

## **Shop Safety Handout**

The single most important issue in the Stanford Product Realization Lab is safety. The primary objective of all people that use the student shops must be to uphold safety in the student shops. There is nothing that you can design or build using the student shops that is worth trading for a permanent disability. This document is intended to give you some guidelines to working safely in the student shops as well as familiarize you with some of the hazards.

You should familiarize yourself with the basic safety parameters of any space when you enter it. Determine where the exits are, how they work, and whether or not they are obstructed. Find out where the emergency assembly point is in case the building needs to be evacuated. Locate the phone, fire extinguisher, and first aid kit before you need them.

The shop is a more hazardous environment than people are used to. 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. Take the time to learn how to safely operate each tool you need to use. Once you know how to use a tool safely, scrupulously follow safe procedures. Beware that familiarity can breed contempt. Be careful to think through each operation before you execute it. Use your common sense. Do not do things that seem unsafe.

The shop staff is here to help you safely use the shop. However, we cannot be everywhere at once. People using the shop must take responsibility for the safe use of the facility. If you are unsure of the proper method to do something, wait until a staff member can give you guidance. If you notice an unsafe condition in the shop, fix it or bring it to the attention of the staff. If you think someone is using the equipment unsafely, suggest a safer alternative or bring their activities to the attention of the shop staff.

### **General Safety Rules**

The rules listed below apply to all people doing work in the Product Realization Lab. They are not all encompassing; most shop areas and machines have specific safety rules that relate to their use. These ten 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 adult present who is capable of rendering assistance in case of an accident. That second person must be able to see you while you are working, and get to you in case you need help. If the second person moves to a place where they can no longer maintain visual contact with you, you must stop working.

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. In the Stanford Student Shops, dial **9-911** to get emergency assistance.

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 leather shoes that completely enclose your feet. Some shop activities will require additional safety gear.**

Eye protection for use in the shop must conform to ANSI standard Z87.1. The shop has safety glasses available for purchase. Safety glasses that conform to the standard are marked with a "Z87" somewhere.

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.

Leather shoes are necessary to protect your feet from stray droplets of molten metal in the welding and foundry areas. Leather shoes are required in all areas of the shop because we do not want to control access to certain shop areas based on footwear.

Certain dusts and fumes require respiratory protection. While the shop does not currently have respirators to sell, we may require you to obtain and wear one for operations that expose you to airborne hazards.

Hearing protection is available from the student shops staff in the form of foam ear inserts.

Leather gloves are available in the foundry and welding areas for protection from the heat and radiation of welding. Please do not get the leather gloves wet. The leather becomes hard and brittle with repeated exposure to water.

Welding requires the use of welding masks 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 arc without the correct eye protection. If you expose bare skin to the light of the arc, the radiation is intense enough to give you a 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.

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.

Rubber bands are available from the shop staff for the purpose of tying up your hair.

Be careful of the hair of visiting friends. Assume responsibility for the safety of people who visit you while you are working in the shop.

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. Ear protection can be obtained from a shop staff member.

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

Many 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 student shop is 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 damage 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 start up 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.

Use the spring-loaded chuck keys when working on the lathes. In the rare instances when the spring loaded key cannot do the job, be extremely careful not to leave the chuck key in the chuck. It is an easy and terribly dangerous thing to do.

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 of contact 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 find 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 a shop staff member 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 a member of the shop staff has introduced you to its safe operation. Please get checked out even on tools you have been taught to operate elsewhere. The shop staff knows the idiosyncrasies of our tool set. We would like the opportunity to pass this knowledge on to you. Also our procedures may require more or less care than you are used to. Only by communicating with you can we exchange information about the safe use of the tools.

### **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 it's use.

Do not let your guard down when you are cleaning up. Many, if not most, of the accidents in the student shop occur during clean up. Continue to be careful.

Carefully cleaning a machine or area that you are unfamiliar with can increase your knowledge of where things are and how things work in the shop.

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

Turn off the main power switch for the machine. If the machine has an emergency stop switch, depress it.

Disengage all power feeds and lead screws.

- 2) **Un-mount or cover all cutters**

Many people have cut themselves trying to clean up around mounted cutting tools.

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

Cover cutters on tools that are normally left with cutters in place. For example, the table saw, the band saws, the planer, and the jointer.

- 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 a shop staff member. If they do not know, 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.**

The way oil is stored in the red oilcans on a table in the machine shop.

Do not put on so much oil that it drips off of the machine. Puddles of oil on the floor can cause people to slip and fall. Any puddles of oil should be cleaned up immediately.

Move the machine slides to one extreme position and oil the exposed ways. Be careful not to damage yourself or the machine when moving it to the end of its travel. 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.**

Be careful of sharp machine corners as you maneuver the brooms around the machines.

In the model shop and sometimes in the machine shop a vacuum cleaner is more effective at collecting debris than a broom.

Collected debris should be either recycled or thrown in the trashcans. Aluminum, brass, bronze, and steel chips can all be recycled if they are pure enough.

7) **Go to a shop staff member on duty and request a five minute clean up job. Every shop user should spend five minutes of each period cleaning some common area of the shop.**

Please do not skimp on the five-minute clean up jobs. They are part of what makes the shop a pleasant place to work. There are many tools in the shop that are used throughout a shop period by one person after another. By sharing the clean up of those tools at the end of the period we do not have to keep track of who is responsible for what mess.

8) **Report missing or broken tools to the shop staff.**

Almost everything in the student shops can be repaired or replaced. But we need to know about failures in order to correct them. The staff would much rather find out about a broken or missing tool at the end of a shop period than at the beginning. There is frequently time between shop periods to solve a problem. Usually the best we can do at the beginning of a period is to take the tool out of service.

## **Shop Hazards**

We have tried to list below the major hazards you will encounter in your use of the student shop. This is intended to sensitize you to the dangers lurking in the shops. We do not claim that it is an all-inclusive list. Please let us know if you notice other hazards that are not listed.

<b>Hazard</b>	<b>Possible effect</b>
1) <b>208 volt electrical service</b>	<b>Electrocution, electrical shock</b>
2) <b>Abrasive processes</b>	<b>Large area wounds</b>
3) <b>Airborne dust</b>	<b>Long-term lung damage, Allergic reactions</b>
4) <b>Airborne fumes</b>	<b>Long term damage, poisoning</b>
5) <b>Earthquakes</b>	<b>Crush wounds, lacerations</b>
6) <b>Fuel gases</b>	<b>Burns, explosions</b>
7) <b>Highly compressed gases</b>	<b>Explosions, impact wounds</b>
8) <b>Hot objects and steam</b>	<b>Burns</b>
9) <b>Lifting heavy objects</b>	<b>Back injuries, muscle strains</b>
10) <b>Loud noises</b>	<b>Long term hearing loss</b>
11) <b>Massive objects in motion</b>	<b>Crush wounds, lacerations</b>
12) <b>Open flames</b>	<b>Burns</b>
13) <b>Rotating spindles</b>	<b>Machine entanglement</b>
14) <b>Sharp edges</b>	<b>Laceration, amputation</b>
15) <b>Slippery surfaces</b>	<b>Falls, muscle strains</b>
16) <b>Toxic substances</b>	<b>Poisoning, long term disease, nerve damage, allergic reactions. Some wood dust (snakewood, ironwood, etc.) can cause paralysis and death if inhaled.</b>
17) <b>Traffic</b>	<b>Vehicle collisions, impalements</b>
18) <b>Ultraviolet and infrared radiation</b>	<b>Eye and skin damage</b>