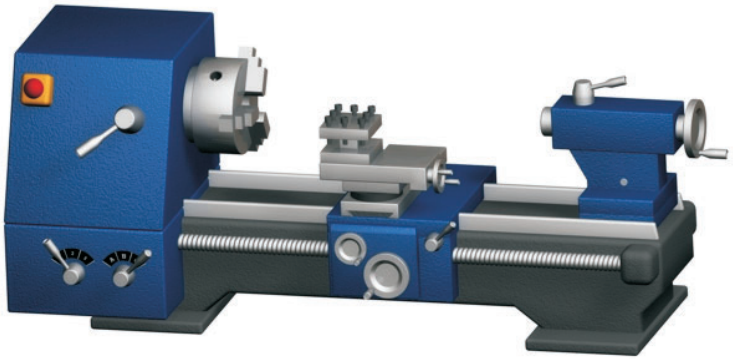
Basic Machine Tool Components

MACHINE TOOLS have a series of components and parts that must all work together for a properly functioning machine. You must learn where each part is and how it functions before using the machines. Many machines will have similar components that are located in different parts of the machine. Leaning about the components helps you use the machines properly.



Objective:

Explain the components of basic machine tools, and interpret assembly and operational diagrams for machine tool components.

Key Terms:

apron
arbor
assembly diagram
band saw
base
blade
blade guides
CNC machine
carriage
column
cutting fluid
drill chuck
drill head
drill press
drive wheel
headstock
idler wheel
knee
lathe
lathe bed
lathe spindle
Machine Control Unit (MCU)
milling cutter
milling machine
operational diagram
overarm
overhanging arm
pulley
quill
saddle
spindle
tailstock
tool post

Components of Basic Machine Tools

LATHE

A **lathe** is a machine for shaping wood, metal, or other material by means of a rotating drive which turns the piece being worked on against changeable cutting tools.

The **lathe bed** is the main frame and provides a base or foundation for the whole machine; it holds the headstock, tailstock and carriage in alignment. It is typically made of metal or iron and all the main components are bolted on to it. Large beds are bolted to the floor. All moving parts of the lathe are usually cast iron; they have high compressive strength and are lubricated.

The **headstock** is one of the main body parts of the lathe and is permanently fastened on left of the lath bed. It holds one end of the work piece with a spindle that is rotated with a motor.

The **tailstock** is located on the right side of the bed and can be adjusted anywhere along the lathe bed relative to the work piece size.

The **lathe spindle** is a horizontal axle revolving on pin or pivot ends. Its function is to hold and rotate the material that is being worked without vibration or flutter during the machining process. There is typically one located on the tailstock and one on the headstock

The **carriage** slides back and forth on the lathe bed that holds the cutting tool; it is located between the headstock and the tailstock. It is composed of a saddle and apron and holds the tool post.

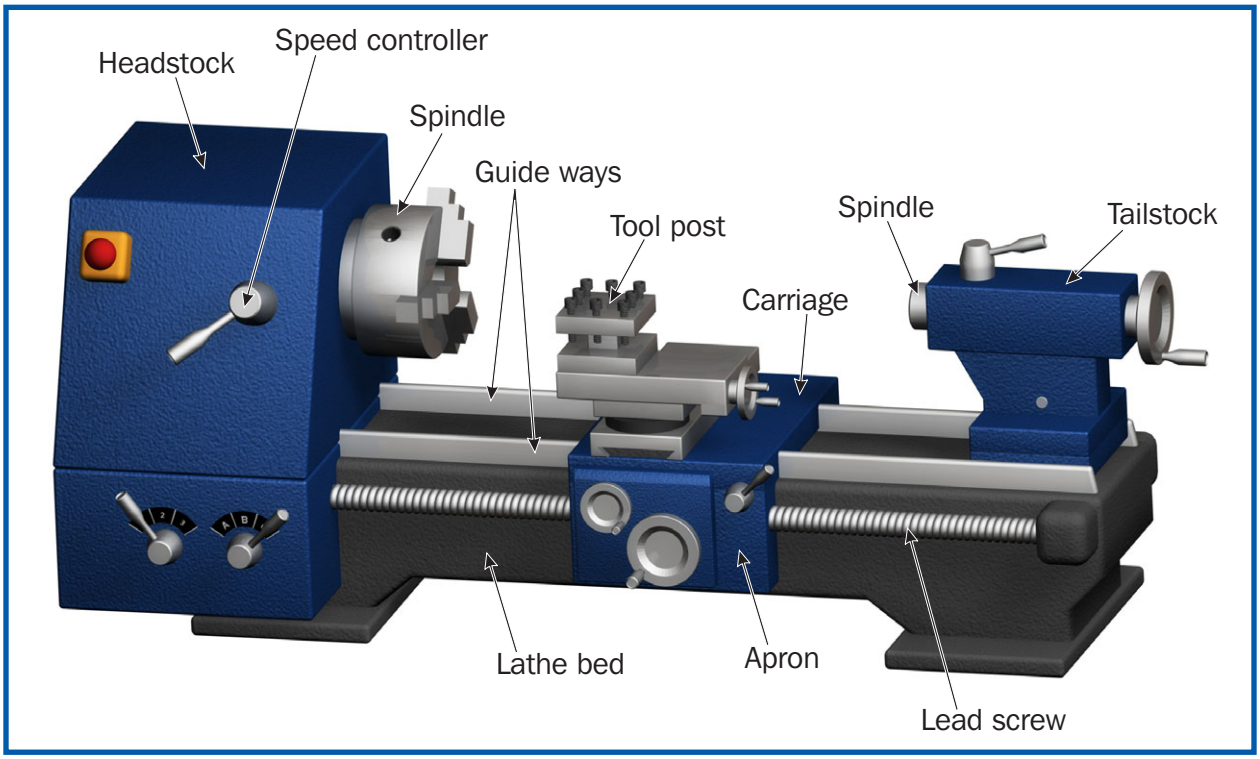


FIGURE 1. Basic parts of a lathe.

FURTHER EXPLORATION...

ONLINE CONNECTION: Parts of a Lathe

There are several basic parts of a lathe. Each one has a specific job. It is important to know and understand how all the parts work together. This ensures they are functioning correctly and you get the proper result.

To learn more about lathe machine parts visit the web link below:

https://www.youtube.com/watch?v=mwo-9NIlbT0

The **tool post** holds the cutting tool that removes material from the work piece. It is bolted onto the carriage.

The **apron** is located on the carriage it has the mechanism and controls for moving the carriage and cross slide. The cross slide is mounted on the traverse slide of the carriage. It uses a hand wheel to feed tools into the work piece. Cross slide on typically located on metal lathes.

The lead screw is used to move the carriage automatically during thread cutting. It is located on the bottom side of the bed.

Guide ways control the movement and accuracy of the tail stock and carriage. There are inner and outer guide rails.

Chips pan is located underneath the carriage and is used to collect the removed material or chips.

Speed controller or spindle speed selector is located on the head stock and controls the speed of the spindle.

MILLING MACHINE

A **milling machine** is used to remove material from a work piece with the help of a revolving cutter. It is also called a milling cutter.

The **base** is the foundation or stand that holds the column and knee. The **column** is the main support for the over arm (or top slide.) It supplies the framing to hold the rest of the components. They are the main casting that supports all other parts of the milling machine. They contain a reservoir of oil used to lubricate the spindle, and a reservoir of coolant used when required by the machine.

A **spindle** is a rod or pin serving as an axis that revolves or on which something revolves. It is located in the upper part of the column and receives power from the motor through belts, gears, and clutches that transmit it to the arbor. The spindle projects from the column face and has a tapered whole which various cutting tools and arbor can be inserted.

The **knee** holds the table and saddle in place. It is attached to the base, and all gearing mechanism is enclosed in the knee. A vertical positioning screw supports the knee and allows for adjustment. The vertical knee traverse crank, or lever, allows one to raise or lower the knee.

The **saddle** is precision machined guide that provides a guide way for the table. It is located on the knee and it supports the table. It slides on guide ways set at 90 degrees to the column face.

The table rest on guide ways on top of the saddle and travels longitudinally. It has T-slots that allow for clamping the work piece. An adjustment screw located under the table is used to re align the table horizontally. Some machines may have a circular base mounted on the saddle that can be swiveled.

The **overarm**, or **overhanging arm**, is located on the top of the machine and holds the spindle in place so it can be adjust to the proper location for cutting the work piece.

The **arbor** a rotating shaft in a machine or power tool on which a milling cutter or grinding wheel is fitted. It attaches the spindle to the over arm. It is an extension of the spindle where cutters are securely mounted and rotated.

A **milling cutter** is a rotary steel cutting tool used in a milling machine for shaping and dressing metal surfaces.

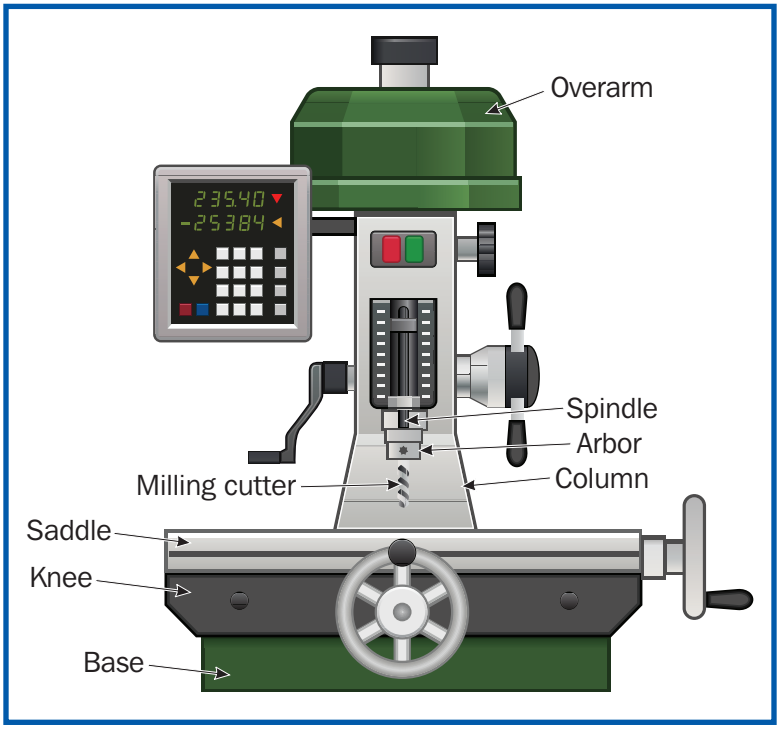


FIGURE 2. Basic parts of a milling machine.

BAND SAW

A **band saw** is a power tool with a long, sharp blade consisting of a continuous band of toothed metal stretched between two or more wheels to cut material. The frame of the band saw is the main part of the tool it is where all the components are attached. The motor is housed in the frame and is located below the table at the lower end of the machine. It drives the blade pulleys.

A **pulley** is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. The drive pulley is mounted on the motor and moves the drive belt. This controls the speed of the blade.

The **drive wheel** rotates the cutting blade in the band saw. The blade is held tightly in place by the idler wheel which is free to rotate. The **idler wheel** is located at the opposite end of the drive wheel to complete the loop of the blade.

The **blade** is a long strip of metal that has a serrated edge (or teeth) for cutting through materials. The type of blade determines the type of material it can cut and the finish. Thicker

blades can cut stronger materials. Thinner blades with more teeth can cut with a smooth finish. **Blade guides** are used to keep the saw blade in place and can be adjusted

Metal cutting band saws require cutting fluid. **Cutting fluid** is a lubricant and coolant used in the machining process, specifically designed for metalworking. There are various kinds of cutting fluids used in different applications that keep the metal from overheating and reduce friction.

DRILL PRESS

A **drill press** is a machine tool for boring holes, having a stand and work table. The base of the machine is where the vertical column is mounted. It supports the column, worktable and attachments. It typically contains T-slots were a work piece can be mounted. The column is a vertical element that supports a table and drill head. It also supports the radial arm that is lowered for drilling.

The drill head is attached to the radial arm and provides power to the drill spindle. The **drill head** holds the drive, transmission, and the quill. It supports all the driving mechanisms. The **quill** is the shaft where the drill bit is attached. It usually contains bearings and a sliding spine to allow the drill bit to be lowered. Drill presses that contain multiple gears attached to the spindle can operate at different speeds.

The hand wheel on a drilling machine allows one to move the chuck and drill bit up and down for drilling. A **drill chuck** is used for holding a drill on a spindle usually by means of adjustable jaws. The drill chuck is adjustable and can hold various types and sizes of drill bits.

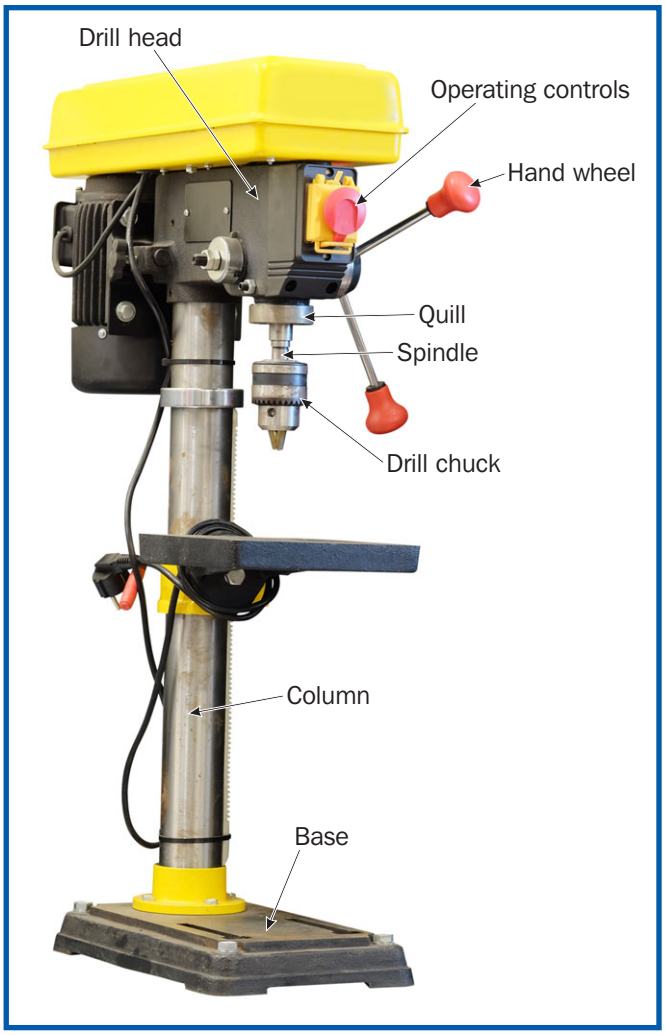


FIGURE 3. Basic parts of a drill press.

CNC MACHINE

A **CNC machine** is a motorized maneuverable tool and often a motorized maneuverable platform, which are both controlled by a computer, according to specific input instructions.

CNC machines can include a range of specific tool functions such as drilling, milling or cutting. They will have a primary input device. This device is link to a computer unit that is attached to the machine. It allows one to input date.

The **Machine Control Unit (MCU)** is the heart of a CNC system. It is used to perform the following functions: to read the coded instructions, to decode the coded instructions, to implement interpolations (linear, circular, and helical) to generate axis motion commands. It sends computer instructions to the machining tool to position the exact speed and locations of the drive axis. It can control functions such as the spindle speed and the changing of tools. In a 3D printer it tells the machine where specifically to add material.

CNC machines have a spindle were a cutter or head bit is located that can slide across a table were the work piece is located. They can move in an X, Y and Z axes. They utilize a driving system or motor that is driven by a design code from a computer.

Interpret Assembly and Operational Diagrams for Machine Tool Components

Learning the assembly and operational diagrams is essential before using any of the machine tools. A **diagram** is a simplified drawing showing the appearance, structure, or workings of something; a schematic representation. An **assembly diagram** is an exploded view drawing, picture, or technical drawing of an object that shows the relationships or order of assembly of various parts. **Operational diagram** are the steps, workstations, activities, or tasks performed to produce the output. It describes the task, activities and operations required to perform the work.

Each machine will have its specific set of instructions and user manual containing important diagrams. Read through all the assembly diagrams and operational instructions.Take notes and ask questions. Write down the order of each step in operating the machine. Most assembly diagrams will have a 3D line drawing of the machine noting each part and the proper steps. All steps must be followed in exact order as they are given.

The machine must be properly set and used for it to work effectively and to avoid problems. Some common problems require basic troubleshooting techniques. In some cases the machine may not be cutting the material properly.

Make sure the cutting tool is properly located in the machine. It should always be centered on the spindle and in the chuck. The cutter cannot be crooked or at an angle, make sure it is fully tightened and locked. You should allow the machine to cool down if it has been working a long time.

The carriage may not move correctly if it is not properly being worked. You need to take time to learn exactly how to handle to move it the correct way. Make sure the power feed handles are being worked properly.

Test out the threads and feed. The dial works differently at different speeds. Make sure that correct speed is set and is able to work with the material. Practice using the machine and cutters to become more comfortable and knowledgeable with the tool.

FURTHER EXPLORATION...

ONLINE CONNECTION: What Are Detail and Assembly Drawings?

Detail and assembly drawings are used all the time in manufacturing and machining. They communicate specific design and detailed information for assembly and production. It is important that you know how to read and use these drawings.

To learn more about detail and assembly drawings visit the web link below:

https://www.youtube.com/watch?v=5E8SCm0K0_4

Vibration is a common problem with some machine tools. Make sure all parts are tight and secure. Check the chuck and body to ensure they are all aligned. Make sure the work piece is fully secured. Check the drive belt to ensure it is has the correct tension.

Summary:

The basic components of a lathe include: the apron, tool post, carriage, lathe spindle, tailstock, headstock, lathe bed, lead screws, guide ways, chips pan, and speed controller.

The basic components of a milling machine include: the base, column, spindle, knee, saddle, table, overhanging arm, arbor, and milling cutter.

The basic components of a band saw include: the pulley, drive wheel, blade, blade guides, and cutting fluid.

The basic components of a drill press include: the base, column, worktable, drill head, quill, and drill chuck.

CNC machines will have similar components as traditional machine tools with the addition of the Machine Control Unit or computer. This controls the movement of the spindle and cutter or head bits.

Learning the assembly and operational diagrams is essential before using any of the machine tools. A diagram is a simplified drawing showing the appearance, structure, or workings of something; a schematic representation. The machine must be properly set and used for it to work effectively and to avoid problems.

Checking Your Knowledge:

1. Where is the drill bit attached?
2. What are blade guides used for?

3. What does the drive wheel rotate in a band saw?
4. How does a spindle work?
5. What part of the lathe slides back and forth holding the cutting tool?

Expanding Your Knowledge:

There are a lot of different machines and tools used in a shop and a lot of things to remember. I great way to learn and remember all the parts is to create your own diagrams of the tools in your shop. This will help you to remember where they are located and how they function.

Web Links:

Parts of a Band Saw
https://bettertoolz.com/what-are-the-parts-of-a-bandsaw/

How to Use a Milling Machine
http://www.americanmachinetools.com/how_to_use_a_milling_machine.htm

Parts of a Lathe Machine
https://www.quora.com/What-are-the-specifications-of-lathe-machine