Standard Operating Procedure
QB3 BNC
Machine Shop Safety and Operations Protocol

I. Purpose
This Standard Operating Procedure (SOP) outlines requirements to be considered by an authorized user of the Machine Shop as well as describes the normal operation of the equipment and any hazards that may be encountered during normal operation. Finally, the SOP explains how to minimize any hazards and how to respond in an emergency situation. This document is to be reviewed one year from the date of approval or as conditions warrant, whichever is the shorter time period.

II. Personnel
A. Authorized Personnel: The Machine Shop may be operated only by authorized personnel who are fully cognizant of all safety issues involved in the operation of such a device. These personnel are to ensure that the equipment is only operated in the manner laid out in this document. To become an authorized user, one must:
   2. Read and fully understand the SOP
   3. Receive training on the equipment by an authorized user.
   4. Sign the authorized user sheet to affirm that the above steps have been completed.

B. Unauthorized personnel: No unauthorized personnel may enter machinery area during operations unless accompanied by an authorized user. All visitors must be briefed on proper safety protocol and must wear appropriate protective eyewear located on the premises.
III. Hazards

Safety is not often thought about as you proceed through your daily tasks. Often you expose yourself to needless risk because you have experienced no harmful effects in the past. Unsafe habits become almost automatic. You may drive your car without wearing a seat belt. You know this to be unsafe, but you have done it before and so far no harm has resulted. None of us really likes to think about possible consequences of an unsafe act.

A). Identifying shop Hazards

A machine shop is not so much a dangerous place as a potentially dangerous place. One of the best ways to be safe is to be able to identify shop hazards before they can involve you in an accident. By being aware of potential danger, you can better make safety part of your work in the machine shop.

B). Eye Protection

Eye protection is a primary safety consideration around the machine shop. Machine tools produce metal chips that may be very sharp, and there is always a possibility that these metal chips may be ejected from a machine at high velocity. Sometimes they can fly many feet.

Eye protection MUST be worn at all times in the machine shop. There are several types of eye protection available.

a. Plain safety glass- these have shatter proof lenses. The most common type of eye protection worn in the machine shop.

b. Side shield safety glasses- these must be worn around any grinding operation.

c. Safety goggle- the type that only covers the eyes, or is worn over prescription non-safety glasses.

d. The full face shield- most often worn on work producing hot sparks or other flying debris.

C). Foot Protection

Shoes must be worn at all times in the machine shop. A solid leather shoe is recommended. SANDALS should not be worn.

D). Ear Protection

Safety regulations are quite strict regarding exposure to noise. Several types of sound suppressors and noise-reducing ear plugs must be worn. Noise is considered an industrial hazard if it is continually above 85 decibels. If it is over 115 decibels for short periods of time ear protection must be worn. Ear muffs or ear plugs should be used wherever high intensity noise occurs. Sudden sharp or high-intensity noises are the most harmful to your eardrums.

Sound level monitoring and assessment is available through Campus EH&S. Contact your Department Safety Coordinator to schedule an EH&S site visit.
THE DECIBEL LEVEL OF VARIOUS SOUNDS

130  Painful sounds: jet engine on ground.

120  Airplane on ground: reciprocating engine.

110  Boiler factory.
     Pneumatic riveter.

100  Maximum street noise.

90   Loud shout

80   Diesel truck
     Piano practice
     Average city street

70   Dog barking
     Average conversation

60   Average city office

50   Average city residence

40   One typewriter
     Average country residence

30   Turning page of newspaper
     Purring cat

20   Rustle of leaves in breeze

10   Gastrointestinal outgassing

0    Faintest audible sound

E). Grinding Dust and Hazardous Fumes

Grinding dust is produced by abrasive wheels and consists of extremely fine metal particles and abrasive wheel particles. These should not be inhaled.

You should wear an approved respirator if you are exposed to dangerous metals, such as beryllium, or the presence of radioactivity in nuclear systems. In these situations, the spread of grinding
dust must be carefully controlled. Note that one must obtain proper safety training, health exam, and respirator fit testing prior to using a respirator; contact EH&S (642-3073) for details.

Some metals such as zinc give off toxic fumes when heated above their boiling point. Some of these fumes when inhaled cause only temporary sickness, but other fumes can be severe or even fatal. The fumes of mercury and lead are especially dangerous, as their effect is cumulative in your body and can cause irreversible damage. Cadmium and beryllium compounds are also very poisonous.

F). Clothing, Hair, and Jewelry

Avoid entanglement with the moving parts of the machinery.

Wear short-sleeved shirt or roll up long sleeves above the elbow. Keep your shirt tucked in. It is recommended that you wear a shop apron. If you do wear a shop apron, keep it tied behind you. If apron strings become entangled in the machine, you may be reeled in as well. A shop coat may be worn as long as you roll up long sleeves. Do not wear fuzzy sweaters around machine tools.

If you have long hair, keep it secured properly. In industry, you may be required to wear a hair net so that your hair cannot become entangled in a moving machine. The result of this can be disastrous.

Remove your rings before operating any machine tool. These can cause serious injury if they should be caught in a moving machine part.

G). Hand Protection

There is really no device that will totally protect your hands from injury. Next to your eyes, your hands are the most important tools that you have. It is up to you to keep them out of danger. Use a brush to remove chips from a machine. Do not use your hands. Chips are not only razor sharp, they are often extremely hot. Resist the temptation to grab chips as they come from a cut. Long chips are extremely dangerous. These can often be eliminated by properly sharpening your cutting tools. Chips should not be removed with a rag. The metal particles become imbedded in the cloth and they may cut you. Furthermore, the rag may be caught in a moving machine.

Gloves must not be worn around most machine tools, although they are acceptable when working with a hand saw blade and when removing sharp chips from lathes and mills. If a glove should be caught in a moving part, it will be pulled in, along with the hand inside it.

Various cutting oils, coolants and solvents may effect your skin. The result may be a rash of an infection. Avoid DIRECT contact with these products as much as possible and wash your hands as soon as possible after contact.

H). Lifting

Improper lifting can result in a permanent back injury that can limit your physical activity the rest of your life. Back injury can be avoided if you lift properly at all times. If you must lift a large or heavy object, get some help or use a fork lift. Don’t try to be a “superman” and lift something that you know is too heavy. It is not worth the risk.
Objects within your lifting capability can be lifted safely by the following procedure:

1. Keep your back straight.
2. Squat down, bending your knee.
3. Lift smoothly, using the muscles in your legs to do the work. Keep your back straight. Bending over the load puts an excessive stress on your spine.
4. Position the load so that it is comfortable to carry. Watch where you are walking when carrying a load.
5. If you are placing the load back at the floor level, lower it in the same manner you picked it up.

I). Carrying objects

If material is over six feet long it should be carried in the horizontal position. If it must be carried in the vertical position, be careful of light fixtures and ceilings. If the material is both long and over 40 pounds in weight, it should be carried by two people, one at each end. Heavy stock, even if it is short, should be carried by two people.

J). Scuffling and Horseplay

The machine shop has no place for scuffling and horseplay. This activity can result in serious injury to you, a fellow student, or worker. Practical joking is also very hazardous. What might appear to be a comical situation to you could result in a disastrous accident to someone else. In industry, horseplay and practical joking are often grounds for dismissal of an employee.

K). Compressed Air

Most machine shops have compressed air. This is needed to operate certain machine tools. Often flexible air hoses are hanging about the shop. A large amount of energy can be stored in a compressed gas such as air. When this energy is released, extremely danger may be present. You maybe tempted blow chips from a machine tool using compressed air. This is not recommended. The air will propel metal particle at high velocity. The can injure you or someone on the other side of the shop. Use a brush to clean chips from the machine. Do not blow compressed air on your clothing or skin. The air can be dirty and the force can implant dirt and germs into your skin. Air can be a hazard to ears as well. An eardrum can be ruptured. A broken air hose will whip about wildly and may cause injury if you happen to be standing nearby and are struck.

L). Electrical

Electricity is another potential danger in a machine shop. Your exposure to electrical hazard will be minimal unless you become involved with the machine maintenance. A machinist is mainly concerned with to on and off control switch on a machine tool.

M). Machine Hazards

There are many machine hazards. Remember that a machine cannot distinguish between cutting metal and cutting fingers. Do not think that you are strong enough to stop a machine should
you become tangled in moving parts. YOU ARE NOT. When operating a machine, think about what you are going to do before you do it.

IV. Normal Operation

The operational procedures for each piece of equipment may be attached to the back of this document or will be on file in the machine shop SOP instruction manuals.

V. Emergency Procedures

A). Injuries: If you should be injured, report it immediately to your supervisor.

B). Power outage: If there is a power outage, turn off the equipment to avoid a hazardous situation when power is restored. It is advised that all personnel in the machine shop exit the shop area until proper lighting is restored.

C). Earthquake: If there is an earthquake, turn off the equipment and immediately take cover either beneath a table or door frame. Avoid areas where equipment and materials may fall, dislodged, or become projectiles. When the shaking has subsided, check for the safety of others and yourself, and if possible exit the building immediately.

D). Emergency Evacuation Alarms: If there is an emergency alarm, turn off the equipment immediately, check for other occupants in the machine shop, exit the building immediately, and report to the building evacuation staging area located in the front of the building (Mining Circle).
**Authorized Users**
I have read and understood the Standard Operating Procedures for the QB3/BNC Machine Shop.

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Appendix A – SHOP CLEAN UP POLICY

At the end of your work time you are expected to clean up the machines you worked on including the area around them: base, chip pans, etc.

Each drill area must be left clean, so if you drill a hole on the drill press, and then go to use the mill you must clean the drill press first, before you use the mill.

After using a machine, tear down all setups and return the machine to its standard setup. Milling machines should be left with a vise securely mounted on the center of the table.

The machine shop is a potentially dangerous environment. By following a few safety rules and applying a lot of common sense you will be able to safely produce quality machine work. We encourage you to plan your machining tasks before you come into the shop. Think before you cut! We also encourage you to take your time in the shop. You will find that if you work slowly and carefully you will obtain the desired results more quickly that if you hurry. The following is a list of shop rules to help you safely produce machine work of consistent quality.

1. Federal and state laws require safety glasses be worn at all times in the shop area. All corrective glasses with the exception of contact lenses provide adequate eye protection. Glasses must be worn whenever you are in the shop regardless of whether you are working or not. Laser safety glasses and sunglasses are not acceptable safety devices because of their tinting.

2. To safely work in the machine shop, you need to be properly dressed. You must wear closed shoes on your feet to protect you from falling objects and metal chips. Sandals are not acceptable. Also long sleeves must be rolled up and long hair tied up or contained in a cap so they do not become caught in any rotating machinery. Rings should be taken off. Gloves are not allowed to be worn in the shop except for handling dirty or sharp material. They are never to be worn when running any machines. This also includes rubber gloves.

3. It is strongly recommended that a minimum of two people be present in the student shop in case there is an accident. If you need to work late at night or on the weekend and it is not possible to have someone accompany you, let someone know where you are going and when you plan to return. Be sure that all people you bring in to the shop with you have safety glasses, appropriate shoes, and that they know where the emergency power shutoff switch, the fire extinguisher and the phone are located.

4. The machine shop is not a place to experiment. Since the machine shop is a potentially dangerous environment no operations that you are not entirely sure will work, should never be tried. If you are not absolutely sure you know what you are doing, ask.

5. As a user of the machine shop it is your responsibility to immediately tend to any potentially dangerous situation that you come across regardless of whether or not you have caused it. Encourage your shop-mates to wear safety glasses. Clean up spilled oil by spreading oil sorb on the spill.
6. Chips should be removed from the t-slots of the table. Lathes should be left with an empty collet chuck or three-jaw on the spindle. Nothing should be in the tailstock and the cutting tool should be removed from the tool post.

7. Brush all of the chips off the machine and place them in the trash. Do not use compressed air for this. Once most of the chip is removed go ahead and blow the ones you missed on the floor. When the chips are removed, wipe all oil and dust from the machine with a rag. Be sure to clean the chip pan or the lather and the base of the mill. Then sweep the floor around your work area and throw the sweeping into the trash.

If the supervisor determines that any person neglected to clean a machine or shop area that he or she was using, that person must immediately return and perform the required cleanup to the supervisor’s satisfaction.
Appendix B – Procedure for Machine Shop Accidents

In the event of a machine shop accident, follow the procedure below:

1. Ensure that the machine is shut off.

2. Provide for the safety of the personnel (first aid, evacuation, etc.) as needed. Note — if an eye injury is suspected, have the injured person keep his/her head upright and still to reduce bleeding in the eye. A physician should evaluate machine injuries as soon as possible.

3. Obtain medical assistance for anyone who may be injured.

<table>
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<tr>
<th>UC Optometry Clinic (Normal Hours)</th>
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<tr>
<td>UC Optometry Clinic (24 Hour Emergencies)</td>
<td>642-0992</td>
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<tr>
<td>University Health Services (urgent care)</td>
<td>642-3188</td>
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<tr>
<td>Ambulance (emergency medical care)</td>
<td>911 or 510-642-3333</td>
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4. If there is a fire, pull the alarm, and contact the fire department by calling 911 (or 510-642-3333 from a cell phone). Do not fight the fire unless it is very small and you have been trained in fire fighting techniques.

5. Inform the Office of Environment Health, & Safety (EH&S) as soon as possible.

6. During normal working hours, call the following:

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<th>BNC Managing Directors Office</th>
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<td>BNC Safety Officer</td>
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<tr>
<td>QB3 EH&amp;S Health &amp; Safety Manager</td>
<td>666-3307</td>
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After normal working hours, call 642-6760 to contact the UC Police Department who can contact the above using their emergency call list.

7. Inform BNC Director and the current group safety officer as soon as possible. If there is an injury, BNC Director will need to submit a report of injury to the Worker’s Compensation Office.

8. After the incident, do not resume use of the machinery until the EH&S has reviewed the incident and approved the resumption of work.
Appendix C - **Important Factors to Remember**

1. All shop users are responsible for cleanup as described below.

2. Do not walk out of arms reach of a running machine.

3. Report any broken or missing tools to BNC Director or supervisor, so they can be repaired. Never use anything but sharp, unbroken tools. A dull tool requires higher cutting forces to do the same work as a sharp too. Increased force causes accidents and damaged work pieces.

4. All work must be securely clamped in the machine before any work is done.

5. Resist the temptation to pull chips away from the cutter with your fingers. They are sharp and hot. If you must remove the chips use a pair of pliers.

6. Never blow compressed air into a large pile of chips. Use a brush to remove most of the chips than blow. Never blow air towards another worker. Never blow compressed air onto your skin or hair.

7. Do not grind non-ferrous material on the grinder. It eventually causes the grinding wheel to crack and fly apart. The grinder is for sharpening cutting tools only. Use the belt sander if you want to grind something that is not a cutting tool. When turning the grinder on do not stand directly in front of the wheels, wait until they have come up to full speed. Never ever clean any grinder or sander with compressed air!

8. Lathe and drill chuck keys must never be left resting in a chuck.

9. Do not leave a machine set up and unattended for any longer than a half hour without the consent of the shop supervisor. If left for longer the set up will be torn down when the machine is needed.
Appendix D. **GO OVER SAFETY CHECK LIST**

1. Do I know how to operate this machine?
2. What are the potential hazards involved?
3. Are all guards in place?
4. Are my procedures safe?
5. Am I doing something that I probably should not do?
6. Have I made all the proper adjustments and tightened all locking bolts and bolts?
7. Is the work piece secured properly?
8. Do I have proper safety equipment?
9. Do I know where the STOP SWITCH is?
10. Do I think about safety in everything I do?
Appendix E. Equipment Manuals

Part 1. Band Saw G0621
Part 2. Lathe G0602
Part 3. Mill Drill G0463
Part 4. Belt Sander H6070
Part 5. Grinder H8126