IOWA STATE UNIVERSITY

Department of Mechanical Engineering

Collegiate Design and Student Organization Shop

Shop Safety Procedures

The safety of the SAE and ASME team members are of the utmost priority. All collegiate design teams adhere to a sound safety program that is reviewed, improved, and modified on a continuous basis by the Mechanical Engineering Safety Officer. Effective procedures have been implemented over the past years that have resulted in a history of safe shop operation. Periodic inspections of the shop are performed by the M.E. Safety Officer to ensure compliance.

Introduction

The shop space located in the Nuclear Engineering building is intended to be supervised by official key -carrying students and is meant for usage by students for collegiate design projects. As the shop doesn't employee paid personnel the enforcement of safe shop procedures is the responsibility of those students granting access to the shop. As with any potentially dangerous work environment the responsible parties to the area carry authority. By reviewing this manual, successfully passing the safety quiz, and signing the safety agreement you are agreeing to abide by this authority structure. The usage of the shop is revocable and the user of the shop agrees to this possibility if his or her actions are deemed unsafe or counter to proper shop etiquette.

This manual is intended to be a general reference for safety measures for the shop located in Nuclear Engineering and that shop only. Any reference to a shop in this manual refers to that shop only as certain information is particular to it. The Mechanical Engineering Department's safety officer has agreed upon this manual and periodic revisions may be performed as seen fit.

Training Program Overview

The manual is divided into two main sections. The first section serves as a general shop safety guide. This ranges from varying safe work practices, maps of important safety features of the shop, preferred safety procedures, and additional general information. The second section is focused more in depth upon specific machinery and tools available in the shop.

Successful certification to use the shop is dependent on the information located in the first section. The ability of the end user to use machinery and tools listed in the second section is dependent on information found in the second section and additional certification on each individual machine.

After reading at minimum the first section of this manual a quiz pertaining to information found in this manual can be taken. For the quiz to be graded it must be signed and the signed quiz acts as a contract agreeing to terms and conditions listed in appendix 2. If the quiz score is above 80% the individual will allowed access

to the shop space.

If additional certification on machinery and tools from section 2 are needed a second quiz will be administered. While the quiz contains sections relevant to all the subsections of section 2 the test taker only needs to answer the questions related to the equipment needing certification. Similar to the general safety quiz the quiz will only be graded if a signature is presented.

Additionally users must demonstrate either ability to use the equipment in question or acquire hands-on training by certified trainers (normally shop supervisors). Each piece of machinery requiring additional certification will have a certification sheet attached on the wall behind the machine. Certified trainers are listed as well as a list of people certified to use the particular machine. Upon adequate safe equipment usage the end user's name should be added to the list.

Every individual using the shop space must recertify yearly no later than the 3rd week of the Fall Semester that calendar year. Recertification can happen after this date, but the user can not use the shop space beyond the 3rd week of the Fall Semester until completion of new quiz. Recertification is identical to the certification process, but revisions to the manual will likely be present in that year's quiz so the individual needs to review such revisions.

Table of Contents

Table of Figures

Section I: General Shop Safety

Commonly students entering a student-run shop space are of the belief that shop safety isn't as strictly enforced as it would be in a professional shop. Shop safety is taken very seriously in the shop-space located in Nuclear Engineering and a lax attitude towards safety and proper shop etiquette will not be tolerated. Violation of not only the information listed in this manual can and will result in the termination of a person's ability to use the shop. If certain behaviors not listed in the manual, but are warned against by an overseer of the shop are repeatedly performed termination of shop privileges can and will be enforced. While this warning sounds dire and might worry the reader that overseers of the shop are interested in removing people's shop privileges this is not true. Safe and proper usage of the shop is common and removal of individuals from the shop is very rare, but the possibility does exist. Just "be smart" about shop safety and there shouldn't be any worry about revocation of shop privileges.

General Rules

Usage of the shop is intended for college sponsored activities. Personal projects are not allowed. While certain activities including: Adding air to a bicycle tire, using a screwdriver to access the batteries in a portable personal device, usage of jumper cables to start a stalled vehicle outside, etc. are generally tolerated. Inquiring to a shop supervisor before such an activity is encouraged.

Usage of the shop is only allowed by individuals who have successfully completed the training listed in the "Training Program Overview" section of this manual. Exceptions are only granted by university faculty and are still at the discretion of the shop supervisors.

At least two people must be in the shop if powered equipment is being used. Access to the shop is not on a scheduled hourly basis. If access to the shop is required send an email to:

sae-shop-supervisors@iastate.edu

to determine if someone can grant you access.

General Shop Map

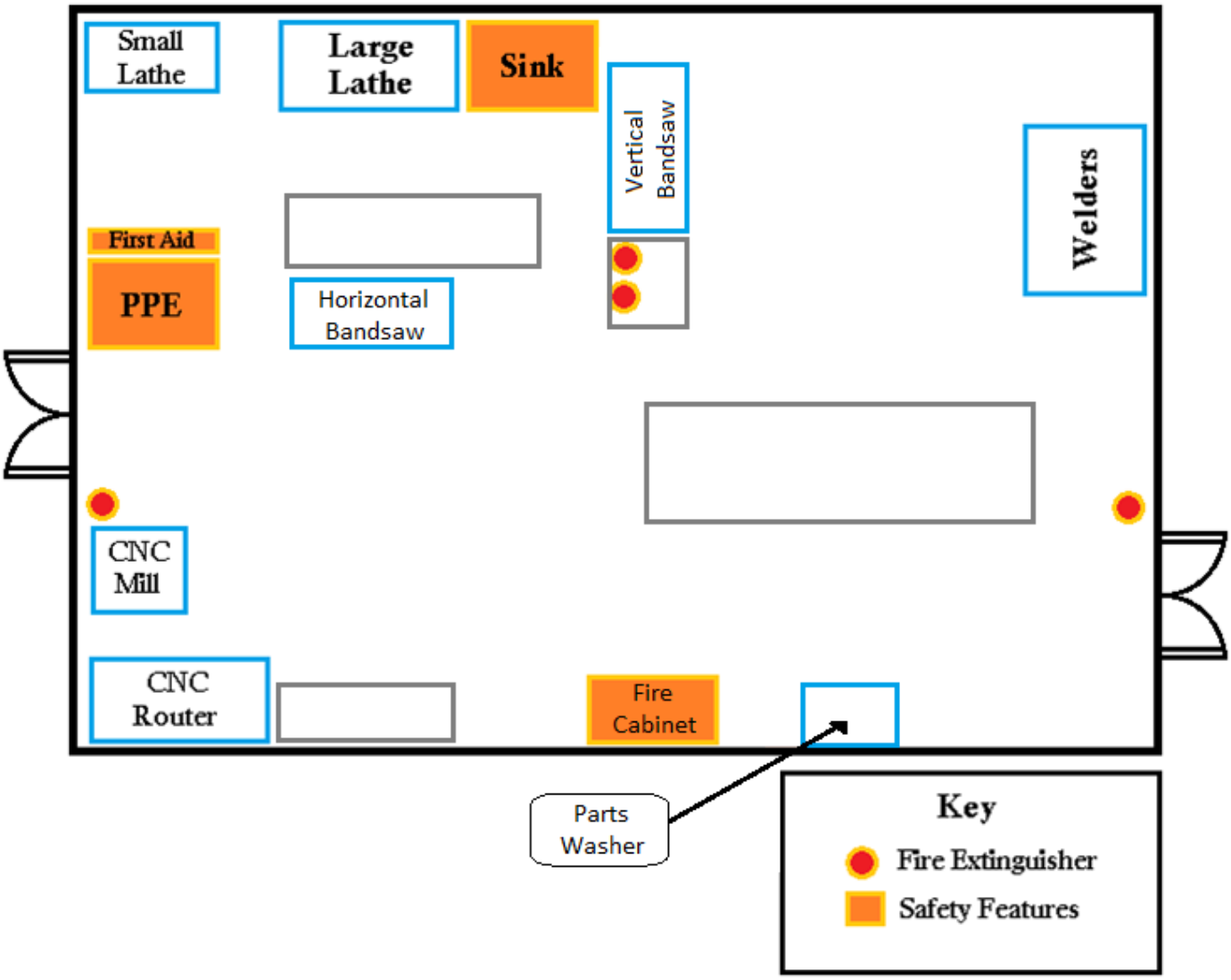

Figure 1A: Shop Safety Map

The general layout of the shop is shown in figure 1A. Notice key areas such as the PPE cabinet which is stocked with safety glasses. Directly behind the PPE cabinet lies the first aid kit. Additionally if eyes need to be flushed out the sink located at the top of the shop will suffice. Flammable, corrosive, or hazardous materials are stored in the fire cabinet at the bottom of the shop and a fire extinguisher resides next to both shop doors. Spare fire extinguishers can be located in the cart next to the vertical band-saw.

This shop map is current as of **Fall 2011** and future revisions might be necessary.

PPE

PPE is the acronym used for Personal Protective Equipment. Immediately upon entering the shop a cabinet of PPE is located directly to the person's left. PPE is a proactive means to lessen a person's risk to bodily injury. While using every piece of PPE available to a person should reduce the risk for bodily injury this isn't very practical and isn't suggested. Certain PPE is required for certain procedures and will be examined in greater detail. Most important in regards to PPE for the shop are safety glasses.

Figure 1B: PPE

Safety glasses or approved impact resistant glasses must be worn inside the confines of the shop space at all times. Approved glasses with have Z87 printed somewhere on the glasses. Immediately upon entering the shop a cabinet of PPE is located directly to the person's left. Inside the PPE cabinet should exist a box of safety glasses. Not using safety glasses inside the shop can result in a user's removal of the shop and repeated offenses may result in stricter punishment up to total revocation of shop privilege.

Splash shields do not satisfy impact requirements and can not be used as a substitute for safety glasses. If a splash shield is being used safety glasses still must be worn underneath. Also safety glasses are not a viable substitute for a splash shield. Handling of caustic or skin irritating chemicals must be performed with a splash shield.

Ear plugs & ear muffs:

While usage of ear protection isn't enforced it is highly suggested in certain procedures. Damage to hearing is permanent and is often preventable. Procedures such as grinding, hammering, engine tuning, usage of air tools, and certain sawing operations can net very high decibel noise. Also worth mention are activities which produce moderate decibel noises. Sustained exposure to moderate level noises can also permanently damage hearing. Again, enforcement of hearing protection isn't mandatory, but it is highly suggested and practiced.

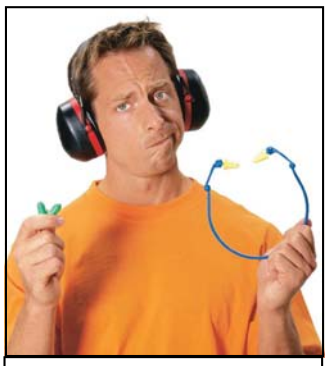

Fig. 1C: Hearing Protection

Inside the shop hearing protection utilized is not allowed to also output sound. A common example of this is audio headphones. Damping sound as to not damage hearing is justified, but listening to music and blocking out external noise is not.

Footwear:

A shoe/boot that totally encloses the foot is required while inside the shop. A pair of tennis shoes is sufficient but a pair of heavy leather boots or steel toe boots is advisable especially when handling material with sharp edges such as large piece of sheet metal or heavy, bulky or awkward pieces of material. Leather boots (especially with a steel toe) are better able to withstand cuts and provides more cushion in the case of something being dropped on the toes.

Figure 1D: Open Shoes

Dust masks & Respirators:

As with hearing protection a lot of breathing protection usage is left to the discretion of the user. While not required it is highly suggested that activities such as grinding, metal chop saw cutting, and being around the operational CNC router are performed using a dust mask. Laborious sanding operations such as with body panels where a D/A is used, emptying of dust receptacles, and any sustained operations where air blows fine particles around do however require some form of respiratory protection. While

respirators are available most procedures such as painting, brake dust cleaning shrouds, etc. require additional ventilation equipment not available in the shop. Since the shop doesn't have the resources for users to safely perform these jobs the need to also use a respirator also proves pointless.

Gloves:

Handling of materials with sharp edges such as large sheets of sheet metal, handling of chemicals labeled as corrosive, toxic, or otherwise listing protection against skin contact, or handling of hot materials necessitates the usage of gloves.

Fig.1E : Using Leather Gloves

More in depth:

Thick leather gloves are ideal in most cases. Handling of bulky, sharp, or perhaps awkward materials should be done with thick leather gloves. Any time a material being handled can cut or penetrate skin and addition of material between the hand and the object being handled would greatly minimize this risk, thick leather gloves should be used.

Latex or vinyl gloves should be used any time materials being handled run risks of chemical burns or skin irritation. Usage of the chemical parts washer or handling of materials in the flame locker must be done while wearing a chemical resistant glove. It is suggested, but not mandatory, that painting, liberal usage of grease, and perhaps shielding an existing injury on the hands should be done with chemical resistant gloves made from perhaps latex or vinyl.

Figure 1F: Proper Gloves

Of notable mention and will be repeated in section 2: there are certain scenarios when gloves are not allowed to be used. Generally operations with high speed rotational machinery where loose clothing can get caught in should not be done while wearing gloves. It is prohibited to operate lathes, belt sanders, and drill presses while wearing gloves.

There is still more PPE which applies to certain situations such as the usage of a welding hood for welding operations, but those PPE requirements are not detailed in section 1.

Shop etiquette

As with certain activities, such as driving an automobile, there are regulated rules or laws which are in place and are mandatory to obey. Then there are other non-regulated "etiquette" rules which to the irritation of some are not practiced. Inside the shop there is etiquette which is up to the discretion of the shop supervisor available as to whether it is enforced or not. This section should alert the reader of such items and point out how much attention should be paid towards them.

Put tools and equipment away after usage.:

Figure 1G: Proper Storage

The shop works best when the communal attitude is embraced. If there is only one of a certain size tool and a person uses it and leaves it perhaps on a table afterwards it inconveniences anyone else needing that tool. Also putting tools back into organizers or in the correct location is important. Any time tools and equipment are going to be used expect to allot time at the end of the task to not only clean up, but to return borrowed equipment. While not directly enforced in the shop repeat offenders to not returning items after usage are often times easily identifiable. Occasional lapses happen, but blatant offenders can receive warnings and in extreme cases not be allowed to use tools or equipment in the shop.

Be mindful of your surroundings:

The shop space is shared by many people. While proper PPE might be used by an individual it is also that individual's responsibility to make sure nearby people also are wearing adequate PPE. Ignorance to surroundings is not a justified reason to endanger bystanders, this includes making sure machinery is properly shut of or disconnected while not in use. Also while not always a safety issue, making sure an activity being performed doesn't interfere with others is considered proper etiquette. Running a vertical band -saw might not affect people directly. The constant loud chattering of the blade might really distract someone nearby who is performing a precision operation that requires concentration. It is common courtesy to warn people before making loud noises and also inquire if doing so might be preferred at a different time.

Figure 1H: Trip Hazards

Clean up after yourself:

While not all shop supervisors strictly enforce this point a majority do. The line between a messy shop and an unsafe one is unclear sometimes. If the shop becomes too messy it can and has been shut down pending attention and re-inspection. Similar to putting equipment away after usage, it doesn't take long to figure out who neglects shop clean-up procedures. Downright dangerous neglect can and will lead to disciplinary action and frequent (even minor) neglect will also eventually lead to disciplinary action.

If a tool is going to be used off and on; such as a sander, a thorough cleaning between uses isn't expected. After the job is complete; unless agreed upon by another person using a tool, it is expected for the last user to clean a tool and/or workspace. While it is realized a majority of the tools and equipment in the shop are well used and attempting to return tools with a fresh coat of wax, some decency needs to be exercised. Generally trying to return tools or equipment in the same or slightly better condition is a good strategy.

Some examples of correct and incorrect cleaning procedures are:

Figure 1I: Don't clean up w/air

Cleaning metal or wood chips:

Right - Using a broom to collect into a dust-pan and dispose into a receptacle.

Wrong - Using compressed air to blow material out from crevices.

Right - Using the shop vacuum to collect hard to reach areas.

Wrong - Using your hand to brush material.

Figure 1J: Chip Clean-up

Cleaning up a spill:

Right - Putting absorbent material from absorbent bucket on top to soak up spill.

Wrong - Using the shop vacuum to collect spill.

Right - If the spill is non-toxic and safe for the trash using paper towels to soak up.

Wrong - Leaving the spill to evaporate by itself

Note: *If absorbent material was applied to a spill make sure to coordinate with someone to sweep up the absorbed material later if the task can't be done personally. Spills should be marked with a sign to indicate a slip hazard as well.*

Slow down!

While there might be multiple people desiring the usage of a single piece of equipment there is never a reason to rush in the shop. There aren't cases of disciplinary action towards individuals working too slowly inside of the shop, but there are instances of disciplinary action towards people working too quickly. If while working with a piece of equipment it is noticeable rushing is occurring a warning might be administered. If rushing is overtly posing a safety risk a shop supervisor reserves the right to remove a person from the shop.

Ask questions!

There is a lot of different tooling and machinery in the shop and it is expected that not everyone knows everything to do with all the items in the shop. Rather than risk injury or damaging tools and equipment try directing questions to shop supervisors. Asking how to use a tool is encouraged over having an accident.

Specific Concerns

While not requiring additional training and special certifications, certain machines and equipment need brief safety mention. Also as with many points covered in this manual, if there are tools or equipment not covered in the text, feel free to pose questions to the shop supervisors.

1) Arbor press

The arbor press takes advantage of lever ratios to allow a user to apply significant force to an item. Make sure the lever isn't going to potentially strike someone and make sure the base of the press is clear of fingers and other crushable appendages. No special PPE above and beyond safety glasses are required while using the press.

2) Grinders (Bench-top and handheld)

There are numerous bench-top style grinders along with electric and pneumatic handheld grinders. Their usage and purposes might differ, but they all have similar safety needs.

Ensure that no combustible or flammable materials are nearby that could be ignited by sparks from the grinder wheel.
Ensure that a guard covers at least 270 degrees of the grinding wheel on bench -mounted machines.
Place the grinder tool rest one-eighth inch from the wheel and slightly above the centerline.
Allow the grinder to reach full speed before stepping into the grinding position. Faulty wheels usually break at the start of an operation.
Unless otherwise designed, grind on the face of the wheel.
Use a locking plier or clamp to hold small pieces.
Slowly move work pieces across the face of wheel in a uniform manner. This will keep the wheel sound.
Do not grind non-ferrous materials (**NO ALUMINUM!!!**)
Periodically check grinder wheels for soundness. Suspend the wheel on a string and tap it. If the wheel rings, it is probably sound.
Replace wheels that are badly worn or cracked.
Never use a wheel that has been dropped or received a heavy blow, even if there is no apparent damage.
Before using a new wheel, let it run a few seconds at full speed to make sure it is balanced.

Figure 1K: Bench-top Grinder

Figure 1L: Improper Grinding

3) Sheet metal shear

The sheet metal shear is rather long and often focus is only paid on the part to be sheared. Before applying any force to the pedal on the brake ensure nothing else is underneath the clamp or shearing face. The shear is intended for sheet metal cutting **only** and not for cutting round materials such as pipes or rods. Trying to force the shear to shear excessively thick pieces of metal is not allowed as it can damage the machine or cause it to tip over and crush someone.

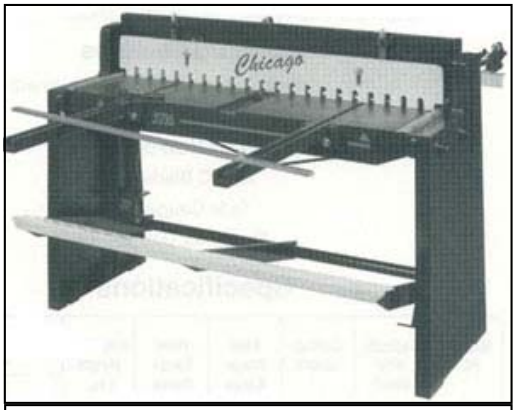

Figure 1M: Sheet Metal Shear

4) Drill Presses

Drill presses can be very useful when accuracy and repeatability is needed when drilling holes in metal and wood. Drill presses do pose some safety risks which need to be addressed. Also as with most stationary rotating tools the use of gloves is not allowed as well as requiring long hair to be tied. For safe tool operation:

Securely fasten work materials to prevent spinning. Never use your hands to secure work materials.
Use a center punch to score the material before drilling.
Run the drill at the correct speed. Forcing or feeding too fast can break drill bits.
Never attempt to loosen the chuck unless the power is off.
Lower the spindle before removing a chuck.
Attach pieces to the table with clamps & vises or utilize a drill press vise
Frequently back the drill out of deep cuts to clean and cool the bit.
Before operation ensure chuck key is removed.

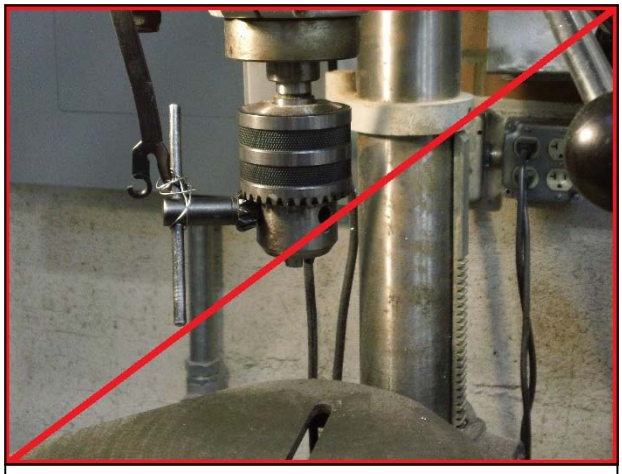

Figure 1N: Leaving Key In Chuck

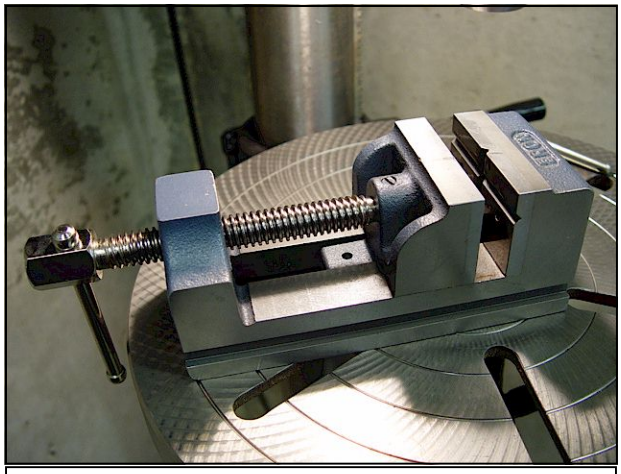

Figure 1O: Drill Press Vise

5) Wood or composite handled tools

Tools such as hammer, axes, or maul heads typically have handles which can loosen inside the head of the tool in time. If the head is loose on such tools bring the tool to a shop supervisor immediately. The same applies if the handle is split or seriously damaged. Swinging tools can break apart or come loose and the head can fly off and cause serious injury or damage.

6) Screwdrivers/pliers/other hand-tools

Screwdrivers are frequently used to purposes aside from removing or installing fasteners. Screwdrivers, ratchets, pliers, etc. are not to be used for hammering, prying, or chiseling. Using simple hand-tools like these incorrectly can and has permanently ruined them. Also do not store pointed tools such as screwdrivers in pockets. A fall could cause the tool to stab or cut someone unintentionally.

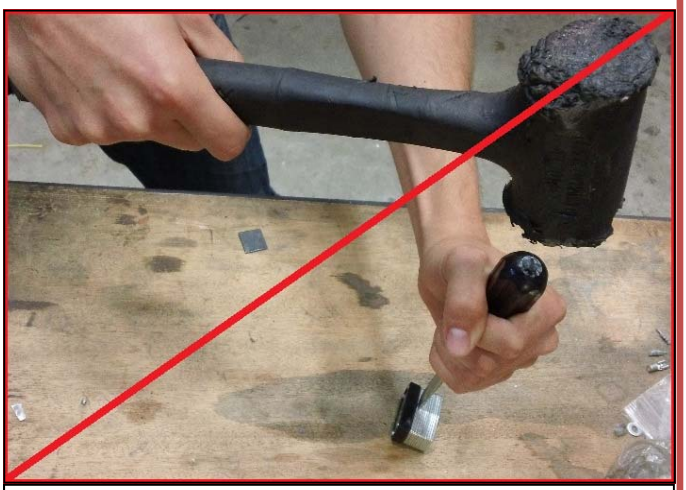

Figure 1P: Don’t use a screwdriver as a chisel

7) Striking tools

Never strike two hardened steel tools together. An example of this would be striking two hammers together. The hardened steel is brittle and can shatter. Also soft steel tools with mushroomed ends should have the ends ground to remove the mushroomed end. Additionally regular sockets can shatter when used in an impact wrench. Only use black-oxide coated impact sockets in an impact wrench.

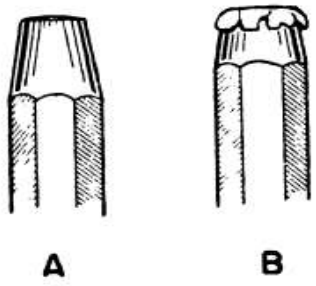

Figure 5-13.—Good and bad shaped chisel heads.

Figure 1Q: Mushroomed Part

8) Power tools

Before usage inspect the cord for damage or broken/missing ground. If the sheathing is damaged alert a shop supervisor. If cord is not fixable cut the male end off and dispose of cord.
Avoid touching cutting, drilling, or grinding components unless tool is unplugged.
Avoid loose clothing, jewelry, or hair which can get pulled into tool.
Use caution with work pieces and bits as they can be hot enough to burn.
Use the correct tool for the job. Usage of tools for purposes it was not designed for or fitting attachments not meant for a tool is not allowed. This can result in damage to property and/or personal injury.
Keep guards in place. If a tool came equipped with a guard or shield the tool must be operated with said safety items in place. The same applies with safety releases or automatic switches.
Make sure to operate tools at correct speeds for the tool or bits. Operating certain tools too quickly or too slowly can result in a tool malfunction and/or personal injury.
Before cleaning or clearing a jam in a tool make sure power is cut off (typically by unplugging the tool). Never use hand to clear jams or blockages.
Do not reach over running equipment. Many injuries occur this way.
For tools where material is fed into use a push stick to feed material. For tools such as grinders work pieces can be held with vice-grips or pliers to lessen the risk of hand injury.
Make sure tool is properly setup before usage. This entails removal of chuck keys, securing stops, locking tables, etc. Tools can become very unpredictable when a guide suddenly falls off or it is over-traveled.
Again make sure bystanders are kept a safe distance away and out of harm's way.

Figure 1R: Clearing a Jam

Figure 1S: 3-Prong Electrical Plug

9) Saw blades, knives, other sharp cutting tools

Figure 1T: Improper Storage

Keep sharp tools away from aisles, edges of tables, etc. Also make sure to store sharp tools so the sharp end isn't pointing outward, scabbards are used when applicable, or guards are secured. Sharp tools can cut someone rummaging through a drawer or stab someone if a fall is encountered and the blade is pointing upward. When using sharp tools always direct the tool away from self or others. Sharp tools can and will slip causing seriously bodily injury. Lastly sharp tools should remain sharp. Dull tools should not be used as blunt edged tools can be more dangerous than sharp ones.

10) Parts Washer

Figure 1U: Parts Cleaner

Make sure as per the PPE section to use chemical resistant gloves when using the parts washer. The parts washer contains mineral spirits which is a skin irritant. Also while not mandatory, a splash shield is recommended to wear while using the parts washer.

11) Sander

Somewhat similar to grinders, sanders come in bench-top styles, along with handheld electrical and pneumatic styles. One big difference between the two tools is the ability for sanders to do light surface removal on aluminum parts. Additionally when using sanders:

Ensure that sanding belts are not too tight or too loose. Never operate a sanding disk if the paper is too loose.
Use the correct grade of abrasive material.
Ensure that the distance between a circular sander and the edge of the table is not greater than ¼ inch. (See Figure 1V)
Do not push materials against sanders with excessive force.
Sand only on the down stroke side of a disk sander.
Do not hold small pieces by hand. Use a jig for pieces that are difficult to hold securely.

Figure 1V: ¼" Gap Between Table and Belt

Important: *Guards must be in place. If a guard is removed to perform maintenance or repairs, follow lockout/tag out procedures. Replace the guard after repairs are completed. Do not disable or move machine guards for any reason. If you notice that a guard is missing or damaged, contact your supervisor and have the guard replaced or repaired before beginning work.*

12) Ladders

Ladders are surprisingly dangerous and account for a large amount of emergency room visits in the U.S. each year. Ensure the correct ladder for the job is being used and safety is exercised when using a ladder. This is accomplished by

a.Inspect ladder beforehand to ensure stability and locking mechanisms are in good working order.
b.Carry ladders horizontally with the front end slightly higher than the back end.
c.To open a stepladder, make sure the spreader is locked and the pail shelf is in position. To open an extension ladder, brace the bottom end and push the rungs or rails out.
d.Place ladders on a solid, level surface to ensure safety:
e.Use common sense when climbing or working on ladders:

Watch for overhead obstructions and power lines.
To prevent ladders from sinking into soft ground, use a large board under the feet of the ladder.
Position a straight or extension ladder so that the base of the ladder is one foot away from the vertical support for every four feet of working ladder height (e.g., if you are working with eight feet of ladder, place the base of the ladder two feet from the wall.)
Do not place the top of a ladder against a window or an uneven surface.
When possible, tie the top of a straight or extension ladder to supports. Stake and tie the feet of the ladder.
An extension ladder used for access to a roof must extend at least 3 feet beyond the support point.
Use a wooden or plastic ladder if you must work near electrical sources.
Do not place a ladder in front of a door unless you lock and barricade the door and post a warning sign on the opposite side of the door.
Wear shoes with slip-resistant soles and make sure they are dry before climbing.
Never allow more than one person on a ladder.
To climb or descend a ladder, face the ladder and firmly grip the rungs, not the rails, with both hands.
Keep your body between the rails at all times. Do not shift your weight to one side.
Have someone steady the ladder if it cannot be secured otherwise.
Do not stand on the top four rungs of an extension ladder or the top two rungs of a stepladder.
When working on a ladder, keep two feet and one hand on the ladder at all times.
Do not stand on the bucket shelf of a ladder.
When working on a ladder, carry small tools on a tool belt. Use a rope to raise and lower heavy tools.
Never leave a raised or open ladder unattended.
Store ladders away from heat and moisture. Destroy damaged or unsafe ladders.

Final Thoughts

As mentioned in the opening the entire purpose of this manual is to raise awareness towards safety inside the shop. There is a lot of material inside this manual and it is available for future reference. Additional questions or comments can be directed to the shop supervisor(s) inside the shop or if none are available messages can be directed via e-mail to: **SAE-Shop-Supervisors@iastate.edu**.

Additionally the faculty advisor overseeing shop safety is James Dautremont and can be e-mailed at:

dautremo@iastate.edu

Section II: Specific Equipment Safety Procedures

As a reminder this section serves to expand upon some of the more dangerous or complex equipment found in the shop. Usage of the tools found in this section is dependent upon understanding and demonstrating competence via a supplementary quiz and hands-on verification through a shop supervisor. It is against shop policy to skip the safety quiz portion for any of the machines listed below and then use said equipment. Recertification follows the same time-line as the general safety section and the safety procedures and rules from the first section still apply. Certain topics are repeated such as listing the use of safety glasses, closed-toe shoes, zero-tolerance drug and alcohol, etc. to emphasize importance.

To gain certification on individual machinery the end operator only needs to fill out applicable quizzes.

For example:

If certification is desired for using the lathes and welders only the quiz sections labeled “Lathes” and “Welders” need to be taken. The non-relevant sections can simply be left blank.

If any additional safety or operational questions are needed contact a shop supervisor or submit an e-mail to: **sae-shop-supervisors@iastate.edu**

Section II: Specific Equipment Table of Contents

Lathe-General

1. Before use of this machine, be sure the proper PPE is worn. This includes; **safety glasses**, **closed-toe shoes**, and if applicable, a fire resistant apron.

2. Remove all jewelry, including watches, rings, necklaces, ties, etc. Remove any loose clothing that could become entangled in the machine and roll sleeves up past the elbow. Be sure long hair is held back from the machine. **Do not wear gloves.**

3. Check to see that the work space is clean and clear of debris.

    a. Clear metal, wood, and plastic debris off the machine.
    b. Wipe off any excess coolant or other liquids that may be on the machine from the previous user.
    c. Be sure the floor around the entire machine is clear. Sweep up all debris, wipe any spills, and put away any trip hazards that may be found in the immediate walkway.

4. Be sure to only use tools or attachments for the purposes they have been designed. Always be sure the machine is off before making adjustments or changing attachments.

5. Make sure chuck key is removed before operation.

6. Give the work undivided attention. Keep visitors at a safe distance from the operating area.

7. Always be sure cutters are sharp, and never force a cutting action. Usage of coolant will promote cutter tool longevity.

8. **Never** operate this machine under the influence of drugs or alcohol!

9. When finished using this machine, be sure to clean up. Remove all debris from the machine, wipe down the work space and clean the floor around the machine.

Jet 1440 Lathe (large)

1. Check to see that the machine has been properly shut off. Observe that both the light over the machine is off, and the red tipped start lever is at the off position. (Fig. 2B)

2. Now, start the machine by flipping on the master switch and red tipped start lever. Test the emergency shut-off by pressing the large red button. (Fig. 2A & Fig 2B)

3. Return the emergency button to its original position, start the machine again, and test the brake. To test the brake, simply step on the large pedal at the bottom of the machine. (Fig. 2B)

4. Observe the above safety shield. (Fig. 2B)

Fig 2A: Control Panel

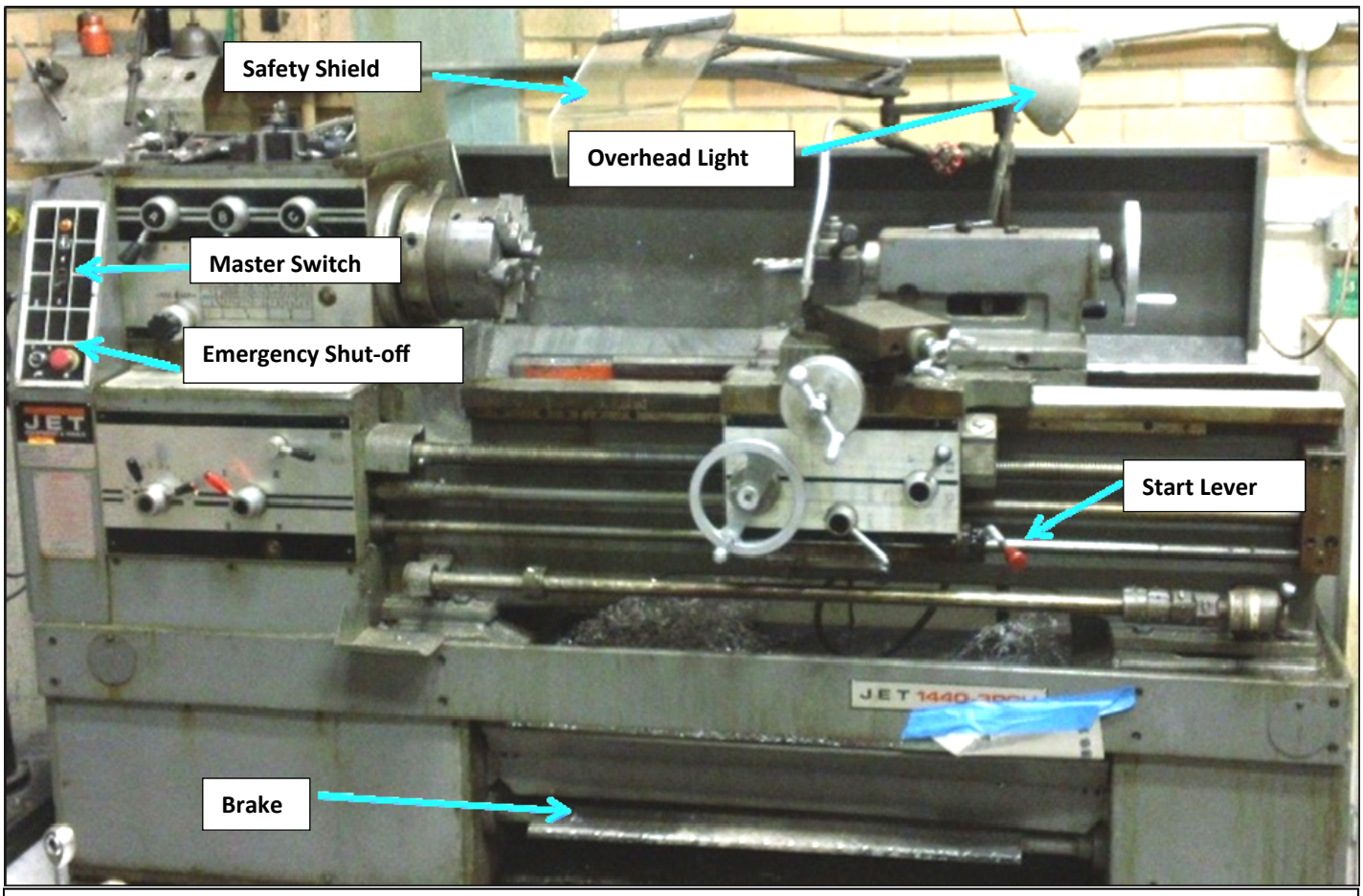

Figure 2B: Large Lathe

Small Lathe

1. Check to see that the machine has been properly shut off prior to operation. To turn the device on, turn **red handled knob**, then **gold handled knob**. (Fig 2C)

2. Shutdown is in reverse order from the **gold handled knob** to the **red handled knob**. (Fig. 2C)

3. Be aware that this device has no emergency shut-off!

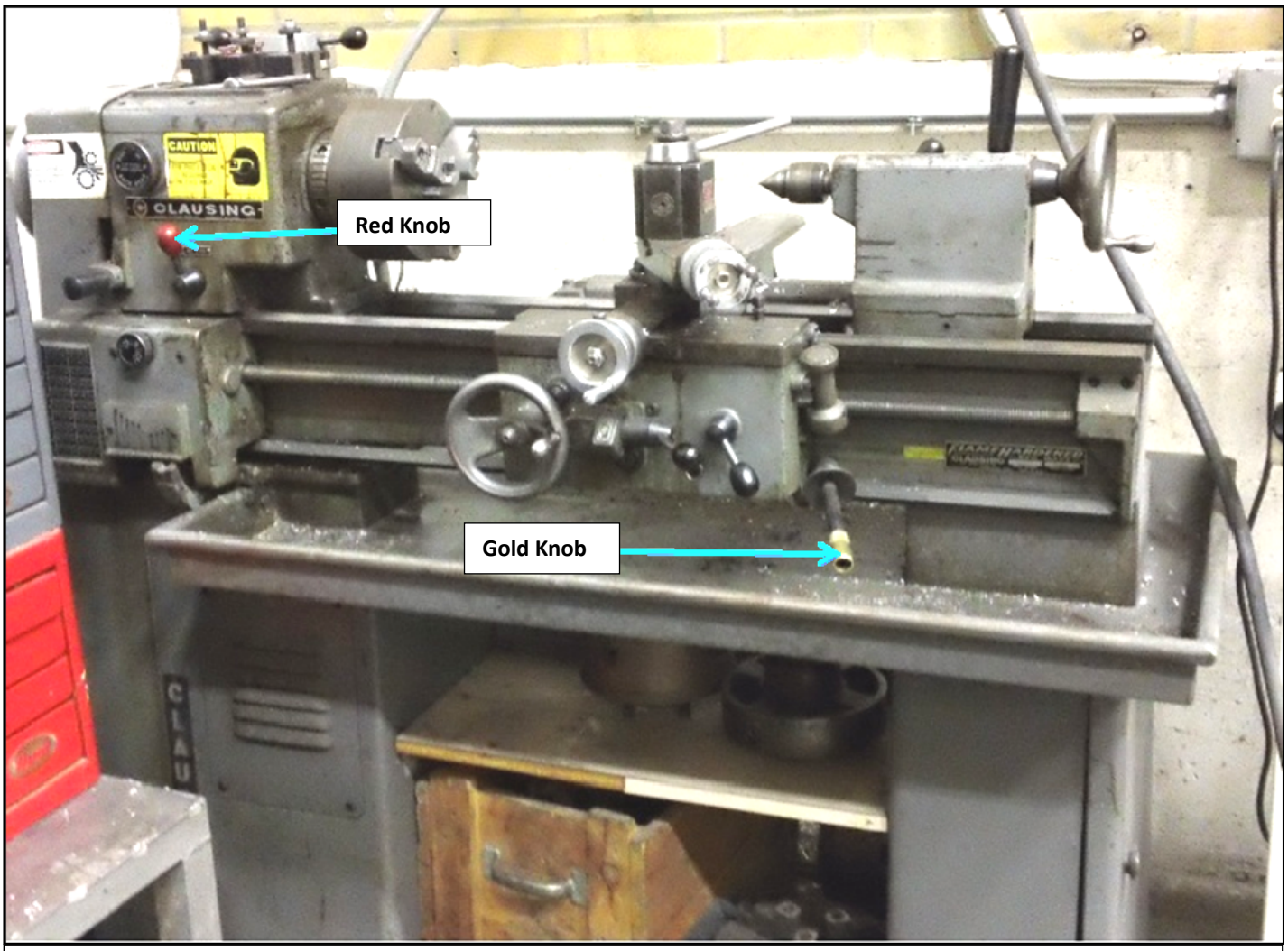

Figure 2C: Small Lathe

Band-saw General

1. Before use of this machine, be sure the proper PPE is worn. This includes **safety glasses** and **closed-toe shoes**.

2. Remove all jewelry, including watches, rings, necklaces, ties, etc. Remove any loose clothing that could become entangled in the machine and roll sleeves up past the elbow. Be sure long hair is held back from the machine. **Do not wear gloves.**

3. Check to see that the work space is clean and clear of debris.

    a. Clear metal, wood, and plastic debris off the machine.
    b. Wipe off any excess coolant or other liquids that may be on the machine from the previous user.
    c. Be sure the floor around the entire machine is clear. Sweep up all debris, wipe any spills, and put away any trip hazards that may be found in the immediate walkway

4. Only cut materials this machine is intended for. Ask an experienced individual for help or maintenance questions.

5. Keep hands and fingers clear of blade and moving parts at all times!

6. Give the work undivided attention. Keep visitors at a safe distance from the operating area.

7. **Never** operate this machine under the influence of drugs or alcohol!

8. When finished using this machine, be sure to clean up. Remove all debris from the machine, wipe down the work space and clean the floor around the machine.

Vertical Band-saw

1. Be aware that this machine has no emergency shut-off!
2. To operate machine, simply flip the white switch to the “on” position. (Fig. 2D)
3. If a procedure requires close action to the blade, a “push stick” is provided on or near the machine.

Figure 2D: Vertical Band-saw

Horizontal Band-saw

1. This device operates with an on/off switch that acts as a kill switch. As the top portion of the machine lowers with use, the lever will be pushed into the off position. (Fig. 2E)

2. Be sure the maintenance panels are **always** shut while operating. (Fig. 2F)

3. Watch the lower tank to avoid overfilling with coolant. (Fig. 2F)

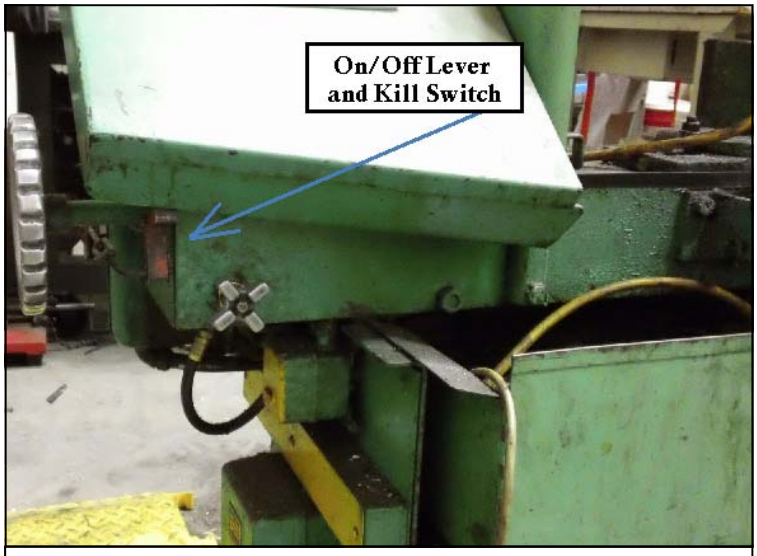

Figure 2E: Close-up of On/Off Lever

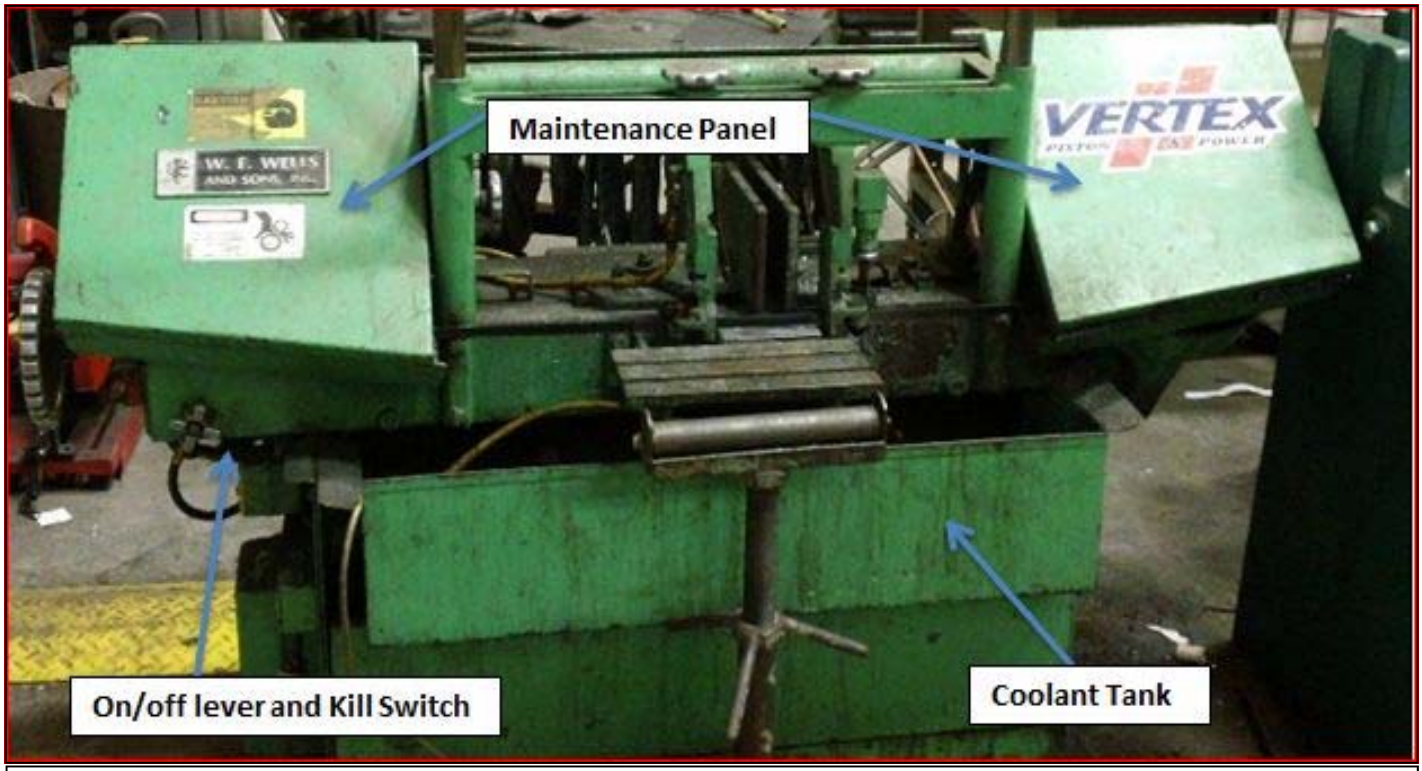

Figure 2F: Horizontal Band-saw

CNC Mill

1. Before use of this machine, be sure the proper PPE is worn. This includes **safety glasses** and **closed-toe shoes**.

2. Remove all jewelry, including watches, rings, necklaces, ties, etc. Remove any loose clothing that could become entangled in the machine and roll sleeves up past the elbow. Be sure long hair is held back from the machine. **Do not wear gloves.**

3. Check to see that the work space is clean and clear of debris.

    a. Clear metal, wood, and plastic debris off the machine.

    b. Wipe off any excess coolant or other liquids that may be on the machine from the previous user.

    c. Be sure the floor around the entire machine is clear. Sweep up all debris, wipe any spills, and put away any trip hazards that may be found in the immediate walkway.

4. Observe the large red button on the control panel. Before operation, test this kill switch button by pressing it. (Fig. 2G)

5. Programs entered into the control panel guide the lower table. (Fig. 2G)

6. Master lockout box located directly behind control panel. (Fig. 2H)

7. Direct air-cooler hose away from self and others. (Fig. 2G)

8. Always be sure table knobs are flip up when not in use or while CNC program is in operation. (Fig. 2G)

9. Keep hands and fingers clear of operating parts

10. Only operate with materials this machine is intended for. Ask an experienced individual for help or maintenance questions.

11. Give the work undivided attention. Keep visitors at a safe distance from the operating area.

12. **Never** operate this machine under the influence of drugs or alcohol!

13. When finished using this machine, be sure to clean up. Remove all debris from the machine, wipe down the work space and clean the floor around the machine.

See next page for visual aid

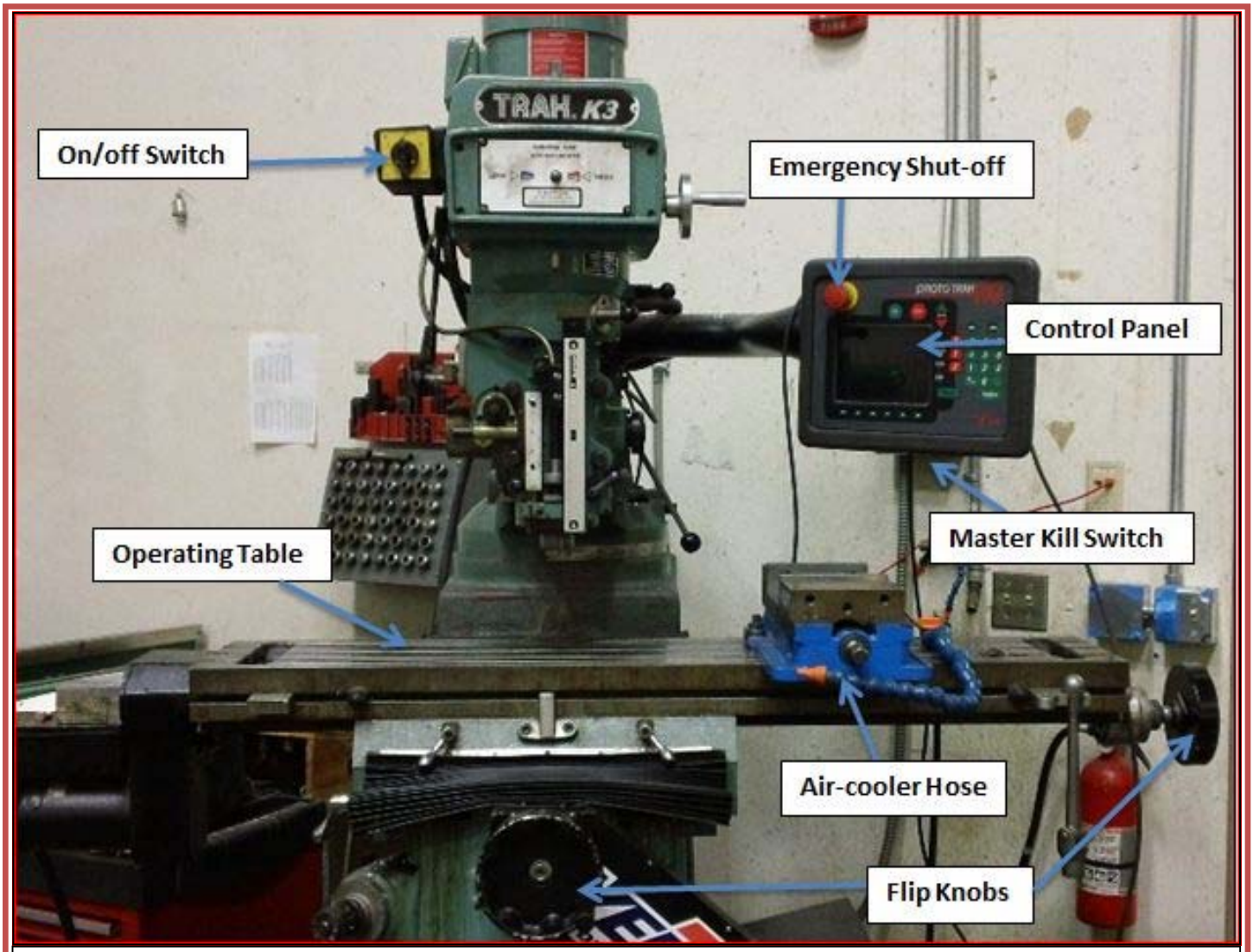

Figure 2G: CNC Mill

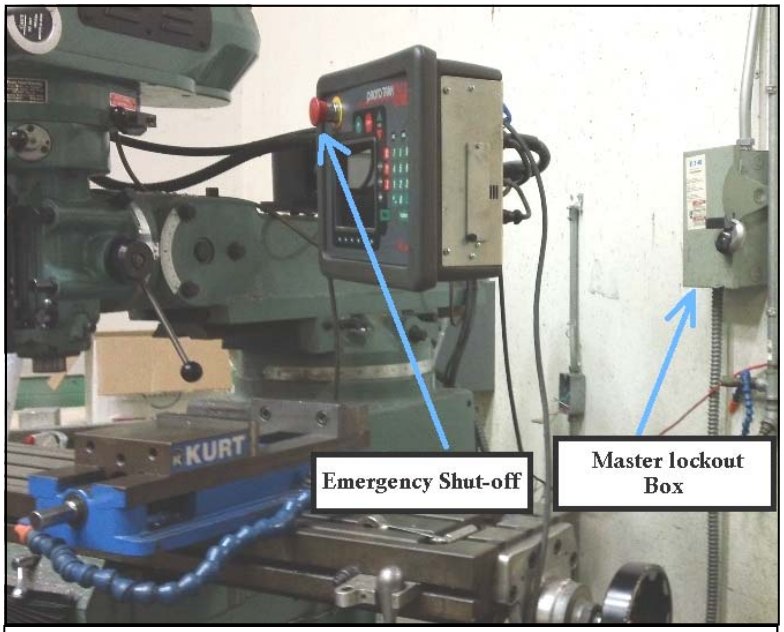

Figure 2H: Side-view of mill showing master lockout box

CNC Foam Router

1. Before use of this machine, be sure the proper PPE is worn. This includes **safety glasses** and **closed-toe shoes**.
2. Remove all jewelry, including watches, rings, necklaces, ties, etc. Remove any loose clothing that could become entangled in the machine and roll sleeves up past the elbow. Be sure long hair is held back from the machine. **Do not wear gloves.**
3. Check to see that the work space is clean and clear of debris.
    a. Clear metal, wood, and plastic debris off the machine.
    b. Wipe off any excess coolant or other liquids that may be on the machine from the previous user.
    c. Be sure the floor around the entire machine is clear. Sweep up all debris, wipe any spills, and put away any trip hazards that may be found in the immediate walkway.
4. Vacuum on/off switch located behind vacuum system. (Fig. 2J)
5. Be sure vacuum is on at all times while in operation!
6. Keep hands and fingers out of track and rails while in operation. (Fig. 2K)
7. Be aware that this machine has no emergency shut-off!
8. Give the work undivided attention. Keep visitors at a safe distance from the operating area.
9. Never operate this machine under the influence of drugs or alcohol!
10. When finished using this machine, be sure to clean up. Remove all debris from the machine, wipe down the work space and clean the floor around the machine.

See next page for visual aid

Figure 2I and 2J: CNC Foam Router Vacuum System (Front and Back)

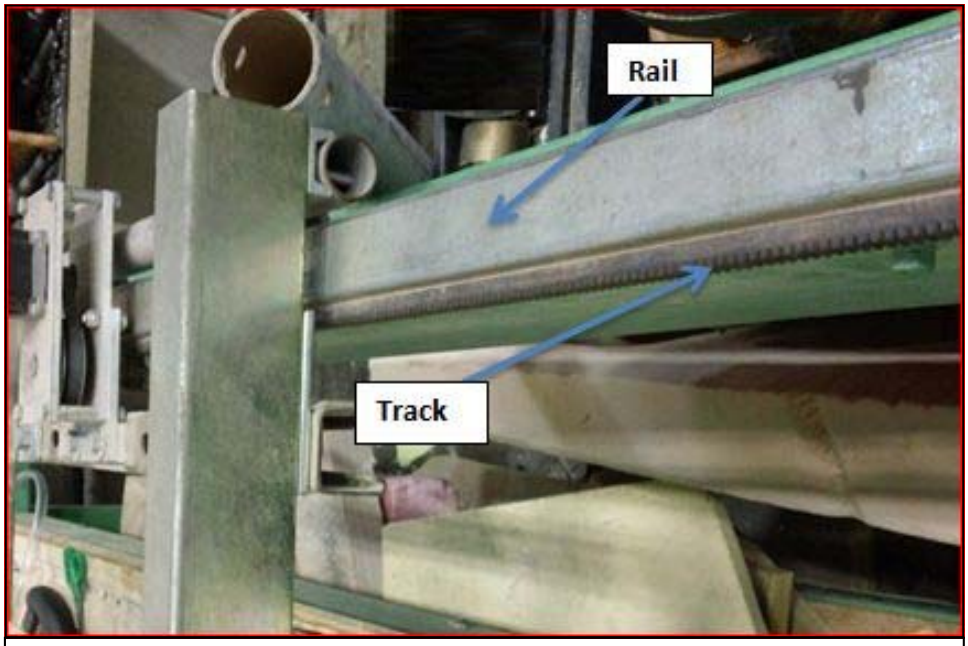

Figure 2K: CNC Foam Router Track and Rail

MIG and TIG Welders

1. Before use of this machine, be sure the proper PPE is worn. This includes; **safety glasses**, **welding helmet, heat and fire resistant gloves, arm shields, long clothing, and closed-toe shoes**.

2. Remove all jewelry, including watches, rings, necklaces, ties, etc. Remove any loose clothing that could ignite. Be sure long hair is held back far from sparks.

3. Check to see that the work space is clean and clear of debris.

a. Clear metal and plastic debris off the machine.

b. Wipe off any other liquids that may be on the machine from the previous user.

c. Be sure the floor around the entire machine is clear. Sweep up all debris, wipe up spills, and put away any trip hazards that may be found in the immediate walkway.

4. Check to be sure gas tanks are safe.

    a. Be sure gas tanks are chained tightly to welder or wall. (Fig. 2L & Fig. O)

    b. Be sure metal caps are placed on top of any gas tank in storage. (Fig. 2O)

    c. **Never** lubricate any of the fittings. Be sure the fittings on the tank and regulator are clean and free of oil or grease before use. (Fig. 2N)

    d. **Always** check to see that the tanks are shut off before and after use, and that excess pressure is released.

5. Give the work undivided attention. Keep visitors at a safe distance from the operating area.

6. **Never** operate these machines under the influence of drugs or alcohol!

7. When finished using this machine, be sure to clean up. Remove all debris from the machine, wipe down the work space and clean the floor around the machine.

8. Do not weld materials with coatings such as zinc, galvanization, etc. Coatings can/will emit toxic fumes. Similarly these welders emit inert gas to shield the weld. Only weld in well ventilated or open areas.

9. Arc welders use high current. It is crucial that the welding area is free of water/moisture as electricity presents electrocution hazards.

10. UV burns from welding can/will burn skin. PPE listed in number 1 of this section help shield the user against getting an artificial tan/burn.

See next page for visual aid

Figure 2L: MIG and TIG Welders

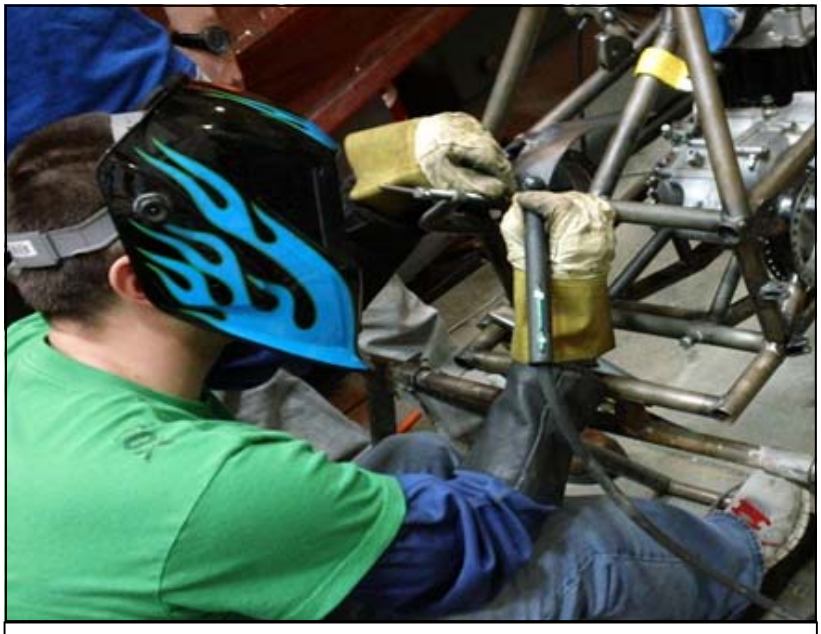

Figure 2M: Proper Welder Safety Gear

Figure 2N: Tank Valve

Figure 2O: Tank Storage

Appendix 1: Glossary

CNC – Computer Numerical Control – Machines with CNC function follow preset programming requiring little to no human interaction while running. Complex geometry or repetitive functions are well suited to following CNC code. Commonly mills, lathes, plasma torches, and routers are controlled via CNC.

DA – Dual Action sander. Sanders which orbit and oscillate to minimize swirl marks on a surface.

EPA – Environmental Protection Agency. Agency regulates shop safety procedures with regards to potentially harmful spills or waste which could impact the environment, people, or animals.

HAZMAT—Hazardous materials. Items deemed "HAZMAT" require special handling and disposal procedures. Contact a shop supervisor if questions or comments arise with regards to the proper handling or usage of items which might be hazardous.

HVLP—High Volume Low Pressure. A type of paint gun which utilizes air pressure to atomize and distribute paint on a surface. The shop does not have sufficient ventilation for HVLP paint gun usage.

MAPP—Methylactylene-propadiene propane gas. MAPP is a trademarked name belonging to Linde Group and refers to a common gas utilized in torches. It is able to achieve temperatures of upwards of 5300 degrees Fahrenheit.

MIG—Metal Inert Gas. This refers to the arc welding process in which the filler metal is fed simultaneously as shielding gas.

MSDS—Material Safety Data Sheet—Data sheets sometimes affixed to containers giving data about the contents of the container. Often materials requiring special care when handling or requiring special procedures for disposal require or will have MSDS's attached.

OSHA – Occupational Safety & Health Administration. Regulates proper worker safety regulations and exercises to ensure the long term health and safety for workers.

Parts Washer—A tank which allows for a cleaning substrate (in this case mineral spirits) to spray through a nozzle and clean parts with. The washer has a tank built in to recycle the cleaning material so the contents operate strictly in a closed circuit environment.

PPE – Personal Protective Equipment. Equipment which can be utilized to reduce the risk of injury to a person.

Respirator—Respirators have removable filters to accommodate different levels of filtration. Fine particulate created in processes like painting can be filtered with a respirator. Face masks do not offer sufficient filtration or sealing and are not recommended when maximum filtration is required.

Safety Guard—Often mistakenly interchanged with "Safety Shield". Safety Guards do similar functions to safety shields, but are not transparent and often semi-permanent. Safety Guards are often removed to replace or repair parts inside of a machine and require reinstallation before using the machine again.

Safety Shield—Often a transparent or semi-transparent material to shield the end-user from a potentially dangerous rotating, cutting, or otherwise precarious tool. Safety shields also differ from safety guards in that they are easily removed or adjustable to accommodate varying situations.

TIG—Tungsten Inert Gas. This refers to the arc welding process in which the arc is made between a piece of tungsten in the welding torch and the base material. Shielding gas is also released to the welding area as well.

Z87—The American National Standards Institute (ANSI) oversees various safety standards and ANSI Z87 rated safety glasses meet varying standards for resisting impact.

Appendix 2: Rules of the shop

A: People under the influence of drugs or alcohol are forbidden from using the shop space. Violators to this will be removed from the shop and prohibited from entering again.

B: Safety glasses must be worn in the shop at all times. This policy is strictly enforced when powered equipment is running in the shop. Additionally closed-toed shoes must be worn at all times inside of the shop.

C: Operators of rotating machinery or machinery which ejects material must ensure the work area is clear before and during machine operation. The operator of a machine is ultimately responsible for the safety of bystanders.

D: Long hair must be tied back and clothing, jewelry, etc. must be removed before operating rotating machinery.

E: The shop supervisors are ultimately responsible for the safe operation of the shop. Abiding by a shop supervisors wishes is mandatory for anyone using the facilities. Issues not covered in this manual, but deemed unsafe by a shop supervisor, are justified to be enforced.

F: Operating powered machinery in the shop alone is forbidden. There must be at minimum of two people in the shop any time powered machinery is being used.

G: Using equipment which outputs harmful emissions such as an internal combustion engine, HVLP spray guns, etc. are prohibited in the shop. The shop isn't rated to handle venting such emissions so this equipment can be stored, but not used. Exceptions involve short term usage such as MAPP torches and inert gas welders.

H: Horseplay in the shop is forbidden. While minor physical interaction is tolerable, there is no throwing of parts or equipment, absolutely zero horseplay around running equipment, and threats to members in the shop will not be tolerated.

I: People in the shop need to behave amicably towards one another. While users of the shop aren't forced to be "friends" with one another there needs to be at the least a professional work relationship with people using the shop. Negative interaction in the shop such as damaging parts or equipment, hiding parts or equipment, etc. will not be tolerated.

J: Equipment and parts in lockers or labeled in the shop are to be respected. Anyone wishing to use such equipment or parts needs to determine who is responsible for it and get permission. As with rule H, using supplies which are not available as general-use constitutes non-professional shop interaction.

K: While not always strictly enforced: Messes in the shop such as spills present safety hazards and do require action. If a shop supervisor requests a mess or area to clean an area of the shop the request must be met.

L: Distractions such as MP3 players or cell phones are not to be used while operating power machinery. This is constituted as unsafe equipment operation.

M: Power cords need to be inspected before usage. If a power cord has visible breaks in the outer sheath or the ground plug is broken off (when applicable) cut the male end of the cord off to prevent further usage and dispose of the cord.

N: During hotter months the temperature inside the shop can surpass 90 degrees. Take precautions such as staying hydrated and frequent breaks to cool down. Working while uncomfortably hot can lead to accidents.

O: Rushing is not condoned in the shop. Individuals trying to finish a task faster by increasing feed speeds, forcing tools or equipment, running, etc. will be warned and repeated or individuals with blatantly unsafe workmanship will be removed from the shop.

P: Using tools or equipment against their intended purpose will not be tolerated. Examples from the manual include: Grinding aluminum, Hammering on screwdrivers, Storing sharp tools without guards, etc. Behavior which potentially damages tools or runs the risk of hurting someone will not be tolerated.

Q: Ignorance to safety is not an excuse. If unsure of the correct method or proper use of an item in the shop ask a shop supervisor questions. Individuals damaging tools or endangering bystanders are in violation of rule O.