Health & Safety Technical Guidelines

HS-TG-04

Machinery Safety

Produced by

HSS – Facilities & GS Department

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1 Purpose

1.1.1 The purpose of this document is to protect the health and well-being of all Qatar University (**QU**) staff, students, and visitors, and to prevent damage to property, equipment, facilities, and the environment associated with the usage of machinery as part of the university's activities.

1.1.2 This document provides guidelines on the application of the requirements and principles of the QU Health & Safety Management System (**HSMS**) to activities associated with these QU workplaces.

2 Scope

2.1.1 This HS Technical Guideline applies to all operations and activities associated with QU activities where machinery is involved, to enable the effective management of HS aspects and risks within these workplaces.

2.2 Responsibilities

2.2.1 Top Management

2.2.1.1 QU top management shall allocate sufficient resources for the effective implementation of the HSMS, including the application of this HS Technical Guideline, and ensure that QU employees, students, contractors and visitors are aware of their responsibilities through appropriate regulation, delegation and communication.

2.2.1.2 The QU Top Management is also accountable for monitoring and reporting HS performance and appropriate programs and actions to ensure compliance with the QU HS Policy.

2.2.2 Other Accountabilities

2.2.2.1 The QU HS and the HS Committee are accountable to the QU Top Management for the implementation of this HS Technical Guideline.

2.2.2.2 Vice President (VPs), , Deans, Directors, Managers, Head Sections/Units and Project Managers are accountable to the QU Top Management for the application of this HS Technical Guideline in areas under their supervision.

2.2.2.3 All QU staff is responsible for performing their duties by complying with the requirements of this HS Technical Guideline as it applies to their activities and workplaces, observing and obeying safety postings and rules, and promptly reporting all incidents and accidents to their supervisors.

3 Guidelines

3.1 Machine Hazards and Safety

Machine hazards are a major cause of accidents and must be identified and controlled to avoid injury to staff working on/or near one of the machines. A hazard is an existing or potential condition which has the potential to harm people, property, or the environment. Thus, any machine motion or condition which can cause injury is considered hazardous and must be guarded against. In addition, any protective device supplied by the manufacturer must remain in place on the equipment, except during properly protected repair and maintenance that utilizes energy neutralization procedures, such as Lockout/Tagout (refer to ***QU HSMS SOP01 – Lockout / Tag out***). All the protective devices shall be re-installed before the equipment is returned to service.

There are four major areas of safety which must be considered for every machine:

- Maintenance
- Servicing and adjustment
- Points of operation where the machine works on material
- Protection from moving parts, other than points of operation.

3.1.1 Maintenance, Servicing and Adjustment

All personnel performing servicing and maintenance of machines must be properly trained, qualified, and competent to perform the task.

Only authorized staff are permitted to perform servicing and maintenance on machines.

3.1.2 Points of Operation

Points of operation are areas of machines where material is processed or changed by the machine, and where work is actually being performed on the material, such as a saw blade cutting a board.

Points of the safeguarding operation depend on the nature of the specific machine and the materials being processed. Normally each machine has specific protective device.

3.1.3 Mechanical Motions

Mechanical motions which may be hazardous include:

- Rotating Motion
- Reciprocating Motion
- Transverse Motion

3.1.4 Rotating Motion

Even slow smooth rotating shafts can pull body parts into dangerous positions. The resulting injuries can be severe or even deadly. Such things as collars, couplings, cams clutched flywheels, shaft ends, spindles and horizontal or vertical shafting are examples of the common rotating parts that are dangerous. Those dangers are increased by bolts, nicks, abrasions, projecting keys, or set screws which can serve as a cleat to grab clothing and/or as a protruding cutter head. These projections are difficult to see during rotation and must be made flush with the shaft if possible.

There are three basic in-running nip point hazards that are created by rotating parts.

- If there are parts rotating in opposite directions that are touching or there are rotating parts that are in close proximity, then a hazard exists where workers could be pulled in-between the rotating parts.
- Another nip point is created between rotating and tangential moving parts such as chain and sprocket drives, V belt drives, or a rack and pinions.
- Nip points can also occur between fixed and rotating parts which create shearing, crushing or abrading hazards. They include: spoked wheels, or flywheels, screen conveyors, or an abrasive wheel and the work rest.

3.1.5 Reciprocating Motion

Reciprocating motions create hazards during their back and forth or up and down motion that may strike a worker or cause him to be caught between a moving and a stationary part. This could include a bed of a milling machine.

3.1.6 Transverse Motion

Transverse motion or movement in a straight or continuous line creates a hazard when the worker is pulled into the pinch or shears point or is dragged by the moving parts into other moving parts.

3.1.7 Mechanical Actions

Mechanical actions are machine motions (actions) which include:

- Cutting
- Punching
- Shearing
- Bending

3.1.7.2 Cutting Action

A cutting action may be created in any rotating, reciprocating or transverse motion. The hazards of a cutting action are created in many points of operation activities. Injuries may occur to fingers, hands, head, arms, or where flying chips or scrap material may strike the eyes or face. Many examples include the cutting hazards of band saw, circular saw, boring or drilling machines, turning lathes, or milling machines.

3.1.7.3 Punching Actions

A punching action is created when power is applied to a stud or dies for the purpose of blanking, drawing, or stamping material. A hazard is created at the point where material is inserted, held, or withdrawn by hand. These hazards could be created on power presses, or iron workers.

3.1.7.4 Shearing Action

Shearing action hazards are created when power is applied to a slide or knife in order to shear or trim materials, such as metal or paper shears.

3.1.7.5 Bending Action

A bending action occurs when two dies together contact under power in order to bend, draw, or stamp metal or another material. The hazard is created at the point where hands are used to insert, hold or withdraw material from the point of operation.

3.1.8 Machine Safeguards

One or more methods of machine guarding must be used to protect the operator and others in the machine area from hazards such as:

- Points of operation
- In-going nip point
- Rotating part
- Flying chips and sparks.

3.2 Machine Safety Basic Rules

Before using equipment and machines or attempt practical work in a workshop you must understand the basic safety rules. These rules will help keep you and others safe in the workshop. Read the safety rules carefully.

Follow instructions.

- Do not run in the workshop, you could ‘bump’ into another person which can cause an accident.
- Know where the emergency stop buttons are positioned in the workshop. If you see an accident at the other side of the workshop you can use the emergency stop button to turn off all electrical power to machines.
- Always wear an apron or lab coat as it will protect your clothes and hold lose clothing such as ties in place.
- Wear good strong shoes. Steel-toe shoes are advisable.
- When attempting practical work all stools should be put away.

- Bags should not be brought into a workshop as people can trip over them.
- When learning how to use a machine, listen very carefully to all the instructions given by the teacher. Ask questions, especially if there is something you do not fully understand.
- Do not use a machine if you have not been shown how to operate it safely by the teacher.
- Always be patient, never rush into the workshop.
- Always use a guard when working on a machine.
- Keep hands away from moving/rotating machinery.
- Use hand tools carefully, keeping both hands behind the cutting edge.
- Report any damage to machines/equipment as this could cause an accident.
- Don't wear loose cloths.
- Always wear the proper Personal Protective Equipment (PPE).

3.3 Safety Requirements for Specific Machines

Note: safety information related to operation of additional tools and equipment is presented in **HS Technical Guideline TG-07 – Operations and Maintenance Safety.**

3.3.1 Use of Milling Machine

Milling machine is a machine tool used for shaping metal.

3.3.1.1 Safe Work Practices

- Ensure that the milling machine has a start/stop button within easy reach of the operator.
- Ensure that the work piece and cutter are mounted securely before taking a cut.
- Check that work is mounted squarely.
- Mount work in a vise that is bolted or fixed magnetically to the table. Use proper hand tools to make adjustments.
- Hold milling cutters with a cloth to avoid being cut when handling them.
- Move table as far as possible from the cutter while setting up work to avoid injuring your hands.
- Mill the largest surface first.
- Keep hands, brushes and rags away from the revolving milling cutter.
- Use a vacuum, brush or rake to remove cuttings only after the cutters have stopped moving.
- Change cutting compounds periodically.
- Keep cutters sharpened correctly and in good condition.
- Keep the working surface clear of scraps, tools and materials.
- Keep floor around the milling machine free of oil and grease.

- Use lifting equipment when appropriate to move heavy work to or from the milling machines. Do not wear gloves, rings, watches or loose clothing. Tie back long hair.
- Do not attempt to mount measure or adjust work until the cutter is completely stopped.
- Do not use an excessively heavy cut or feed as it can cause the cutter to break. The flying pieces could cause serious injury.
- Do not reach over or near a revolving cutter. Keep hands at least 30 cm (12 in.) from a revolving cutter.
- Do not lean or rest hands on a moving table.
- Do not make any adjustments while the machine is running.
- Do not use paper shims to check the distance between the cutter and the stock.
- Do not move the operating levers without knowing what they control and what action is going to take place.
- Do not leave machine unattended while it is running.
- Use safety glass and steel toe shoes working with the Milling Machine.

3.3.1.2 Before starting the machine, make sure that:

- All guards are in place.
- Work is properly secured in place.
- Bolts used to hold down work clear the tooling.
- Tooling and supporting pieces are properly tightened in position.
- Table stops are secured properly.
- Handles on all feed screws are in neutral positions.
- Table is free of stock, tools or other loose material.
- The arbor and arbor support are clear of the work.

3.3.2 Use of Lathe Machine

Lathe is a machine tool which spins a block of material to perform various operations such as cutting, sanding, knurling, deformation with tools that are applied to the work piece to create an object that has symmetry about an axis of rotation.

3.3.2.1 Safe Work Practices

- Ensure that the lathe has a start/stop button within easy reach of the operator.
- Follow job specifications for the speed, feed and depth of cut for materials being turned. Make sure all work runs true and centered.
- Center drill work deeply enough to provide support for the piece while it is turning.
- Adjust tool and tool rest so that they are slightly above the center of the work.

- Use a lifting device to handle heavy chucks or work.
- Inspect chucks for wear or damage. Flying pieces can be very dangerous.
- Remove chuck wrench immediately after adjusting chuck.
- Use a barrier guard when operating the lathe in semi-automatic or automatic mode.
- Guard all the power transmission parts.
- Remove all tools, measuring instruments and other objects from saddle or lathe bed before starting the machine.
- Ensure that the chip and coolant shields are in place.
- Shut off the power supply to the motor before mounting or removing accessories.
- Stop the lathe before taking measurements of any kind.
- Use a vacuum, brush or rake to remove cuttings only after the lathe has stopped moving.
- Keep the working surface clean of scraps, tools and materials.
- Keep the floor around the lathe clean and free from oil and grease.
- Do not wear gloves, rings, watches or loose clothing. Confine long hair.
- Don't lean on machine. Stand erect; keep your face & eyes away from flying chips.
- Do not place hands on work turning in the lathe.
- Do not use calipers or gauges on a work piece while machine is moving.
- Do not make heavy cuts on long slender pieces because the work could bend and fly out of the lathe.
- Do not leave the lathe unattended while it is running.
- Use safety glass and steel toe shoes while working with the Lathe Machine.

3.3.2.2 Steps to follow when filing

This procedure is done by hand. Take extra care because it involves reaching over rotating work.

- Cover the lathe bed with paper.
- Set the lathe at twice the speed used for turning.
- Adjust work freely between centers. If available, use a rotating dead center.
- Disengage lead screw by placing the reverse lever in a neutral position.
- Select a suitable long-handled lathe or mill file with a properly fitted handle.
- Grip file handle in the left hand and use the fingers of the right hand to balance and guide the file at the point. This method ensures that arms and hands will be clear of the head stock.
- Move file along work after each stroke so that each cut overlaps approximately one half the width of the file.
- Use long strokes, applying pressure only on forward stroke.
- Use approximately 40 strokes per minute.
- Clean loaded file with file brush and rub file teeth with a little chalk.

3.3.3 Use of Bench Grinder

The Bench Grinder is used for grinding the edges of flat metals, removing burrs from the ends tubing or rods, and minor shaping of some metal tools.

3.3.3.1 Safe Work Practices:

- Do not operate while under the influence of drugs, alcohol, or medication.
- Secure any loose fitting jewelry or clothing, tie back long hair - they can get caught in moving parts.
- Inspect the wheels for cracks or chips before use. A cracked wheel will disintegrate when operated.
- Guard must be used at all times.
- Eye shields must be over work area.
- Grind only on the face of the wheels. Grinding on the side of the wheel weakens the wheel and may cause breakage.
- Always use tool rest when working with this machine.
- Do not force metal into the moving grinding wheel.
- Do not make any adjustments to tool rests or spark arrestors while grinder is "ON".
- Remove any wrenches from the grinder before use if you make adjustments to the tool rest.
- Never grind soft metals (bronze, zinc, copper) on wheels designed for hard metal. The grinder is normally set up for grinding hard metals, i.e. steel. Soft metals can become incorporated within the wheel resin, causing overheating and subsequent wheel disintegration.
- For safe operation, the tool rest must not be in contact with the grinding wheel.
- Adjust angle of tool rest to the desired position and tighten nuts securely. Maintaining 1/16" - 1/8" clearance between tool rest and grinding wheel.
- The spark arrestor should be adjusted for approximately 1/16"- 1/8" clearance between it and the grinding wheel.
- Adjust eye shield to position aliening center of eye shield in line of sight to tool rest. The eye shields can swivel.
- Do not hold material above tool rest while grinding. Doing so can cause you to lose your grip on the material.
- Be aware of the gap between the tool rest and the grinding wheel. If too much gap exists, the material can get pinched or be projected towards the user.
- If you need to grind a small object, use a pair of vise grips to keep your fingers away from the grinding wheel.
- Be aware that this tool takes a long time to come to a rest (stop spinning).
- Never leave the machine on and step away.
- Use a grinding wheel "dressing stone" from time to time in order to tune up the wheel face and prevent wheel break up.
- Recommended Personal Protection Equipment while working with the Bench Grinder:
    - o Clear face shield or safety glass
    - o Leather jacket and long pants
    - o Leather gloves
    - o Leather top shoes or boots
    - o Wear ear plug or ear muffs during all grinding operations as the grinding process may generate high decibels.
    - o Respirator, N95

3.3.4 Use of Mug Welding Machine

The Mug Welder is used for joining two pieces of similar metals

3.3.4.1 Safe Work Practices:

- Do not operate while under the influence of drugs, alcohol, or medication.
- Secure any loose fitting jewelry or clothing, tie back long hair - they can get caught in moving parts.
- Do not wear flammable clothing. Avoid permanent press and nylon clothing because of the difficulty of putting out their fire.
- Do not touch live electrical parts.
- Do not adjust voltage range or voltage switch while operating the welder.
- Do not weld near a flammable source.
- Do not weld on drums, tanks, or any closed container it contained flammable material.
- Do not weld on containers or hollow castings which do not have vents.
- Never weld without adequate ventilation.
- Do not pick up hot objects. Assume that every metal objet around a weld bead or cut line is hot.
- Do not leave the electrode in contact with a metal table top or any grounded surface while the machine is on.
- Do not look at the welding arc without adequate eye protection.
- Do not strike an arc without checking the area to be certain that it is free of bystanders without safety equipment.
- Recommended Personal Protection Equipment while working with the Mug Welding:
    - o Shade 8 Helmet or better
    - o Leather welding jacket and long pants
    - o Leather welding gloves
    - o Leather top shoes or boots
    - o Respirator, N95

3.3.5 Use of Oxygen Acetylene Torch

Depending on the type of attachment, the Oxy/Acetylene torch can be used for heating and bending, welding, or cutting metal.

3.3.5.1 Safe Work Practices:

- There are two sets of regulators and valves: one for oxygen (color code – green) and one for the acetylene (color code – red).

- There are two gauges on each regulator, one on the right, indicating the tank pressure, and one on the left that indicates gas pressure in the line.
- Check all connections before lighting the torch.
- Never stand directly in front of or behind a regulator when opening the cylinder valve.
- Turn both cylinders off immediately when the torch flashes back, or if it is burning on the side. First oxygen and then acetylene
- Never open both fuel (acetylene) and oxygen valves before lighting the preheat flame.
- Always turn the oxygen cylinder valve all the way open.
- Open the acetylene cylinder valve not more than one turn. One-half turn is preferred.
- Always place the welding tip so that it points to the side of the torch to which the acetylene hose is attached.
- Always weld at least 5 feet from the cylinders.
- Do not use any oil or grease on any oxygen or acetylene connections.
- Never hammer on oxygen or acetylene regulators or stuck valves.
- Do not light a torch with a match or open flame. Use a striker.
- Before lighting torch, be positive that hose, tanks, or any inflammable material will not be exposed to heat, flame, or sparks.
- Beware of the high acetylene pressure. Never use acetylene gas when the pressure is greater than 15 pounds per square inch (acetylene gas when compressed to more than 15 pounds per sq. in. becomes a very high explosive.).
- Do not hold welding or cutting tip too close to your work.
- Never use a tip that gets too hot.
- Never use a torch that leaks.
- Never leave torch burning and go away from it.
- Never leave torch valves open.
- Do not adjust, alter, change, build, or do any experimental work on cylinders, regulators, torches, or any other gas equipment.
- Do not lift cylinders by the caps or valves.
- Do not transport the cylinders without the caps in place.
- Cylinders must be stored in upright position and chained to the wall.
- Keep valves closed on empty cylinders.
- Never weld a closed or jacketed vessel without air vent.
- Never weld a vessel that has contained any explosive or flammable material until you are positive that it has been thoroughly emptied and purged, and then use extreme care.
- Recommended Personal Protection Equipment while working with the oxygen acetylene torch:

- Shade 5 goggles
- Leather welding jacket and long pants
- Leather welding gloves
- Leather top shoes or boots
- Respirator, N95

3.3.6 Use of Power Hack Saw

The Power Hack Saw is used for cutting metal; it can cut pipe or flat stock perpendicular to the saw base and is only used to make straight or angled cuts. A masonry cutoff wheel can be used cut masonry on this saw.

3.3.6.1 Safe Work Practices:

- Do not operate while under the influence of drugs, alcohol, or medication.
- Secure any loose fitting jewelry or clothing, tie back long hair.
- Always know what type of metal you are cutting.
- Do not force the saw to cut through material.
- Always use vise. Do not ever attempt to hold a piece of metal and use this saw.
- Inspect the cutting wheel for cracks or flaws before use. If a crack of flaw is evident, the wheel must be discarded.
- Do not cut wood or plastic with this saw.
- Avoid bouncing the wheel or giving it rough treatment when in use. If this occurs during the operation, stop the tool and inspect the wheel for damage.
- Angles are best clamped and cut with both legs resting against the saw base.
- A spacer block slightly narrower than the work space can be used to increase wheel utilization.
- Long work pieces must be supported by a block or material support stand so it will be level with top of base. The cutoff end should be free (not supported).
- The vise has a quick travel feature. To release the vise when it is clamped tightly, turn the crank counterclockwise one or two times to remove clamping pressure.
- For accurate angle cutting, first use a protractor or adjustable angle to set adjustable fence.
- Recommended Personal Protection Equipment while working with the power hack saw:
    - Clear face shield or safety glass
    - Steel toe shoes
    - Respirator, N95

3.3.7 Use of Drill Press

Drill press is a fixed style of drill that may be mounted on a stand or bolted to the floor or workbench. Drill press are often used for sanding, honing or polishing, by mounting sanding drums, honing wheels and various other rotating accessories in the chuck.

3.3.7.1 Safe Work Practices:

- Wear appropriate safety glasses.
- Ensure that the drill press has a start/stop button within easy reach of the operator.
- Use a vacuum, brush or rake to remove cuttings.
- Remove burrs and chips from a drilled hole. When making deep holes, clean out the hole frequently.
- Use a clamp or drill vise to prevent work from spinning.
- Lubricate drill bit when drilling metal.
- Reduce the drilling pressure when the drill begins to break through the work piece. This action prevents drill from pulling into the work and breaking.
- Keep drill bits clean and sharp. Dull drills are a common cause of breakage.
- Keep floor around the drill press free of oil and grease.
- Keep the working surface clean of scraps, tools and materials.
- Keep guards in place and in good working order.
- Do not wear any loose clothing or ties. Roll sleeves above the elbow to prevent them from being caught in revolving parts. Confine long hair.
- Do not wear gloves, rings, watches, or bracelets while working with a drill press.
- Do not set speeds, adjust, or measure work until machine is completely stopped.
- Do not leave the chuck key in the drill chuck. Make adjustments and remove key immediately.
- Do not hold work by hand when drilling holes larger than 12 mm (1/2 in.) in diameter.
- Do not place hands under the stock being drilled.
- Do not stop the rotation of chuck and spindle with your hand.
- Do not remove a broken drill with a center punch and hammer.
- Do not leave the drill press running unattended.
- Recommended Personal Protection Equipment while working with the drill press:
    - Clear face shield or safety glass
    - Steel toe shoes

3.3.8 Use of Furnace

Furnaces are used to heat a material at a high temperature. Sometimes these are capable of heating to temperatures over 1000 degrees Celsius. There are no interlock devices to prevent the furnaces from being opened when they are hot and quite often it is necessary to do so. This procedure should be carried out with great care - stand at one side of the furnace as the door is opened.

3.3.8.1 Safe Work Practices:

- Wear protective gloves as well as lab coat (with sleeves rolled down).
- Wear safety glasses.
- Use tongs for loading/ unloading the furnace.
- Do not leave furnaces on overnight.
- Always check the temperature at which the ovens and furnaces are set. They are used at various settings and may not be set at the temperatures you require.

3.3.9 Use of Mechanical Shaper

A Mechanical Shaper is a machine tool used for shaping or surfacing metals and other materials.

3.3.9.1 Safe Work Practices:

- Always keep guards in place and in proper operating condition.
- If you are not properly trained in the use of a shaper do not use it until the proper training has been obtained.
- Read, understand and follow the safety instructions included in this manual. Know the limitations and hazards associated with this machine. Electrical grounding: Make certain that the machine frame is electrically grounded and that a ground lead is included in the incoming electrical service. In cases where a cord and plug are used, make certain that the grounding plug connects to a suitable ground. Follow the grounding procedure indicated in the National Electrical Code.
- Eye safety: Wear an approved safety shield, goggles, or glasses to protect eyes. Common eyeglasses are only impact-resistant, they are not safety glasses.
- Before operating the machine, remove the tie, rings, watch and other jewelry and roll up sleeves above the elbows. Remove all loose outer clothing and confine long hair. Steel Toe shoes should be used. Where the noise exceeds the level of exposure allowed in Section 1910.95 of the OSHA Regulations, use hearing protective devices. Do not wear gloves.
- Keep the machine guards in place for every operation for which they can be used. If any guards are removed for maintenance, do not operate the machine until the guards are reinstalled. Work area: Keep the floor around the machine clean and free of scrap material, saw dust, oil and other liquids to minimize the danger of tripping or slipping. Be sure the table is free of all scrap, foreign material and tools before starting to cut. Make certain the work area is well lit and that a proper exhaust system is used to minimize dust. Use anti-skid floor strips on the floor area where the operator normally stands and mark off the machine work area. Provide adequate work space around the machine.

- Maintain a balanced stance and keep your body under control at all times.
- Before turning on the machine, remove all extra equipment such as keys, wrenches, scraps, and cleaning rags away from the machine.
- Give the work you are doing your undivided attention. Looking around, carrying on a conversation and “horseplay” are careless acts that can result in serious injury. Disconnect all power sources: Before performing any service, maintenance, adjustments or when changing cutters. A machine under repair should be RED TAGGED to show it should not be used until the maintenance is complete.
- Never shape stock less than 12 inches in length without special fixtures. When practical, shape longer stock and cut to size.
- When shaping, never allow your hands to come closer than 12 inches from the cutters.
- When shaping with collars, the collar must have sufficient bearing surface. The work must also be fairly heavy in proportion to the cut being made. Do not use short, lightweight stock when the opening between the fence plates should only be enough space to clear the cutter.
- Always use the meter gauge and clamping mechanism when edge shaping stock less than 6" wide.
- Feed stock opposite to the direction of the cutter rotation. Never back stock out of the cutter once the cut has been started. Instead, pull the stock straight back away from cutter and begin the cut again.
- Make sure the spindle and the draw bar are tightened on the arbor.
- Never operate the shaper without the safety locking keyed washer located immediately under the spindle nut. This prevents the nut from coming loose when the spindle is running in a counterclockwise direction. Do not substitute any other type washer in place of the safety lock washer.
- If you are not thoroughly familiar with the operation of spindle shapers, seek advice from your supervisor, instructor or other qualified person.
- Maintain cutting tools in top condition: Keep blades sharp and clean for safe and best performance. Dull tools increase noise levels and can cause kickbacks and glazed surfaces. Check the condition and adjustment of the tools before making any cuts. Never use a tool that is not balanced and rated for the selected RPM.
- Do not clear chips and sawdust with hands; use a brush.
- If the operator leaves the machine area for any reason, the shaper should be turned "off" and the cutter should come to a complete stop before their departure. In addition, if the operation is complete, they should clean the shaper and the work area. Never clean the shaper with power "on" and never use hands to clear sawdust and debris; use a brush.

3.3.10 Use of Computer Numerical Control (CNC) Machine

Computer numerical control (CNC) is a computer "controller" that reads G-code and M-code commands and drives a machine tool, a powered mechanical device typically used to fabricate components by the selective removal of material.

3.3.10.1 Safe Work Practices:

- CNC machines are very safe to use as they are designed to be as safe as possible. One of the main advantages of CNC machines is that they are much safer than manually operated machines.
- CNC machines are designed so that the cutting tool will not start unless the guard is in position. Also, CNC machines automatically lock the guard in position even as the cutter is shaping material. The guard can only be opened if the cutter has stopped.
- It is essential that students / machine operators receive ‘quality’ instruction before attempting to use any CNC equipment.
- CNC routers, used for shaping materials such as woods and plastics, have built in extraction. Dust can be very dangerous if inhaled and can also cause eye irritation. Use respirator N95 and safety glass if necessary.
- Most CNC machines work behind a guard or even a closed, transparent safety door. This means that the operator cannot be hurt by 'flying' pieces of sharp/hot material.
- Commonsense applies to the use of all machines including CNC machines. Basic safety training regarding working in a workshop and with other machines applies to CNC machines as well.

4 Document Control

This Technical Guideline is a controlled document. The controlled version of this guideline is located on the QU Electronic Documentation Management System.

Any printed copies of this controlled document are reference copies only. It is the responsibility of all of those with printed copies to ensure their copy is kept up to date.

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