

## Shop Safety

The School of Engineering's principal Machine (Model) Shop is located on the first floor of Featheringill Hall in the west wing. A smaller Model Shop is located in Olin Hall on the first level. Additional machine tools and associated equipment are located in some of the research labs in the School. The single most important issue in the School in using any of these Shop facilities is safety. The primary objective of all people that use the Machine Shops must be to uphold safety. There is nothing that can be designed or built using the Machine Shops that is worth trading for a permanent disability. This handout is intended to give you some guidelines to working safely in the Machine Shops as well as familiarize you with some of the hazards.

The Machine Shop is a more hazardous environment than people are used to. All personnel must be properly trained before using the equipment. When you enter the shop, you should make a conscious effort to adjust mentally and physically to the increased hazards around you. Consult the first five safety rules below to adjust yourself to existence in a shop environment. Scrupulously follow safe procedures. Be careful to think through each operation before you execute it. Use your common sense. Do not do things that seem unsafe.

The shop supervisor or faculty PI or trained assistant is there to help you use the shop. However, they cannot be everywhere at once. Users of the shop must assume responsibility for the safe use of the facility. If you are unsure of the proper method to do something, wait until the shop supervisor or other trained person can give you guidance. If you notice an unsafe condition in the shop, fix it or bring it to the attention of the shop supervisor. If you think someone is using the equipment unsafely, suggest a safer alternative or bring that activity to the attention of the shop supervisor.

### General Safety Rules

The rules listed below apply to all people doing work in the School's Machine (Model) Shops. They are not all encompassing. Most shop areas and machines have specific safety rules that relate to their use, and these should be consulted. The following rules are a good general guide to safe use of the facility.

#### 1) **Never work alone.**

When you are working in the shops you must have a second person present who is capable of rendering assistance in case of an accident. Accidents do happen. You need to have a second person present so that if you become unable to help yourself, the second person can render aid and contact outside help. At Vanderbilt, the emergency number to call for assistance is 1-1911.

#### 2) **Never work when you are impaired. This includes times when you are too tired, stressed, or otherwise inhibited from exercising appropriate caution in the shop.**

Do not enter the shop when you are under the influence of any intoxicants or medications that might make you drowsy or alter your ability to be alert to reality.

Do not use the shop when you are too frantic to think clearly and carefully. Try to avoid last minute shop work in favor of a consistent weekly effort. Deadline-driven haste can lead to ruined projects and/or serious injuries.

Do not use the shop if you are wearing a cast or bandage that limits your mobility. In an emergency you must be able to react quickly to avoid injury.

**3) Wear all necessary protective gear and clothing. This always includes safety glasses and shoes that completely enclose your feet. Some shop activities will require additional safety gear.**

All persons, including visitors, entering the Machine Shop shall wear eye protection appropriate to the hazard. All such eye protection must conform to ANSI standard Z87.1. Safety glasses that conform to the standard are marked with a “Z87”.

If you wear glasses already you should be aware that most eyeglasses purchased in the United States conform to ANSI Z87.1 for frontal impact. You may wear such glasses for work in the shop. To protect your eyes from side impact you can add side shields to your existing glasses or purchase prescription safety glasses for use in the shop.

Do not wear contact lenses in the welding shop. The intense light from the arc welding torches can cause contact lenses to damage your eyes. Additional information can be obtained from the American Welding Society, <http://www.aws.org>, web site under Safety & Health.

Persons exposed to foot injury hazards shall wear foot protection appropriate to the hazard. Leather shoes are necessary to protect your feet from stray droplets of molten metal in the welding area. Additional information can be obtained from the American Welding Society, <http://www.aws.org>, web site under Safety & Health.

Certain dusts and fumes require respiratory protection. In the event that a respirator is necessary, the Shop Supervisor may require you to obtain and wear one for operations that expose you to airborne hazards. Additional information can be obtained from the American Welding Society, <http://www.aws.org>, web site under Safety & Health. Any employee or personnel wearing any respirator other than a dust mask must have medical surveillance through the Vanderbilt Occupational Health Clinic, <http://www.vanderbilt.edu/HRS/wellness/occhealth.htm>, and be fit-tested by VEHS.

When it is not practical to reduce sound levels below ninety decibels, then persons exposed to such sound levels shall wear hearing protection in the form of foam ear inserts.

Leather gloves are available in the welding areas for protection from the heat and radiation of welding. Additional information can be obtained from the American Welding Society, <http://www.aws.org>, web site under Safety & Health.

Welding requires the use of welding masks with appropriate eye-protective lenses and natural fiber clothes that completely cover your skin. The electric arc in particular is an intense source of ultraviolet and infrared radiation. Even a brief exposure of your unprotected eyes can cause severe damage to your sight. Do not look at an electric without the correct eye protection. If you expose bare skin to the light of the arc, the radiation is intense enough to give you severe sunburn. Natural fiber clothes are required because they will not melt onto you in the presence of high heat, as some man made materials will. Additional information can be obtained from the American Welding Society, <http://www.aws.org>, web site under Safety & Health.

**4) Long hair must be tied up securely.**

Most of the power tools in the shop are based around a rapidly rotating shaft. In use the shaft is frequently sticky with oil. Long, loose hair can stick to such a rotating shaft and pull the owner of

the hair into the tool. Long hair must be kept out of harm's way by tucking it into a cap, tying it up. Or knotting it in a way that prevents it from dangling.

- 5) **Remove all personal accessories and loose clothing that might get caught in moving machinery. This includes rings, watches, jewelry, personal stereos, shop rags, ties, and open jackets.**

Like long hair, things that dangle from your person can get caught in rotating machinery. Regardless of the fashion, it is not worth risking your health.

Loose garments must not be worn in the shop. Tuck in loose shirttails and sweat pants ties. Keep tight fitting jackets or coats closed.

Do not keep shop rags in your pockets.

Do not wear personal stereos or headphones while you are working in the shop.

- 6) **Never leave a machine running unattended.**

Some of the tools in the shop can be set to cut automatically. You must keep your attention focused on the machining operation. If you are focused on the process, you will be more likely to react appropriately in the event of an accident.

The Machine (Model) Shops in the School are used primarily for building prototypes. As a result most set-ups are not tried and tested in a production sense. It is inevitable that some set-ups will go bad. If you are paying attention to the operation, you may be able to avert injury to yourself and the people around you.

- 7) **Never leave a chuck key in a chuck or a drawbar wrench on a drawbar. If the key or wrench is in use your hand must be on it.**

Chuck keys and drawbar wrenches can be accidentally launched across the shop if they are left in place. The startup power of the lathes and mills can throw the tools with enough force to puncture a body cavity. You must be careful not to leave the chuck keys and drawbar wrenches in place when they are not in use.

The same rule applies to the chuck keys used to tighten the chuck on the drill presses.

- 8) **Keep your hands well away from the point of contact between the work piece and the cutter. If you must hand hold the work to keep it in place, your set-up is unsafe; improve it.**

While working on the lathes and mills you should never hand hold your work. If the tool or work piece is vibrating, the chances are high for a sudden shift in the set-up. If you are hand holding the tool or work piece, you might not be able to get out of the way as the parts come together. Besides, the cutting forces are too large for you to be effective in securing the work piece or tool.

When using the drill presses, especially with large drills and tough to cut materials, you must clamp the work to the drill press table. If the drill catches an unclamped work piece, the rotating part can cut your hand.

On the band saws, table saw, router table, chop saw and any other tool that is designed to be used with a hand fed work piece, be certain to keep your hands, fingers, and other body parts out of the path of cutters and away from the point between the work piece and the cutter.

Keep all parts of yourself at least 6 inches from the point of contact between any work piece and any cutter.

Do not remove chips with your fingers. Use brushes, pliers, or compressed air.

**9) Support work pieces and cutting tools as securely as possible.**

A vibrating set-up is usually an indication that the work piece and/or tool are not held strongly enough to resist the applied cutting forces. You must take the time to secure the set-up to resist the force of cutting or use a different operation to do the job. Do not try to make do with a flimsy set-up.

Expect to spend a lot (80% or more) of your time in the shops making set-ups. It is the nature of prototyping. Unfortunately, it is also hard to visualize when you are thinking about work in the shop. This is where a well-metered approach to work in the shop will pay off. If you think things are taking longer than you expected, you can scale down or redesign your work. At the last minute it is hard to make such large changes.

**10) Have the shop supervisor or other trained person check you out the first time you use each machine or process in the shop. Do not operate any machinery with which you are unfamiliar.**

Each and every tool in the shop has safe operating procedures associated with it. Do not work on any tool in the shop until the shop supervisor or other trained person has introduced you to its safe operation. You should get checked out even on tools you have been taught to operate elsewhere. The tools in the shop may have idiosyncrasies that you should know about.

## **Clean Up Procedures**

Careful clean up is part of the safe operation of the shops. If a person cannot find a needed tool in its regular place or if a person is required to work in someone else's mess, the result will be frustration. It is difficult to keep safety in mind when you are frustrated. So it is important, especially in times of heavy use, to keep the shop clean with everything returned to its correct place at the end of its use.

**1) Shut off power to the machine.**

Turn off the main power switch for the machine.  
Disengage all power feeds and lead screws.

**2) Un-mount all cutters**

Remove all end mills, lathe tools, drills, and similar tools from their tool holders.

**3) Put away all measuring tools, hand tools, material scraps, and drawings.**

Put away all objects that do not belong permanently with the machine. If you do not know where something goes, ask the shop supervisor. If the shop supervisor is unavailable, leave whatever it is in plain sight on a table. It is better to leave it out than to put it away in the wrong place.

**4) Clean chips and excess oil from machines and chip pans.**

Protect your hands from sharp chips with a shop rag.

Most machines can be wiped down completely with a shop rag. If you must use compressed air, be careful with it. Do not point compressed air guns at people. Blown chips can become

lodged in eyes and the compressed air itself can do severe damage to a person's body. Use the compressed air early in the clean up process. Otherwise you will blow chips all over the areas you have already cleaned.

Do not use brooms or brushes on the machine tools. The brushes and brooms pick up abrasive dirt from the floor. If abrasive gets on the machine tools they will wear very quickly.

You should clean the equipment well enough that the next user will not be able to tell what material you were using.

**5) Put a light coat of way oil on the machine ways.**

Move the machine slides to one extreme position and oil the exposed ways. Next move the ways to the middle of their travel and oil the newly exposed sections. Leave the machine slides at the approximate center of travel.

**6) Sweep the floor in the vicinity of the machines you have used.**

Collected debris should be either recycled or thrown in a scrap container.

**7) Ensure all hazardous materials such as used paint, oils, solvents, degreasers, etc. are properly labeled and stored.**

Vanderbilt Environmental Health and Safety (VEHS), <http://www.safety.vanderbilt.edu>, should be notified of anything requiring disposal.