Machine Tool Set-up and Operation

MACHINES are very powerful tools and can be very dangerous if not properly used. Safety guidelines for set-up and operation standards must always be followed. They are created to ensure your safety and proper use of the tool. When you follow every step and standard procedure you'll be able to manufacture and create rough cuts and final pieces with confidence.

Objective:

Follow machine tool safety guidelines and standard set-up and operation guidelines.

Key Terms:

carriage
chuck
chuck key
chuck wrence
clamp
contact mat
curtain guard
cutting tool
dry run
guard fencing
home position
lathe carrier
lathe dog
OSHA
safety guidlines
spindle
vise
work piece

Follow Machine Tool Safety Guidelines

MACHINE TOOL SAFETY GUIDELINES

Safety guidelines are an aid to understand and implement safety rules. Common machine safety guidelines include the following.

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Guards and Covers

Ensure all machines have effective and properly working guards and covers.

Authorization

Operate machines when authorized to do so by the instructor/supervisor and only when the instructor/supervisor is present.

Tool Selection

Select and use the correct tool for the job. For example, ensure the bits, cutters, or grinding wheels selected are appropriate for the material and the job.

Secure Work Piece

Ensure materials and cutting tools on any machine are clamped securely before you start to work. Secure work pieces with a vise or clamp. A **vise** is a mechanical apparatus used to secure an object to allow work to be performed on it. A **work piece** is a material such as wood or metal that is in the process of manufacture or refining.

FIGURE 1. Clamps or a vise must always be used to secure your work piece.

Proper Work Speeds

Use power tools only at their operating speeds. Do not use while they are powering up or coming to a stop. Work the tool at its proper speed do not over force it, or use an object to stop it. Allow the machine it to come to complete stop before you leave when it is slowing down.

Working Guards

Keep guards in place and in working order.

Tool Cleaning

Repair and clean tools as needed. Turn off and unplug the tool before cleaning or repairing. Use the proper steps listed in the tool manual.

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Changing Bits and Cutters

Turn off and unplug the tool when changing bits, cutters or any part of the tool. Pull the plug out directly, do no pull on the cord. Use new and sharp blades and bits. Dull ones will ruin the work piece and put strain on the machine.

Ventilation

Ensure the ventilation system is turned on and working for those machines that require ventilation.

Operation Manual

Learn all about the machine before operation. Read the operation manual and make sure you have been trained on that specific machine. Know where the switching is, the power, and any other adjustments. Ensure it is clean and clear of any debris.

Machine Problems

Turn off the machine immediately if it is not working properly, making noises or shaking.

CNC/CN MACHINE SAFETY GUIDELINES

Training

Training on the specific machine is required before any operation.

Inspection

Inspect the machine for any damage or any debris and know exactly where the emergency stop button is located.

Protective Equipment

Wear the required protective equipment: safety glasses, non-slip shoes, and hearing protection, do not wear gloves.

FURTHER EXPLORATION...

ONLINE CONNECTION: CNC Machine Safety

Your number one concern when operating a CNC machine is safety. Even though the machine is computer controlled it can still be very dangerous. It is always important that proper set-up, maintenance and safety checks always be performed.

To learn more about CNC safety visit the web link below:

https://www.youtube.com/watch?v=2wEdguNDQgY

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Secure All Parts

Ensure the work piece it properly clamped.

CNC Observation

Observe the CNC machine at all times when in operation.

Guards and Fencing

Ensure all curtain guards and guard fencing are in place. Be aware of the contact mats. A **contact mat** is used to stop the CNC machine. Standing on the mat stops the machine instantly. A **curtain guard** is designed to shield the machine operator from the risk of tool fragments or airborne chips. The **guard fencing** marks the maximum working area of the machine. The fence keeps the operator away from any moving parts.

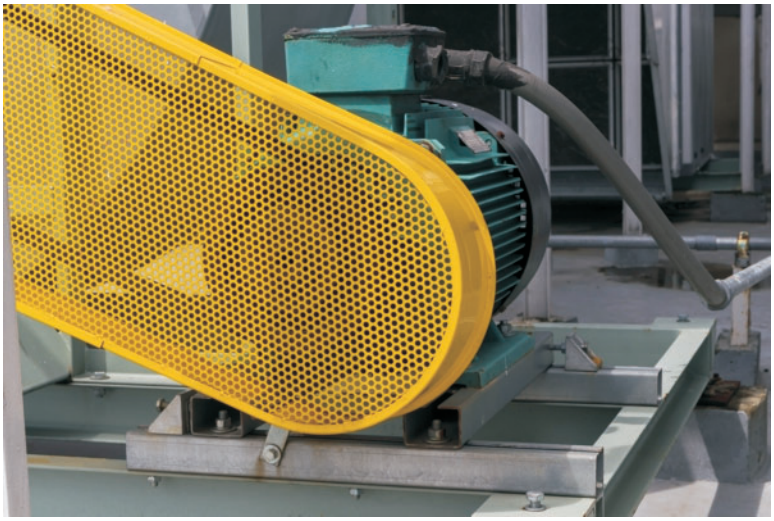

FIGURE 2. Ensure all guards and fencing are in place before operating any machinery.

Machine Shut Down

Never touch the machine when it is on. The machine must complete its cycle and return to the home position before removing the part. The **home position** is the default origin point on a CNC machine. It is set when the machine is started.

Approved Materials

Use only those materials approved for a specific machine's operation.

Follow All Tool Specific Guidelines

Follow all other specific machine tool safety guidelines.

GENERAL SHOP SAFETY GUIDELINES

General shop safety guidelines include the following.

Occupational Safety and Health Administration

Follow all OSHA guidelines for machine shop safety. **OSHA** (Occupational Safety and Health Administration) assures safe and healthful working conditions by setting and enforcing standards, and by providing training, outreach, education and assistance.

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FURTHER EXPLORATION...

ONLINE CONNECTION: Safety Awareness in the Machine Shop

A machine shop can have many powerful tools with lots of moving parts. It is very important that you are always aware of the dangers of each tool you are using. The machine's moving parts can grab, pull and push parts, clothing, and parts of your body quickly and with a lot of force. Your safety depends on your awareness of each tool and how they work.

To learn more about safety awareness visit the web link below:

https://www.youtube.com/watch?v=PV-B7MaE_iw

State of Mind

Refrain from using any power tools if you are fatigued, ill, on medication or distracted.

Proper Clothing

Wear proper clothing for the type of work done. The wearing of thin-soled shoes, sandals, open-toed shoes, or high heels is forbidden in a machine tool setting. No loose-fitting clothing, neckwear, bracelets, or any jewelry are allowed when operating machine tools as they can get caught in the tools.

Eye and Face Protection

Wear shop safety glasses at all times. Prescription lenses do not qualify as safety glasses. Safety glasses must have the ANSI Z87.1 logo to be impact resistant: the national standard for eye and face protection devices. Some machining processes and tools require larger face shields and goggles. Welding requires specific welding eye protection.

FIGURE 3. Safety glasses must be worn at all times.

Secure Hair

Secure long hair including beards. Hair and beards are covered with a band or cap and, if necessary, secured under a shirt.

No Drinks or Food

Bringing in any food or drinks in work areas of the shop is prohibited.

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FURTHER EXPLORATION...

ONLINE CONNECTION: Machine Shop Safety

There are many safety concerns when working in a machine shop. You should be aware of each one. The more you learn and review all safety standards and operations the more confident and safe you will be working.

To see a range of videos on machine shop safety visit the web link below:

https://www.youtube.com/playlist?list=PL293EB6F4FD6C1B47

No Electronic Equipment

Use of cell phones is prohibited while working on a machine, as well as any music-playing device. Ensure that all electronic devices are turned off while working in the shop.

Zero Distractions

Focus on the machine and tooling process, do not look away or engage others while running machines. Turn off the tool and stop working if someone is asking you a question or creating a distraction.

General Machine Operation

Refrain from walking behind people operating a machine. Operating a machine or switches is done by one person at a time. Never leave a machine while it is running.

Follow Standard Set-up and Operation Guidelines

CNC

Standard Set-Up

CNC standard set-up includes the following procedures.

1. Review all operating and programming procedures provided.
2. Prepare, download and review your program. Use the steps provided to load your program for the cutting paths.

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3. Check program for format, clarity, safety, and correctness. You can perform a dry run with the machine or the path can be run graphically on the control screen to check for any errors. A **dry run** is a practice exercise: rehearsal, trial.
4. Make a check list of the tools needed and get them ready.
5. Clamp all work securely before starting.
6. Stop the spindle completely for set up work and before changing the tool or your work piece.
7. Ensure the machine is all clear of any other tools or materials and all guards are in place.

Operation

CNC operation guidelines include the following:

1. Power up the machine and bring the machine spindle to its home location.
2. Press the cycle start (or similar) button to begin. Locate the emergency stop button if needed.
3. Watch the machine and work piece at all times.
4. Ensure the cycle is completed and the spindle returns to its home position once the machine is finished.

LATHE

Standard Set-Up

Lathe standard set-up includes the following procedures:

1. Put on your safety glasses.
2. Lubricate the spindle bearings with the provided oil.

FURTHER EXPLORATION...

ONLINE CONNECTION: Lathe Set-up and Operation

There are many steps that must be followed for the set up and operation of a lathe. It is very important for both your safety and making the correct parts that you follow each step and review all the procedures before using a lathe. It can also be helpful to right down all the steps and create a check list for you.

To learn more about how to use a lathe visit the web link below:

https://www.youtube.com/watch?v=SOnPEwP9bCA

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3. Mount your work piece to the machine.
4. Use the correctly sized clamp or vise for the piece being machined and secure it properly in the lathe chuck or mount prior to the machining process. A **clamp** is a device used to fasten, hold, or secure objects tightly together to prevent movement or separation. A **vise** is a mechanical apparatus used to secure an object to allow work to be performed on it.
5. Use sharpened drill bits only and cutting tools in good condition.
6. Turn the chuck to ensure there is no binding or danger of the work striking any part of the lathe. Ensure the cutting tool will not run into the chuck or lathe dog. The **chuck** is a device for holding a work piece in a lathe or a tool in a drill, typically having three or four jaws that move radially in and out. The **lathe dog**, also known as a **lathe carrier**, is a device that clamps around the work piece and allows the rotary motion of the machine's spindle to be transmitted to the work piece.
7. Ensure the spindle has the cup center imbedded, and that the tail stock and tool rests are securely clamped. Be aware of the direction and speed of the carriage or cross-feed prior to engaging the automatic feed.
8. The **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.
9. The **carriage** is the whole assembly of saddle, apron, top and cross slide. This may be referred to as the "Saddle," but technically this is not correct.

Operation

Lathe operation guidelines include the following:

1. Keep hold of the chuck wrench until it is returned to its storage. A **chuck wrench** or **key** is a device used to loosen or tighten the bolts or cam locks on the chuck.
2. Remove the chuck wrench from the chuck before startup.
3. Run the lathe forward only. Running the lathe backwards will cause the chuck to unscrew itself.
4. Keep eyes on the machine at all times when it is running.
5. Stop the machine before clearing any chips, do not clear chips from the cutting tool with your hand.
6. Use the correct speed and feed for the specific material and cutting tool.
7. Stop the machine immediately if odd noise or vibration occurs.
8. Shut off the power to the machine and allow it to a come to a complete stop when you are finished.

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MILLING MACHINES

Standard Set-Up

Milling machine standard set-up includes the following procedures:

1. Secure the material or work piece and select the proper cutting tool and any accessory according to the machines specifications.
2. The **cutting tool** is any tool that is used to remove material from a work piece by means of shear deformation. This may be accomplished by single-point or multipoint tools. Each tool will have a specific geometry depending on the work it performs.
3. Fasten work pieces and stock rigidly to the mill bed with clamps, a vise, or special fixtures.
4. Clear the cutting from the work piece before starting the machine.
5. Put on safety glasses.

Operation

Milling machine operation guidelines include the following:

1. Ensure all guards are in place while operating the machine.
2. Keep all hands and objects away from machine while in operation.
3. Operation is by one person only at a time.
4. Keep your eyes on the machine at all times.
5. Use appropriate speeds and feeds for the type and size of cutter being used with the material.
6. Stop the machine and remove all chips around the work piece or machine. Remove chips from the mill bed and stock with proper gloves and a brush or rag.
7. Turn the machine off and make sure it comes to a complete stop when finished.

BAND SAW

Standard Set-Up

Band saw standard standard set-up includes the following procedures:

1. Put on your safety glasses.
2. Check that the band saw being used is correct for the material

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FIGURE 4. There are several different types of band saws. Some are used for small detailed pieces of wood, some for larger wood stock, and some are used for metal. It is always important that you use the correct tool for the material and job.

3. Plan your cuts and allow for curves.
4. Close the guard doors and adjust the blade. Tighten and sharpen the blade before turning on the machine.
5. Adjust the upper guard assembly to within 1/4 inch of the material or working piece, and ensure the saw is at the appropriate speed.
6. Open gate and turn on dust collection

Operation

Band saw operation guidelines include the following:

1. Allow the saw blade reach full speed before cutting, and do not force feed any material or working piece.
2. Feed the work piece with a tool or push stick.
3. Ensure the work piece is laying flat and held firmly against table top.
4. Feed stock at the appropriate rate for the cut and material. Cut only as fast as the blade can remove the material.
5. Keep your hands several inches away from the blade, use a push stick when necessary.
6. Turn the blade off and allow it to come to a complete stop; then use a stick or brush to remove any scrap.
7. Turn the machine off and wait until it has come to a complete stop to retrieve you piece.

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DRILL PRESS

Standard Set-Up

Drill press standard set-up includes the following procedures:

1. Locate the stop and start buttons before operating a drill press.
2. Use only sharpened drill bits, sockets, and a chuck in good condition.

FIGURE 5. A drill press is a very useful tool, and it is important that you follow all the standard procedures for set-up and operation.

3. Center punch the hole location on the work stock.
4. Insert drill bit into the chuck and tighten the chuck using the chuck key; then remove the key before starting the drill.
5. Use a clamp or vise to firmly secure your work stock to the press table.
6. Clear the press table off completely except for the stock piece before starting the press.
7. Ensure all belts and pulleys are secure.
8. Check the drill speed and drill bit are the correct type for the stock being machined. Refer to the user manual.
9. Mount the drill bit to its full length and center it on the chuck.

Operation

Drill press operation guidelines include the following:

1. Ensure all guards and covers are in place while the machine is in use.
2. Turn off the drill press before making any adjustments and ensure the drill press is not in motion. Turn off the drill press and ensure it is not in motion before inserting the chuck key.
3. Keep your hands at least 3" away from the drill bit, and keep an eye on the work piece at all times.
4. Raise the bit up and down several times when drilling deep holes to clear out the cuttings.
5. Never reach around or behind the drill bit when in use. Stop the press by the power switch only, never use anything else.

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FURTHER EXPLORATION...

ONLINE CONNECTION: Drill Press Set-Up and Operation

It is very important to follow all the steps for the set up and operation of a drill press. This ensures your safety and that you are able to properly use the machine and all its functions. It is also helpful to create a check list by writing down all the steps.

To learn more about how to use a lathe visit the web link below:

https://www.youtube.com/watch?v=6JyIR5nwRho

6. Turn the drill press off when you are done. Waite until it comes to a complete stop; remove the drill bit after it has cooled.
7. Clean up all the shavings using a bench brush and pan. Do not blow them or use your hands.

GRINDING MACHINE

Standard Set-Up

Grinding machine standard set-up includes the following procedures:

1. Locate the emergency stop button and ensure the work area is clear.
2. Keep the grinder clear of people and debris with at least a 2' perimeter.
3. Wear your eye and hearing protection.
4. Turn on the vacuum or dust collection equipment.

FIGURE 6. Grinding machines have several moving parts and can produce a lot of debris and sparks, so it is important to follow all steps and make sure you wear proper protection.

5. Check the wheel housing guards and the grinder to ensure they are secure and fitted.
6. Inspect the wheels for any cracks.
7. Ensure the grinder is secured to a tabletop or the floor so it will not move.
8. Keep tool rest at 1/8" from the wheel just below center.

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9. Use pieces that can be properly supported on the tool rest; do not use small stock for your piece. Grip and secure the piece firmly. Use pliers if necessary to help with a grip.
10. Locate your work piece properly and ensure it is not touching the wheel before it starts.
11. Ensure the grinder is turned off before making any adjustments.

Operation

Grinder operation guidelines include the following:

1. Turn on the grinding wheel and remain on one side of the machine.
2. Allow the machine to run up to its full speed before use.
3. Grind on the edge of the wheel only; do not grind on the side of the wheel.
4. Bring the work piece slowly in contact with the wheel, avoid any impact or jabbing.
5. Move the piece back and forth across the front of the wheel to prevent grooves.
6. Wait until the work piece cools before you check it.
7. Turn off the grinder and wait until it is completely stopped, do not use any object to try and slow it down.

Summary:

Safety guidelines are an aid to understand and implement safety rules. Common machine safety guidelines include: guards and covers, authorization, tool selection, secured work pieces, proper work speeds, working guards, tool cleaning, changing bits and cutters, ventilation, operation manuals, and any machine problems.

CNC safety guidelines include: training, inspection, protective equipment, secured parts, CNC observation, guards and fencing, machine shut down, approved materials, and tool specific guidelines.

General shop safety guidelines include the following: OSHA, your state of mind, proper clothing, eye and face protection, secure hair, no drinks or food, ne electronic equipment, zero distractions, and general machine operation.

Standard set-up and operation guidelines are always very important for every machine they include the following: review all operating and programming procedures, ensure your work piece or stock is secure, wear proper protection, use the correct tools and materials, ensure all guards are in place, stopping, touching or working on a machine when it is running is prohibited and very dangerous, ensure machines come to a complete stop, never walk away from a working machine, power it off and always wait for it to completely stop then clean up.

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Always review the operation procedure for each specific machine before powering up the machine and using it.

Checking Your Knowledge:

1. What must you do before you clean the tool, make any adjustments or remove your work piece?
2. What electronic equipments are prohibited to use in the shop?
3. What distance should you always keep your hands away from the drill bit?
4. How many people are allowed to operate a machine or switches at a time?
5. What must you wear at all times to protect your eyes?

Expanding Your Knowledge:

There are a lot of different machines and tools used in a shop and a lot of things to remember. A great way to learn and remember all the steps and safety procedures is to observe someone who is an expert on the machines. You can ask your instructor to give you the names of a few people who are experts in the shop and set up a time to observe them when they are working. Keep a list of the steps for set-up and operation in a notebook.

Web Links:

Machine Shop Safety
https://vimeo.com/230452225

Machine Shop Safety Rules
http://www.wiu.edu/vpas/ehss/manuals/machine_shop.php

Top Ten Safety Tips for Machine Shops
https://solutions.borderstates.com/top-10-safety-tips-for-machine-shops/

Wood Workers Guides
https://guildoforegonwoodworkers.org/Resources/Shop/Tools/WOODWORKERS%20GUILD%20SAFETY%20MANUAL.pdf

Toolbox Talks
https://www.oshatraining.com/Toolbox-Talks.php

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