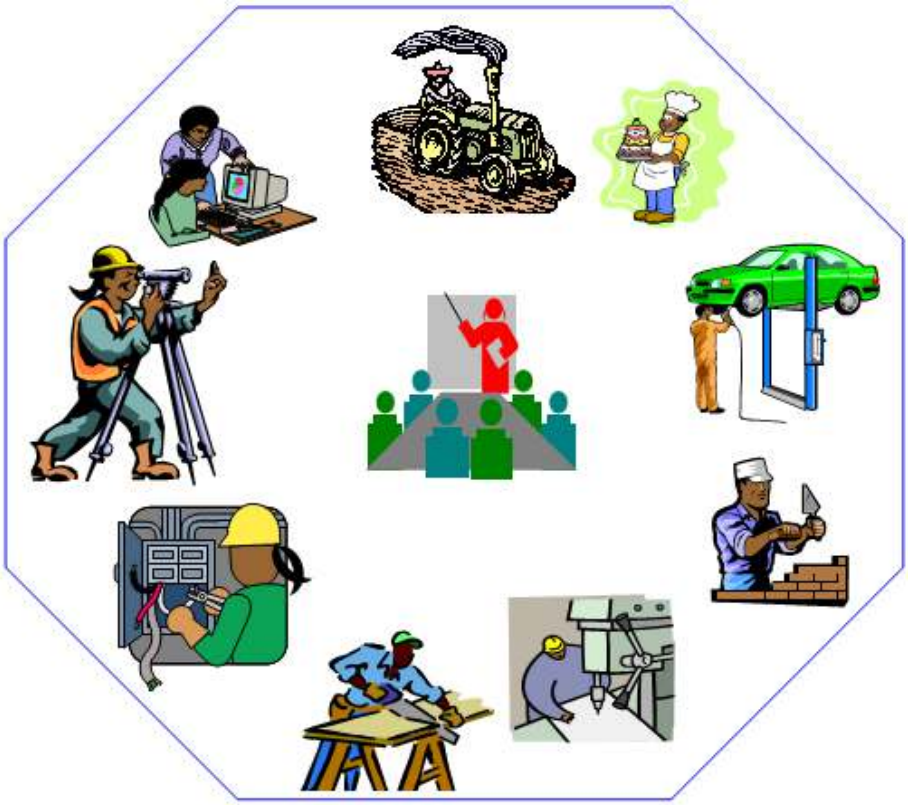
# Bamboo Product Processing

## Level-III

Based on October, 2021 Version 1 OS and Nov.2021, V1 Curriculum



## Module Title: Producing Bent Laminated Components.

## LG Code: IND BPP3 M04LO (1-3) LG (14-16)

## TTLM Code: IND BPP3 TTLM 0322v1

**March, 2022**

**Adama, Ethiopia.**

**Contents**

| LG #14 | LO #1- Prepare for work |
|---|---|

**Instruction sheet**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Storing materials
- Determining furniture design
- Selecting and checking tools and equipment's
- Ensuring work area

This guide will also assist you to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, you will be able to:

- Store materials
- Determine furniture design
- Select and check tools and equipment's
- Ensure work area

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

## Information Sheet 1- Storing materials

### 1.1 STORING BAMBOO

### POST-HARVEST TREATMENT

**Bamboo culms** are vulnerable to decay and attack by fungi or insects, especially powder post beetles. Such attacks reduce the natural durability of bamboo and diminish its value and utility. Post-harvest treatments can help to reduce the risk of decay and attack by pests and thereby increase the useful life and value of bamboo culms. Depending on the end use of the culm, several methods of preservation may be applied to culms prior to their sale or industrial utilization.

### DRYING AND SEASONING

Drying culms is common in the processing of bamboo culm for most uses. Culms are also subjected to seasoning prior to machining, processing, and finishing products that are durable, stable and of a high quality. Bamboo culms can be air-dried with or without sunlight or they may be kiln-dried. Air-drying is more common that kiln drying since it is more economical. Bamboo culms may be split into halves to speed up drying operations. Bamboo culms may be thoroughly air-dried in well-ventilated shade for several weeks. Drying can be done by letting the culms stand in a covered area with good air circulation (as shown below). A large planting hole facilitates the growth of roots and rhizomes. Drying can also be done by stacking culms horizontally on racks. In drying large quantities, the butts and tops of the culms are placed alternately, and then tied in bundles to prevent bending. Straightening green culms without application of heat requires several weeks. This is done under the shade, either by suspending the freshly-cut curved culm by the tip and attaching a weight at the other end, or by laying the green culm on a flat surface and applying sufficient pressure over the culm during the period of drying and setting.

### MOLD PREVENTION

The risk of molding in bamboo culms can be reduced by drying culms such that the water content is reduced to less than 15 percent. Stacking bamboo culms above the ground helps prevent molding and subsequent rotting. Storing bamboo in a cool and dry area also helps reduce decay from molding. Coating the bamboo culms with borax or wood preservative chemicals inhibits the formation of molds.

## PRESERVATION

Bamboo culms are susceptible to biological and physical deterioration especially when harvested young. Deterioration of the bamboo culm is mainly due to attack by powder-post beetles, termites, and decay caused by staining fungi. Methods to increase the durability or prolong the service life of bamboo culms are broadly classified into non-chemical and chemical methods.

## NON-CHEMICAL METHODS

Many of the methods mentioned below are practiced traditionally and are suitable for small-scale industries or farmers with limited resources.

- **Curing**: After harvesting, the culms are left in the field for some time with branches and leaves intact. The transpiration of moisture through the leaves contributes to the reduction of starch in the culm.
- **Smoking**: The bamboo culms are cut into the desired length and stacked above a fire in an enclosed area. The smoke causes the culms to blacken and the heat destroys the starch in the parenchyma cells.

  Bamboo culms cured with smoke are known to last more than 15years.
- **White Washing:** whole or split bamboo culms are painted with slaked lime. This prevents the entry of moisture into the culm, keeping away stain fungi and halting decay.
- **Construction Methods:** mounting bamboo poles over a concrete or stone foundation helps prolong their service life. Since the bamboo is not in contact with the ground, it is less susceptible to attack by fungi and termites.
- **Time of Harvesting:** harvesting mature (3 years old or older) culms during the dry season when their starch content is lowest makes them less vulnerable to attack by termites and fungi. If properly dried after harvesting, their useful life is significantly extended.

- **Plastering**: plastering bamboo culms or strips using cow dung mixed either with lime or mortar is effective in extending the durability of low-cost bamboo constructions.

**CHEMICAL PRESERVATION METHODS**

Using chemicals for preserving bamboo culms generally provides more effective protection than non-chemical methods. Chemical methods however imply greater costs and are only used when greater added-value and a higher quality product are required.

- **Fumigation:** involves the use of chemicals such as Methyl bromide for insect control.
- **Steeping or Sap Displacement:** green bamboo culms are allowed to stand vertically in a container of preservative solution till adequate chemical is picked up. At times, the culm may be freshly cut with branches and leaves on.
- **The Open–tank Treatment:** culms are cut to a desired length and are soaked in a solution of a water-soluble preservative for several days.
- The solution penetrates the culm by diffusion through the ends and partly through the sides.
- **Butt Treatment:** the bottom part of green bamboo or dried bamboo culm is immersed in a container of preservative, for example an old oil drum. The culms are left for about one week.
- **Old Engine Oil:** many farmers have been reported to use old engine oil particularly for green culms. The effectiveness of this method has not been widely reported and documented.

**1.2 Raw material**

The selection and control of proper raw material is the precondition of successful manufacturing of bamboo flooring & bent laminated component. To select proper raw material, it is necessary to bear in mind four words: ***age, freshness, straightness and diameter.***

***Age:*** This means the raw bamboo must be four or more years old. Bamboo material of this age has stable texture, high density, high rigidity, low water content and small shrinkage.

***Freshness:*** Raw material must be fresh. For avoiding mould and withering the time of its storage (from cutting to boiling-bleaching or carbonization) must be as short as possible, especially in spring and summer of high temperature and high humidity. In this period of time bamboo is growing highly, its content of water and carbohydrate is high; the time of storage should not exceed five days. In autumn and winter bamboo is entering a rest period, the content of water and carbohydrate is reducing, temperature is declining, the air is dry, fungi breed slowly. In these seasons it is better to store more raw materials, but the time of storage should not exceed 15 days. It is desirable to store bamboo strips as much as possible, while raw bamboo must be less. Because boiled, bleached or carbonized strips can be stored longer than two months.

***Straightness:*** Bamboo culm must be straight, of small obliquity, high utilization ratio.

***Diameter:*** The diameter of raw bamboo must exceed 100 mm. Greater diameter means higher utilization ratio. If the diameter is great, its culm wall is thick, which is more suitable for making bamboo flooring & bent laminated component.

**Figure: - 1 Raw bamboo.**

### 1.3 Bamboo slats

Bamboo is into people's life widely and deeply, not only flooring, but everywhere. By using bamboo to decorate the house, it will enhance your life and make your house natural and eco-friendly. Bamboo slats are made from carefully selected bamboo, processed from bamboo shoots and prepared into beautiful accent pieces

for furniture and countertops. Bamboo slats are harvested from the outer skin and wall of large diameter bamboo and cut into strips along the length of the pole. Three sides of the bamboo are machine milled while the face side is left natural.

Bamboo slats are used for wall covering, bars, ceilings, wainscotings, also can trim picture frames and mirrors. Bamboo slats are sold in their natural honey color or various stained colors. A simple oil based stain can transform our natural slats to any desired color to enhance and match any decor with this natural and eco-friendly material. Bamboos slats are installed using screws inserted into pre-drilled holes or are nailed through the nodes using pneumatic nail guns. Application is easy and effortless; each strip can be nailed, screwed, glued or bolted. Each piece can be joined side by side for a tight and finished look.

Standard slats size is 1000x40x8mm, but can be cut to size. Bamboo slats are perfectly straight.

**Features:**

1) The back of the bamboo slats has been sanded to make a flattened surface.
2) Easy to install, hand work, diy material.
3) Wide usage and applications by disguise joints on decorative mats and boards, borders for chair-rails or wainscot dividers.

**Bamboo Slats Size: 1830 x 45mm or 1830 x 50mm**

**Figure: - 2 Bamboo slats.**

## 1.4 Woven mats

### 1.4.1. Production of Woven bamboo mats

### 1.4.2. Harvesting bamboo

Matured bamboo culms are extracted following the locally prescribed Silvicultural methods and are crosscut into convenient lengths varying from 50 to 250 cm. The nodal portions are retained in species with short internodes, such as *Dendrocalamus strictus* (30 cm), whereas in species with long internodes such as *Ochlandra travancorica* and *Melocanna baccifera* (50 cm to 100 cm), the nodal portions are removed. The splits of long-internode species, such as *Ochlandra travancorica* are of a more even thickness than those of short-internode species such as *Dendrocalamus strictus*. Although both species are suitable for mat making, about 40 percent more resin is required for bonding mats made of *D. strictus* and other similar short-internode species.

During the course of the IDRC-sponsored BMB research project at IPIRTI, several bamboo species were studied for BMB manufacture. All were found to be suitable.

### 1.4.3. Splitting bamboo

**The crosscut bamboo lengths can be split with:**

- **A machete;**
- **Hand splitting knives; or**
- **A splitting machine.**

When using a splitting machine, the bamboo pole is fixed longitudinally in front of the set of splitting knives and a mechanical pushing device pushes the bamboo over the knives to produce splits of a uniform size. The number of splits produced depends upon the number of knives present in the splitting knives set. In general, the width of the splits varies from 10 mm to 15 mm depending on the species and quality of bamboo. The splits are then allowed to dry in the air or in artificial ventilation to reduce their moisture content to around 30 percent.

### 1.4.4. Knot removal

It is necessary to remove the nodes to maintain an even thickness of sliver and to facilitate further processing. The inner and outer knots are removed from the splits either manually with a sharp knife or mechanically with a knot removal and width-

sizing machine. This machine also sizes the width of the splint and planes the surface.

### 1.4.5. Sliver making

The green epidermal layer of the splints is removed using a sharp knife and can be set aside and used for making other products. It is not suitable for making into slivers. Slivers 0.6 mm thick (+/-10 percent) and 12 mm to 16 mm wide are made manually from splints using a sharp knife or a slivering machine. Keeping the variation in thickness of the slivers to within 10 percent is very important. Higher variation than this results in increased requirements for resin.

### 1.4.6. Drying and weaving

Slivers are dried to around 15 percent moisture content. The dried slivers are manually woven into mats of different sizes and patterns depending on the specific requirements set. The two most common weaving patterns are the herring bone pattern (45 degrees) and the rectangular pattern (90 degrees). The most common sizes of the mats are 250 cm x 125 cm, 180 cm x 125 cm, and 180 cm x 150 cm.

**Figure: - 3 Woven Bamboo mats.**

### 1.4.7. Storage of mats

Woven mats can be air-dried further and stored without any treatment for three to four weeks. Prophylactic treatments must be applied if they are likely to be stored for a longer period. The simplest and most effective treatment for mats, if they are not likely to be exposed to water, is to spray them with a 1 percent solution of a mixture of boric acid and borax in a 1:1 ratio. Spraying can be done with a hand sprayer or a knapsack sprayer. Alternatively, the mats can be soaked in the solution for about ten minutes.

Treated mats are dried either in the air or in a drier, and stored under cover. Treated mats should not come into contact with the ground and hence it is

advisable to store them on wooden pallets of 12 to 18 cm (4 to 6 inches) above ground level. Treated bamboo mats can be stored for three to four months without deterioration. They must be stored in well-ventilated locations with low relative humidity and negligible changes in humidity. The chances of fungal or insect attack are increased if the relative humidity is very high. Mats should be re-sprayed once every three months and should be checked regularly (at least once per fortnight) for any signs of fungal growth, mold and/or borer attack.

## 1.5 Crush bamboo

### 1.5.1 How We Make Crushed Bamboo

Crushed bamboo mats are made by splitting and flattening the bamboo poles. It's very important that only fresh, healthy bamboo is cut. The perfect shade of green helps determines the right age, about 3 - 4 years old are considered the best age.

**Figure: - 4 Crushing techniques.**

Splitting all the nodes of the bamboo with a hatchet is the first step. The second step is to slice the bamboo pole with a bamboo spade to perforate all the nodes.

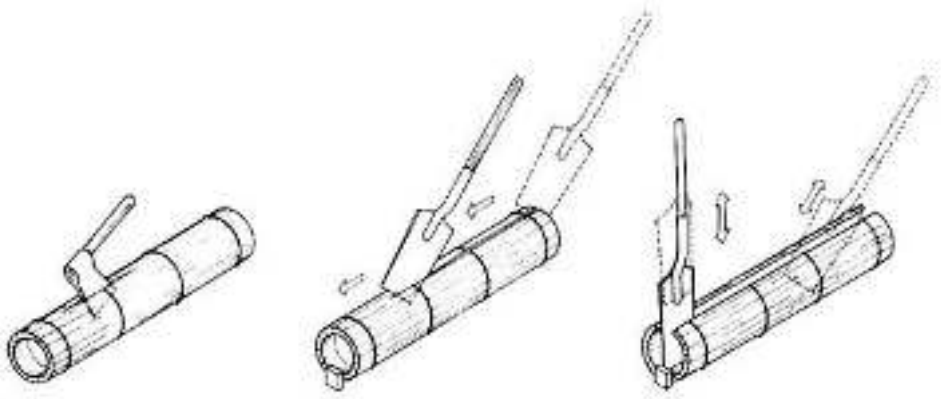


**Figure: - 5 Crushing procedure.**

Once all the nodes are perforated, the third step is to pound it with a mallet until the bamboo panel is flat.

***Fourth Step***: After the bamboo is flattened it's crucial to remove the inner white layer. The 4th step is important because the inner layer is very attractive for insects.

Once the bamboo mats are cleaned, the fifth step is to preserve them against future insect attacks and mold. Treatment is done by submerging the bamboo in tanks with a mixture of non-toxic preservatives and water for 12-14 days.

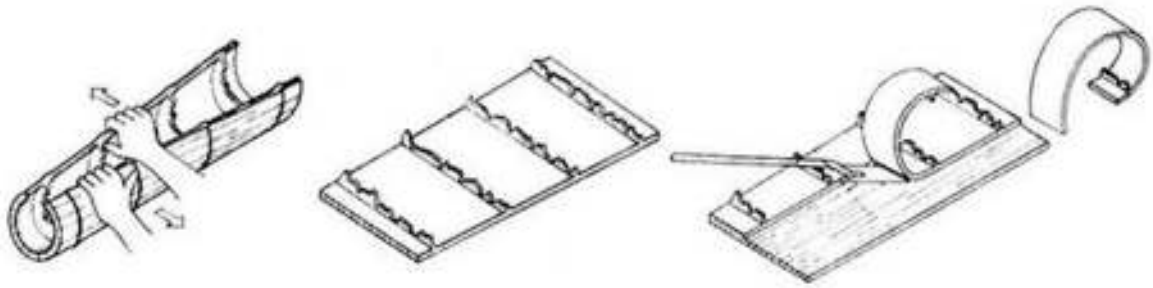


**Figure: - 6 removing the inner layer techniques.**

***Finally; the 6$^{th}$ step the drying process.***

Air drying of crushed bamboo takes about 1-2 months depending on time of season and the humidity levels.

**Figure: - 7 Air dries.**

## Uses of Crushed Bamboo

Crushed bamboo can be used for many things. It can be used in its natural form or it may be sanded, shredded, pressed to make it for a specific use. Flattened bamboo is also a lot less costly to transport than round poles, which makes it a very lucrative for manufacturers of value added bamboo products (flooring, panels, furniture, composite lumber, fabric etc.)

**A/ Crushed Bamboo Used as Ceiling Panels**

Crushed Bamboo mat is also used as bamboo interior/exterior walls, ceiling and floor panels in tropical architecture, and now even mainstream designers are incorporating it into the designs. Bamboo mats/panels can be stained or even painted to add some color and at home in any décor or design.

**B/ Crushed Bamboo Used as Wall Panels**

Sasa is also used as wall covering or paneling, or can even be integrated as a wall support system. Due to Philippine bamboo's strength and flexibility, using crushed bamboo wall mats then plastered with adobe will provide a substantially cheaper solution to drywall or especially to HCB or brick. Using bamboo with natural made plasters will make these walls earthquake resistant and non-toxic and biodegradable, also this forms very effective insulation protection from sound and temperature, fire retardant and even water resistance!

**Figure: - 8 Wall Panels.**

**C/ Crushed Bamboo Used as Flooring**

Crushed bamboo used in flooring is another very popular use, either our natural (with nodes) or the sanded finish. Of course the smoother the finish you require, the more work will be involved. The top layer could even be sanded and then finished with a polyurethane top coat and then glued together to a backing. We can also provide these complete services at the client request.

**Figure: - 9 Flooring**

**D/ Crushed Bamboo Used as Timber & Beams**

Crushed bamboo timbers and beams are a very eco-friendly way to produce very strong load bearing beams/timbers or just thick boards. As many crushed bamboo panels that are needed for the desired dimensions are glued and hydraulically pressed, cured and then sawn into client specific dimensions. Worldwide laboratory test has proven that the mechanical properties of these bamboo beams are simply amazing with tensile strength exceeding steel.

**Figure: - 10 Timber & Beams.**

| **Self-check 1** | **Written test** |
|---|---|

**Name…… ID…… Date…….**

**Directions:** Answer all the questions listed below accordingly. Examples may be necessary to aid some explanations/answers.

**Part I: Fill in the blank space.**

1. _____ helps to reduce the risk of decay and attack by pests and thereby increase the useful life and value of bamboo culms. (1 point)

2. Methods of preservation to increase the durability or prolong the service life of bamboo culms are broadly classified into _____ and _____ methods. (2 point)

**Part II: Write short answer for the following questions**

1. List the selection of proper raw material precondition to manufacture bamboo flooring & bent laminated component. (4 point)
   1, _____,
   2, _____,
   3, _____,
   4, _____,
2. The crosscut bamboo lengths can be split with: (3 point)
   1, _____,
   2, _____,
   3, _____,

You can ask you teacher for the copy of the correct answers.

***Note: Satisfactory rating - 5 points*** ***Unsatisfactory - below 5 points***

Score = _____

Rating: _____

## Operation Sheet 1 – Produce woven bamboo mat.

**Objective: -** By using different types of hand tools and equipment to performing woven bamboo mat.

**Equipment tools and materials: -** A machete, Hand saw, Hand splitting knives, a Splitting machine, shovel, mallet hammer, knode removing and sizing equipment, raw bamboo.

**Operation procedure:- produce woven bamboo mat**

1. Select fresh bamboo based on the requirement
2. Split bamboo
3. Remove outer knots
4. Make slivers and size with the required dimension
5. Dry and weave bamboo mat
6. Store woven mat

After confirmation, production can be continuous

## Operation Sheet 2 Produce Crashed bamboo ply.

## Information Sheet 2 - Determining furniture design

**Objective: -** By using different types of hand tools and equipment to performing crushed bamboo ply.

**Equipment tools and materials: -** A machete, Hand saw, Hand splitting knives, a Splitting machine, shovel, mallet hammer, knode removing and sizing equipment, raw bamboo.

**Operation procedure: - produce crushed bamboo**

1. Select fresh bamboo based on the requirement
2. Cut the required length
3. Remove outer knode
4. Split all knode by using the proper hand tools
5. Slice the bamboo pole with a bamboo spade to perforate all the knode
6. Pound with the mallet until the bamboo panel is flat.
7. The bamboo is flattened remove the inner white layer.
8. Apply treatment by submerging the bamboo tank with the available mixture.
9. Dry and store properly

After confirmation, production can be continuous

### 2.1 Introduction

We believe that the ideal home decor solution lives at the intersection of function and beauty. When redecorating, giving equal thought to the furniture and where it is placed will provide you with a room that works for you in every way.

Here are five steps you should take to determine the most efficient furniture design for your space:

**2.1.1. Measure and Draw**

Start by taking detailed measurements of the space (including windows and entryways) and the pieces of furniture you plan to keep. If you have doors that swing into the room, measure how far the door swings out when open.

Next, draw out your space to test out different placements and determine which works best. You can draw it out on graph paper, with virtual planners (such as Planner 3D,2D), or on-site with painter's tape.

**2.1.3. Choose Size-Appropriate Furniture**

If you are designing a smaller space – whether it is your first home or you have downsized to a condo – your current furniture may not fit. The furniture should not only be in-scale with the space but also with the other furniture you choose.

**2.1.3. Design with Purpose**

As great as a room may look, if it's not functional, it's not practical. Does the space need to be kid-friendly? You may need to maximize floor space, acquire easily-moveable furniture, and choose durable, easy-to-clean fabrics. If you are more of an entertainer, consider the size of table you'll need to host dinner parties and layouts that are conducive to large conversations and gatherings.

**2.1.4. Consider the Traffic Flow**

How you arrange your furniture will depend on whether you're decorating a high-traffic or low-traffic room. If people regularly walk through the room to get to another room in the house, avoid placing furniture in the path of traffic (which tends to go from doorway to doorway).

The pathway should be at least two feet wide (ideally more) and go around your furniture arrangement rather than through it. You may also choose to create two separate furniture arrangements and have the pathway run between them. Rugs can often help identify furniture arrangements and create a natural pathway for traffic to follow.

### 2.1.5. Determine A Focal Point

Creating a focal point is often determined by the purpose of the room, and can be anything from a fireplace to a piece of artwork to a wall with bold wallpaper or eye-catching color. Your room may already have an established focal point, such as a fireplace or window. If that's the case, embrace that focal point and build your furniture arrangement around it, ensuring that the decorating details you choose don't take away from the focal point, but complement it.

| Self-check 2 | Written test |
|---|---|

Name…… ID…… Date…….

**Directions:** Answer all the questions listed below accordingly. Examples may be necessary to aid some explanations/answers.

**Part I: Write short answer for the following questions**

1._____ is start by taking detailed measurements of the space? (2pts)

2. Write five steps you should take to determine furniture design? (4pts)

1, _____,

2, _____,

3, _____,

4, _____,

5, _____,

2. _____ is at least two feet wide and go around your furniture arrangement. (2pts)

3. Creating a _____ is often determined by the purpose of the room. (2pts)

*You can ask you teacher for the copy of the correct answers*.

***Note: Satisfactory rating - 5 points*** ***Unsatisfactory - below 5 points***

Score = _____

Rating: _____

## Information Sheet 3:-Selecting and checking tools and equipment's

### 3.1 Introduction

Tools are particularly important in construction work. They are primarily used to put things together (e.g., hammers and nail guns) or to take them apart (e.g., jackhammers and saws). Tools are often classified as ***hand tools*** and ***power tools*****.** Hand tools include all **non-powered tools,** such as hammers and pliers. **Power tools** are divided into classes, depending on the power source: electrical tools (powered by electricity), pneumatic tools (powered by compressed air), liquid-fuel tools (usually powered by gasoline), powder-actuated tools (usually powered by an explosive and operated like a gun) and hydraulic tools (powered by pressure from a liquid). Each type presents some unique safety problems.

***Hand tools*** include a wide range of tools, from axes to wrenches. The primary hazard from hand tools is being struck by the tool or by a piece of the material being worked on. Eye injuries are very common from the use of hand tools, as a piece of wood or metal can fly off and lodge in the eye. Some of the major problems are using the wrong tool for the job or a tool that has not been properly maintained. The size of the tool is important: some women and men with relatively small hands have difficulty with large tools. Dull tools can make the work much harder, require more force and result in more injuries. A chisel with a mushroomed head might shatter on impact and send fragments flying. It is also important to have the proper work surface. Cutting material at an awkward angle can result in a loss of balance and an injury. In addition, hand tools can produce sparks that can ignite explosions if the work is being done around flammable liquids or vapours. In such cases, spark-resistant tools, such as those made from brass or aluminum, are needed.

**Power tools,** in general, are more dangerous than hand tools, because the power of the tool is increased. The biggest dangers from power tools are from accidental start-up and slipping or losing one's balance during use. The power source itself can cause injuries or death, for example, through electrocution with electrical tools or gasoline explosions from liquid-fuel tools. Most power tools have a guard to protect the moving parts while the tool is not in operation. These guards need to be in working order and not overridden. A portable circular saw, for example, should have an upper guard

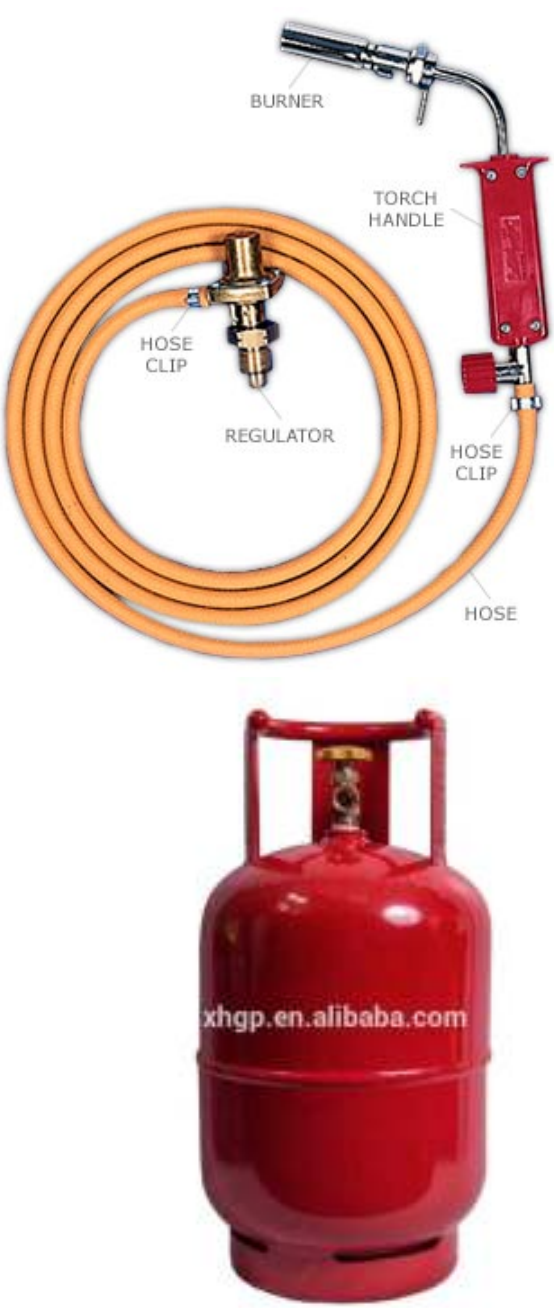
covering the top half of the blade and a retractable lower guard which covers the teeth while the saw is not operating. The retractable guard should automatically return to cover the lower half of the blade when the tool is finished working. Power tools often also have safety switches that shut off the tool as soon as a switch is released. Other tools have catches that must be engaged before the tool can operate. One example is a fastening tool that must be pressed against the surface with a certain amount of pressure before it will fire.

### 3.2. Tools and equipment's

#### 3.2.1 Blow Torch

Commonly used where a diffuse (wide spread) high temperature naked flame heat is required but not so hot as to cause combustion or welding. Temperature applications are ***soldering, brazing, material softening, (such us metal; bamboo culm for bending) melting roof tar, or pre-heating large castings before welding for repairing***.

Valve




Body/Gas tanker

**Figure: - 1 Blow Torch with Gas Cylinder.**

### 3.2.2. Jigs

A jig may be defined as a device which holds and located a work piece and guides and controls one or more cutting tools. The holding of the work and guiding of the tool is such that they are located in true positions relative to each other. In construction, a jig comprises a plate, a structure, or box made of wood or in some cases of metal having

provisions for handling the components in identical positions one after the other, and then guiding the tool incorrect positions on the work in accordance with the drawing, specification, or operation layout.

**Figure: - 2 Router holding jig.**

### 3.2.3. Knife

It is used in splitting, cutting, and slicing the bamboo.


**Figure: - 3 Splitting Knife.**

### 3.2.4. Chisel

A **chisel** is a tool with a characteristically shaped cutting edge (such that wood chisels have lent part of their name to a particular grind) of blade on its end, for carving or cutting a hard material such as wood, stone, or metal by hand, struck with a mallet, or mechanical power. The handle and blade of some types of chisel are made of metal or wood with a sharp edge in it.

- **A gouge** (one type of chisel) serves to carve small pieces from the material, particularly in woodworking, woodturning and sculpture. Gouges most frequently produce concave surfaces. A gouge typically has a 'U'-shaped cross-section.

**- Chisel** use involves forcing the blade into some material to cut it. The driving force may be applied by pushing by hand, or by using a mallet or hammer. In industrial use, a hydraulic ram or falling weight ('trip hammer') may be used to drive a chisel into the material.

**Figure: - 4 (A)-Gouge** **(B)-bended chisel**

### 3.1.1. Pliers

Pliers are made in various shapes and sizes and for many uses. Some are used for gripping something round like a pipe or rod, some are used for twisting wires, and others are designed to be used for a combination of tasks including cutting wire.

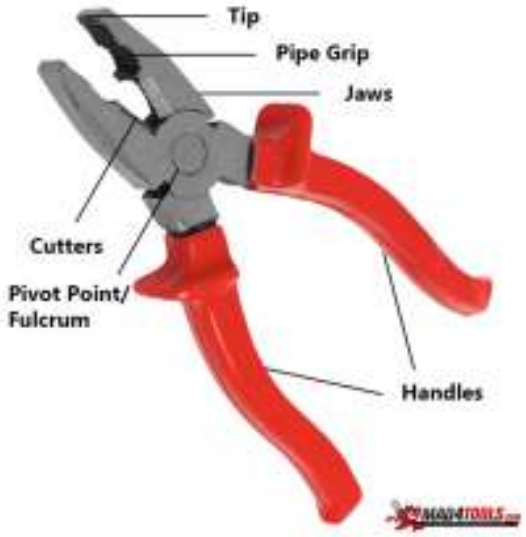



**Figure: - 5 Plier**

### 3.1.2. Scissors

The scissor is defined as the cutting instruments or materials used in cutting the paper, cloth, hair, and other materials with two sharp blades that are screwed at the center to cut together.

**Figure: - 6 sewing scissor.**

### 3.1.3. Drill

A power drill is a tool with an electrical motor that rotates a replaceable drill bit at your choice of speeds to **create a hole in a variety of materials**. The drill can also take screwdriver bits, to allow easier driving of screws through different materials.

**Figure: - 7 Portable drilling machine.**

### 3.1.4. Grinder

**A grinding machine**, often shortened to grinder, is one of **power tools** or **machine tools** used for grinding. It is a type of machining using an abrasive wheel as the cutting tool. Each grain of abrasive on the wheel's surface cuts a small chip from the work-piece via shear deformation.

**A/ A bench grinder** is a bench-top type of grinding machine used to drive abrasive wheels.

**B/ Portable grinders** are handheld power tools that are used for **grinding, cutting or polishing.** These versatile tools can be used for a variety of tasks when used with the proper grinder wheels according to the manufacturer's recommendations, including: Removing paint, rust or mortar.


**Figure: - 8 (A) Bench grinder Machine.** **(B) Portable grinder Machine.**

### 3.1.5. Sander

Belt sanders are multiuse tools. They are commonly used for **sand very rough surfaces, leveling surfaces** (like a replacement board in a hardwood floor) and freehand rounding and shaping.

**Figure: - 9 portable belt sander.**

### 3.1.6. twin-blead saw machine

The use of a twine-blade saw is more appropriate for bamboo species with interweaving grain in order to avoid the use of a splitter that produces slats with irregular edges. Slats produced from a twine-blade saw have uniform width and even edges that need only slightest secondary processing.

**Figure: - 10 twin-blead bamboo saw machine.**

### 3.1.7. Splitter

Bamboo Splitting Machine is widely used in Toothpicks Production Line, Chopsticks Production Line, Bamboo Spoon Production Line, Bamboo Ice Cream Stick Production Line and Bamboo Clothespin Production Line.

This machine is used for splitting of bamboo into number of equal parts it depends upon the module of die it might of four or six equal parts and so on... Bamboo Chain Splitter Machine is designed to split the long bamboo to required number of pieces. The machine uses splitter grills and mechanical power for the same. Various grills with different number of blades can be used as the requirement of the final product to be made.

**Figure: - 11 Bamboo Splitting Machine.**

### 3.1.8. Hot press

The hot press machine for bamboo board with multi-step and single-layer is made of main body and control system. Main body is composed of mainframe, hot platen, carrier plate,

hot oil pipe, oil cylinders, hydraulic water pipe, balance device, side-pressing device and so on. The control system includes hydraulic system and electric system.

**Figure: - 11 hydraulic Hot press.**

### 3.1.9. Cold press

Used for making doors, room dividers and other kinds of products, the hydraulic cold press system works attractively for producing reliable and efficient results. These machines can be used to work on plywood, MDF sheets and various other surfaces.

**Figure: - 12 hydraulic cold press.**

### 3.1.10. Clamps

Clamps are versatile tools that serve to temporarily hold work securely in place. They are used for many applications including **carpentry, woodworking, furniture making, welding, construction and metal working**.

**A/ C-Clamp**

**B/ Bar-Clamp**

**C/ F-Clamp**

| Self-check 3 | Written test |
|---|---|

**Name…… ID…… Date……..**

**Directions:** Answer all the questions below accordingly. Examples may be necessary to aid some explanations/answers.

**Part I: Write short answer for the following questions**

1. Tools are often classified as _____ and _____. (2 points)

2. _____ include a wide range of tools, from axes to wrenches. (1 points)

3. _____ is in general more dangerous than hand tools, because the power of the tool is increased. (1 points)

4. _____ is used for temporarily holding tools that apply including carpentry work, furniture making, welding, construction work and metal work. (1 points)

5. List dawn at list five types of hand tools? (5 points)

*You can ask you teacher for the copy of the correct answers*.

***Note: Satisfactory rating - 5 points*** ***Unsatisfactory - below 5 points***

Score = _____

Rating: _____

## Information Sheet 4:-Ensuring work area

### 4.1 Introduction

Workplaces are troubled with danger. Whether on a work shop, accidents and injuries are a daily occurrence. Fortunately, most will be small and easily addressed; it is unlikely anybody is going to die from a paper-cut. But that does not mean they should be treated as any less severe. Accidents not only change lives, they can cost your company substantial sums in time and compensation. Proper safety procedures are never going to prevent all accidents, but they will help limit the risk factors reducing occurrences and potential damage.

**Keeping a Neat Workplace**

The cleaner a working area the safer it will be. Whether it is tools left out, spills not cleaned up, or piles of paperwork building up; curbing clutter reduces the number of ways things can go wrong. Good practices start from the top down; management set the example for the rest of the workforce. Assessing problem areas and working on dedicated solutions to aid removing the clutter can significantly reduce the risk of things going wrong. Think about factors both large and small; for example, installing more recycling points or creating bespoke storage solutions.

**Equipment Inspection, Maintenance, and Selection**

Routine maintenance and inspection of industrial machinery may seem like an obvious step in preventing dangerous accidents. But it’s also important to keep up with the inspections and maintenance of lesser risk equipment. Checking storage areas for safe stacking can save lives as easily as maintaining high-powered drilling equipment. It’s also important to regularly review the tools and equipment used to make sure they are still the safest choice for the job.

**Create a Safety Plan**

All workplaces should have a comprehensive safety plan in place that every worker, contractor, and visitor have access to. There are some clear risk factors that should be outlined e.g. the use of personal protective equipment, but a good safety plan should go further than that. Each workplace is unique and will have unique risk factors and challenges in maintaining worker safety. Make sure to routinely assess your working environments for new and evolving hazards and update the plan. Your plan should also include the procedures in place in the event of an incident. Finally, it's crucial to make sure copies of the plan are readily accessible to all employees and visitors, and that they have appropriate time allocated to review it.

**Training and Qualifications**

Proper training and access to formal safety qualifications is an essential step in preventing accidents. Training should be provided at regular intervals and systems put in place to help employees self-evaluate when they may need a refresher. When dealing with contractors and other professionals that may be outside your direct control, you can utilize contractor safety management systems – as offered by BNG Conserve – to aid in keeping track of the documentation.

**Record Keeping**

Regardless of how many precautions you take accidents may still occur. Maintaining detailed records of the incidents and causes can help you to assess the associated risk factors and work towards mitigating them in the future. A dedicated safety officer should be appointed to maintain a log of every incident, big or small, and work with employees and management to remove or reduce the factors leading up to them. Safeguarding your workplace from the risk of injury and incident can be an endless task. Ensuring your employees and contractors maintain qualifications in the latest safety standards not only keeps you WHS compliant but will help to reduce the risk of accidents. BNG Conserve offers a comprehensive contractor safety management system, enabling you to track and verify contractor qualifications and safety standards compliance helping to ensure everybody in your workplace is as safe as they can be.

| Self-check 4 | Written test |
|---|---|

**Name…… ID…… Date…….....**

**Directions:** Answer all the questions listed below accordingly. Examples may be necessary to aid some explanations/answers.

**Part I: Write short answer for the following questions**

1. _____ are industrial machinery may seem like an obvious step in preventing dangerous accidents. (2 points)

**2.** _____ have a comprehensive safety plan in place that every worker, contractor, and visitor has access. (2 points)

**3.** _____ and _____are an essential step in preventing accidents?(4pts)

4. Good practices start from _____ management set the example for the rest of the workforce. (2 points)

*You can ask you teacher for the copy of the correct answers*.

***Note: Satisfactory rating - 5 points*** ***Unsatisfactory - below 5 points***

Score = _____

Rating: _____

| LG #15 | LO #2- Perform bending |
|---|---|

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Resizing materials
- Bending and straightening raw bamboo
- Shaping materials using blower, chemicals, jigs and pressing equipment
- Producing component parts
- Making Component parts using carpentry and fabrication techniques
- Monitoring process
- Checking and minimizing waste.

This guide will also assist you to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, you will be able to:

- Resize materials
- Bend and straighten raw bamboo
- Shape materials using blower, chemicals, jigs and pressing equipment
- Produce component parts
- Make Component parts using carpentry and fabrication techniques
- Monitor process
- Check and minimize waste.

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

## Information Sheet 1:-Resizing materials

### 1.1 Converting bamboo poles into slats

One of the initial steps in bamboo processing is the conversion of poles to slats. Slats can be made from bamboo poles by splitting or sawing. Splitting is done with a handheld knife or splitter (Figure1.) or with an automatic machine splitter. The splitter ring containing the knives is placed centrally at one end of the pole, and then pressed towards the other end of the pole. This action separates the pole along its length into several pieces referred to as slats, where the quantity formed depends on the number of knives and the desired width of the individual pieces.

**Figure 1:- Hand held splitter with 8-knives**.

When slats are made by splitting the bamboo pole, recovery is affected by grain alignment of bamboo species. The bamboo will split following the line of least resistance, which means that separation will conform to the grain direction. Consequently, species which has relatively shorter internode distances and where grain direction changes at every node, the likelihood of producing crooked split-bamboo is high. Another limitation of the splitting method is that a splitter with a given number of knives will be useful only for a given range of pole diameters. To improve efficiency, poles will have to be classified according to diameter size prior to splitting. Also, large- diameter poles cut with a splitter having a fixed number of knives will produce bigger or wider slats. In most cases, slats with uniform width are desired, so a higher proportion of the material is wasted in bringing the width of the

slats to the target dimension. To aid in selecting the splitter ring to use, we devised (Table1.) which shows the number of knives corresponding to the diameter of culms to be split. We strongly recommend that bamboo processors consult this table to maximize recovery of bamboo material during slat preparation.

**Table 1 Appropriate number of knives on the splitter corresponding to diameter of culms.**

| | **Bamboo Pole Outer Diameter (inches)** | | | | | |
|---|---|---|---|---|---|---|
| **Rough Size** | 5” | 5” | 5” | 6” | 6” | 6” |
| **Slat Width (inch)** | Nº. of Slats Produced (with the use of splitter) (Assuming 1/8” allowance on both sides. Larger allowance needed for thicker culms). | | | | | |
| **Culm wall thickness** | ¼” | 4” | 3.5” | 5.5” | 5” | 4.5” |
| **Culm Inner diameter** | 4.5” | 4.5” | 4.5” | 4.5” | 4.5” | 4.5” |
| **No. of 1” slats** | 11 | 10 | 8 | 13 | 12 | 11 |
| **No. of 1 ½” slats** | 8 | 7 | 6 | 9 | 8 | 8 |

**Guide for using Table 1:**

1) First determine the outer diameter of the bamboo pole in inches.

(**Example:** Bamboo pole to be split has an outside diameter of 5”).

2) Next, determine the thickness of the culm wall. Match the measurement with the corresponding value in row 4 (culm wall thickness) of the table. Use the lower dimension among the 3 choices given in the table (i.e., ¼”, ½”, ¾”) if the culm wall thickness is not exactly the same as one of the values given. This will also provide the inner diameter of the bamboo pole.

(**Example:** The bamboo pole has a culm wall thickness of 13/16”. Hence, use the value 3/4” from the table).

3) Then, determine the width of slats that you want to produce from the pole. (The choice is limited to 1” and 1-½” slat-width.)

(**Example**: Assuming that 1” slats are desired. Looking at the table, specifically the yellow-colored row, then choose a splitter with 8 knives to produce 8 pieces of 1-inch slats from the given bamboo pole).

The use of a twine-blade saw is more appropriate for bamboo species with interweaving grain in order to avoid the use of a splitter that produces slats with irregular edges (Figure 1). Slats produced from a twine-blade saw have uniform width and edges that need only minimal secondary processing. Slats obtained from uneven-grained bamboo species that come out of hand-held or machine splitters will need additional machining (ripping) to produce straight and even edges, to make them ready for lamination. During this edge-straightening process, substantial portions of the bamboo are removed, lowering the percent material recovery from each pole.

**Figure 2:- Producing slats with the use of a twin-blade saw.**

If rework or further milling of the slats cannot be avoided, wood jigs are recommended to machine them, especially in squaring and producing straight edges. Jigs are machine guides and serve as protection or safety tools for machine operators who handle small substrates that are fed to high-speed woodworking machines.

| **Self-check 1** | **Written test** |
|---|---|

**Name…… ID…… Date…….**

**Directions:** Answer all the questions listed below accordingly. Examples may be necessary to aid some explanations/answers.

**Part I: Write short answer for the following questions**

1. Slats can be made from bamboo poles by _____ or _____. ( 2 points)

2. Slats produced from a twine-blade saw have uniform width and edges that need only minimal _____. (2 points )

3. Explain the advantage of sowing operation by using a twine-blade saw machine? (4-points)

*You can ask you teacher for the copy of the correct answers*.

***Note: Satisfactory rating - 6 points*** ***Unsatisfactory - below 6 points***

Score = _____

Rating: _____

**Information Sheet 2:- Bend and straighten raw bamboo**

### 1.1 How to make straightening Jig / column

**A straightening column** can be a wooden log of 7-8 feet long X 20-30 cm in diameter. Depending on the diameter of the bamboo poles to be bent, prepare holes on the wooden poles for easy front and back movement of bamboo poles during bending. Peg the wooden poles firmly in the ground. The height of straightening column could be adjusted according to the height of the craftsman and the length of bamboo poles to be bent. Alternately sawn timber with grooves can also be used.

**Figure: - 1 A straightening column**

Bamboo poles used in furniture production should be straightened for accurate joinery, ease in assembly and quality final product. Cross cut the bamboo poles of desired length (7 or 8 feet long), as the maximum component length of furniture is 7 feet.

**Bending column** the bending column is a kind of auxiliary tools for bending tubes. A wooden column is made in T-shape, the width of column is about 13 cm and the length is about 250 cm. several holes are made at a height of 120 up to 140 cm. the diameter

of the hole is 3 up to 5 cm. bamboo tubes to bent are inserted in to the holes and heated over for bending. Now a blowtorch is used for bending.

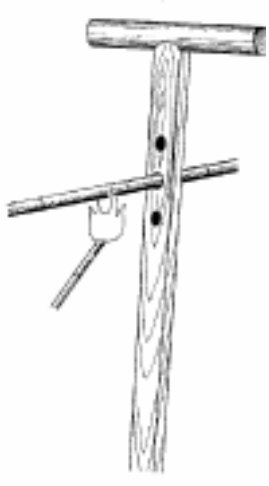


**Figure: - 2 Bending column**

**Straightening/ Bending**

**A/ Straightening**

Apply heat on the specific portion of the bamboo poles and its surrounding area, where straightening needs to be performed. Move the blow torch or bamboo back and forth to avoid heating at a single point). Blow torch connected to a gas cylinder or kerosene blowers or traditional blowers using charcoal or wood can be used as a heating source. Heating increases flexibility of bamboo, which allows bending or straightening of bamboo.

Straightening

**Figure: - 2 Straightening procedures.**

**B/ Bending**

Using the support of bending column (holes on wooden logs to accommodate the diameter of bamboo), straighten or bend the bamboo poles in the desired form by applying force. Use eye alignment to check the straightness. As soon as the specific bent is straightened apply water with the help of the cloth to the heated part for cooling

down, which enables the pole to retain the new shape / form. Continue the process until the entire bamboo pole is bending.

**Figure: - 3 Bending procedures.**

| Self-Check 2 | Written test |
|---|---|

**Directions:** Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

**Part I. Write short answer**

1. _____ is made from wooden poles 7-8 feet long X 20-30 cm in diameter that help bamboo culm straighten easy for bamboo poles during furniture prodution. (2-points)
2. _____ is a kind of auxiliary tools for bending bamboo culm. (2-points)

3. List down four tools and equipment's that we need to perform straightening and bending operation? (4-points)

A/ _____

B/ _____

C/ _____

D/ _____

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers

Score = _____

Rating: _____

**Information Sheet 3:- Shape materials using blower, chemicals, and jigs pressing equipment.**

### 3.1 Introduction

Bamboo is a widely grown, renewable resource. It is used in crafts, furniture making, and even as a building material. When bamboo is freshly cut and green, it is very pliable, and can be shaped and manipulated for various uses. Learn how simple it is to shape/bend bamboo to meet your needs.

**Shaping/Bending Bamboo Using Water**

1. **Fill a tub with lukewarm water.** Place your bamboo poles in the tub and allow them to soak overnight.

- As with wood, bamboo requires moisture to bend. The moisture softens the lining and hemicellulose in the bamboo cells and allows them to flex. Without heat and moisture, these molecules crystallize making them virtually immovable.
- Depending on the size and thickness of the bamboo, soaking time may be longer.

2. **Test your bamboo.** Pull the bamboo out of the water and slowly bend the bamboo, attempting to coax it into the shape you need. If you hear a crackling sound, the bamboo has not been soaked long enough, and needs to be placed back in the water.

3. **Draw your desired shape.** Take a large sheet of paper and sketch out the shape you want you bamboo to take. Place this paper on top of your large piece of bourd.

4. **Nail the design.** Using the sketch as your guide, hammer nails into the plywood, following the sketched shape. Each nail should be approximately an inch apart.

- Hammer in a second row of nails. This row should run parallel to the shape you just nailed and the distance between the two rows should be slightly larger than the diameter of the bamboo.

5. **Shape your bamboo.** Once your bamboo has been adequately soaked and is pliable, remove it from the water and place it on the board between the nails. Allow the bamboo to dry 1-3 days.

- You can test whether your shape has been set by picking the bamboo off the board. If the bamboo retains the desired shape, it has finished drying into shape.


**Shaping/Bending Bamboo Using a Knife**

This method is frequently used by furniture makers to either correct a crooked piece of bamboo, or for creating a gentle curve or rounded edge. This technique can be used both on round bamboo canes or split bamboo.

1. **Cut your bamboo.** Make a V-shaped cut right beneath one of the bamboo nodes. A node is one of the joints in the bamboo pole that looks like a knee and divides the cane into segments.

- Make your cut narrow if the bend you desire is slight. Make your cut wider if the bend you need is more dramatic.
- The cut can be as deep as two-thirds the diameter of the pole. Cuts can be shallower for less dramatic bends.

2. **Make multiple node cuts in the same cane to create a circular shape.** Cutting near a node makes this alteration less visible.

3. **Bend your bamboo into shape.** Secure it either by lashing it, or using an adhesive to set your bamboo in place.

**Shaping/Bending Bamboo Using Heat**

This method is more advanced than the ones above. It is used primarily by seasoned craftsmen who use the bamboo to make furniture and very complex handicrafts.

1. **Hollow out your bamboo poles.** Use a piece of rebar (a steel bar commonly used as a tension device to reinforce concrete) to drill the bamboo's internal nodes. This is

done by shoving the rebar in and out of the bamboo pole on one end, then the other. You should end up with a hollow tube.

2. **Drill some vapor holes.** Vapor builds up during the application of heat to the bamboo pole. In order to let the vapor escape, it is recommended that you drill a few holes at the nodes.

3. **Heat your bamboo.** Take your torch and begin applying heat to the pole with the flame, continually moving from the widest part of the bamboo, to the thinnest. The heat should be above boiling temperature. This achieves two things:[9]

- The heat coloring of the bamboo. Application of the heat acts as a stain on the bamboo and gives it a warm, coffee color.
- The lignin and pectin in the bamboo becomes soft and pliable allowing you to more easily mold the bamboo.

4. **Check the bamboo for flexibility.** Using a wet rag, sweep down the bamboo pole, wiping moisture over surface. Test the flexibility of the bamboo by bending the pole slightly. It should give fairly easily.

5. **Plug one end of your bamboo and fill it with fine sand.** Hit the bamboo with the side of your hand or the side of the small shovel to move the sand all the way to the bottom of the pole. The sand stabilizes the bamboo so the walls do not buckle when you bend it.

6. **Prepare to bend the bamboo pole.** Dig a hole in firm earth that is 6"-8" deep and slightly larger than the circumference of the pole. Holding it firmly for leverage, you are now ready to shape the pole.

- Begin by torching the pole again. Concentrate on the area you wish to bend, and keep the flame moving.
- Periodically wipe the pole with a wet rag. The water prevents the bamboo from drying out and becoming brittle. Dried bamboo can break or split easily.
- As you work the pole with the torch, begin to bend the bamboo pole into your desired shape.
- Repeat torching, bending, and dampening until you finesse the bamboo into the desired shape. This may take time. It is at this point that bamboo often splits, due to all of the stress it is under. The more time you take shaping the bamboo gradually,

7. **Enjoy your newly-bent, heat-colored bamboo pole!** These larger poles are used primarily for furniture, but can also be made into a variety of crafts.

| Self-Check 3 | Written test |
|---|---|

**Directions:** Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

**Part I. Write short answer**

**1._____** Take your ***torch and begin applying heat*** to the pole with the flame, continually moving from the widest part of the bamboo, to the thinnest.(2-point)

2. Write ***initial*** process of Bending Bamboo Using ***Heat***? (2- Point)

_____.

3. _____ method is frequently used by furniture makers to either correct a crooked piece of bamboo, or for creating a gentle curve or rounded edge. This technique can be used both on round bamboo canes or split bamboo. (2-point)

4. List dawn the three Shaping/Bending methods. (6-point)

***Nôte:*** **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

You can ask you teacher for the copy of the correct answers

Score = _____

Rating: _____

**Operation Sheet 1 – Shape materials using blower, chemicals, and jigs pressing equipment.**

**Objective: -** By using different types of hand tools to performing crushed bamboo ply and woven mat.

**Equipment tools and materials: -** A machete, Hand saw, Hand splitting knives, a Splitting machine, shovel, mallet hammer, knode removing and sizing equipment, raw bamboo.

**Operation Procedure 1:- Shape materials using heat/ blower.**

1. Prepare bamboo pole with the size of 35 mm diameter 1000 mm length to be bend,
2. By using round still bar drill the inter Knode to fill sand.
3. Drill a few holes at the nodes, In order to let the vapor escape,
4. Sketch out the shape you want your bamboo to take.
5. Take your torch and begin applying heat to the pole with the flame.
6. Test the flexibility of the bamboo by bending the pole slightly.
7. Fill sand in to the bamboo pole and sill both ends.
8. Begin by torching the pole again.
9. Periodically wipe the pole with a wet rag. Because to protect the bamboo is burn.
10. Repeat torching, bending, and dampening until you finesse the bamboo into the desired shape.
11. Finally make a curved shape with the diameter of 500 mm.

After confirmation, production can be continuous

**Information Sheet 4:- Produce component parts.**

## 1.1 Producing Component parts.

Depending on the design of the product, list the various components needed along with the accurate measurements. Mostly the bottom portion of bamboo culms is used for structural components ***(front legs and back legs),*** and depending on strength and design requirements, other parts of bamboo can be used as supporting frames, seat support, slats etc. This is also referred to as ***'Grading'*** (or selection of bamboo poles depending on the design).

Do marking on the bamboo poles as per the specification of each component using a measuring tape and pencils/markers.

***Note:*** *While selecting bamboo components, keep in mind the symmetry of the various components as per design and make the selection of bamboo components accordingly (in terms of diameter, wall thickness, surface etc.).*

*Discard the poles with any kind of blemishes or deformity.*

**Figure: - 3 producing Component parts.**

| Self-Check 4 | Written test |
|---|---|

**Directions:** Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

**Part I. Write short answer**

1. Mostly the bottom portion of bamboo culms is used for _____. (3-point)

2. Depending of design requirements, parts of bamboo can be used different parts. This is also called _____. (3-point)

3. Marking on the bamboo poles as per the specification of each component by using _____ and _____. (3-point)

***Nδte:*** **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers

Score = _____

Rating: _____

## Operation Sheet 1 – Produce component parts.

**Objective: -** By using different types of hand tools to performing Produce component parts.

**Equipment tools and materials: -** Hand saw, Hand splitting knives, meter, knode removing and sizing equipment, raw bamboo and scraper.

**Operation Procedure: - Producing Chair legs.**

1. Prepare bamboo pole with the size of 35 mm diameter and 900 mm length 2-pieces, and 40 mm diameter and 450 mm length 2- piece.
2. Remove the outer knode.
3. Scrap and clean bamboo poles,
4. Check the length,
5. Fill the inter knode with the solid wood.
6. Finally sand well by using the proper sand paper.
7. Store properly.

After confirmation, production can be continuous

**Information Sheet 5:- Make Component parts using carpentry and fabrication techniques**

### 1.1 Scraping/Knot Removal

Remove the knot portion using hand planer or machine (angle grinder) to smoothen out the surface. Then, using curved knife or scrapper, scrap the outer skin of bamboo pole (similar to scrubbing). This is best achieved when done manually.

### Marking for different kinds of joinery

Mark a straight reference line on the entire length of component using straightened bamboo slat or meter tape or wooden ruler. Mark the locations of joinery using measuring tape and pencils by keeping the straight line as reference. Marking aids are vital in making accurate joinery, assembly and thereby standardized product.

Depending on the design of the product and/or location of joinery, different methods or techniques are adopted (shown below).




### Filling inter-nodal part

On locations of joinery, fill the hollow inter-node portion of bamboo with split solid bamboo pieces or with other wood.

**Mortise and Tenon or Tongue and Groove Joinery**

**Mortise making**

After marking, use a chisel (Flat Chisel) and a mallet hammer to make the grooves on the bamboo. The depth of the groove should be slightly more than half of the diameter of bamboo.



**Tongue making**

To exactly fit the groove as well as the curvature of the bamboo, carve out the joint in the shape of a flat tongue / tenon with curved edges or shape similar to a fish mouth. Firstly use the hand saw to make a cut on both sides of the flat tongue, Secondly using the knife or chisel, scoop out the bamboo above the cut portions of bamboo.

The tongue should exactly fit in the groove to ensure strength / sturdiness of the product. While making joinery, number the components / joinery, (two components of joinery - tongue and groove should have the same number), for ease in assembly.

Please note, in locations where there is a need for joinery of two components, cut the edges of both the tongue to 45 degrees for an exact fit.




**Corner Joint / 45 Degree Joint**

Cut the edges of both components to 45 degrees, so that both the edges exactly fit each other.

**Round Hole Joinery**

Using round chisel or bench drill make hole until half the diameter of bamboo. Curve the other component of furniture to exactly fit the hole prepared.

| Self-Check 5 | Written test |
|---|---|

**Directions:** Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

**Part I. Write short answer**

1. The processes of removing the outer skin and cleaning the surface by using curved knife are called _____. (2-point)

2. _____ used us to make accurate joinery, assembly and thereby standardized product. (2-point)

3. _____should exactly fit in the groove to ensure strength of the product. (2-point)

4. Define Round Hole Joinery?
   (4-point)

***Note:*** **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

**You can ask you teacher for the copy of the correct answers**

Score = _____

Rating: _____

## Operation Sheet 1 – Produce Component parts using carpentry and fabrication techniques

**Objective: -** By using different types of hand tools Produce component parts.

**Equipment tools and materials: -** Hand saw, Hand splitting knives, meter, knode removing and sizing equipment, chisel, mallet hammer, raw bamboo and scraper.

**Operation Procedure: - Producing Chair legs and components part.**

1. Select material based on specification
2. Scrap and clean bamboo poles,
3. Mark and lay out based on specification,
4. Make mortise based on specification,
5. Make tenon joint based on specification,
6. Check the accuracy of joint,
7. Produce bamboo slates,
8. Produce bamboo nail.
9. Finally sand well by using the proper sand paper.
10. Store properly

After confirmation, production can be continuous

**Information Sheet 6:- Monitoring process.**

## 1.1 Introduction

**Planning and implementing a project monitoring**

Setting up a project monitoring system involves nine steps. These need to be considered in the planning stage and then fulfilled at project start-up and throughout project implementation.

**Steps in planning a project monitoring system**

(1) Assess the existing readiness and capacity for monitoring

(2) Establish the purpose and scope of Monitoring

(3) Identify and agree with stakeholders the project's outcomes and development goal(s)

(4) Select key indicators and an evaluation framework

(5) Set baselines and plan data collection and analysis

(6) Select results targets

(7) Plan monitoring, data analysis, communication and reporting

(8) Plan the form and timing of critical reflection and interim evaluations

(9) Plan for the necessary conditions and capacities

Key points for each of these nine steps are outlined below.

**(1) Assess the existing readiness and capacity for monitoring**

- Review current capacity within the organization and its partners which will be responsible for project implementation, covering: technical skills, managerial skills, existence and quality of data systems, available technology and existing budgetary provision.
- Identify any barriers to Monitoring of the project such as a lack of political will, expertise or experience.
- What other organizations such as universities, private consultants or government agencies have the capacity to provide technical assistance and/or training?

**(2) Establish the purpose and scope**

- Why is Monitoring needed and how comprehensive should the system be?
- What are national requirements with regard to Monitoring?
- In particular, what should be the scope and degree of rigour of the evaluation of final project impact?

- Should the Monitoring process be participatory? In planning and implementing project M&E it is important to recognize the potential benefits of stakeholder participation. There can be benefits from these at all stages of the project cycle including monitoring and evaluation.

**(3) Identify and agree with main stakeholders the project's outcomes and development objective(s)**

- Setting a development goal and the project purpose or expected outcomes is essential in building a monitoring system. In project design the specification of outputs, activities and inputs follows from this, and the expectation that achievement of outcomes will contribute to the higher level development goal(s) provides the justification for the project.
- In Monitoring design, indicators, baselines and targets are similarly derived from the setting of goals and outcomes.

**(4) Select key indicators and an evaluation framework**

- Indicators are the qualitative or quantitative variables that measure project performance and achievements.
- Indicators should be developed for all levels of project logic, i.e. indicators are needed to monitor progress with respect to inputs, activities, outputs, outcomes and impact, to feedback on areas of success and where improvement is required.

Each indicator initially selected for inclusion in the Monitoring programmer needs to be carefully scrutinized and tested before acceptance. Criteria against which indicators can be tested to ensure that they are suitable for inclusion are presented in.

- The evaluation framework sets out the methods to be used to address the question of whether change observed through monitoring indicators can be attributed to the project interventions. The depth and rigour of impact evaluation required for a specific project given available resources needs to be carefully considered. A range of approaches are possible, but all require careful planning in conjunction with the selection of indicators if data omissions and weaknesses are to be avoided, and valid and reliable results produced. Assuming use of an experimental or quasi-experimental evaluation design, determination of which population units will receive the intervention and which will not, and establishing baseline information for all units are two reasons for detailed planning of impact evaluation in advance.

**(5) Set baselines and plan data collection and analysis**

- The baseline is the first measurement of an indicator, which sets the pre-project condition against which change can be tracked and evaluated. A single point in time or current value may not be representative and it may be better to use an average, for example, for the three previous years if such data are available. Baseline data must be gathered for the key indicators and this may require implementation of a baseline survey unless existing data sources are adequate.
- Subsequent data gathering and repeat surveys for the implementation period of the project and beyond should then be planned. Data collection may be continuous or periodic depending on the nature and purpose of an indicator. A wide range of data collection methods are applicable. The analytical approaches that will be required to match the needs of managers for information and of the evaluation framework must also be considered. In projects concerned with land use changes, use of modern technologies such as remote sensing should be considered.
- Ideally there should be sufficient capacity and resources to allow *ad hoc* special studies or investigations to be carried out to address specific problems or issues revealed by the on-going evaluation of monitoring data. These will be one-off, focused investigations of the issue at hand.

**(6) Select results targets**

- Following definition of outcomes, indicators and baselines, target setting is a key step in building a results-based approach. A target is a specification of the quantity, quality, timing and location to be realized for a key indicator by a given date. Starting from the baseline level for an indicator the desired improvement is defined taking account of planned resource provision and activities, to arrive at a performance target for that indicator. Most targets are set annually, but some could be set quarterly or for longer periods. Targets do not have to be single numerical values and sometimes a range of achievement may be more appropriate. Targets should also be kept under review and revised flexibly as necessary to take account of changing resource availability or other factors beyond the control of project management, but not to disguise poor project performance.

- It is important to be realistic, taking account of what is feasible and being sensitive to the political issues associated with targets that are publicly announced. As outcomes are typically longer term it is usually necessary to establish targets as short-term objectives on the path to achievement of an outcome. For project management, targets for 'leading indicators' are particularly useful. Interim targets over shorter time periods for which inputs can be better known or estimated, and set with reference to desired outcomes and impact, are also important for process-orientated interventions for which work plans and resource provision are not fully planned in detail in advance.

**(7) Plan monitoring, data analysis, communication, and reporting**

- Implementation monitoring' tracking the inputs, activities and outputs in annual or multiyear work plans, and 'results monitoring' tracking achievement of outcomes and impact, are both needed. The demands for information at each level of management need to be established, responsibilities allocated, and plans made for:
  – What data to be collected and when;
  – How data are collected and analyzed;
  – Who collects and analyses data;
  – Who reports information, and in what form, to whom and when?
- An assessment of the flow of information and degree of detail needed by each level of management will help to clarify the indicators to be measured. The agency managing the project will require different types of information for its own internal management, compared to the reporting requirements of higher levels of government and development agencies.

**(8) Plan the form and timing of critical reflection and interim evaluations**

- For managers evaluation should be a continuously available mode of analysis utilized whenever evaluation results can be useful. Scheduling of events such as management team meetings can, however, be useful to ensure that analysis of progress and critical reflection takes place. Similarly, periodic project review workshops to facilitate analysis and discussion with project partners and other stakeholders may be necessary. Supervision requirements of governments and funding agencies may require periodic and formalized evaluations to take place. The data needs and analysis requirements for mid-term, terminal and ex post evaluations should be considered, and planning for these

linked to the planning of monitoring and choice of evaluation framework. A timetable of formal evaluation reports should be set out.

- An indication also needs to be given at the design stage about feedback mechanisms for evaluation results beyond donor formalities such as mid-term and completion reviews. This is linked both to the development of accountability within the project, sector and higher levels of government, and the need to provide information to support decision-making. For example, flows of information may need to be timed to fit into national budget planning

  Activities, and should inform and influence identification and appraisal of any similar future projects or programs.

**(9) Plan for the necessary conditions and capacities**

- It is necessary to plan the organizational structure for Monitoring including whether a Monitoring unit specific to the project is needed. Appropriate organizational structures for M&E should be discussed with partners and other stakeholders. Each partner's responsibilities and information requirements should be considered. Planning should cover: staffing levels and types, responsibilities and internal linkages, incentives and training needs, relationships with partners and stakeholders, horizontal and vertical lines of communication and authority, physical resource needs and budget.
- Monitoring should normally be the responsibility of the project managers. Impact evaluation may often require the expertise and capacity of external specialists.

| Self-Check 6 | Written test |
|---|---|

**Directions**: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

**Part I. Write True or False.**

1. Monitoring is useful for identifying problems early within the progress of a project. (2-point)
2. Impact assessment can be considered to be a type of evaluation.(2-point)
3. Evaluation can only be carried out at the mid-way point and end of a project. (2-point)

**Part II. Write short answer.**

4. List nine steps a project monitoring system involves. (4point)

**a.** _____
**b.** _____
**c.** _____
**d.** _____
**e.** _____
**f.** _____
**g.** _____
**h.** _____
**i.** _____

***Nδte:*** **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

**You can ask you teacher for the copy of the correct answers**

Score = _____

Rating: _____

**Information Sheet 7:- Checking and minimizing waste.**

### 1.1. The Four Principles of Waste Reduction

Simple lifestyle changes can make a significant different in the amount of waste you produce. Individual consumers can substantially reduce waste by following these basic principles:

**REDUCE** the amount of trash discarded.

- Reduce the amount of unnecessary packaging.
- Adopt practices that reduce waste toxicity.

**REUSE** containers and products.

- Consider reusable products.
- Maintain and repair durable products.
- Reuse bags, containers, and other items.
- Borrow, rent, or share items used infrequently.
- Sell or donate goods instead of throwing them out.

**RECYCLE** use recycled materials, and wastes.

- Choose recyclable products and containers and recycle them.
- Select products made from recycled materials.
- Compost yard trimmings and some food scraps.

**RESPOND** to the solid waste dilemma by reconsidering waste-producing activities and by expressing preferences for less waste.

- Educate others on source reduction and recycling practices. Make your preferences known to manufacturers, merchants, and community leaders.
- Be creative — find new ways to reduce waste quantity and toxicity.

| Self-Check 7 | Written test |
|---|---|

**Directions**: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

**Part I. Write short answer**

1. List dawn four principles of west reduction. (4-points)
   a. _____
   b. _____
   c. _____
   d. _____

2. _____ is the amount of trash discarded. (2-points)

3. List dawn the reconsidering solid waste dilemma waste-producing activities and by expressing preferences for less waste by. (4-points)
   - _____
   - _____

***Note:*** **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

**You can ask you teacher for the copy of the correct answers**

Score = _____

Rating: _____

| LG #16 | LO3. Clean up |
|---|---|

**Instruction sheet**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Collecting and storing reusable materials
- Removing waste and scrap
- Tagging unserviceable equipment and identifying fault
- Accomplishing Necessary documentation

This guide will also assist you to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, you will be able to:

- Collect and store reusable materials
- Remove waste and scrap
- Tag unserviceable equipment and identify fault
- Accomplish Necessary documentation

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

**Information Sheet 1:- Collecting and storing reusable materials.**

## 1. Introduction

Recycling raw materials saves unnecessary demanding of our forests, conserving a valuable living resource. By removing used materials from going into the waste bin your business could benefit from a reduced total waste disposal charge. Your business may also be able to reuse the material or sell the better pieces of this salvaged material. Raw material that is not chemically treated or painted can be reused for a tremendous range of applications, including construction and furniture making.

Material such as bamboo, dimensional lumber, stumps and limbs are readily recyclable. Material that has been treated (with creosote, for example), painted, stained or contaminated is not appropriate for recycling and should be properly disposed of.

## 2. Benefit of re-using

Re-using site collected materials can play a key role in saving costs on a project by avoiding use of materials and reducing waste disposal costs.

Seizing opportunities to re-use materials can lead to a more cost-efficient project outcome with improved performance for contractors and clients.

***Key benefits that adopting re-use on-site can deliver, include:***

- Reduced waste disposal costs covering both transportation and disposal;
- Avoidance of primary material use reducing cost of build;
- Evidence to support external and internal environmental management systems.
- Raised staff awareness of re-use opportunities for future projects; and
- Good publicity and industry recognition for achievements and potential to differentiate your business from the competition.

***Cost savings associated with re-use of site collected materials can include:***

- Reduced need to purchase new materials: cost savings associated with recovery and re-use of items from demolition, e.g., bricks, ornamental objects, high value materials;
- Savings from reduced waste management costs; and

- Positive publicity, e.g., contribution to local community projects or wider national community / sustainability initiatives.

| Self-Check - 1 | Written test |
|---|---|

**Directions:** Answer all the questions listed below. Examples may be necessary to aid some explanations/answers. (2 points each)

**Test I Short Answer Questions**

1. Explain benefit of re-use.
   _____
   _____
   _____
2. Explain how to store un used and cut off materials to store
   _____
   _____
   _____

***Note:*** **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

**Information Sheet 2:- Removing Waste and scrap.**

## 1.1 Introduction

**How to Reduce Scrap and Save Money**?

Manufacturing scrap is often considered certainty, something that just happens as a natural consequence of the manufacturing process. While some manufacturing waste from scrap production is inevitable, scrap production can actively reduce from your company's bottom line.

**In what way** the scrapping of whole parts of the way through production wastes the materials and labor spent on the manufacturing process. In a best-case scenario, the scrapped part can be refinished and put to use (meaning only some time and labor is lost). However, in a worst-case scenario, the part may have to be thrown out entirely to be recycled into raw materials (assuming the part can be recycled). This can be incredibly wasteful of both resources and valuable manufacturing time.

So, eliminating scrap in the manufacturing process is an important part of lean and competitive manufacturing processes. How can you reduce manufacturing waste and scrap in your parts making processes? Here are a few ideas that you may be able to employ in your own production line:

**Scrap Reduction Tip #1: Minimize Manual Handling of Delicate Parts**

Marlin Steel's manufacturing team use factory automation for a great number of reasons, including safety. Not just for the workers themselves, but for the parts that are being assembled—which helps to minimize manufacturing scrap from damaged parts.

How does automation help eliminate scrap in manufacturing processes?

First, machines don't get sick or tired the way manual laborers do. A machine doesn't get a muscle spasm because of a repetitive motion stress injury or sneeze and drop a multi-thousand-dollar load of small, delicate, no-scratch parts all over the floor.

If you can set up a machine to handle a given task in a way that doesn't risk damage to the parts you manufacture, then automating that process is often the best option. Not only will

you save money on reprocessing your parts, you'll improve your time to market by getting parts right the first time.

This is often easiest when your production process uses specialized steel wire baskets to hold parts from one phase of your process to another, which helps to limit physical contact with your delicate manufactured parts.

**Scrap Reduction Tip #2: Use the Right Metal Forming Tool for the Job**

Reducing scrap in manufacturing processes means more than just making cuts efficiently it requires using the right tool for the job to maximize efficiency. The tools and techniques you use to shape metal forms go a long way towards reducing the amount of excess scrap that is created during your manufacturing process.

**For example,** here at Marlin Steel, we use a number of different machines to cut and shape steel sheet metal, including:

- A CNC Metal Punch. With the Trumps CNC punch, Marlin Steel can both cut and make bends in sheet metal forms. For large work pieces, the ability to make bends at the cut site can help to conserve materials and production steps for more complicated sheet metal forms—which helps minimize manufacturing scrap.
- A Cutting Laser. Laser cutters such as the 1030 allow for incredibly precise cuts to be made in sheet metal with very smooth edges. When cutting shapes out of a sheet metal plate, laser cutters can make cuts incredibly close to one another, maximizing the number of forms that can be made from a single plate of sheet metal and minimizing manufacturing waste.

The choice of machine to use depends on a number of factors, such as whether or not the sheet metal needs to be bent into specific shapes. By choosing the right tool for the job, scrap can be kept to a minimum.

Other tools that you might want to take a closer look at include the containers that you use to hold your parts through the production process. Inefficient container designs contribute to part damage and scrap production during late-stage production processes such as ultrasonic parts cleaning or heat treating.

Sometimes, eliminating scrap may be as simple as revising the design of your parts cleaning baskets for better handling of parts.

**Scrap Reduction Tip #3: Keep Employees Trained and Motivated**

No matter how heavily you've invested in factory automation, your people are still key to your company's success. It's your workers who set up, operate, and maintain the machinery that you use to meet your production goals. Keep their skills up to date while motivating them to find ways to improve efficiency is a key part of eliminating scrap.

How so? Here's a hypothetical scenario:

Say that you have a part that you need to produce, and want to optimize the process to eliminate scrap and save money. You hand the task of creating the part to two teams of workers, team A and team B.

Team A consists of workers who have trained with all of your manufacturing equipment and have detailed knowledge of manufacturing processes and the mechanical properties of the materials you work with. Team B has no such experience or training.

Which team would you expect to be more successful at eliminating waste in the production process and staying on task?

The team with the greater knowledge and training will naturally be better at reducing scrap and other forms of waste that cost your company money. They'll make smarter use of your resources, and not have to go through nearly as many "trial and error" experiences to find out what does and does not work.

Finding ways to keep these employees motivated to reduce scrap is another challenge altogether.

One method that Marlin Steel has had success with is the use of a performance-based bonus program that rewards employees for meeting aggressive production goals. These goals are difficult, if not impossible, to meet with wasteful processes, so employees are motivated to seek efficient solutions to production challenges that reduce scrap.

**Reducing Scrap Tip #4: Consider the Containers for Your Products**

It happens all the time freshly-made parts go into one end of an ultrasonic parts cleaning or parts finishing process, and scratched-up junk comes out the other end that has to be scrapped. This is often because the containers used to hold the parts aren't built in a way

that properly protects the parts they hold. Instead, they were built on the cheap to fulfill a basic operating requirement.

The problem with these simple container designs is that they fail to take into account the specifics of the manufacturing process and the design of the parts they hold. This leads to an increase in damaged parts that have to be scrapped. So, these “money saving” baskets end up costing more in the way of manufacturing scrap and wasted time than they save in up-front expenses.

Using a custom wire basket or sheet metal form that is optimized for the specific manufacturing application is crucial for eliminating scrap from parts damage. For example, adding a soft polymer coating to an ultrasonic cleaning basket can prevent metal-to-metal contact during the cavitation process eliminating the risk of scratches and dents that cause parts to be scrapped or need remanufacturing.

| Self-Check - 2 | Written test |
|---|---|

**Directions:** Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

**Part I. Write short answer**

1. Write four of west reduction methods. (4-points)

2. Using a custom wire basket or sheet metal form that is optimized for the specific manufacturing application is crucial for eliminating scrap from parts damage. (2-points)
   A/ true B/ false
3. Eliminating scrap may be as simple as revising the design of your parts cleaning baskets for better handling of parts. (4-points)
   A/ true B/ false
4. Parts finishing process, and scratched-up junk comes out the other end that has to be _____. (2-point)

***Note:*** **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers

Score = _____

Rating: _____

**Information Sheet 3:- Tagging unserviceable equipment and identifying fault.**

## 1. Introduction.

Preventing the breakdown of a machine is much better than having to fix it after the event. A lot of time and money is spent on setting up an effective preventative maintenance schedule to avoid breakdowns. However, even with the best preventative maintenance program in the world, breakdowns will occur. When this happens qualified maintenance personnel are usually called in to make any repairs. The first step towards maintaining an effective preventative maintenance program is to have a running maintenance program and reporting procedures in place. An important part of any running maintenance program is identifying faults and using an appropriate sign system, called tagging, on faulty machines and equipment.

- Describe the process by which unsafe plant and equipment is:
  - ✓ Identified;
  - ✓ Withdrawn from service; and
  - ✓ Returned to service after being made safe.

## 2. Identifying problems

Identifying faulty equipment and machinery is part of both preventative and running maintenance. Problems are considered to be either major or minor. Deciding what kind of problem exists will determine what kind of maintenance needs to be carried out.

### ✓ Major problems

Major problems are all maintenance tasks that need specialist maintenance personnel to fix them. The problem may be a complete breakdown or an occasional malfunction. If you think that a major problem exists there is usually a procedure to follow for reporting the problem.

### ✓ Minor problems

Minor problems do not require specialist personnel. Machine operators or other trained staff are usually able to deal with them. A minor problem may be present if:

- ✓ The machine operates but production levels are reduced, or
- ✓ The quality of output is affected.

**Common Terms**

- ✓ **Authorized person**

A person authorized by the local manager/supervisor, who is sufficiently competent to make the plant or equipment safe to use, or confirm that the plant or equipment has been made safe to use.

- ✓ **Danger tag**

A label/sign that identifies that cleaning, servicing, repairing or alteration is being undertaken on isolated installations, plant or equipment.

- ✓ **Out-of-service tag**

A label/sign attached to plant or equipment that indicates the plant or equipment is faulty or unsafe to operate and is currently out of service.

## 3. Tagging equipment

When a machine breaks down or is faulty it must be locked out and tagged with a sign that can be easily seen by workers. This sign should be a clear warning to workers that the machine cannot be used until the necessary maintenance has been carried out.

### ✓ Locking out

Locking out of equipment or machinery is the most effective way of preventing accidental operation while maintenance is carried out. Locking out is effective because it uses a "one key per lock" and "one lock per person" system. If there is only one key per lock, the key has to be with the person carrying out the maintenance. Where more than one person is working on equipment or machinery a multi-lock system should be used. Each person must attach a 'personal' lock to the equipment or machine's multi-lock switch.

✓ **Tagging**

There are two types of signs or tags used to warn workers that machines cannot be used: Danger tags and Out of Service or Caution tags.

These tags are used to indicate that the situation may constitute a hazard. They must be used in specified ways and whenever a machine or equipment has been identified as faulty or has broken down.


## 4. Steps of tagging

- **Tagging and removing faulty plant and equipment**

The Head of Division must ensure that staff and students have access to suitable resources, including access to out-of-service tags, for implementation of this procedure. Staff members or students who become aware of plant or equipment which is faulty or unsafe to use must:

- ✓ Turn off or de-energise plant or equipment, if safe to do so;
- ✓ Make safe the plant or equipment;
- ✓ Complete an out-of-service tag, ensuring that the tag describes the:
  - Plant or equipment that is out of service;
  - Reason the plant or equipment is out of service;
  - If applicable, conditions under which the plant or equipment can be used safely;
  - Name of the person completing the tag; and
  - Date;
- ✓ Place the completed out-of-service tag on the plant or equipment at:
  - The point of isolation from the energy source; or
  - The main control panel; or
  - A prominent position;

- ✓ Notify the manager/supervisor responsible for the plant or equipment; and
- ✓ Make arrangements (directly or through the manager/supervisor) for the plant or equipment to be repaired or removed from the work area.

Unless authorised, no person may use plant or equipment that has been tagged with an out-of-service tag or remove the tag.

- **Out-of-service tag**

An out-of-service tag must list the:

- ✓ Plant or equipment that is out of service;
- ✓ Reason the plant or equipment is out of service;
- ✓ If applicable, conditions under which the plant or equipment can be used safely;
- ✓ Name of the person completing the tag; and
- ✓ Date.

- **Returning to service**

The authorised person returning the plant or equipment into service must:

- ✓ review the reason why the plant or equipment was removed from service;
- ✓ repair or otherwise make safe the plant or equipment, or confirm that the plant or equipment has been repaired or otherwise made safe;
- ✓ document any repair works undertaken and declare that the plant or equipment is safe to return to service; and
- ✓ Hand over the plant or equipment to the local manager/supervisor or delegate.

- **Removing the tag**

An out-of-service tag may only be removed under the following conditions:

- ✓ the authorised person has repaired or otherwise made the plant or equipment safe to use;
- ✓ the authorised person has confirmed that the plant or equipment is safe to use; and
- ✓ the manager/supervisor, after consulting with the person who initially placed the tag, confirms that the plant is safe to use.

| Self-Check – 3 | Written test |
|---|---|

**Directions:** Answer all the questions listed below. Examples may be necessary to aid some explanations/answers. (2 points each)

**Test I Short Answer Questions:**

1. define major problem
   _____
   _____
2. explain Minor problems
   _____
   _____
3. what is Danger tag
   _____
   _____
4. What is Out-of-service tag
   _____
   _____

***Note:*** **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

**Information Sheet 4 – Accomplishing necessary documentation.**

## The Importance of Documentation

Documentation plays a serious role in any management setting. Documentation helps assure continuity of care. There are many important moments in management. Proper documentation can help the practitioner to recall serious moments. Behaviors and emotions can help tell a story; being able to discover patterns can help to uncover reasons for certain behavior. Documentation is a very simple tool to help any practitioner is unveiling patterns. It can help track the progress in addressing thought patterns and unhealthy behaviors. If a practitioner isn't utilizing the tool of documentation it would prove to be very difficult to make continual progress on any one area, let alone multiple areas.

Thorough documentation helps to assist the client's subsequent care. It's important for practitioners, who may serve the client down the line, have proper information. Without meaningful documentation, it would prove difficult for any future practitioner to continue timely progress. As I mentioned earlier, it is important to identify patterns and track the clients progress; if the new practitioner isn't aware of the knowledge, insight, and progress you have made, it would be a hindrance to any further progress until the practitioner is able to discover and the learn the insight on their own. This is not only a determent to the subsequent practitioners but to your client as well.

In every field, it's important to minimize as much risk as possible. Documentation is a great tool in protecting against lawsuits and complaints. Documentation help ensure consent and expectations. It helps to tell the narrative for decisions made, and how yourself or the client responded to different situations. In this same manor, it is important to record information that can help support the proper treatment plan and the reasoning for such services. There are many legal and regulatory requirements in this field, and proper documentation helps to maintain compliance. If documentation isn't up to par it could affect licenses and or accreditation. It would be difficult to defend or explain one's actions to a licensing board without the supporting documentation.

Any professional is always looking for ways to improve, or a better approach, a more successful course of treatment, or fresh ideas to tackle ongoing problems. Documentation is crucial in achieving these measures. When something is successful it's important to

document the approach and results so it can be replicated. Documentation will help determine if these were isolated results or a possible approach to treatment that could continually produce successful outcomes.

One of the most important issues close to me is the quality of care. Documentation is the only long term way to assure the quality of care is not only maintained but consistently improved. If there are problems or issues that are hindrance to providing quality service, it's important to document it and the progress in rectifying them. When something is identified to be problematic it's crucial to create effective preventative measures.

Having worked for some time in utilization review documentation is the single most important tool. Documentation helps to determine if services are being productive and should continue. On the flip side, if documentation is lacking it's next to impossible to defend the continuation of treatment. Many clients rely on insurance to be able to afford treatment and other services. If documentation cannot support the services being provided it is the client who suffers when they no longer can have a means to pay for such services. It's proven difficult to present a case to continue treatment when there isn't enough documentation supporting it. Providers want to see the treatment being successful and if not what the plan is.

Recently, providers have switched from a fee based model, to a performance based fee. What's so unique about this approach is it takes into account more than a single client. It looks at services provided as a whole. This is important to recognize because documentation is the only way to truly measure results over a long period of time. It's interesting how much documentation effects. I have multiple discussions with other professionals and personally I feel and practitioner who doesn't produce accurate and proper documentation is failing their clients. Documentation assures the client is receiving the best possible treatment; it can determine the availability for funds to afford the treatment. Documentation is part of the treatment process itself. If documentation isn't being done, or is inadequate it's easy to determine the client isn't getting the best possible treatment because an integral part of the treatment process isn't being completed.

Another role documentation plays is the collaboration among team members. Often clients are seen by multiple members of the same team. One team member needs to be able to see what other members have discussed, or begun working on. They need to be able to see what goals the client is working on, and where they are in that process. Every team member has

specific specialties and documentation helps assure they can maximize the quality of the services they provide.

To sum everything up, documentation is one of the most vital parts in the course of treatment. It has a vast multitude of purposes. It assures the quality of services rendered, the continuity of care, and protections for the client, as well as the practitioner. It maintains compliance for legal and accreditation purposes. It helps to direct the course of treatments as well the ability to afford such treatments. Documentation plays so and integral part in any practitioner's process, it would wise to maximize the usefulness of documentation. Documentation is so important in any treatment process; the lack of documentation not only may seem negligible but could quite possible be deemed negligible. It is impossible to plan a course of treatment without proper documentation. It would be able to measure the growth or progress in treatment without solid documentation. It's unfair to the client, your team members, and any future practitioners.

Another way to look at documentation is to echo the old philosophical question; if a practitioner renders services and there is no documentation to support it, did it happen?

| Self-Check – 4 | Written test |
|---|---|

**Directions:** Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

**Test I Short Answer Questions:**

1. _____ helps the practitioner to recall serious moments. (2-points)

2. Documentation is a great tool in protecting against _____ and _____. (2-points)

3. Documentation is a part of the treatment process itself. (2-points)

   **A/ true** B/false

4. Write four importance of documentation? (4-points)

   A, _____.
   **B,** _____.
   **C,** _____.
   **D,** _____.

***Note:*** **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____