



FURNITURE MAKING

NTQF Level - 1

Learning Guide # 8

Unit of Competence: - Operate Basic Wood working Machines

Module Title: - Operating Basic Wood working Machines

LG Code: - IND FMK1 LO1-LG-23

TTLM Code: - IND FMK1 TTLM 2019v1

LO1. Prepare for work

Instruction Sheet	LEARNING GUIDE
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This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- OHS requirements: ventilation
- Identify work instructions
- Select materials Quality & quantity

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to** –

- 1.1 identify Work instructions are use to job requirements, including quality, materials, equipment, and quantities
- 1.2 **Workplace health and safety requirements**, including ventilation requirements and personal protection needs, are observed throughout the work
- 1.3 **Material** for machining is select and inspect for quality
- 1.4 identifies and checks **Tools, equipment** and machines, cutting tools and jigs

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 6.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed.
Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” **in page -. 07**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

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Introduction

What is safety & care?

- ☞ Safety is the first essential requirement and every personnel must learn the safety measures even before he starts working on a machine or on equipment.
 - ☞ Safety is an attitude, a form of mind of worker. If the attitude of worker towards safety is good and he is safety conscious, then he himself will develop the safe working habits.
 - ☞ Before you can use equipment and tools or attempt practical work in a workshop you must understand basic safety rules. These rules will help keep you and others safe in the workshop.
- In general, personnel in the various wood workshops of the TVET know by long training how to use workshop tools, machine tools and equipment. Only trained and competent persons should be admitted to these wood workshops and permitted to operate equipment & tools. Untrained personnel should be discouraged from using workshops unless they have acquired some degree of proficiency as determined by the workshop supervisor.
- Safety is a precaution to avoid accident.
 - Care is a technique of properly handling tools, equipment & materials.

General Safety Rule

General safety rule is very important to reduce the accident while you working in workshop. Some of them are listed below,

- ☞ Always dress properly: - Dress properly for your work. While you must wear your aprons are provided so that you can work on the machines. Remove any jeweler, neckties, chains, bracelets, and rings. Roll up your sleeves and tie any hair back in a ponytail before beginning any work
- ☞ Follow directions:-understanding the procedures of using by hand tools & machines.
- ☞ Keep the shop clean: - Keep the floor clear of debris and sawdust the floor should be clear of scrap blocks, excessive material, and sawdust. Keep projects, sawhorses, and other equipment and materials you are using out of travel lanes.

- ☛ Learn to use the tools correctly-Understanding using of hand tools in proper ways.
- ☛ Don't fool around

Personal Safety

- ⇒ **Stay alert** Do not use a power tool while tired or under the influence of drugs, alcohol, or medication. A moment of inattention while operating power tools may result in serious personal injury.
- ⇒ **Dress properly:** - Do not wear loose clothing or jewelry. Contain long hair. Keep your hair, clothing, and gloves away from moving parts. Loose clothes, jewelry, can be caught in moving parts.
- ⇒ **Use safety equipment.** Always wear eye protection. Dust mask, non-skid safety shoes, hard hat, or hearing protection must be used for appropriate conditions.

Causes of Accidents

The accidents may take place due to **human causes**, **environmental causes** and **mechanical causes**. These causes are discussed as under.

Human Causes

1. Unsafe or dangerous equipment rotating, reciprocating and moving parts.
2. Operating machines without knowledge, without safety precautions, without authority, without safety devices.
3. Accidents generally occur while operating or working at unsafe speed.
4. Accidents may occur while working for long duration of work, shift duty etc.
5. Accidents may occur while working with mental worries ignorance, carelessness, tension, dreaming etc.
6. Accidents occur because of not using personal protective equipment.

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Environmental Causes

1. Accidents may occur during working at improper temperature and humidity causes fatigue to the workers so chances of accidents increases with workers having fatigue.
2. The presence of dust fumes and smoke in the working area may causes accidents.
3. Poor housekeeping, congestion, blocked exits;
4. Accidents occur due to not enough light.
5. Improper ventilation in the plant may also leads to industrial accidents.

Mechanical Causes

- ↗ use by old, poor maintained or unsafe equipment may result in accidents.
- ↗ use of unguarded or improper guarded machines or equipment.
- ↗ Unsafe processes, unsafe design and unsafe construction of building structure may lead to accidents in the place.
- ↗ Accidents occur due to improper material handling system and improper plant layout.
- ↗ Accidents may occur due to not using of safety devices such as helmets, goggles, gloves, masks etc.

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Self-Check -1	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. . Who should you notify for an unsafe condition?
A. Supervisor B. Safety officer C. Division officer D. Commanding officer
2. Do not allow power cords to kink or come in contact with oil, grease, or what other item?

A. Non-skid B. Hot surfaces C. The machinery D. Another electrical cord
3. 3, . When safety shoes are designed to prevent sparks from causing an explosion, what item is removed?

A. The heel B. Shoelaces C. Steel toe plate D. Metallic nails
4. . In the protective helmet, what factor minimizes injuries from falling objects?

A. The fiberglass bill B. The electrical rating C. Shock-absorbing suspension D. The construction shape
5. . What safety item is a must when working in high places?

A. Gloves B. Helmet C. Hearing protection D. Safety belt and safety strap

Note: Satisfactory rating - 3 points

Unsatisfactory - below 3 points

Answer Sheet

Name: _____

Score = _____
Rating: _____

Date: _____

Short Answer Questions

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Information Sheet-2	Identify work instructions
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Identify work instruction

Work instruction is the procedural way of the task and also the sequential order of work when the trainee makes different projects with the wood working machine in wood work shop. the primary activities prior to take any action should be put safety first and efficiency follows, whatever the operation, the safe way is the right way and the efficient way

The followings are some working instruction

- ◆ Know the safe procedures before operating any machine;
- ◆ Make sure all guards and safety devices are functioning;
- ◆ Ensure that the machine's exhaust system is properly working;
- ◆ Avoid reaching across moving machine parts;
- ◆ Limit your conversation while the machine is running;
- ◆ Do not force stock into the machine;
- ◆ Stop the machine completely before removing jammed stock;
- ◆ After turning off the power, do not attempt to stop the motion of the cutting edges with a stick or your hand.
- ◆ Know the locations of all emergency switches;
- ◆ Avoid horseplay;
- ◆ Wear approved eye protection;
- ◆ Get first-aid treatment for even the slightest cut or scratch.

Self-Check -2	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is work instruction?
2. What is the benefit of work instruction?

Note: Satisfactory rating - 3 points

Unsatisfactory - below 3 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Short Answer Questions

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Information Sheet-3	Select materials Quality & quantity
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1.2 Select materials

Material selection is a step in the process of designing any physical object. In the context of product design, the main goal of material selection is to minimize cost while meeting product performance goals. Systematic selection of the best material for a given application begins with properties and costs of candidate materials

Material selection is a difficult task. Regardless of whether the material in question is wood, metal, stone, or plastic, selecting the proper material for a given application is a complex process. Before one even begins thinking about the materials, one must consider the requirements of the manufacturing processes involved, cost targets (and constraints), environmental concerns (in-use and post use), regulatory agency requirements, and often cultural and political considerations as well.

However, material selection is not about finding the “best” possible material for an application. Rather, it is about finding one or more suitable materials that—in combination with an effective design, proper processing, and eventual integration into a final system—result in a product that meets its intended use and satisfies (and hopefully delights) the needs of the end user. Far too often, in our quest to find the best material, we often forget that the real goal is to make the best possible product. The ultimate goal of effective material selection is to optimize the performance of the product itself. While this may seem like a trivial statement, it is an important one.

Need for a Material Selection Procedure:

- ☐ Large number of materials developed
- ☐ Newer Processing Techniques
- ☐ Material-Shape-Process-Function is inter-related

Quantity

After the scope has been analyzed and broken down into construction tasks, each task must be quantified prior to pricing. Equal emphasis should be placed on both accurate quantity calculation and accurate pricing. Quantities should be shown in standard units of measure and should be consistent with design units

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Self-Check -3	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is material selection mean?
2. The procedure of material selection?

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Score = _____

Rating: _____

Name: _____

Date: _____

Short Answer Questions

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FURNITURE MAKING

NTQF Level - 1

Learning Guide - # 8

Unit of Competence: - Operate Basic Wood working Machines

Module Title: - Operating Basic Wood working Machines

LG Code: - IND FMK1 LO2-LG-24

TTLM Code: - IND FMK1 TTLM 0919v1

LO2. Operate machines

Instruction Sheet	LEARNING GUIDE
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This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Basic wood working machines
- Check safety equipment
- Set and adjust machines in accordance with manufacturers’ instructions
- Operate machines in accordance with manufacturers’ instructions/in standard
- Methods of minimizing wastes
- Defected machines reported

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

Prepare work place

Personal safety

Work place safety

Accident

Causes of accident

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 6.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask your teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” **in page 40**
5. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
6. Submit your accomplished Self-check. This will form part of your training portfolio.

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INTRODUCTION

Wood working Machines used in woodworking and the machine of wood working is very dangerous, particularly when used improperly or without proper safeguards. Workers operating woodworking equipment suffer the following common injuries: laceration, taking away, disengaged fingers, and blindness. Wood dust and the chemicals used in finishing are health hazards, and workers in this industry can suffer from skin and respiratory diseases in the module understand operation of wood work machine.

2 Types of basic wood working machines

Basic wood working machines are classified in to five depending on the function. Those are

1: Sawing machines;

- Table saw machine
- Radial arm saws
- Band saws

2: Planning machines

- Jointer planers
- Thicknesses planers

3: drill machines;

- Bench type drill
- Floor type drill

4: Sanding machines;

- Stroke sanders
- Edge sanders
- Disc sanders
- Belt sanders
- Edge sanders

5: Grinding machines;

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2.1: Circular saws machine

Table saw machine is one of the wood working machines that can be found in all workshops. Circular saw machine is used for ripping, cross cutting, beveling, chamfering, mitering, & grooving.

The universal and variety circular saw:

Universal circular saw machine r are is saw that has two arbors so that ripping and cross cut can be mounted at the same time, it designed the heavy work;

Varity has single arbor when changing from ripping to and saw blade changed cross cut the machine must be stopped and saw blade (inter changeable blade). it design the medium work

Table saw

saw is basically made up of a smooth, heavy work surface, a saw which is operated by a motor, a handle for raising and lowering the saw blade, a handle for adjusting the angle of the blade, and a connection for collecting the debris produced whilst cutting.

Collectively A table saw is a versatile machine consisting of a circular saw blade, mounted on an arbor, that is driven by an electric motor (either directly, by belt, or by gears). The blade protrudes through the surface of a table, which provides support for the material, usually wood, being cut. The depth of the cut is varied by moving the blade up and down: the higher the blade protrudes above the table, the deeper the cut that is made in the material

A table saw Size

The size of table saw machine is indicated by the diameter of the cutting tools (circular saw blades) that are mounted (clamped) on the machines. Accordingly, the typical sizes or diameter of the saw blades to be mounted on the machines are 250, 300, 400, or 500mm.the greater the diameter of the saw blades, the larger is the table.

How to remove and replace the blade



To remove the blade:-

1. Disconnect the power
2. Remove the throat plate
3. Select a wrench that fits the arbor nut.
4. Loosen the arbor nut.

Note: arbor nut is loosened in the same direction that the saw blade rotates or by turning it in the direction the teeth are pointing

5. Remove the nut, collar and the blade.

Replacing the circular saw blades:

The following are the steps to be followed for replacing the circular saw blades.

Steps:

1. to replace the circular saw blades, reverse the procedures for removing
2. Make sure that the teeth of the blades point toward the operator
3. Replace the collar and tighten the nut securely.

Note: the arbor nut is tightened against, or opposite, the rotation of loosening during operation.

4. Rotate the blade by hand to make sure that it is running clear.
5. Replace the plate or metal insert.

What should you avoid when working with a table saw?

Do not saw freehand. Always hold the stock firmly against a rip fence to position and guide the cut.

- ✓ Do not reach around and over moving blades.
- ✓ Do not feed the work piece faster than the saw can accept.
- ✓ Do not leave a saw running unattended. Turn off the power and make sure the machine has stopped running before leaving the area.

Avoiding kickback

Kickback happens when the blade catches the work piece and violently throws it back to the front of the saw, towards the operator. It can be thrown very hard and can injure the operator. It is not uncommon for the object to have high enough velocity to become embedded in a wall or to cause other damage or injury. **Never stand** in a direct line between the blade and the fence when ripping narrow stock. A kickback can be fatal.

Kickback happens when ripping if:

1. The wood pinches the blade because of internal stresses.
2. The wood is allowed to rise up or moved sideways during a cut, then

Pushed back down, taking too big a bite at the top of the blade.

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Kickback can also happen when crosscutting boards with internal stresses.

A chop saw or circular saw is the best preference for cutting poor lumber.

- Blade must be sharp and clean, if not the blade greatly increases friction and decreases the quality of the cut, causing it to burn, Pitch also increases the probability of kickback.
- Saw must be aligned.
- Use the blade guard when possible.
- Push the work piece past the blade. Do not release a work piece until it is past the blade and removed from the saw. Turn the saw off before removing small cut off pieces.
- Always maintain control. Do not execute a cut where you do not have complete control of the situation. Make sure there are no obstructions. Do not cut a work piece that is too large to handle.
- Do not use the rip fence as a guide during crosscuts. If you need to make a series of equal length crosscuts, use a stop block in front of the blade so the work piece is not in contact with the rip fence during the cut. It is easy for the work piece to twist out of perpendicular at the end of the cut and thus get caught by the blade and thrown.
- Check for flaws in the wood. Cutting through a loose knot can be dangerous. Cutting a warped or twisted board along the rip fence is dangerous because it can get pinched between the fence and blade.

❖ Therefore the main points to remember when using a table saw are:

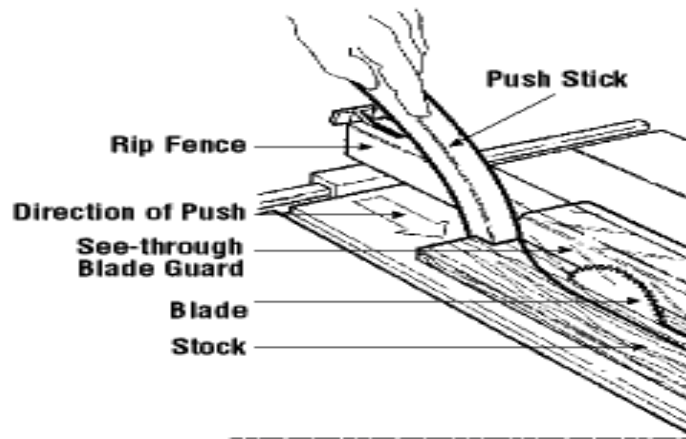
- the sharpness of the blade,
- the squareness of the fence and
- the flatness of the table

❖ **Causes of table saw injuries include:**

- ☞ Failure to read warning labels and the owner's manual before use.
- ☞ When the saw is not in use, leaving the blade projecting above the table.
- ☞ Not using a **push stick** or other such safety device when making cuts that otherwise requires fingers to be come close to the blade.
- ☞ Failing to be alert and pay consistent attention.
- ☞ Removing the blade guard
- ☞ Wood being cut can violently kick back.
- ☞ Not wearing eye protection and Lack of ear protection. Causes steady loss of hearing.
- ☞ Wearing clothing that's excessively loose-fitting, and failing to tie back long hair. These are dangerous if they come in contact with the blade.
- ☞ Blade misadjusted so it's not perfectly parallel with the fence and the miter slots. If it is not parallel, the work piece can often become pinched between the blade and the fence, inducing violent kickback and causing injury.

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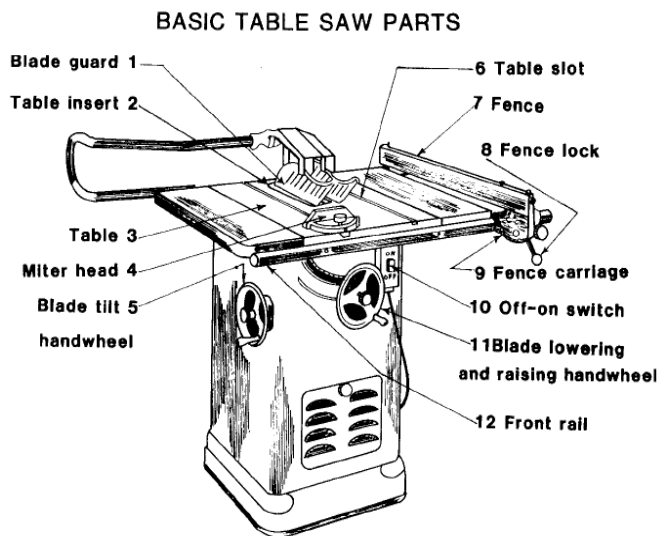
- ☞ Not pushing the material past the saw when finishing a cut. These pieces can get caught and violently drawn into the blade, resulting in kickback.



Therefore What safety procedures should you follow when using a table saw?

- ✓ Wear safety glasses or a face shield.
- ✓ Wear hearing protection that is suitable for the level and frequency of the noise you are exposed to in the woodworking area.
- ✓ Pay particular attention to the manufacturer's instructions on reducing the risk of kickback (when the wood can be violently thrown back toward the operator).
- ✓ Choose proper blades for the type of work being done.
- ✓ Keep blades clean, sharp, and properly set so that they will cut freely without having to force the work piece against the blade.
- ✓ Use the guards provided with the saw or ones designed for use with the saw that you are using.
- ✓ Ensure that the fence is locked in position after the desired width has been set.
- ✓ Hold the work piece firmly down on the table and against the fence when pushing the wood through.
- ✓ Feed stock into the blade against the direction of its rotation.
- ✓ Move the rip fence out of the way when cross cutting. Never use it as a cut off gauge.
- ✓ Use a push stick when ripping narrow or short stock.
- ✓ Keep hands out of the line of a saw blade.
- ✓ Keep the body and face to one side of the saw blade out of the line of a possible kickback.
- ✓ Provide adequate support to the rear and sides of a saw table for wide or long stock.
- ✓ Keep area clean and clutter-free. Operate machines in a non-congested, well-ventilated area.
- ✓ Use the proper sawdust exhaust systems as required by operation.

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The essential Part of circular saw

- ✓ **Arbor:-**also called spindle, is a metal rod on which the blade is mounted. Most tables saw machine have tilting arbor, i.e. arbor that can be tilted to the required angle for making angular cuts.
- ✓ **The Table:** The central section of the tabletop on most table saws is made from cast iron, and it is this part of the machine which will determine, to the greatest degree, the accuracy of your cut. It's used to Support the work while cutting is done.
- ✓ **The Blade and Guard:** The blade in a table saw is interchangeable, and you can choose coarser blades or finer blades, depending on the type of wood that you are working with, as well as from a wide range of different designs.

The Rip Fence: The rip fence, or fence, is the rail which is fitted to the table, along which you slide the wood on to the saw blade. Table saws commonly have a fence (guide) running from the front of the table (the side nearest the operator) to the back, parallel to the cutting plane of the blade. The distance of the fence from the blade can be adjusted, which determines where on the work piece the cut is made.

The fence is commonly called a "rip fence" referring to its use in guiding the work piece and determining the accuracy of the cut during the process of making a rip cut.

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- ✓ The On/Off Switch: This control should be large and mounted at the front of the machine so that the user can knock the switch to the ‘off’ position with his knee, without taking his eyes from the saw blade.
- ✓ Raising wheel: This controls the blade height and so the depth of the desired cut.
- ✓ Tilting wheel, made of cast iron, used to tilt the saw blade or tilt the table, depending on the type of saw.
- ✓ Splitter: A splitter or riving knife is a vertical projection located behind the saw blade. It is slightly narrower in width than the blade and located directly in line with the blade. The splitter prevents the material being cut from being rotated thereby helping to prevent kickback. Operating a saw without a splitter is the cause of many injuries, yet is considered by many to be unnecessary. This is one of the most useful safety devices on a table saw.

2.2, Radial arm saw machine

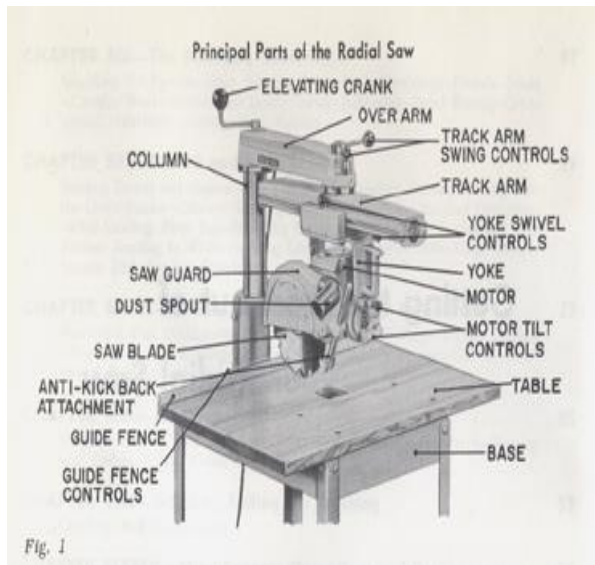
A Radial Arm Saw machine is basically a cutting machine consisting of a circular saw mounted on a horizontal arm that can slide from front to back. On the other hand “Radial arm saw machine” means a machine with a circular blade and motor suspended from a horizontal arm above the work surface which is pulled through the material.

It is sometimes simply called "radial saw,” which is primarily designed for Crosscutting, i.e., cutting long pieces of stock to length and Dadoing, i.e., cutting Grooves across a board's Grain, into one piece of wood into which another piece of wood will fit snugly, however, on most radial arm saws, the saw or the "head" can be pivoted 90 degrees so that it can be used to rip wood with the grain.

It has a suspended blade motor carriage on a yoke, which slid along a long horizontal arm. The yoke allowed the head to tilt for bevel cuts and to swivel for rip cuts. Mounting the arm to a pivoting column allowed miter cuts, and raising and lowering the column changed the blade's depth of cut.

Size: The size of a radial arm saw is determined by the diameter of the blade. Like table saws and miter saws, most radial arm saws are 10" or 12", though larger models are available for commercial use. If you have another saw with circular blades that are the same size as the blades your radial arm saw uses, you can swap blades between saws and save yourself some money.

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radial arm saw

Basic Radial Arm Saw Parts

Column
Blade Guard
Blade
Fence

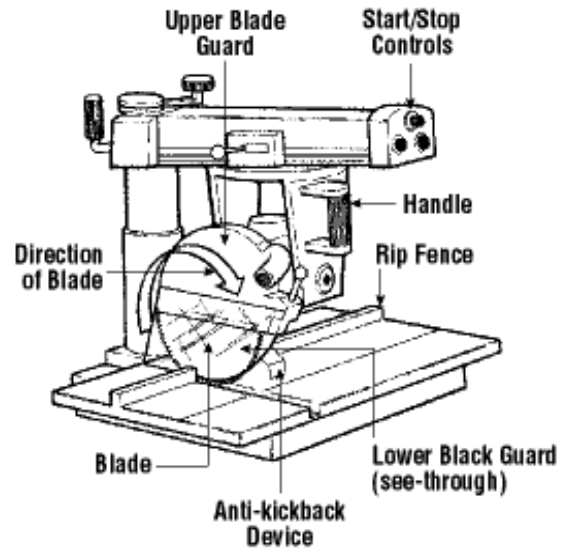


Fig:

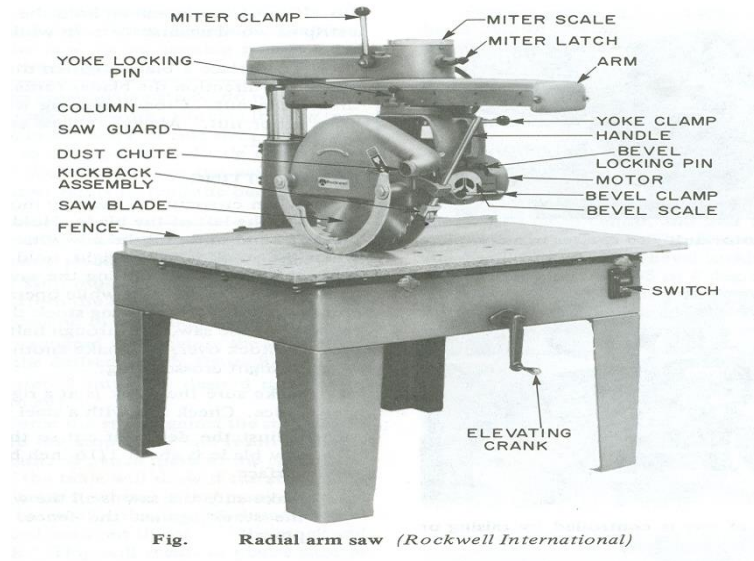
Switch
Track Arm
Handle
Table

The essential Part of radial arm saw

1. Arm: a holding motor and blade assemble: can be pivoted on column for making miter cuts.
2. Blade guard: protect the operator from the blade and channels debris to the dust fitting.
3. Miter clamp lock the arm in position for crosscut and miter cuts.,
4. Power switch: an on off switch often equipped with a safety key.
5. Handle: used to pull or push the blade.
6. Bevel clamp: lock a motor and blade assemble at any angle between 00and 900 relative to the blade fro making bevel cut at 900at the table blade can be used to cut rabbet or groove .
7. Yoke: slide along a track in the arm for making crosscut: rotates to position blade parallel to fence for rip cuts,
8. Blade guard clamp: hold blade guard in position;
9. elevating handle : raise and lowers column to adjust depth of cut,

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10. Fence: a guide work pieces during rip cut acts as a backstop for work place during crosscuts . kerfs at 900and 450 angle in fence are made as reference point by owner after installing.
11. Table clamp: one of the two thumbscrew clamps tight ended to hold the table and fence assembly together.
- 14, Front table: comprises a hard board or play wood auxiliary table glued a top particle board sheet bolted to the saw from . Kerfs at 900and 450 angles and rip though in a table are made by owner after installation.



Basic advantages of radial arm saw

- ⇒ When a radial arm saw is used for *crosscutting*, the stock remains stationary on the saw's table, and the blade is advanced slowly across the stock, In contrast with table saw machine in which the blade is fixed and the material to be cut is slowly moved into the saw blade.
- ⇒ Long work pieces can be reduced in to the required length without any problem, which is impossible for other machines
- ⇒ The blade of radial arm saw can rotate full circle since it mounted to the sliding overhang radial arm.
- ⇒ In radial arm saw machine (RAS) the operation consists of work pieces cut by pulling the rotating blade over the work piece, which makes the cutting operation fully visible to the operator, while for the table saw, the operation consists of work pieces cut by moving them over the rotating blade; which is not fully visible for the operators.

What safety procedures should you follow when using a radial arm saw?

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- ✓ Wear safety glasses or a face shield.
- ✓ Wear hearing protection that is suitable for the level and frequency of the noise you are exposed to in the woodworking area.
- ✓ Feed stock against the direction of the blade (the blade should move downward when viewed by the operator).
- ✓ Only use saw blades rotated at or above the speed of the saw arbour. (An arbour is the attachment from motor to blade)
- ✓ Use only the accessories designed for that specific saw and application.
- ✓ Ensure the guard consists of two parts:
 - 1 Upper hood type that covers arbor
 - 2 . Lower guard that rides on the stock, adjusting automatically to the thickness being cut.
- ✓ Stand on the handle side when cross cutting. Pull the cutting head with the hand nearest the handle and maneuver the stock with the other hand.
- ✓ Make sure the hand holding the stock is never in line with the blade.
- ✓ Return the cutting head completely to the back of the saw table after each cut. The saw should be designed so that the blade will not move forward under its own weight or if the machine is vibrating.
- ✓ When ripping, make sure that the overall length of the saw table (both in feed and out feed) is twice the length of the longest pieces of lumber.
- ✓ When ripping, make sure that the stock is fed against the direction of the blade (from the side where the saw blade rotates upward toward the operator). The blade should extend slightly into the table. The motor head must be locked at the correct height and angle.
- ✓ Clamp stock to the table on one side of the saw blade, when making mitre, bevel or compound mitre cuts. Clamping prevents the wood from sliding along the fence during the cut.
- ✓ Turn off the saw when making any adjustments or changes in the set up.
- ✓ Be sure material is held firmly against the guide fence and table before starting a cut. Support long pieces of stock.
- ✓ Always turn the power off and wait until the blade stops rotating before removing wood scraps or leaving the radial arm saw.
- ✓ Devote your undivided attention to the work being performed. Do not talk to others or be engaged in “horseplay” while using the radial arm saw.

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- ✓ Always pull the saw through the stock slowly to insure full control. This saw tends to pull itself into the work and it may have to be held back on thick stock.
- ✓ Check the stock for nails, screws, and loose knots before sawing.
- ✓ Allow the saw to reach full speed before starting a cut.
- ✓ Always stand with your face and body to one side of the saw blade.
- ✓ Make measurements by placing the wood to be cut against the stop gauge. When measuring with a tape measure or ruler is necessary, turn off the saw until the measuring is complete.

2. What should you avoid when working with a radial arm saw?

- Do not take your hand away from the operating handle unless the cutting head is behind the fence.
- Do not remove the stock from a saw table until the blade has been returned to its "resting" position at the back of the saw table. Use a stick or brush to remove scrap from the saw table.
- Do not cut "free hand". Use the back guide or fence, or other device to keep the work piece from moving.
- Do not use cracked or dull blades.
- Do not leave a running saw unattended - leave only after the saw has been turned off and it has come to a complete stop

2.3, Band saw Machines

- Band saw machine :is one of the most important machines to choose, which is primary designed for making curves, circles and irregular shapes on small or relatively large pieces of wood. However, it is great and can also be used for making straight cutting such as resawing(cutting thick pieces in to two or more thinner pieces) and ripping (cutting along the grain of wood).
- The size of the band saw is determined by the diameter of the wheel.

Main parts of Band Saw

1. **Wheels:** the band saw consists of two large wheels around which a continuous band of steel with cutting teeth is driven.

Upper wheel: it is not power driven, it running free during the operation.

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The upper wheel may also be tilted back or forth to center the blade on the wheels. To protect the teeth of the saw blade,. The upper wheel is also adjusted up or down to put tension on the saw blade.by hand wheel.

Lower wheel: Unlike the upper wheel the lower wheel is power driven, and does not tilt on its axis and also it does not move up and down,and fix with the motor .. Like the upper wheel, the rim of the wheel is covered by a rubber tire.

2 , Blade Guide Assemblies: Blade guide assemblies are found above and below the table of the band saw.

They must also be moved towards or away from the blade on both side of the blade with a clearance of about the thickness of the piece of paper.

1. **Table:** like many machine table the band saw table also used to support the work during machining. The table may be tilted; this enables to make cut to the required angle. There is a slot in the table from the center to the edge for removing and replacing the saw blade.

3. **Metal (table) insert:** is a soft metal which is used to cover the opening or the slot on the table. Soft metal is used for the insert because the band saw blade occasionally comes in contact with it. It is replaced when worn.

Guards: is a thin sheet of metal which is used to cover the band saw wheels and are used during the band saw operations.

6. **Blade Tension Adjustments:** As the name implies it used to adjust the blade tension.

Note: too much tension causes blade breakage.

7. **Fence:** used for guiding the stock during machining
8. **Control switch:** used to start and stop the motor.
9. **Dust chute:** used to remove the dust from the machine.

Band saw Blades

Band saw blades can be categories or classified based on the width of the blade and the type of the teeth that the blade have.

i. Depending on the width of the blade:

- a) **narrow-type** is used to cut a very small radius of curves. The width of the blade ranges from 0-75mm. It can be also used to make sharp curves.

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b) **wide-type blade** is used for making curves having a large diameter and also used for ripping and re-sawing operations.

ii. Depending on the type of teeth:

- ♣ **Standard or regular:** for straight cuts across the grain or diagonal to the grain ideal for intricate curves or cuts when the orientation of the blade to the grain changes during the cut.
- ♣ **Skipped-tooth or buttress design:** so called because every other tooth is missing .for long gentle curves with the grain cuts faster but more roughly than a standard blade A $\frac{1}{4}$ Inch skip tooth blade with 4-6teeth per inch .it is good all purpose blade.
- ♣ **hook-tooth blade:** For straight cuts and curving with the grain but best for ripping and pr-sawing.

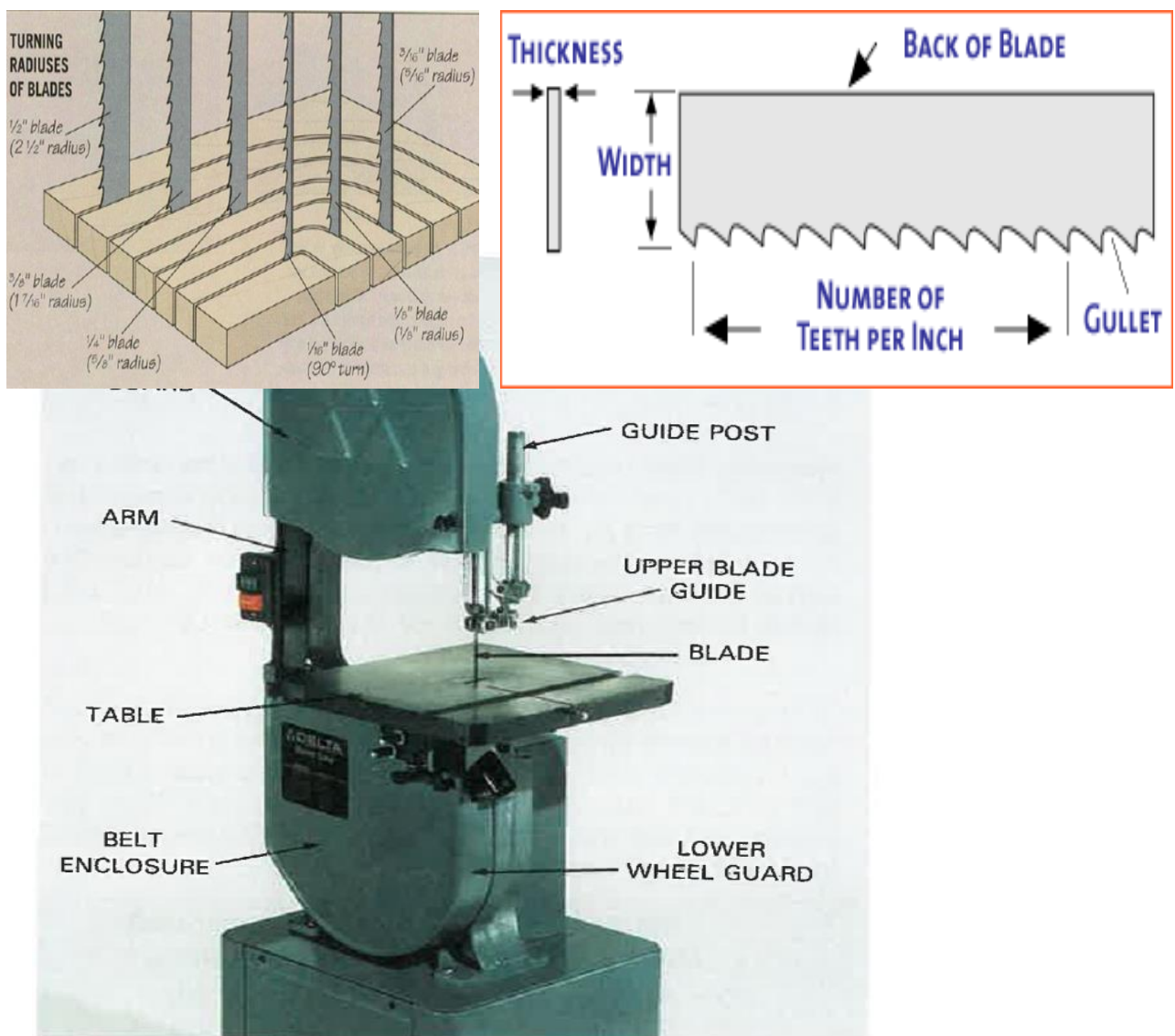


Fig. 15-1. Parts of a standard band saw.
(Delta International Machinery Corp.)

General Safety of Band saw

- ♣ Wear your safety glasses at all times
- ♣ Take off all jewelry
- ♣ Do not wear loose clothing
- ♣ Make sure you are the only person in the safety zone when operating the band saw
- ♣ Keep your material tight against the table
- ♣ Do not race through the blade
- ♣ Keep your hands out of the blade path (off to one side)
- ♣ Clear scrap or cut material with a brush, other scrap material, or your project from the table. Do not use your hands.

2.4, Jig Saws machine / scroll saw

Jig saws are useful for precision-cutting intricate curves and patterns on thin stock. They have thin blades that move rapidly up and down through the opening in the saw table. The blade is held in upper and lower chucks that pull it tight and keep it from bending. A hold-down adjusts to the thickness of the wood being cut.

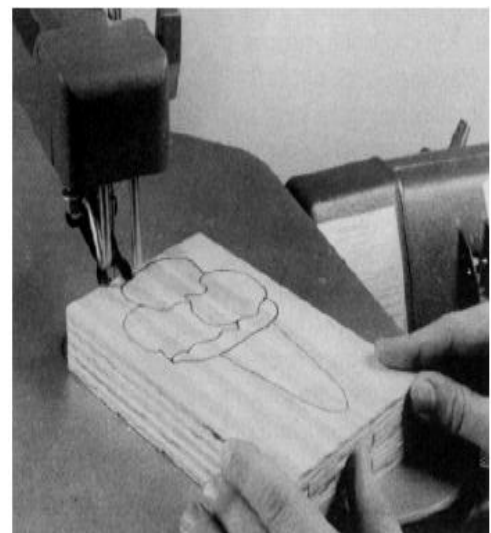
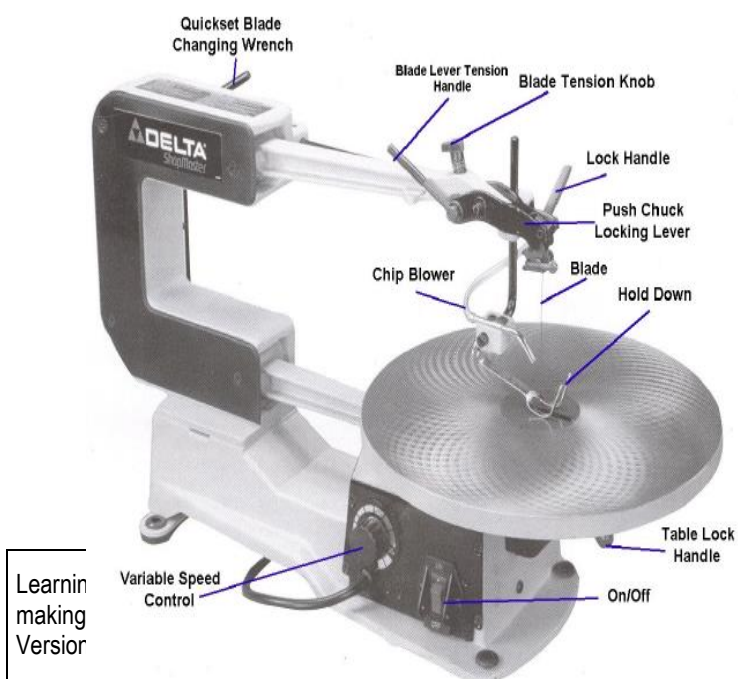


Figure 15-11. Several layers of material can be stacked, fastened together temporarily and cut all at one time for duplicate parts.

The table on a scroll saw needs to be particularly smooth to produce as little friction as possible so that your work pieces will slide around easily. It should also be easy to tilt, so that you can make angled cuts, and must lock firmly in position. There are no fences on scroll saw tables, and all work is done freehand.

Motor Power

Scroll saws need little power to operate efficiently and their motors are rated at around 100 watts. They all use induction motors, and run extremely quietly.

Hold downs

These are used, as the name suggests, to hold the work down onto the table. They are only really needed when working very thin stock, which can get lifted by the blade on the upstroke. They also serve a secondary function as blade guards, making it difficult to get your fingers too close to the blade.

Guarding

In addition to the hold down, some machines incorporate a Perspex guard that hinges down over the blade. Any fitting that makes a tool safer for the user is normally to be applauded, however these guards are both cumbersome and unnecessary on such a docile machine, and personally I would prefer not to have them.

Blades

There are two different types of scroll saw blade; plain ended and pin ended. The pin ended have a locating pin in each end, similar to a junior hacksaw blade, that makes it very easy to fit and tension them in the machine. The plain ended blades must be held in clamps, and can be a little more fiddly to install. The main difference is that the plain ended blades can be considerably narrower than the pin ended blades as they do not need to have the width to accommodate the pin, obviously. All the machines here can accept either type of blade

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A selection of different blades

Scroll saw blades, like jigsaw blades, are available in a range of sizes and patterns to suit different jobs and materials. They are graded from 1 to 12 with the lower numbers having the finer tooth pattern suitable for thin materials and more intricate cutting and the larger number becoming coarser and thicker making them more suitable for heavier work. When installing a blade, always make sure that the teeth are pointing down towards the table.

Cutting speed

When tackling particularly intricate jobs, or when cutting difficult materials, the ability to vary the cutting speed is a great help. All the machines except the Record have variable speed. The Record has a two position selector switch offering high or low speeds

2.5 Planning Machines

2.5.1 Jointer planner machine

Jointer” means a machine with a revolving cutter head set into an adjustable table over which the material is passed over the cutter head. The jointer is a machine for power planning stock on faces edge and ends . It is the first tool used to straighten a board by truing one face and one edge, followed by using a thickness planer to make the board an even thickness, and then the other edge is cut parallel with a table saw. The planning is done by a revolving cutter head equipped with three or more knives.

The size of a jointer is designated by the width, in inches, of the cutter head.

The essential Part of jointer machine

a) **Table:** Table of jointers consists of two parts

i). **The in feed table**

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The in feed table, also called the front table, is a part on which the work pieces are placed and fed to the cutters. The in feed table is adjustable in height, which means it can be raised or lowered by means of hand levers or wheels.

ii). the out feed table

The out feed table, also called the rear table, is the part which supports the work piece after it has been cut.

b) Cutter head

Cutter head of jointers is a heavy steel cylinder mounted between the in feed and out feed tables. It is the operative unit of jointers on which two, three or four cutter knives are mounted, and rotate together with it during operation.

Note:-The surfacing capacity of jointers, i.e. their size is determined by the length of the cutter head and that of the knives mounted on it.

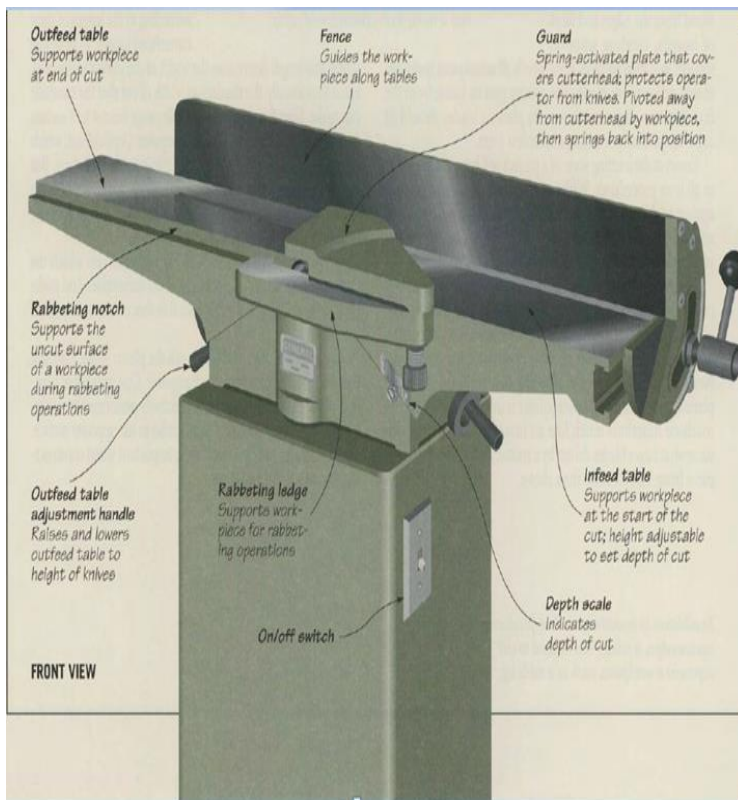
c) Fence

The fence of jointers is that part which supports and guides the work piece being fed into the machine. It is set or adjusted vertically at 90 degrees to the machine table for most operations. However, it can be tilted to various angles, usually up to 45 degrees both ways (forward and backward) from vertical position.

d) The guard

The guard of jointers is protective devices covering the cutter head during thus safeguard the operator.

- Avoid feeding work into the jointer against the grain this may result in chipped and splintered edges.
- .Feed work into the jointer with the grain Feed with the grain to obtain a smooth surface..



Jointer machine safety

Safety Rules

When you are using a jointer machine:

- ✓ ! Always keep the knives sharp. Dull knives tend to cause kick back, poor planning,
- ✓ Vibration that may allow the board (stock) to kick back.
- ✓ ! Never adjust the fence while the jointer is running.
- ✓ ! Cut with the grain, never plan against the grain.
- ✓ ! Do not try to cut too heavy cut.
- ✓ ! Always put the guard in place, to cover the cutter.
- ✓ ! Keep your finger at least 100mm away from the cutter.
- ✓ ! Never stand in line with the cutter .You must to one side of the jointer.
- ✓ ! Always allow the machine to come to full speed before using it.
- ✓ ! Do not plan pieces of short length. They can only be done by using special push stick.
- ✓ ! Use a brush to clean shavings. Never use your finger.
- ✓ ! Remember to switch off the power after you have finished using the machine. Never
- ✓ Leave the machine running unattended, wait until the cutters stop running.

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✓ ! Do not plane boards that are shorter than **305mm**.

✓

2.5.2 Thickness planer (surfaces planer)

Planning machines, also called **surfacing machines** that are used for removing irregularities such as rough spots, scratches, twists, etc. which are left on wood surfaces after ripping or crosscutting operation on the circular saws. As a result of removal of irregularities, the wood surfaces will become straight, level and smooth. This process is known as **surfacing**, and hence the name of the machines.

According to the purpose for which they are designed, there are two types of planning machines: **Thickness Planers** and **Jointing Machines**. Jointers and planers or their hand equivalents, are necessary for flattening, squaring, and smoothing wood.

Thickness Planers

“**Thickness Planer**” means a machine with a revolving cutter head set above an adjustable table on which material is passed under the cutter head by powered rollers

The **thickness planer**, also called **planer**, **surface or thicknesser**, is a machine used for planning the opposite faces of work pieces accurately parallel and reducing the work pieces to the required thicknesses. It is a machine which is used to create boards that are of an even thickness throughout their length and flat on both surfaces.

Type of thicknesser machine

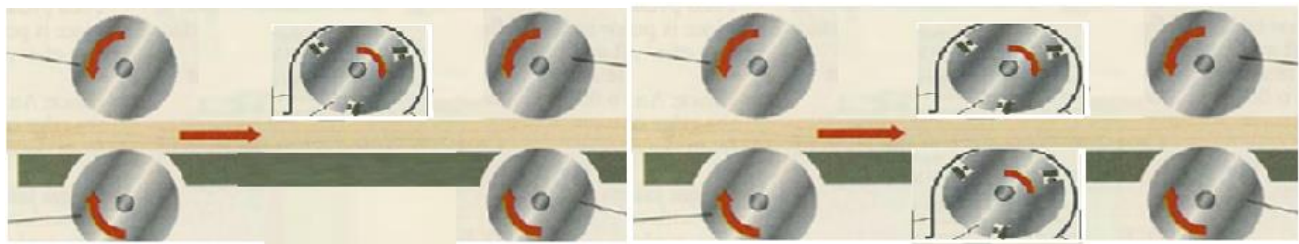
A), knife type cutter head thicknesses planer

B), Abrasive thicknesses planer

A). knife type cutter head thicknesses planer: is ether single and double cutter heads

☛ Singles cutter heads have one cutter heads and

☛ Double have tow cutter heads which means top and bottom cutter heads



Single cutter head Double cutter head

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Abrasive thickness planner: is one of the large abrasive belt that belt moves material from the surface of board.

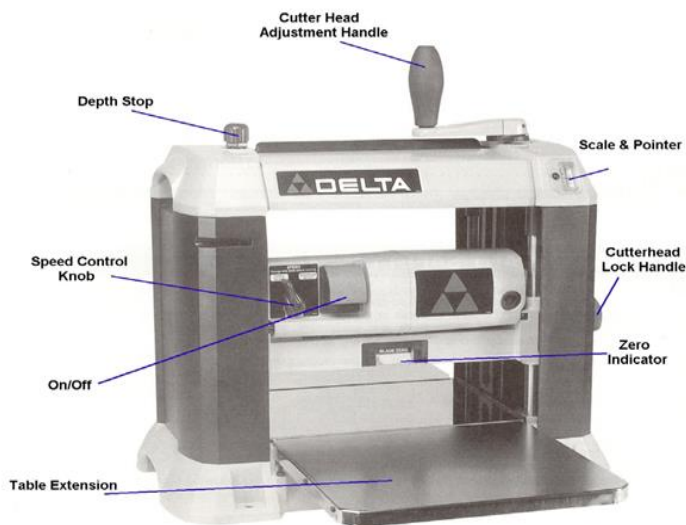
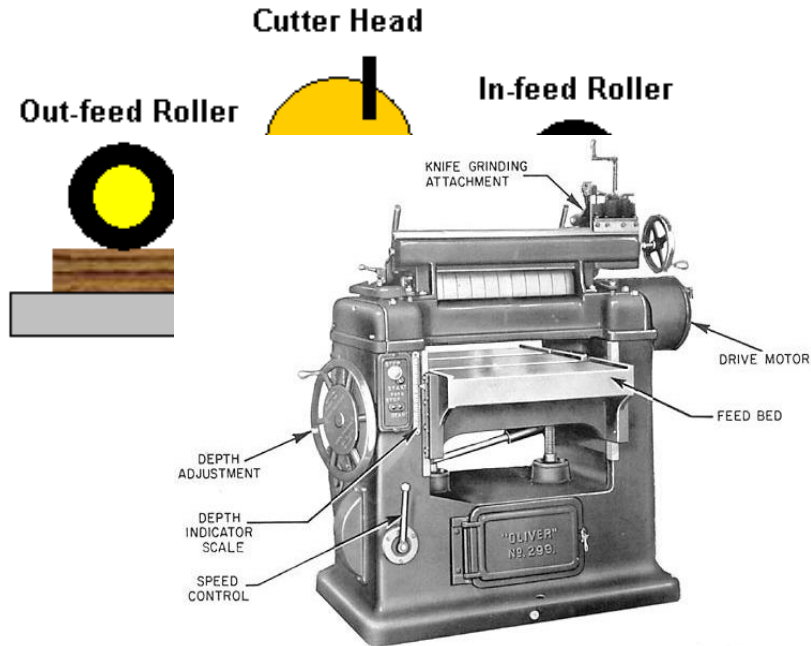
The advantage of abrasive planer over advantage of the cutter head planer is:-

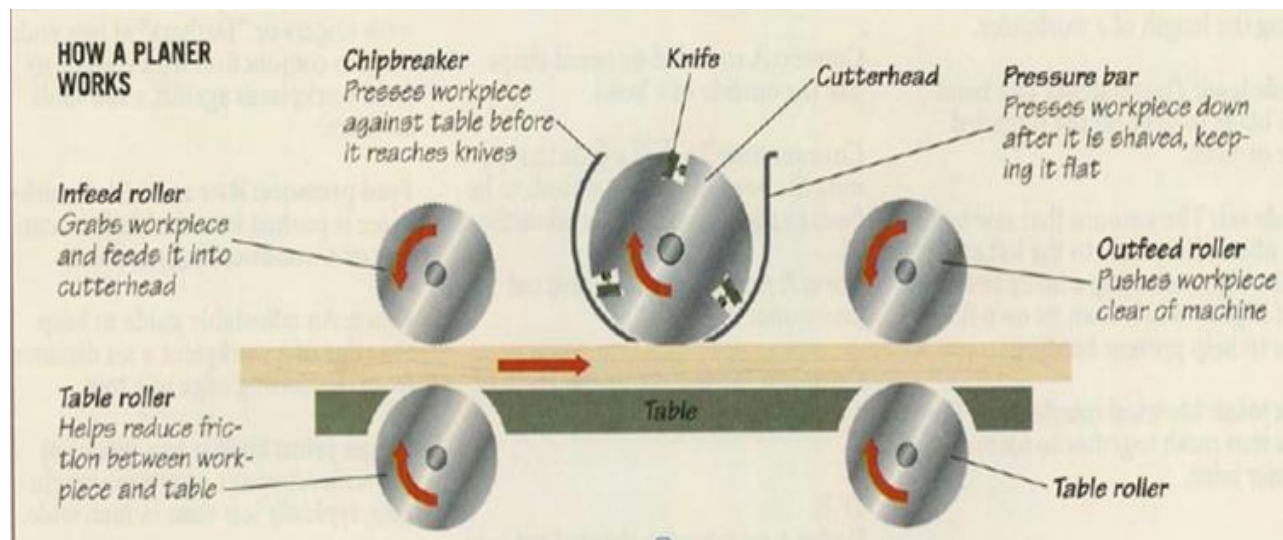
- ✓ Have a less noise
- ✓ No chipping and splitting
- ✓ The grain is tear out
- ✓ Cut deep with one passes
- ✓ Less danger and kick back
- ✓ Low maintenance and adjustment
- ✓ Maintained by low cost

Main parts of thickness planer

A thickness planer consists of three main elements:

- ✓ . a **cutter head**,
- ✓ . a set of **in feed** and **out feed** rollers and a table.





.1 Main parts of thickness planer

i Table: The table, also called bed of thicknesses, is that part on which the work piece rides during machining. The table is adjustable in height relative to the cutter head to control the resultant thickness of the board.

ii Cutter head: The cutter head is a heavy steel cylinder cutter knives are mounted. It is similar to the cutter head of the jointers.

NOTE: the size of the thickness planers depends on the length of the cutter heads or the cutter knives and the width of the table .

iii Feed mechanism : The feed mechanisms of thickness planers is (set of in feed and out feed rollers which draw the board through the machine;)the part which moves the stock through the machines, thus advancing the stock to the rotating cutter head and moving away the stock after it has been planed.

✓ The feed mechanism of typical thickness planes consists of the following parts:

A, In-feed rollers: - is the front top and bottom feed rollers that grasp the stock and feed it to the rotating cutter head.

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B. Out-feed rollers: - is rear top and bottom feed rollers used to feed the stock out of the machine after it has been planned to thickness.

C. Feed chains: - are devices used to transmit rotary motion from the feed drive motor to the feed rollers.

a) . Chip breaker:- has dual functions: is located behind the carriage in feed rollers

- it serves as chip breaker to break the kick back chips into smaller pieces;
- hold the stock down and grip to the cutter head during planing.

b). pressure bar: - is located behind the cutter head .which is spring loaded and up and down. and used to hold the stock down during machining to prevent vibration.

v. Thickness control handles (or hand wheel): Thickness control handle or hand wheel is used to adjust the table in height for controlling the thickness of the stock being machined. On some machines, there is an electrical control for raising or lowering the table.

vii. Feed-control level: Feed control lever is that part which engages or disengages the feed mechanism. It operates the in-feed and out-feed rollers which feed the stock to the cutter. On some machines, the feed-control lever not only operates the in-feed and out-feed rollers but also regulates the rate of feed from slow to fast

Thickness planer Safety

- **Safety checks, to demonstrate:**
- Correct positioning of in feed table and guards and electrical isolation when planing is complete, leaving the machine safe for the next operator, i.e.
- Adjusting the in feed table to a minimum cut
- Lowering the bridge guard to its lowest position, fully covering the cutter block
- Locking the machine to off

Drill Press machine

A drilling machine, also called **drill press,** is one of the most versatile machines in the workshops. It's used to cut holes into or through metal, wood, or other material to make all standard size of holes.

Drilling machines use a drilling tool that has cutting edges at its point. This cutting tool is held in the drill press by a chuck and is rotated and fed into the work at variable speeds.

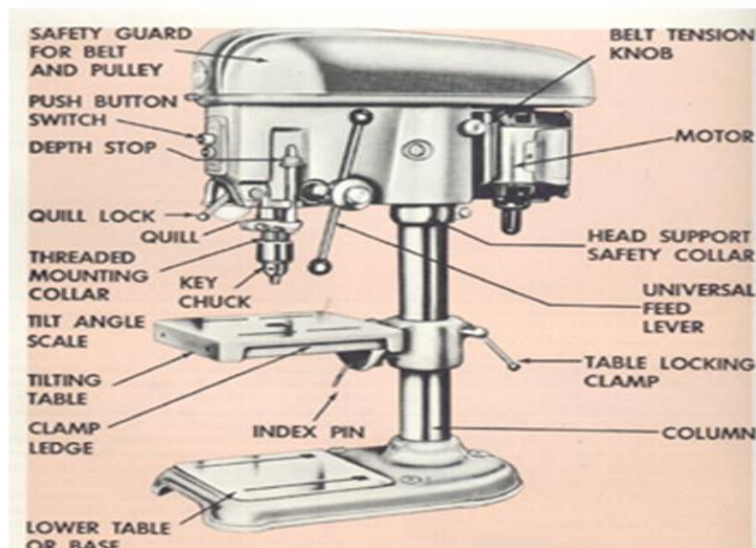
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Drilling machines may be used to perform other operations. They can perform **countersinking, boring, counter boring, spot facing, reaming, and tapping** .

Drill press operators must know how to set up the work, set speed and feed, and provide for coolant to get an acceptable finished product. The size or capacity of the drilling machine is usually determined by the **largest piece of stock** that can be center-drilled (by the distance from the **column to the center** of the chuck.) A common size is 15 inches. For instance, a 15-inch drilling machine can center-drill a 30-inch-diameter piece of stock.

Other ways to determine the size of the drill press are by the largest hole that can be drilled, the distance between the spindle and column, and the vertical distance between the worktable and spindle.

Main parts of Drill Press



Machine 3



Pillar/Vertical Drill

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1. **Table:** a part that holds the work piece. It is adjustable for height. Some can be tilted to angles other than 90° to enable inclined holes to be drilled.

1. **Base:** made from cast iron, which supports the column and other parts of the machine.
2. **Column:** made of machined steel, on which the table, head and motor assembly are fitted.
3. **Lock ring:** a part of drilling machine which prevents the table from supporting down ward and should be securely tightened when adjusting the table height.
4. **Feed lever:** also called operating handle. Which is use for raising and lowering the spindle (on which the chuck is fitted) during the drilling operation
5. **Quill:** moves up and down by means of operating handle. In most models the length of the quill stroke is about 4 inches. The quill may also be locked in any position. Adjusting stops are provided to limit the stroke of the quill to any desired depth.
6. **A chuck:** a part which inserted in the bottom of the quill. It holds the cutting tools and is tightened by means of a chuck key.
7. **Head:** the drill press head is mounted at the top of the column. It consist the motor assembly, the spindles, quill, and stepped pulleys belts.

Belt Guard: is a safety device which covers the belts.

Start and stop switch: used for starting and stopping the motor.

☞ **Sand contours.** Shape parts on your drill press using an inflatable drum sander. You can adjust the stiffness of the drum by adding or removing air. Pumped up, it acts like a typical drum sander. Drain some air out and the sander will conform to the shape being pressed against it, gently rounding the corners, as shown in the photo above. The drum mounts to a metal base clamped to your.

☞ **Use an angled ramp.** Instead of tilting the drill press table, drill angled holes on a shop-made ramp. The ramp allows you to keep your table set square and gives you an instant, accurate setup for drilling angles. Cut the ends of the ramp using a miter saw or your tablesaw's miter gauge.



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Sand contours Use an angled ramp

Drill Press machines safety

2.6 WOODSANDING MACHINE

There are many kinds and sizes of sanding machines ranging from small portable power sander to large multi-belt sanding machines. But, the common types installed in the school work shops include, the spindle sander, disc sander and belt sander. Each is built in a number of different styles and sizes according to the work to be done.

A sander is a power tool used to smooth wood and automotive or wood finishes by abrasion with sandpaper. Sanders have a means to attach the sandpaper and a mechanism to move it rapidly contained within a housing with means to hand-hold it or fix it to a workbench.

The most and the only important function of sanding machine is, it is a machine used to sand down wood and other materials to shape it and make ready for finishing purposes. The purpose of each of these sanding machines is to sand wood smooth before finishes are applied.

Common type of sanding machines

The following notes cover some of the more common sanding machines available within the furniture industry.

Belt sander and drum sander are used on flat surface

Spindle and disc sander are used curve and irregular shaped work,

A), Belt sander: The best sanding machine belt that moves around two pulley, on a belt sander sanding accomplished either by the belt travel across the face of the work while it is held stationary, or by holding the work on the travel belt. The belt sander positioned vertical or horizontal which is used to regular and irregular shapes and flat surface

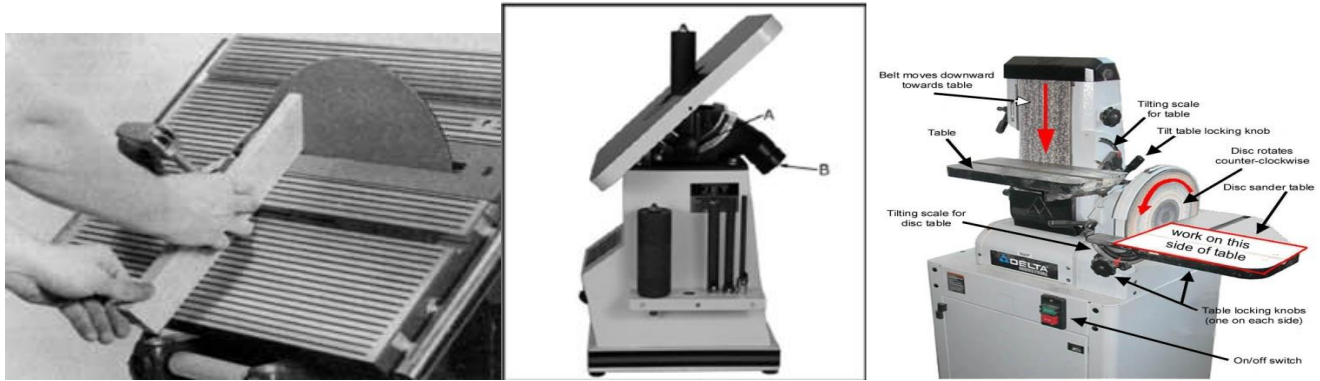
B). Disc sanders: is used to mainly for sanding straight curve concave and edge stock

C). Spindle sanders: is the vertical spindle that project through the horizontal table it has a removing Spindle on which an abrasive sleeve is fastened, this produces a smooth finish.

D), Belt Stroke sanders: is the best machine for sanding large surface such as the top of desk table and cabinets.

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E), Edge sander: is a belt sander with the narrow belt in a vertical position which is used to sanding for metal polished and hard wood stock



A). Belt sander & disk sander

B), disk sander

C), spindle sander



D), Belt stroke sander

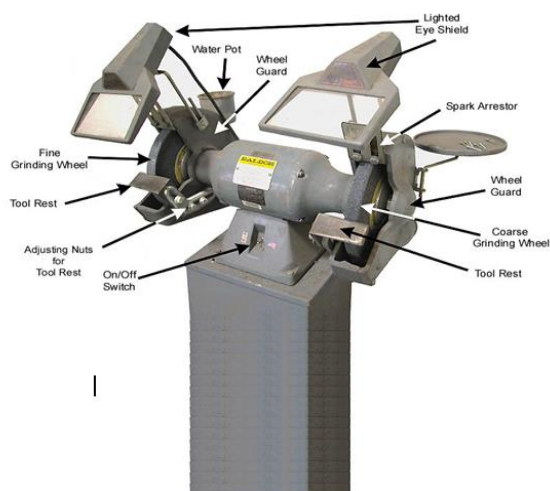
E), edge sander

2.8 Grinding machine

Grinding is the process of removing metal by the application of abrasives which are bonded to form a rotating wheel. When the moving abrasive particles contact the work piece, they act as tiny cutting tools, each particle cutting a tiny chip from the work piece. It is a common error to believe that grinding abrasive wheels remove material by a rubbing action; actually, the process is as much a cutting action as drilling, milling, and lathe turning. The grinding machine supports and rotates the grinding abrasive wheel and often supports and positions the work piece in proper relation to the wheel.

The grinding machine is used for roughing and finishing flat, cylindrical, and conical surfaces; finishing internal cylinders or bores; forming and sharpening cutting tools; snagging or removing rough projections from castings and stampings; and cleaning, polishing, and buffing surfaces. Once strictly a finishing machine, modern production grinding machines are used for complete roughing and finishing of certain classes of work.

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Safety

1. Operate only with the instructor's permission and after you have received instruction.
2. Remove jewelry, eliminate loose clothing, and confine long hair.
3. Make sure all guards are in place and operating properly.
4. Work area should be prepared for safe operation. (Flammables, etc)
5. Always use proper personal protective equipment (face shield should be used).
6. All materials should be inspected for defects such as warps, knots and foreign objects.
7. Make all adjustments with the power off and machine unplugged.
8. Tool rests must be adjusted to within 3 mm (1/8") of the grinding wheel.
9. Spark deflectors must be adjusted to within 3 mm (1/8") of the grinding wheels.
10. Do not grind on the side of the grinding wheels. Only the face of the wheel must be used.
11. Stand to one side when starting the machine.
12. Immediately report to instructor when grinding wheels are excessively smaller have become cracked.
13. Small work pieces should be held with locking pliers.
14. Do not leave the machine until the grinding wheels have come to a full stop.
15. Grinding materials generate a lot of heat, be careful as it may cause a burn.
16. Clean up workspace.

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Self-Check -1	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What saw has an arm that limits the length or width of a cut?

A. Band B. Compound miter C. Radial arm D. Table

2. Which of the following saws is pivoted to the correct angle and dropped onto the material?

A. Band B. Compound miter C. Radial arm D. Table

3. Which of the following saws is designed for making curved cuts?

A. Band B. Compound miter C. Radial arm D. Table

4. What shop tool is considered the oldest of all woodworking machines?

A. Drill press B. Jointer C. Planer D. Woodworking lathe

5. What shop tool is also called a single planer?

A. Bench grinder B. Shaper C. Surfacer D. Tile saw

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

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Information Sheet-2	Check safety equipment
----------------------------	------------------------

2.2 Safety equipment

1. There are different producers to Check safety equipment those are listed below these:
2. 1, Operate only with the instructor's permission and after you have received instruction.
3. Remove jewelry, secure loose clothing, and confine long hair.
4. Make sure all guards are in place and operating properly.
5. Always use personal protective equipment (PPE).
6. Turn machine off and disconnect from power source before installing or removing accessories, before adjusting or changing set-ups, when making repairs or inspecting, or cleaning the work area.
7. Inspect the blade before operation. Check for warping, cracks, teeth missing and that proper blade is in place.
8. All materials should be inspected for defects such as warps, knots and foreign objects.
9. Never start the machine with the stock touching the blade.
10. Never perform layout or setup work on the table saw.
11. Always use guards, splitter, and anti-kickback pawls whenever possible.
12. Remove debris before startup and when you are finished with power off.
13. Always use the ripping fence or the cut-off guide (miter gauge). You must use one or the other...never freehand. You can never use both at the sometime unless you use a "clearance block".
14. Stand to one side of the saw while operating. If a board kicks back from binding it will not hit you if you are to one side of the saw. (Never have any part of your body in line with the blade)
15. Keep hands and fingers away from the blade.
16. Avoid kickback by:
 - a. keeping the blade sharp;
 - b. keeping the rip fence parallel to the blade;
 - c. using guard and splitter for every possible operation;
 - d. pushing the stock pass the saw blade before release;

- e. never rip a piece of stock that is twisted, warped or does not have a straight edge to guide along the fence;
 - f. never saw a large piece of stock that cannot be controlled;
 - g. use a feather board when anti-kickback pawls cannot be used; and
 - h. never rip a piece of stock that is shorter than 10”.
17. To ensure safety set the saw blade 3mm- 6mm (1/4”) above the stock when cutting.
 18. Always use the proper blade designed for different operations...example a ripping blade for ripping material.
 19. Always turn the blade down to the lowest position when finished.
 20. Always use a push stick when the fence is set under 75mm (3”) to the blade.
 21. Only cut materials intended for cutting on the table saw (i.e. hardwood, softwood, plywood, OSB, other wood products, plastics). See instructor before cutting.

Self-Check -2	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

3. Which of the following type(s) of Personal Protective Equipment (PPE) is frequently used?

a. Safety glasses d. Gloves b. Lab Coats e. All of the above c. Face Shields

1. What are the 3 most common ways accidents or incidents occur in the laboratory?

1.

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Short Answer Questions

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2.3 Set and adjust machines in accordance with manufacturers' instructions

SETTING UP

Whether your table saw sits poised to make its first cut, or is a seasoned machine with a home full of furniture to its credit, it cannot cut with precision unless its adjustable parts are in proper alignment. A table saw with misaligned parts can result in any one of several frustrating problems, including excessive vibration, increased risk of kickback, blade damage, burn marks on workpieces as well as inaccurate cuts. Even errors as little as $\frac{1}{64}$ inch can compromise the quality and strength of a piece of furniture.

The components of your table saw requiring the most attention are those

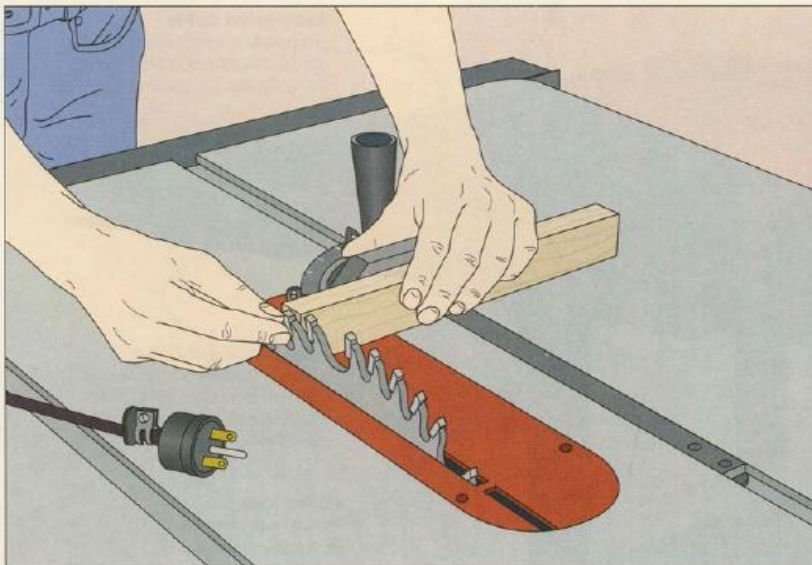
that contact and guide the workpiece during cutting operations: the saw table, the blade, the miter gauge and the rip fence. Before putting a table saw through its paces on the cutting techniques described in this chapter, first set up the machine properly by checking and, if necessary, adjusting the alignment of its parts. For best results, unplug the saw, adjust the table insert setscrews to make the insert perfectly flush with the saw table, and crank the blade to its highest setting. Then follow the steps shown below in the sequence that they appear. There is little point in aligning the miter gauge with the saw blade, for example, if

the blade itself has not been squared with the table.

To confirm that your table saw is properly tuned, make a few test cuts. A good way to ensure that your saw is cutting in precise, straight lines is to cut a squared board in two and flip one of the pieces over. Butt the two cut ends together. They should fit together without any gaps as perfectly as they did before the board was flipped.

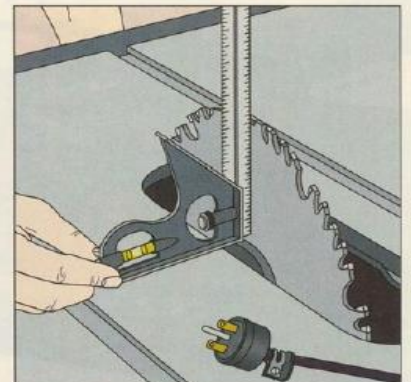
Because the normal vibration from cutting can upset proper alignment, tune your table saw periodically; many woodworkers take the time to adjust their saws before starting each project.

ALIGNING THE TABLE AND SAW BLADE



1 Checking table alignment

Position the miter gauge at the front of the saw blade. Hold or clamp a perfectly squared wood block against the miter gauge and butt the end of the block against a saw blade tooth (*above*). Then slide the miter gauge and the block together toward the back of the table while rotating the blade by hand. The block should remain butted against the tooth as the blade rotates from front to back. If a gap opens between the block and the tooth, or the block binds against the blade as it is rotated, align the table following the owner's manual instructions.

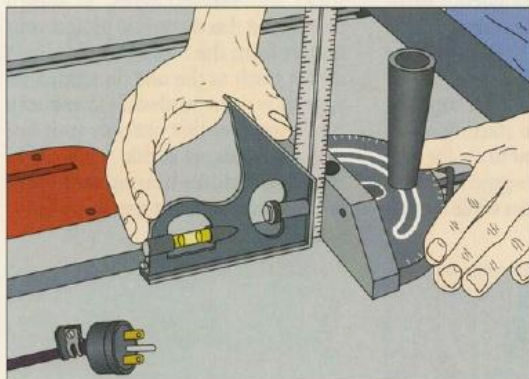


2 Checking blade angle

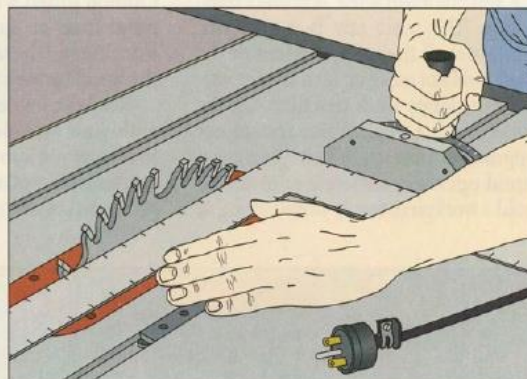
Remove the table insert, then butt a combination square against the saw blade between two teeth as shown. The blade of the square should fit flush against the saw blade. If there is a gap between the two, rotate the blade angle adjustment crank until the saw blade rests flush against the square's blade.

TABLE SAW

SQUARING THE MITER GAUGE

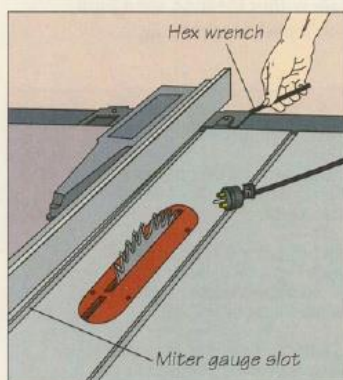


1 Aligning the miter gauge with the saw table
With the miter gauge out of the table slot, use a combination square to confirm that the head of the gauge is square with the edge of the gauge bar. If it is not, use the adjustment handle on the gauge to square the two. Then butt the square against the gauge (*above*). The blade of the square should fit flush against the gauge. If there is a gap between the two, have the gauge machined square at a metalworking shop.



2 Aligning the miter gauge with the saw blade
Butt a carpenter's square against the miter gauge and the saw blade between two teeth. The square should fit flush against the gauge. If there is a gap between the two, loosen the adjustment handle on the gauge (*above*) and swivel the miter head to bring it flush against the square. Tighten the adjustment handle on the gauge.

ADJUSTING THE RIP FENCE

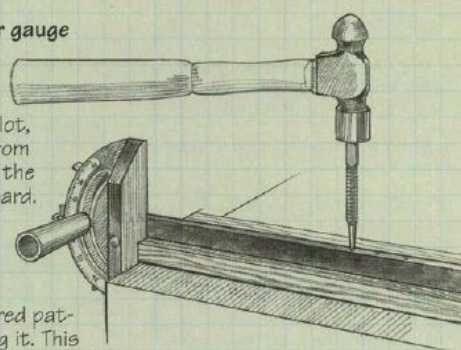


Aligning the rip fence
Set the rip fence alongside the miter gauge slot. If there is any gap between the two, align the fence following the owner's manual instructions. On the model shown, turn the adjustment bolt at the front of the table with a hex wrench.

SHOP TIP

Fixing a loose miter gauge

To eliminate excessive side-to-side play of the miter gauge in its slot, remove the gauge from the table and place the bar edge-up on a board. Use a ball-peen hammer and a prick punch to strike the edge of the bar in a staggered pattern every inch along it. This will raise bumps on the edge of the bar and result in a tighter fit in the slot. If the fit is too tight, file the bumps down as necessary.



CROSSCUTTING

As cutting with the grain is synonymous with the use of the rip fence, so crosscutting is defined by the device used to make the cut: the miter gauge. The general technique for making a crosscut, as shown below, begins with correct hand placement to keep the workpiece both flush on the table and firmly against the miter gauge. The workpiece is fed into the blade at a steady rate. As with ripping, make sure that scrap pieces do not pile up on the table, and keep both hands out of line with the blade. Also, keep the rip fence well back from the blade to prevent any cut-off

part of the workpiece from becoming trapped between the blade and fence and kicking back.

To reduce the amount of sanding you will need to do later, remember that the slower the feed, the smoother the cut, especially when the blade breaks through the workpiece at the end of the cut. Although a combination blade can be used for crosscutting, a crosscut blade will produce a finer cut.

When a longer workpiece is being cut, it is a good idea to attach an extension to the miter gauge to provide a more secure base. Miter gauges commonly have

two screw holes for just such an addition—normally, a piece of hardwood 3 to 4 inches wide and about 2 feet long. Use the miter gauge extension in conjunction with a stop block to make repeat cuts (page 32).

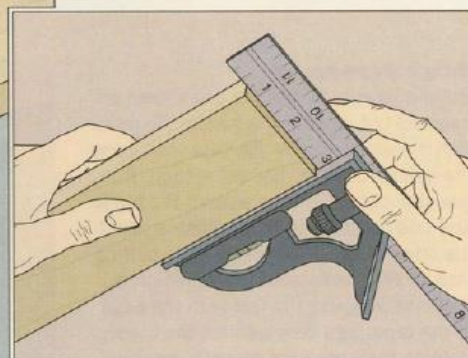
For wide panels or long boards, a shop-made crosscutting jig (page 33) is particularly helpful, and will ensure very accurate cuts. The jig can also be used for smaller pieces and provides a safe, convenient way to perform most crosscuts. Many experienced woodworkers consider it the single most indispensable accessory for crosscutting.

SQUARING THE WORKPIECE



1 Making a crosscut

Before measuring or marking a workpiece for a crosscut, cut one end of it square. To avoid jamming the blade, align the workpiece with the blade so that it will trim $\frac{1}{2}$ inch or so. With the thumbs of both hands hooked over the miter gauge, hold the workpiece firmly against the gauge (above) and push them together to feed the workpiece into the blade. (Caution: Blade guard removed for clarity.)

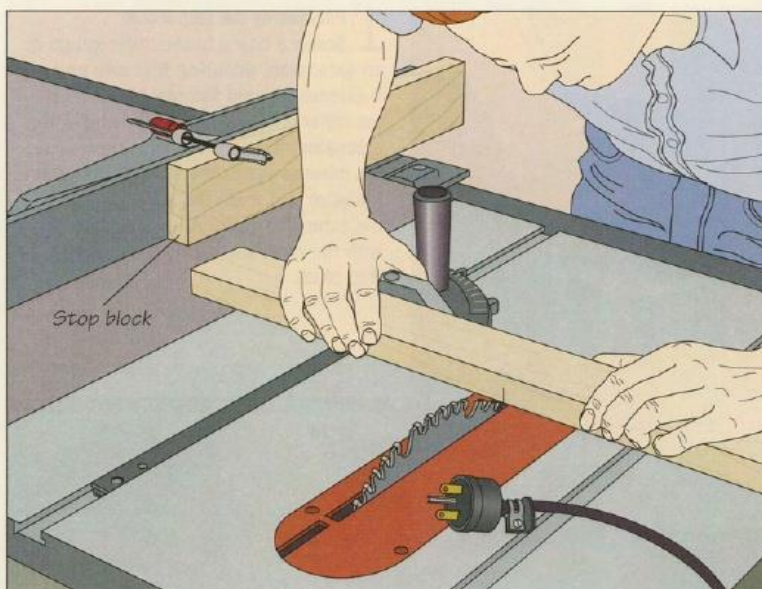


2 Checking for square

Use a combination square to confirm that the cut end of the workpiece forms a 90° angle with the edge. With the workpiece and square held up to the light, there should be no gap visible. Mark an X on the cut end to help you remember which end has been squared.

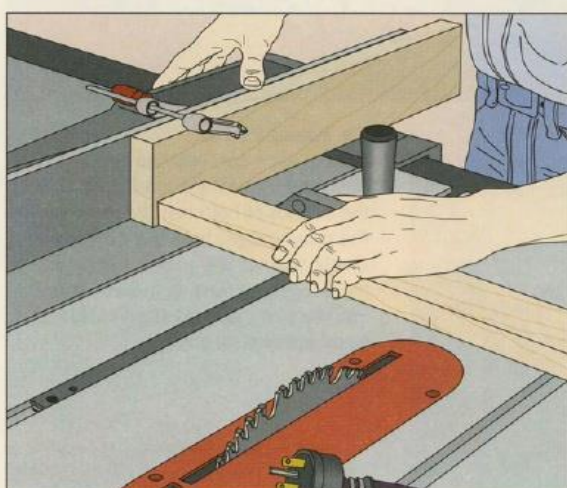
TABLE SAW

REPEAT CUTS: USING THE RIP FENCE AS A GUIDE



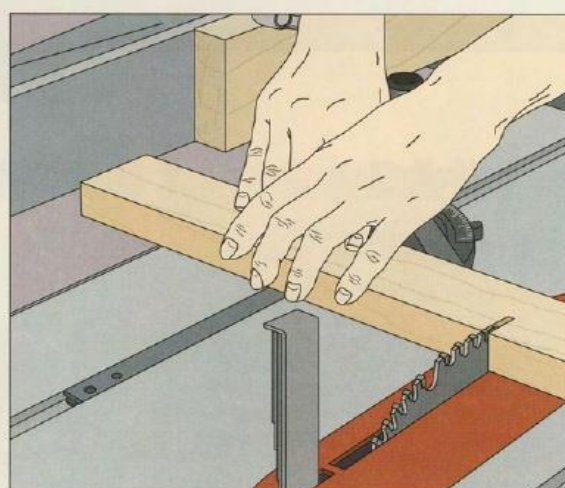
1 Setting up the cut

Clamp a board to the rip fence as a stop block. To prevent jamming the workpiece between the stop and the blade—which could lead to kickback—position the stop far enough toward the front of the table so that the workpiece will clear the stop before reaching the blade. To line up the cut, hold the workpiece against the miter gauge and push the gauge and workpiece forward until the workpiece touches the saw blade. Slide the workpiece along the miter gauge until the cutting mark is aligned with the blade (*left*).



2 Positioning the rip fence

Holding the workpiece firmly against the miter gauge, pull both back from the blade and butt the stop block against the workpiece (*above*). Lock the rip fence in position. Check to see that the workpiece does not contact the stop block when the workpiece reaches the blade.



3 Making the cut

Set the end of the workpiece flush against the stop block. With the thumbs of both hands hooked over the miter gauge, hold the workpiece firmly against the gauge and push them together to feed the workpiece into the blade (*above*). (**Caution:** Blade guard removed for clarity.)

RIPPING

Ripping has traditionally been defined as “cutting with the grain.” But considering that some woods today—plywood and particleboard, for example—have no overall grain pattern, the definition needs some amending. A more appropriate description focuses on the table saw accessory used to make a rip cut. Whereas crosscutting is done using the miter gauge, ripping involves

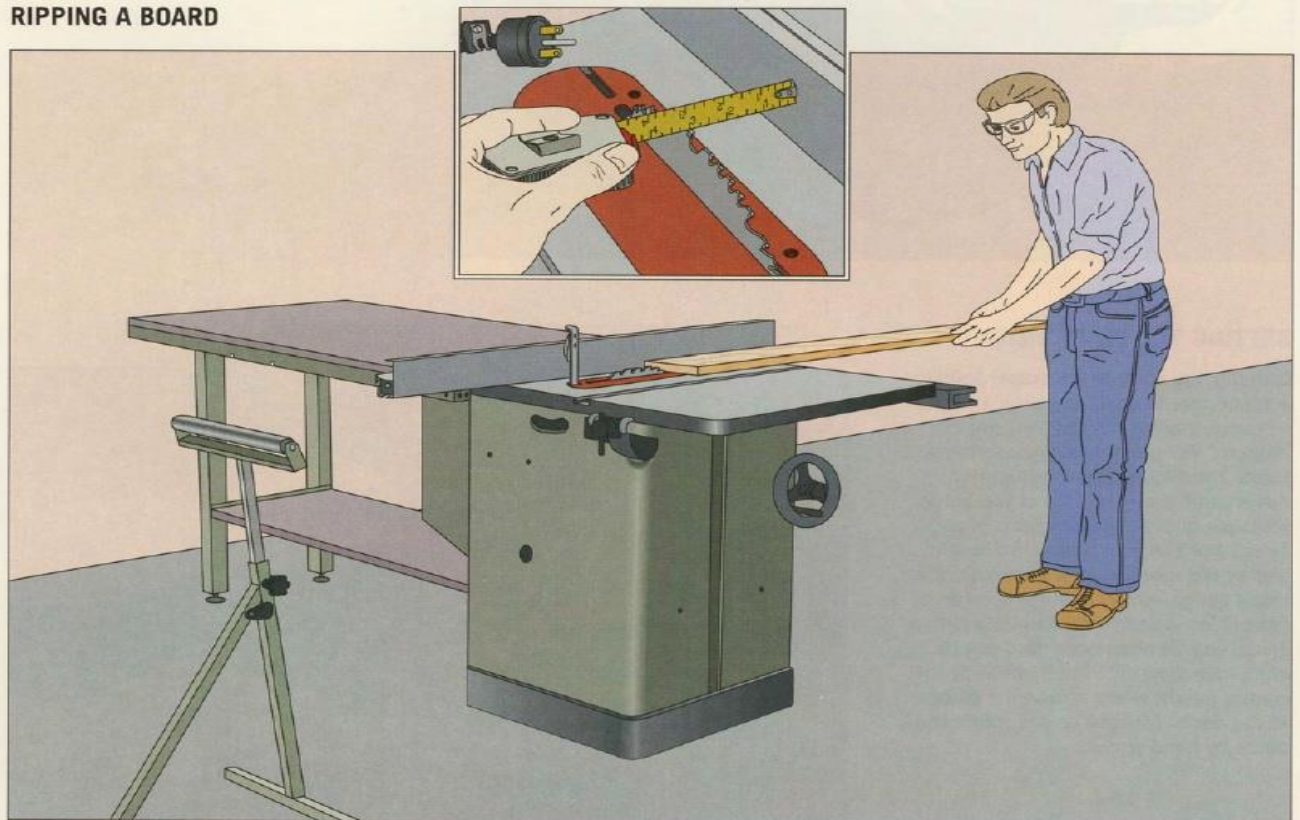
the rip fence. (Except for certain cuts that do not pass completely through the workpiece, such as a dado cut, the rip fence and miter gauge should never be used at the same time, or jamming and kickback can occur.)

Before ripping a workpiece, set the height of the saw blade (*page 23*), then lock the rip fence in position for the width of cut. The most crucial safety

concern when ripping is keeping your hands out of the blade’s path. For protection, use accessories such as push sticks, featherboards and hold-down devices.

To use a hold-down device, it may first be necessary to screw a wood auxiliary fence to the rip fence. Auxiliary fences are ideal surfaces for clamping; many woodworkers make them a permanent fixture on their saws.

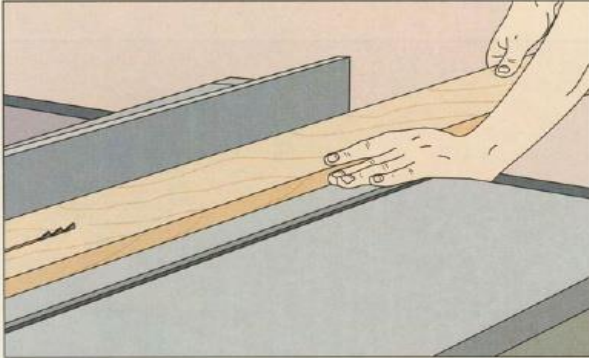
RIPPING A BOARD



1 Starting the cut
Measure the distance to the edge of a tooth nearest the fence (*inset*). Position the fence and set one end of the workpiece on the saw table close to the blade. Use your left hand to press the wood down on the table and flush with the fence;

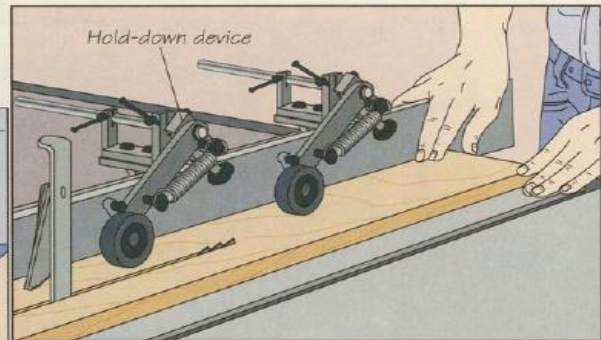
use your right hand to feed the wood into the blade (*above*). Continue feeding the board into the blade at a steady rate until the trailing end of the board approaches the table. (**Caution: Blade guard removed for clarity.**)

TABLE SAW



2 Approaching the blade

Hook the thumb of your left hand over the edge of the table and rest your palm on the table, keeping the wood pressed down firmly on the table and up against the fence (*left*). Continue feeding the board with your right hand until the trailing end of the board approaches the blade.



3 Passing the blade

Straddle the fence with your right hand (*left*), making sure that neither hand is in line with the blade. If any finger comes within 3 inches of the blade, complete the cut using a push stick, a jig, or a hold-down device (*above*) mounted on the rip fence. The rubber wheels of the hold-down device keep the workpiece firmly against the table; to prevent kickback, they also lock when pushed against the direction of the cut, keeping the board from shooting backward. If you are using a hold-down device, begin feeding the workpiece from the front of the table, then move to the back to pull the wood through. Otherwise, finish the cut from the front of the table (*step 4*).



4 Finishing the cut

Keep pushing the board until the blade cuts through it completely. When the workpiece is clear of the blade, use your left hand to shift the waste piece to the left side of the table (*left*). With your right hand, carefully lift the good piece and place it to the right of the rip fence before turning off the saw. Do not allow pieces of wood to pile up on the saw table.

Self-check 3	Short answers
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1. Which of the following saws is pivoted to the correct angle and dropped onto the material?

A. Band B. Compound miter C. Radial arm D. Table

2. Which of the following saws is designed for making curved cuts?

A. Band B. Compound miter C. Radial arm D. Table

3. What shop tool is considered the oldest of all woodworking machines?

A. Drill press B. Jointer C. Planer D. Woodworking lathe

4. What shop tool is also called a single planer?

A. Bench grinder B. Shaper C. Surfacer D. Tile saw

5. What shop tool is designed primarily for edging curved stock and for cutting ornamental edges?

A Bench grinder B. Shaper C. Surfacer D. Tile saw

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

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Score = _____

Rating: _____

Name: _____

Date: _____

Operation sheet 1	Operate machines in accordance with manufacturers' instructions/in standard
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Operate a Radial Arm Saw

- ☞ 1. Inspect, clean, and lubricate a radial arm saw.
- ☞ 2. Remove and replace radial arm saw blades.
- ☞ 3. Make a crosscut to predetermined size.
- ☞ 4. Crosscut duplicate lengths.
- ☞ 5. Cut a miter and compound miter to predetermined size.
- ☞ 7. Install dado head to predetermined size.
- ☞ 8. Cut a dado to predetermined size
- ☞ 9. Cut a groove to predetermined size.

Set and adjust machines in accordance with manufacturers' instructions

Jointing Machines

“Jointer” means a machine with a revolving cutter head set into an adjustable table over which the material is passed over the cutter head. The jointer is a machine for power planing stock on faces and edges. It is the first tool used to straighten a board by truing one face and one edge, followed by using a thickness planer to make the board an even thickness, and then the other edge is cut parallel with a table saw. The planing is done by a revolving cutter head equipped with two or more knives. The size of a jointer is designated by the width, in inches, of the cutter head.

The jointer derives its name from its primary function of producing flat edges on boards prior to joining them edge-to-edge to produce wider boards. Jointing machines also called Jointers, and these planing machines designed for straightening one edge and one face of the stock (is a machine used to produce a flat surface along a board's length). Straightening one face and one edge of the stock is known as facing and jointing respectively.

Fundamentally, a jointer consists of two parallel tables, a moveable fence which is normally set perpendicular to the tables and a cutter head which is typically driven by an electric induction motor.



The two tables are referred to as the in feed (table from which the work piece is fed into the machine) and out feed (table to which the work piece is fed as it leaves the machine). The work piece to be planed flat is placed on the in feed table and passed over the cutter head to the out feed table.

The in feed and out feed tables can be raised or lowered independently of each other and in relation to the cutter head although the out feeds table is normally set so that it is level with the knives when at the top dead center of the rotation of the cutter head.

The in feed table is adjusted so that it is lower than the out feed table and this gives the depth of cut.

The in feed table is set a small distance below the height of the knife head and the rough wood is fed over it, thus slicing off the lowest parts of the bottom of the wood.

The size of a jointer is usually measured by the width of the cutter head and the length of the tables. The cutter head contains two or more knives which are honed to a very sharp edge.

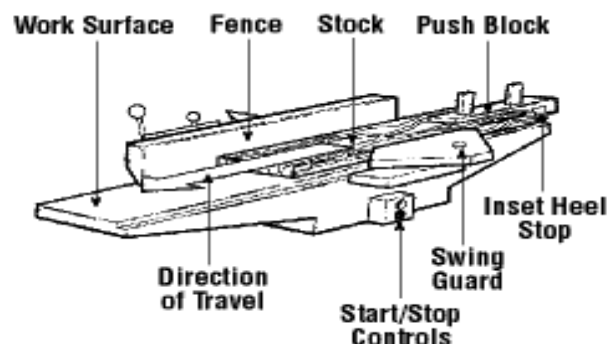
The typical jointer is made up of a base, the rotating cutter head, an in feed table and an out feed table and a jointer fence. The cutter head and blades face and rotate toward the in feed table.

A piece of wood is edged by feeding it through on edge with one of the faces held against the jointer fence.

The jointer fence is usually set 90 degrees to produce square faces and edges, but it can be tilted to any desired angle to produce beveled edges.

The depth of cut is set by raising or lowering the in feed table below the top of the fixed jointer knives mounted in the cutter head.

The depth of cut is the difference between the height of the knives and the top of the in feed table.



Operation sheet	Drill machine
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Operate a Drill and Drill Press

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- 1, Inspect, cleans and lubricate a drill and drill press.
- 2, Select appropriate cutting tool for the job; remove and replace cutting tool and adjust table and stops.
- 3, Drill and bore holes in stock.
- 4, Counter bore holes in stock.
- 5, Countersink holes in stock.
- 6, Drill holes in round stock.
- 7, Make plugs.
- 8, Demonstrate ability to fasten stock to work surface.
- 9, Bore holes at an angle.
- 10, Bore spaced holes.
- 11, Drill dowel holes in miters

Information Sheet #5	Methods of minimizing wastes
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2.5 Methods of minimizing wastes

Waste Reduction: - the prevention of waste material.

3R REUSE

REDUCE

RECYCLE

Methods of Reusing and Reducing

1. Reuse of second-hand products
2. Repairing broken items instead of buying new
3. Designing products to be refillable or reusable
4. Encouraging consumers to avoid using disposable products
5. Designing products that use less material to achieve the same purpose

Better WASTES MANAGEMENT leads to a better quality of the product
--

- Reuse of scrap material

Scraps can be immediately re-incorporated at the beginning of the manufacturing line so that they do not become a waste product. Many industries routinely do this; for example, paper mills return any damaged rolls to the beginning of the production line, and in the manufacture of plastic items, off-cuts and scrap are re-incorporated into new products.

Self-check 1	Short answers
---------------------	----------------------

1. What is waste?
2. How to minimize wastes ?

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Information Sheet #6	Defected machines reported
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2.6 Defected machines reporte

Date-----

TO-----

NO	Item name	Model	Spaceficati on	Materials requaired	Defected machine part of	
					Electrical	Mechanic al
1.					Lose of fuse	Lose of belt
2.					Lose of phase	Dade blade
3.					Electrical Inistalation	Bolt and nut
4.					Dade of motor power	Lack of lubricatio n

FURNITURE MAKING

NTQF Level - 1

Learning Guide - # 8

**Unit of Competence: - Operate Basic Wood working
Machines**

**Module Title: - Operating Basic Wood working
Machines**

LG Code: - IND FMK1 LO3 -LG-25

TTLM Code: - IND FMK1 TTLM 0919v1

LO3 Operate machines

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Instruction Sheet	LEARNING GUIDE	25
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This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Basic wood working machines
- Check safety equipment
- Set and adjust machines in accordance with manufacturers’ instructions
- Operate machines in accordance with manufacturers’ instructions/in standard
- Methods of minimizing wastes
- Defected machines reported

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, **you will be able to –**

Prepare work place

Personal safety

Work place safety

Accident

Coues of accident

Learning Instructions:

7. Read the specific objectives of this Learning Guide.
8. Follow the instructions described in number 3 to 6.
9. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
10. Accomplish the “Self-check 1” **in page 51**
11. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
12. Submit your accomplished Self-check. This will form part of your training portfolio.

3.1 methods of collecting and storing reused materials Storage

Good organization of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis. There will also be fewer strain injuries if the amount of handling is reduced, especially if less manual materials handling is required. The location of the stockpiles should not interfere with work but they should still be readily available when required. Stored materials should allow at least one metre (or about three feet) of clear space under sprinkler heads.

Stacking cartons and drums on a firm foundation and cross tying them, where necessary, reduces the chance of their movement. Stored materials should not obstruct aisles, stairs, exits, fire equipment, emergency eyewash fountains, emergency showers, or first aid stations. All storage areas should be clearly marked.

Flammable, combustible, toxic and other hazardous materials should be stored in approved containers in designated areas that are appropriate for the different hazards that they pose. Storage of materials should meet all requirements specified in the fire codes and the regulations of environmental and occupational health and safety agencies in your jurisdiction

Self-check # 1	Answer key
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Give short answers

1. Why we stored materials?
2. How we store materials?

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Information Sheet #2	Workplace procedures in dealing with wastes or scraps
-----------------------------	--

3.2 Workplace procedures in dealing with wastes or scraps

- Reuse of scrap material

Scraps can be immediately re-incorporated at the beginning of the manufacturing line so that they do not become a waste product. Many industries routinely do this; for example, paper mills return any damaged rolls to the beginning of the production line, and in the manufacture of plastic items, off-cuts and scrap are re-incorporated into new products.

Self-check2	Answer key
--------------------	-------------------

1. What is scrap material?

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

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Name: _____

Date: _____

Information Sheet #3	Maintenance requirement for equipment
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3.3 Maintenance requirement for equipment

General requirements for equipment maintenance include:

- Obtaining a copy of the maintenance schedule recommended by the manufacturer.
- Ensuring that maintenance is performed as required.
- Ensuring that the person(s) performing the maintenance are competent (e.g. licensed mechanic).
- Retaining records of maintenance/service conducted.
- Specifying who is responsible for overseeing equipment maintenance and where the records are kept.
- Set up a system for removal and tagging of damaged or defective tools and equipment.

Self-check 3	Answer key
---------------------	-------------------

1. What is maintenance?
2. Maintenance objectives are?

3.4 housekeeping requirements

Why should we pay attention to housekeeping at work?

Effective housekeeping can eliminate some workplace hazards and help get a job done safely and properly. Poor housekeeping can frequently contribute to accidents by hiding hazards that cause injuries. If the sight of paper, debris, clutter and spills is accepted as normal, then other more serious health and safety hazards may be taken for granted.

Keeping of work shop clean & store the tools in proper place is to ensure our body & tools from the accidents of machine while working & breakage of tools respectively. The workshop is kept in different ways .Some of themes are:

- Work benches should be free & clean of clutter.
- Tools & equipment's should be safely stored.
- Keep the floor clean & clear.
- Immediately wipe of spilled liquids which can create a slippery surface.

Principles of Good Housekeeping

Housekeeping consists of the simpler aspects of building care and maintenance:

- Maintaining operational tidiness and order,
- Properly controlling waste, and
- Regulating activities such as smoking that can lead to hazardous conditions.
- To be successful, housekeeping requires organization and continuous monitoring.

Effective housekeeping results in:

1. reduced handling to ease the flow of materials
2. fewer tripping and slipping accidents in clutter-free and spill-free work areas
3. decreased fire hazards
4. lower worker exposures to hazardous substances (e.g. dusts, vapours)
5. better control of tools and materials, including inventory and supplies
6. more efficient equipment cleanup and maintenance
7. better hygienic conditions leading to improved health
8. more effective use of space

- 9. reduced property damage by improving preventive maintenance
- 10. less janitorial work
- 11. improved morale
- 12. improved productivity (tools and materials will be easy to find)

Self-check 4	Answer key
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1. Write the Principles of Good Housekeeping?

Answer

Poor housekeeping can frequently contribute to accidents by hiding hazards that cause injuries

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

OTHER REFERENCES

- General Wood working CHRISH.GRONEMAN (6TH Edition)
- The motivate series wood work technology J. K.N.Sackey.
- The complete Book of stationary poma tool techniques 1988 R.J.ED cristofore.
- Wood machining complete guide to effective and safe working practice 1987, N.S Voisey
- Wood tuning 1988, Klaus pracht
- Carpentry, 1964, Gaspar J.Lewis Cabinet making patun making and mill
- operation of modern woodworking machines NERMAN HJORTH,WILLIAM F. HOLTROP