



# Trades Lab Safety Manual

**LaurelRidge**  
COMMUNITY COLLEGE  
**WORKFORCE**  
SOLUTIONS

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# Laboratory Safety Manual

## Trades Lab Safety

Important Phone Numbers .....	4
General Laboratory Safety .....	5
Emergency Procedures .....	9
Fire .....	11
Chemical Spills .....	13
Specific Hazards and Safe Handling of Some Common Chemicals .....	15
Labeling Systems for Chemicals .....	18
General Guidelines for Safe Chemical Storage .....	20
Eye Protection .....	21
Eye Protection Test .....	22
Hand Tools .....	22
Hand Tool Test .....	24
Compressed Air .....	25
Compressed Air Test .....	26
Portable Power Tools .....	27
Portable Electric Drill .....	28
Portable Electric Drill Test .....	30
Portable Electric Sanders – Belt and Orbital .....	31

Portable Electric Sander Test .....	32
Portable Circular Saw .....	33
Portable Circular Saw Test .....	34
Welding SOP .....	36
Arc Welder Safety .....	43
Arc Welding Test .....	44
Oxy-Acetylene Welding and Cutting .....	45
Oxy-Acetylene Welding and Cutting Test .....	46
Grinder Safety .....	47
Grinder Test .....	48
Hot Metal .....	49
Hot Metal Test .....	50
Gas Forge .....	51
Gas Forge Test .....	52
Power Hacksaw .....	53
Power Hacksaw Test .....	54
Milling Machine .....	55
Milling Machine Safety Test .....	56
Electrical/ Electronic .....	57
Air-conditioning/ refrigeration .....	71
Plumbing .....	75

## IMPORTANT TELEPHONE NUMBERS

### **FOR AN EMERGENCY CALL: 911**

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When reporting an emergency:

1. Give the building and room number
  2. Nature of the emergency
  3. The number you are calling from
  4. Your name
- 

#### **OTHER NUMBERS:**

**Campus Police phone number from an on-campus phone:**

**38 - 7114**

**Campus Police when using a cellphone or calling from a place off campus:**

**1-540-868-7114**

Campus Police are available 24/7.

## LAUREL RIDGE COMMUNITY COLLEGE GENERAL LABORATORY SAFETY

*This document is intended as a general guide to safety and laboratory procedures.*

### Introduction

LAUREL RIDGE Community College aims to maintain a high standard of health and safety in the laboratory. The college recognizes its responsibility to provide safe systems of work, a safe teaching and work environment, safe equipment and materials, and adequate training. In seeking to control hazards and minimize risk, LAUREL RIDGE COMMUNITY COLLEGE seeks not only to meet legal requirements but to conform to criteria established by federal, state, and local authorities.

This publication has been prepared as part of the schools' overall commitment to achieving a healthy and safe teaching environment for students, faculty, and staff.

#### **1. Laboratory Safety**

All occupants of a laboratory must have regard for themselves, fellow students, co-workers, the community and environment outside the laboratory. Never adopt a casual attitude in the laboratory. Always plan ahead and be conscious of potential hazards.

Know the location of firefighting and First Aid equipment and the procedures associated with each, i.e. extinguishers, fire blankets, eye wash stations, safety showers, and first aid kits.

1. Do not smoke, handle or consume food or drink in the laboratory. This includes chewing gum, etc.
2. Pipetting by mouth is prohibited.

3. Students are not allowed in the laboratory unless an instructor is present.
4. Children, family of students, and friends of students are not allowed in the laboratory.
5. Do not work in isolation - a second person should be within earshot.
6. Regard all substances as hazardous unless there is definite information to the contrary.
7. Never undertake work unless aware of possible hazards and safety Precautions.
8. Know the location and use of all fire equipment in the laboratory.
9. Observe all caution and danger signs. Be alert, pay attention at all times to horns, alarms or verbal commands. Be sure to follow all Material Data Safety Sheets (MSD)
10. Avoid loud talking, shouting, and other distracting behaviors in the classroom and laboratory.
11. Wear proper clothing in the mechanics laboratory.
  - a. No loose clothing, loose jewelry, or unsecured long hair.
  - b. No open heel or open toe shoes.
  - c. Eye protection is required at all times.
  - d. Special eye, face, or skin protection is required when performing certain tasks.
  - e. Students who wear contact lenses will wear fully enclosed safety goggles due to risk of chemical absorption onto contact lenses which may cause ongoing damage to the eye.
12. Use guards and safety devices at all times.
13. Turn off power equipment immediately after use
14. Operate power equipment only on a one student at a time basis.
15. Check power equipment for safety before putting it into operation.
16. Avoid carelessness and/or "horseplay" which will not be tolerated.
17. Notify the instructor in case of accident, injury, fire, defective equipment or tools, or any prevailing safety hazard.
18. Use only those tools or machines in which you have completed safety instruction and passed a written test to become certified.
19. Keep all walkways and exits clear of tools, chemicals and equipment. They create a hazard and prevent proper cleaning.
20. Be sure that you are familiar with all controls before using power equipment.
21. Do not leave the laboratory or work area unless the instructor gives you permission.
22. No use of any alcohol, drug products, or any to other unwarranted medications that would alter your sense of perception before or during lab time.

**Misconduct of any kind, as determined by the instructor, will result in your dismissal from the class. Students who are dismissed from class for disregard of safety rules will be referred to the appropriate divisional college administrator for follow-up which may include discipline or judicial procedure.**

## 2. Housekeeping

1. Clean up all spills immediately according to the MSDS for that particular chemical. Keep benches, shelves, and cupboards tidy.
2. Leave your work areas clean at the end of your class time.
3. Return all tools and supplies to their appropriate storage area
4. Sweep and wipe down your work station.
5. Wash hands before leaving lab.
6. Do not allow work areas and shelves to become cluttered with tools, supplies, chemicals or equipment.
7. A clean and well-organized work area is a safer and more effective zone.
8. Put away things no longer in use.

## 3. Working with Chemic

### **Treat all chemicals as potentially dangerous!**

All reagents will be labeled with appropriate HMIS labels -which should be read and the conditions adhered to. Material Safety Data Sheets (MSDS) and the Chemical Hygiene plan are kept in their respective binders in each lab.

Read labels -understand the symbols

1. Carefully read the label on the container, noting any special precautions required.
2. Always label containers accurately and clearly.
3. Ensure correct disposal procedures are followed as demonstrated by instructor.
4. Always locate chemicals, reagents and solvents, in correct storage areas (for example, flammable solvents must be stored in the appropriate solvent cupboards).

## 4. Waste Disposal

All wastes are the responsibility of the generator. Waste must be placed in appropriate containers, provided for correct disposal of glass, chemicals, solvents, sharps and biological waste. Instructors will direct the correct disposal of different wastes from laboratory areas.

Solvents are to be separated into those containing chlorinated hydrocarbons and others. If solvents contain any extremely toxic materials, laboratory personnel in the specific areas must be notified. Personnel are not to store more than two liters of waste solvent in their general work area.

### **DO NOT DISPOSE OF SOLVENTS DOWN DRAINS!**

## 5. Fire Prevention

Prevention of fires is as important as the development of efficient means of fighting them. All occupants should be acutely aware of the need to avoid dangerous practices and the danger to life in the event of a fire getting out of control.

Preventative measures:



1. Be aware of the locations of fire alarms, fire extinguishers, hoses, etc.
2. Switch off all electrical equipment when not in use.
3. Keep all passages and exits free from obstructions.
4. Observe the greatest care in the use of matches, portable heaters, electrical appliances, and other possible sources of ignition.

## EMERGENCY PROCEDURES

Know the locations and proper use of each piece of emergency equipment in the area:

1. Spill Kits
2. Eye Washes
3. Emergency Showers
4. Fire Extinguishers
5. Exits
6. Fire Blankets
7. First Aid Kits
8. Telephone
9. Fire Alarms

If an emergency occurs, the first concern is for the health and safety of people in the area; property damage is secondary.

1. Alert co-workers in the area of the danger.
2. Assess the severity of the emergency.
3. Based upon the severity of the emergency, Call for Help

### Emergency Procedure

In the event of an incident, students should immediately inform the instructor. The instructor will assign one of the students to go to the receptionist / guard on duty to call 911 and notify the administrator on duty. For no reason should the instructor leave the sight of the incident, especially if it is due to a student medical emergency. In the event of a serious accident, the instructor will stay with the injured student until appropriate emergency medical personnel arrive. It is vitally important that all students follow instructions given by the instructor.

Bleeding - elevate injury and press edges of wound together Burns - flood with cool water

The instructor will fill out an incident form (supplied in the lab), including all persons involved, and turn it in to Human Resources.

## Emergency Evacuation Procedure

When fire alarm sounds, all students remain at their lab stations and prepare to evacuate. It is mandatory that all students follow instructions given by the instructor in an emergency situation.

LAUREL RIDGE COMMUNITY COLLEGE evacuation plans are posted in the hallways and show the evacuation pathways appropriate to the area.

All lights are to be turned off and doors closed.

If smoke is showing from under a door DO NOT OPEN THAT DOOR UNDER ANY CIRCUMSTANCES. Not only will the fire be confined to that room, but also any fire needs oxygen to continue burning and will violently explode towards an oxygen source which would become available should the door be opened.

## 24 Hour Emergency 911

# FIRE

## Prevention

Fires can be prevented by eliminating the source of ignition. When working with flammable materials, consider all potential sources of ignition: open flames, sparks, electrical sparks inside motors, etc. Proper housekeeping can reduce the possibility and severity of fires in the laboratory. If an extremely flammable material is being used (HMIS rating of 3 or 4; see Section IV-B for information on HMIS) observe the following procedures:

1. Use a fume hood
2. Insure no one in the surrounding area is using an open flame
3. Post "NO SMOKING, NO OPEN FLAMES" signs in the hallways and watch for these signs when in the lab buildings.

## General – When a Fire Occurs

Prompt action may prevent small fires from getting out of control. Alert others in the area of the fire and send someone for help.

Small fires in glassware can be smothered by placing an inverted beaker or a watch glass over the fire.

If the fire is too large to smother, evacuate the area. Only people trained in fire extinguisher use should attempt to fight the fire.

## Never Attempt to Fight a Fire Alone

When fighting a fire, put yourself between the fire and the exit to ensure a means of escape.

If the fire can't be immediately controlled, call the fire department at 9-911. Pull the alarm located to the left of room 113's door. Try to contain the fire to the lab area by closing fume hood sashes and the doors to the lab as you leave.

Fire Extinguisher letters (including suggestions on how to remember them).

**A**(think: **Ashes**) = paper, wood, etc.

**B**(think: **Barrel**) = flammable liquids

**C**(think: **Circuits**) = electrical fires

## People

If you or a co-worker's/Students clothing or hair catches fire, the best thing to do is to drop him/her to the ground and smother the flames. You may need to knock a person to the ground to prevent them from running and fanning the flames. Fire blankets, located on each floor of the lab buildings, can be used to smother or pat out the flames on a person.

Send someone to call for help, **911**

## Metal

Metal fires cannot be extinguished with regular extinguishers. Use a Class D fire extinguisher or sand to smother the fire (CO<sub>2</sub> and dry chemical extinguishers will intensify some types of metal fires). Before starting work with metals, check that there is sand, or a Class D fire extinguisher located in your area.

## CHEMICAL SPILLS

**Consider what to do in the event of a spill before starting a project.** Spills may cause serious health and environmental problems if not handled correctly. Familiarity with chemical hazards and the proper spill control measures will help minimize the effects of a chemical spill. Again, the first concern is for the health and safety of the people in the area; property damage is secondary.

### General Procedures

Alert students in the area of the danger.

Assess the severity of the emergency. Consider the possibility of exposure through contact, inhalation, and the increased fire hazard associated with flammable materials.

Based upon your best judgment of priorities, and knowledge of the chemical, **Call for Help**

<b>Extreme Emergency</b>	<b>Middletown Fire Dept.</b>	<b>911</b>
<b>Evenings and Weekends</b>	<b>Security</b>	<b>38-7114</b>

If necessary evacuate the area and keep people from re-entering before help arrives.

The person spilling the chemical is responsible for contacting lab staff/faculty as soon as the severity of the spill allows. Minor spills not involving human contact should be contained whenever possible. Depending on the hazard and size of the spill, lab staff/faculty will either direct the person responsible to clean-up the spill or perform the clean-up themselves.

Anyone noticing a leak or spill is also responsible for contacting lab staff/faculty to initiate the clean-up process.

## Chemical Spills on People

If a chemical is spilled on a person, IMMEDIATELY rinse the exposed area of the body and continue rinsing for 15 minutes. Use an eyewash station, emergency shower, or the sink to rinse the exposed area. Consult the MSDS for information on any delayed bodily reactions. Notify the person in charge to fill out an Accident Report.

Eyes are extremely susceptible to chemical burns. Prompt and continued rinsing (for 15 minutes) can prevent severe eye damage. Seek medical attention as soon as possible.

In the event the spill contaminates clothing, remove all contaminated clothing and rinse the exposed area. Contaminated clothing must be washed separately.

If the exposure is severe, someone in the area must call 911 to get Para-medics on the scene. Be sure to continue rinsing the exposed areas until directed to stop by the Para medics.

In the case of minor exposures: rinse affected areas for a minimum of 15 minutes, seek medical attention.

## Flammable Materials

If flammable materials have been spilled, immediately eliminate all sources of ignition. Unplug all electrical devices, extinguish open flames, etc. Absorb the material quickly with vermiculite or sand, and call Lab Stores.

## SPECIFIC HAZARDS AND SAFE HANDLING OF SOME COMMON CHEMICALS

### Acids and Bases

e.g. **Hydrochloric Acid, Sodium Hydroxide.**

Concentrated acids and bases are very corrosive. Protective eye wear (always!) and appropriate gloves must be used. When diluting, always add acid to water, watching for excess heat that is produced. (If water is added to concentrated acid, the intensity of the reaction creates enough excess heat and gas that may spatter the acid and/or break the glassware).

Clean up spills immediately with sodium bicarbonate.

1. **Hydrofluoric Acid (HF)** exposure may not be immediately recognized and has a delayed, severely corrosive effect upon contact with skin, eyes, etc. It is also a systemic poison (absorbed through the skin).
2. **Nitric Acid (HNO<sub>3</sub>)** and sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) are strong oxidizers and must be stored away from organic compounds.
3. **Perchloric Acid (HClO<sub>4</sub>)** is a strong oxidizer that may react violently with organic compounds and can form explosive anhydrous perchloric acid upon dehydration. It must be used only in a specially designed fume hood (Lab II, 3232). Prevent dehydration during use: use a reflux setup; ensure there is sufficient water added during an experiment; do not heat with just sulfuric acid - add water. Organic matter should be digested with nitric acid before contact with HClO<sub>4</sub>.
4. Picric acid on dehydration becomes explosive. It must be monitored and inventoried carefully.
5. Mixing **Hydrochloric Acid (HCl)** and **Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>)** produces poisonous **chlorine gas**. Also, mixing **bleach (sodium hypochlorite)** and **ammonia** produces **chlorine gas**. Use in a hood when mixing.



## Solvents

### Acetone, Hexane, Ethanol.

Most common solvents are flammable, volatile, narcotic, and systemic poisons. Keep them away from ignition sources and oxidizers, use with good ventilation, use small quantities, wear gloves, and store stoppered in the appropriate facilities (see Sections IV and IX-B).

1. **Ethyl ether** (anhydrous ether) is particularly volatile and flammable.
2. Many **halogenated hydrocarbons**, such as **chloroform**, are toxic and/or carcinogenic. Use proper gloves and fume hoods.
3. **Aldehydes, ethers, ketones, and alkenes** can form explosive peroxides. Do not evaporate to dryness. These compounds need to be carefully inventoried and monitored. If an old or suspicious container is found, **DO NOT MOVE IT** - call Lab Stores.

## Reactive Chemicals

Certain **heavy metal salts** can be explosive. Disposal in the sewer system is legally forbidden for many heavy metal salts and also pose an explosion hazard by accumulation in drainpipes.

**Peroxides** are violently reactive or explosive. These compounds need to be carefully monitored and inventoried and used only after specific training.

## Toxins (Poisons, Carcinogens)

### **Lead (II) compounds, Benzene.**

Many toxins are absorbed through the skin or through inhalation. Use appropriate gloves and work in a fume hood.

1. **Mercury (Hg)** is a cumulative poison present in many thermometers, which are easily and frequently broken. Spills must be made non-volatile by sprinkling with zinc dust or other commercial product such as "Resisorb". Then it must be thoroughly cleaned up with a special vacuum device. Once collected, the mercury may be stored safely by covering with water. Leftover traces of spilled mercury can be checked with a powdered mercury indicator.
2. **Formaldehyde** is often used for preservation of biological specimens. It is volatile, an irritant of the eyes and upper respiratory tract, and a suspected human carcinogen. Use gloves and either a fume hood or a well-ventilated work space. Alternative preservatives are recommended.
3. **Hydrocarbons** like **turpentine and gasoline** are a systemic poison and narcotic. Use gloves, and work in a hood or well-ventilated area.

## Compressed Gases

### **Air, Argon, Helium, Hydrogen, Oxygen, Nitrogen.**

1. Cylinders containing compressed gases are under high pressure and are therefore potentially explosive. Compressed gases may cause toxic, irritant, or anesthetic effects, burns, asphyxiation, explosions, or frostbite (from cryogenic liquids).
2. Wear safety glasses and know the particular hazards of the compressed gas used.
3. The cylinders must be stored (Section VD) and transported (Section YD) correctly, chained or strapped to a bench or wall, and kept capped when not in use.
4. Appropriate regulators must be used with each gas cylinder.
5. Never direct compressed air or gases at a person, or use them to blow away dirt and dust.

## LABELING SYSTEMS FOR CHEMICALS

Chemical labeling systems are used to both standardize and summarize hazard information about a chemical. Labeling must provide enough information so one can discern the proper hazard class and general handling requirements of a chemical. The labeling system we have chosen to use on campus is the **HMIS or Hazardous Materials Information System**. The system gives a numerical rating (0 as none, to 4 as high) to Health Hazard, Flammability, and Reactivity.

The HMIS rating system also has a Personal Protection category but does not assign it a numerical value. Instead, it provides a list of what protective equipment is recommended for use. Some of these items include safety goggles, gloves, apron, use of fume hood, and respirators.

The definitions for the ratings in the Health, Flammability, and Reactivity categories are as follows:

### Health Hazard

1. MINIMAL HAZARD - No significant risk to health
2. SLIGHT HAZARD - Irritation or minor reversible injury possible
3. MODERATE HAZARD - Temporary or minor injury may occur
4. SERIOUS HAZARD - Major injury likely unless prompt action is taken and medical treatment is given
5. SEVERE HAZARD - Life threatening major or permanent damage may result from single or repeated exposures

### Flammability Hazard

1. MINIMAL HAZARD - Materials which are normally stable and will not burn unless heated
2. SLIGHT HAZARD - Materials that must be preheated before ignition will occur. Flammable liquids in this category will have flash points at or above 94C (200F). (NFPA Class IIIB)
3. MODERATE HAZARD - Material which must be moderately heated before ignition will occur, including flammable liquids with flash points at or above 60C (100F) and below 94C (200F). (NFPA Class II & Class IIIA)
4. SERIOUS HAZARD - Materials capable of ignition under almost all normal temperature conditions, including flammable liquids with flash points below 23C (73F) and boiling points above 100F as well as liquids with flash points between 23C (73F) and 60C (100F). (NFPA Classes IB and IC)
5. SEVERE HAZARD - Very flammable gases or very volatile flammable liquids with flash points below 23C (73F) and boiling points below 60C (100F). (NFPA Class IA)

### **Reactivity Hazard**

1. **MINIMAL HAZARD** - Materials which are normally stable, even under fire conditions, and which will not react with water.
2. **SLIGHT HAZARD** - Materials which are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy violently.
3. **MODERATE HAZARD** - Materials which in themselves are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water.
4. **SERIOUS HAZARD** - Materials which are capable of detonation or explosive reaction, but require a strong initiating source, or must be heated under confinement before ignition, or materials which react explosively with water.
5. **SEVERE HAZARD** - These materials are readily capable of detonation or explosive decomposition at normal temperatures and pressures.

## GENERAL GUIDELINES FOR SAFE CHEMICAL STORAGE

1. Store chemicals in appropriate containers (Section IX-B).
2. Label all containers and store by chemical class only in designated storage areas.
3. Store small amounts.
4. Use opened chemicals first.
5. Return chemicals to their proper storage place - If unsure of the correct storage, ask!
6. Date all chemicals when received and opened.
7. Inventory annually, checking dates, condition, and amounts. Check particularly for ethers and peroxide forming materials, discarding within one year of opening.
8. Avoid storing above eye level when possible - particularly hazardous chemicals.
9. Do not store chemical containers on the floor.
10. Shelves should have lips or doors to prevent bottles from slipping off.
11. Shelf assemblies must be secured to the wall.

## EYE PROTECTION

1. The State Department of Labor requires that anyone entering the laboratory while activities are in progress must wear eye protection.
2. Safety glasses are required at all times in the laboratory and in other areas specified by the instructor.
3. The safety glasses used in the laboratory must have a manufacturer emblem and a Z87 logo. The Z87 logo means that the safety glasses are industrial quality.
4. Equipment that requires special eye and face protection:
  - a. Arc Welding – Welding helmet with a #10 filter lens and safety glasses.
  - b. Oxy-Acetylene Welding – Gas welding goggles or shield (with safety glasses) with a #5 lens.
  - c. MIG or TIG Welding – Welding helmet with a #12 filter lens and safety glasses.
  - d. Stationary and Portable Grinders – Clear face shield and safety glasses.
  - e. Metal Lathe – Clear face shield and safety glasses.

## EYE PROTECTION TEST

### **Fill in the Blank**

1. \_\_\_\_\_ law requires that a student wear safety glasses while in the laboratory.
2. Safety glasses should be worn \_\_\_\_\_ in the laboratory.

### **Short Answer**

List the special eye and face protection needed when using the following pieces of equipment:

3. Arc Welder: \_\_\_\_\_
4. Oxy-acetylene unit: \_\_\_\_\_
5. TIG Welder: \_\_\_\_\_
6. Grinders: \_\_\_\_\_

## HAND TOOLS

1. Never cut toward yourself unless the tool is specifically designed for that type of cutting.
2. Use tools of the proper size for the job.
3. Do not handle tools in a careless manner.
4. Use only those files and rasps that are equipped with handles.
5. Use the proper tool for the job and use it in the correct manner. Example: Never use a wrench as a hammer.
6. Keep tools clean for safety reasons and to extend tool life.
7. Handle sharp and pointed tools with extreme caution.
8. Secure work in a vise or clamp when sawing, welding, or other times when needed.
9. Do not endanger other persons or co-workers in any way. You are responsible for your actions.
10. Report all broken tools or items of equipment to the instructor immediately.
11. Return all tools or other work items to the proper storage location when the job is completed.



## HAND TOOLS TEST

### Short Answer

1. What should you do if you find a hammer or other tool that is broken?
  
  
  
  
  
  
  
  
  
  
2. Explain why you would put your work in a vise while sawing, filing, drilling, etc..

### True/False

- |    |   |   |   |
|----|---|---|---|
| 3. | T | F | You are responsible for your actions while working in the laboratory.                   |
| 4. | T | F | It is best to keep tools such as screwdrivers in your pocket while not in use.          |
| 5. | T | F | Never use a wrench as a hammer.   |
| 6. | T | F | Always cut away from you unless the tool is specifically designed to be used otherwise. |
| 7. | T | F | Never use a file with a handle, the handles are dangerous.                              |
| 8. | T | F | Throwing tools or other objects is not allowed.   |

## COMPRESSED AIR

1. Use the lowest possible pressure to accomplish the job.
2. Avoid stretching the hose.
3. Do not insert objects into the connections.
4. Stand to the side while connecting or disconnecting air lines.
5. Do not use compressed air to clean off clothes or any part of the body.
6. Do not direct the stream of air at any person.

## COMPRESSED AIR TEST

### True/False

- |    |   |   |   |
|----|---|---|---|
| 1. | T | F | Always use the highest possible air pressure since there is plenty of air.        |
| 2. | T | F | Avoid stretching the hose.  |
| 3. | T | F | Inserting a screwdriver in the connection is a good method to clean the air line. |
| 4. | T | F | Stand to the side when connecting or disconnecting air lines.                     |
| 5. | T | F | Compressed air should not be used to clean clothing or parts of the body.         |
| 6. | T | F | Do not direct the stream of air at any person.                                    |

## PORTABLE POWER TOOLS

1. Wear industrial quality eye protection when using portable power tools.
2. Wear hearing protection, ear plugs or ear muffs, when using portable power tools.
3. Avoid loose fitting clothes when using construction portable power tools.
4. Do not use portable power tools which have cords that are cut, frayed, or separated from the tool housing. Such cords should be repaired before continued use.
5. Keep tools and equipment well maintained, i.e. blades sharp, cords well maintained, guards in good working order, etc.
6. On all metal portable power tools make sure that a 3-pronged grounding type plug is always used.
7. When working outside always use a "Ground Fault Circuit Interrupter" (GFCI) type extension cord.
8. Don not put extension cords around your or shoulders when using portable power tools.
9. Make sure that long extension cords are sufficiently large in size to carry the current (amps) necessary for the tools being used. Sufficiently large wire size in cords will help avoid large voltage drop and tool burn-out.
10. Be sure to read and become familiar with the manufacturer's recommended operating procedures and safety before using any portable power tool.

## PORTABLE ELECTRIC DRILL

1. Wear safety glasses when operating with portable electric drill.
2. Disconnect the drill from the electrical supply when installing bits.
3. Clamp stock so it will not move during the drilling operation.
4. Before drilling, turn the drill on to see if the bit is centered and running true.
5. Align the bit with the desired hole location before turning the drill on.
6. Hold the drill firmly with both hands while drilling.
7. When drilling deep holes with a twist drill, move the bit up and down several times while drilling to remove cuttings and reduce overheating in the bit.
8. Do not allow the cord to become wrapped around the drill when working.
9. If the electrical cord becomes frayed or starts to separate from the drill housing, repair it immediately!
10. Remove the bit from the drill as soon as the work is completed.
11. Select the correct bit for the finish and material being drilled. Make sure the bit is securely tightened in the drill chuck.
12. Be extremely careful when using larger portable electric drills (3/8" and 1/2"). If the bit should hang or get caught the drill will twist in the operator's hands causing a sprain or bruised fingers.
13. Always remove the key from the chuck before drilling.
14. To prevent seizing, reduce the feed pressure when the drill bit is about to come through the material.
15. Operating Procedures
16. Always center punch or make a starting indentation in the material being drilled to get an accurate starting point for the drill bit.
17. Tighten the drill bit by rotating the chuck key to all three holes in the chuck. This will help to keep the drill bit centered.

18. Use only straight shank or Silver and Deming drill bits in portable electric drills.
19. Apply moderate even pressure to the drill during the drilling operation. If excessive pressure is required to make the bit cut then the bit is dull and needs to be sharpened.
20. Maintain good balance at all times when drilling.
21. Use slow drill speeds for drilling metal and fast speeds for drilling wood.
22. To obtain holes that are placed accurately, drill a small pilot first then drill the final hole.

## PORTABLE ELECTRIC DRILL TEST

### True/False

- |    |   |   |  |
|----|---|---|--|
| 1. | T | F | It is safe to use an electric drill around flammable materials.  |
| 2. | T | F | If the drill bit will not cut, you should apply more pressure to the drill to force it through the work.               |
| 3. | T | F | Always place the drill on the bench before the chuck stops turning.  |
| 4. | T | F | The drill press should be used if at all possible. If it is not possible, then it is proper to use the portable drill. |
| 5. | T | F | Always place the drill bit end of the drill down first on the floor or bench.  |
| 6. | T | F | Never use portable electric drills around wet areas.   |
| 7. | T | F | Always remove the chuck key from the chuck before operating the drill.   |
| 8. | T | F | It is not necessary to secure drill bits in the chuck of the portable drill.   |

## PORTABLE ELECTRIC SANDERS – BELT AND ORBITAL

1. Install sanding belts properly and securely. Unplug the sander before installing new sandpaper or sanding belts.
2. Always secure the material being sanded so as to avoid damage to the project or injury to yourself.
3. Properly ground the cords to avoid electrical shock.
4. Keep the power cord away from the moving belt.
5. Do not lay the sander down after you have finished using it while the belt is still moving.
6. Do not apply the sander to the work until the sander is at operating speed.
7. Always remove the sander from the work before stopping the motor.
8. Do not apply any extra pressure to the sander. This causes the sander to overheat.
9. Never touch the belt or sandpaper while it is moving.



## PORTABLE ELECTRIC SANDER TEST

### True/False

1.    T    F    The sander should be laid down while the belt is moving after you have finished using it.
2.    T    F    Sanding belts should be installed properly before operating the sander.
3.    T    F    The power cord should be kept away from the moving belt of the sander.
4.    T    F    Material being sanded should be secured to avoid damage to the project or yourself.
5.    T    F    If the sander is not doing its job quickly, apply extra pressure to help speed the process.
6.    T    F    Always stop the motor before removing the sander from the work.
7.    T    F    Never touch the belt or sandpaper while it is moving.

### Fill in the Blank

8.    In order to avoid electrical shock, the power cord of the sander should be \_\_\_\_\_.
9.    Do not apply the sander to the work until the tool reaches \_\_\_\_\_.

## PORTABLE CIRCULAR SAW

1. Feed the saw into the work after the motor has reached full operating speed.
2. Let the saw do the work. Do not use force to push the saw while cutting.
3. Keep the base of the saw flat on the work while cutting.
4. Do not hold the guard in the open position with your fingers while the saw is running.
5. Before starting the saw, be sure that the extension cord is away from the saw and will remain free of the blade, without restricting movement, throughout the length of the cut.
6. Be sure that the guard returns to its normal position immediately after cut has been completed.
7. When the blade binds, cut the saw off immediately.
8. Unplug from the electrical outlet when removing the blade or making an adjustment.
9. Always have the portable hand saw in working position prior to starting.
10. Never set the saw on the floor or work bench while the blade is still in motion.
11. Observe the work carefully at all times to avoid cutting into the bench or saw horse on which the material is held.

## PORTABLE CIRCULAR SAW TEST

### True/False

1. T F Feed the saw into the wood before the motor reaches full operating speed.
2. T F Apply force to the saw when cutting.
3. T F Keep the base of the saw flat on the work while cutting.
4. T F Leave the guard open after cutting.
5. T F Remove the plug from the electrical outlet when removing the blade or making adjustments.
6. T F Always have the portable circular saw in working position prior to starting.
7. T F Do not attempt to hold the guard open with your fingers while the saw is running.
8. T F Never set the saw on the work bench while it is still running.

### Multiple Choice

9. Before starting the cut, be sure:
  - A. the extension cord is clear and free to move
  - B. the saw has a carbide blade
  - C. the saw is kicking out sawdust.
10. Unplug the saw when:
  - A. making any adjustments,
  - B. marking wood measurements
  - C. both of the above.
11. When the blade binds:
  - A. knock it loose with hammer
  - B. keep the saw running but back it out
  - C. turn the saw off

12. Observe the work carefully:
  - A. to keep the saw cutting straight and to prevent it from cutting into the workbench.
  - B. to prevent the saw from binding
  - C. both of the above.

## WELDING – STANDARD OPERATING PROCEDURES

### Orientation Guide

Below is a list of things that your Instructor will discuss to help you understand what to expect throughout the course and to help you understand what is expected of you throughout the duration of the course.

#### Safety

1. **Personal Protective Equipment (PPE)** - Discuss safety glasses, goggles, face shields, standard welding shields, auto-darkening welding shields, ear plugs, ear muffs, respirators, flame retardant jackets, welding aprons, leather jackets, ankle spats, steel toe boots, denim jeans. Also discuss appropriate type of materials that work clothes should be made of. Discuss the proper use of ventilation tubes in each welding booth. Instructors will discuss the location of all fire extinguishers, and fire blankets and discuss how to use them.
2. **Grinder Safety** - Instructors will discuss the correct method of using an angle grinder. Instructor will also demonstrate how to properly use a grinder, how to properly change a grinding wheel, and how to service the grinders.
3. **Band Saw Safety** - Instructors will discuss safe use of the band saw and demonstrate how to properly make a cut.
4. **Eyewash Stations** - Instructors will discuss with students the locations and proper use of the eyewash stations and demonstrate the proper use of each eyewash station.
5. **Protective Screens** - Workers or other persons adjacent to the welding areas shall be protected from the radiant energy and spatter of welding and cutting arcs by noncombustible or flame-resistant screens or curtains. Whenever students are in the welding shop during class time they are required to wear the proper personal protective equipment needed for that environment. Eye/face protection and protective clothing such as long denim pants, long sleeve cotton shirt, and steel toe work boots. Suitable radiation-protective, semitransparent materials are permissible. Booths and screens should permit circulation of air at floor level as well as above the screen.
6. **Wall Reflectivity** - Where arc welding is regularly carried on adjacent to painted walls, the wall should be painted with a finish having low reflectivity to ultraviolet radiation.
7. **Welding Booths** - Where operations permit, welding stations should be separated by noncombustible screens or shields.
8. **Eye and Face Protection** - All approved safety spectacles must meet ANSI Z87.1 impact standards as defined by the ANSI.

9. Arc Welding and Arc Cutting with Open Arcs - Helmets or hand shields with filtered lens and cover plates shall be used by operators and nearby personnel when viewing the arc. Safety spectacles, goggles, or other suitable eye protection shall also be worn during arc welding or cutting operations. Safety spectacles with side shields or goggles must be worn when protection from injurious rays from adjacent work or from flying objects is required. The spectacles or goggles may have either clear or filtered lenses, depending upon the amount of exposure to adjacent welding or cutting radiation.
10. Oxygen Cutting - Goggles or other suitable eye protection with filter lenses and side shields shall be worn during all oxyfuel gas cutting operations.
11. Protective Clothing:
  - a. Selection - Appropriate protective clothing for any welding and cutting operation will vary with the size, nature and location of the work to be performed. Clothing should provide sufficient coverage, and be made of suitable materials, to prevent skin burns caused by sparks, spatter or radiation. Woolen clothing is preferable to cotton because it is not so readily ignited and helps protect the welder from changes in temperature. Cotton clothing, if used for protection, should be chemically treated to reduce its combustibility. Synthetic or plastic materials which can melt and cause severe burns are not recommended for use as clothing near arcs. All outer clothing such as jumpers or overalls should be reasonably free from oil or grease. Sparks may lodge in rolled-up sleeves, pockets or clothing, or cuffs of overalls or trousers. It is therefore recommended that sleeves and collars be kept buttoned and pockets be eliminated from the front of clothing. When pockets are present, they should be emptied of flammable or readily combustible materials. Trousers or overalls should not have cuffs and should not be turned up on the outside. Trousers should overlap shoe tops to prevent spatter from getting into shoes.
  - b. Gloves - All welders and cutters shall wear protective flame-resistant gloves. Gloves made of leather or other suitable materials are recommended. Insulated linings should be provided beneath the areas exposed to high radiant energy.
  - c. Capes and Sleeves - Cape sleeves or shoulder covers with bibs made of leather or other flame resistant material should be worn during overhead welding or cutting operations.
  - d. Other Protective Gear - Properly fitted flame resistant plugs in the ears or other suitable means shall be used where hazards to the ears exist from sparks or spatter. Caps made from flame resistant material should be worn under helmets to prevent head burns.
12. Secure Cylinders During Use - A suitable cylinder truck, chain or steady device shall be used to keep cylinders from being knocked over while in use.
13. Fire Protection - Cylinders shall be kept far enough away from actual welding or cutting operations so that sparks, hot slag, or flame will not reach them, otherwise fire resistant shields shall be provided.

14. Electric Circuits - Cylinders shall not be placed where they might become part of an electrical circuit. Cylinders shall be kept away from radiators, piping systems, layout tables, etc., that may be used for grounding electric circuits such as for arc welding machines. The tapping of electrodes against a cylinder shall be prohibited. Do NOT strike an arc on cylinders.
15. Cylinder Emergencies:
  - a. Fuel Valve Packing Leak - If a leak is found around the valve stem of a fuel gas cylinder, the packing nut should be tightened, or the cylinder valve closed.
  - b. Fuel Gas Leaks Which Cannot be Stopped - If tightening the packing nut does not stop a valve stem leak, or if a fuel gas valve is leaking at the seal and cannot be stopped by closing the valve firmly, or if a leak should develop at a cylinder fuse plug or other safety device, then the fuel gas cylinder should be moved to a safe location outdoors, away from any source of ignition, marked properly, and the supplier advised. A warning sign should be posted not to approach the cylinder with a lighted cigarette or source of ignition. The cylinder valve may be opened slightly too gradually discharge the contents.
  - c. Fuel Cylinder Fires - Small fires at fuel gas cylinders should be extinguished, if possible, by closing the cylinder valve or by the use of water, wet clothes or fire extinguisher.

### **Arc Welding and Cutting and Equipment Safety**

1. Personnel – persons in charge of the equipment or designated to operate the arc welding and cutting equipment shall have been properly instructed and qualified to maintain or operate such equipment and judged competent by their employers for their work responsibilities. Rules and instructions covering the operation and maintenance of the arc welding and cutting equipment shall be readily available.
2. Safety Aspects in Selection of Arc Welding Equipment:
  - a. Safety Standards – the safety aspects of welding shall be given consideration in the choice of arc welding equipment for the job to be done. Consideration for safety in design is obtainable by choosing apparatus complying with applicable NEMA standards, or ANSI/UL 551-1980, Safety Standard for Transformer-Type Arc Welding Machines.
  - b. Environmental Conditions – when welding or cutting is to be done with covered electrodes using alternating current or single-phase transformer-rectifier arc welding machines and under electrically hazardous conditions due to water or perspiration, the welding operator shall take special care to prevent electrical shock by the use of dry gloves and clothing in good condition, use of electrical hazard footwear, and avoiding accidental contact with live electrical parts. If a significant amount of work time is spent in electrically hazardous conditions, the use of automatic controls is recommended to reduce the no-load voltage to a value not to exceed 38 rms alternating current or 50 volts direct current at rated input voltage.

- c. Open Circuit Voltage (special processes) – when special welding and cutting processes require open circuit voltages higher than those specified in NEMA EW-1, Electric Arc Welding Apparatus, adequate insulation or other means shall be provided to protect the operator from making accidental contact with the high voltage.
  - d. Work Terminal to Grounded Enclosure – if a welding lead terminal intended to be used exclusively for connection to work is connected to the grounded power source enclosure, it shall be done by a conductor smaller in diameter (at least two AWG sizes higher) than the grounding conductor and the terminal shall be marked to indicate that it is grounded. Terminals for welding leads should be protected from accidental electrical contact by personnel or by metal objects (vehicles crank hooks, etc.). Protection may be obtained by the use of dead front construction utilizing receptacles for plug connections by locating terminals in a recessed opening or under a non-removable hinged cover, by heavy insulating sleeves or by other equivalent mechanical means to satisfy the requirements.
  - e. Control Devices – no connections for portable control devices such as push buttons to be carried by the operator shall be connected to an alternating circuit of higher than 120 volts. Exposed metal parts of portable control devices operating on circuits above 50 volts shall be grounded by a grounding conductor in the control cable.
  - f. Equipment Loading – care should be taken in applying arc welding equipment to ensure that the current rating chosen is adequate to handle the job. Welding machines should not be operated above the current ratings and corresponding rated duty cycles as specified by the manufacturer and shall not be used for applications other than those specified by the manufacturer. Consideration should be given to the fact that actual welding currents may be higher than shown by indicators on the machines if welding is done with short leads or low arc voltages. Particularly high over-currents are likely on general purpose welding machines when used with low arc voltage processes such as GTAW.
  - g. Welding Cables – shall be of the flexible type designed for the rigors of welding service and of a size adequate for reasonably expected current and duty cycles. Special attention should be paid to the insulation of cables used with equipment which includes high voltage, and high frequency oscillators.
3. Installation of Arc Welding Equipment:
- a. Code Requirements – installation including grounding, necessary disconnects, fuses and type of incoming power lines shall be in accordance with the requirements of the current ANSI/NFPA 70, National Electrical Code, and all local codes.
  - b. The Work – the work piece of metal upon which the welder welds shall be grounded to a good electrical ground.



- c. Grounding – grounding can be done by locating the work on a grounded metal floor or platen, or by connection to a grounded building frame or other satisfactory ground. The work lead is not the grounding lead. It is preferable to connect the work lead direct to the work. Care should be taken to avoid double grounding; otherwise the welding current may flow through a connection intended only for safety grounding and may be of a higher magnitude than the grounding conductor can safely carry. Special radio frequency grounding may be advisable for equipment using high frequency arc stabilizers.
- d. Current Return – welding current should be returned to the welding machine by a single cable from the work to the welding machine. Connection of a cable from the welding machine to a common conductor or properly bonded structure on which the work rests, or to which the work is connected, is a permissible alternate procedure. Single-phase alternating current machines in groups of three with their inputs connected in wye on the secondary circuits may use a single work lead from the neutral of the three units to the structure being welded. The single cable shall be of a size suitable for the current rating of at least one machine.
- e. Conduit and Pipe Ground Limitations – conduits containing electrical conductors shall not be used for completing the work lead circuit.
- f. Prohibited Work Lead Connection – chains, wire ropes, cranes, hoists and elevators shall not be used to carry welding current.
- g. Checking Connections – after assembling any connection to the machine, each assembled connection shall be checked once before starting operations to ascertain that it is properly made. In addition, the work lead shall be firmly attached to the work; magnetic work clamps shall be freed from adherent metal particles and spatter on contact surfaces. Coiled welding cable should be spread out before use to avoid overheating and damage to the insulation. Jobs alternately requiring long and short cables should be equipped with insulated connectors so that idle lengths can be disconnected when not needed.
- h. Machine Frame Grounding – grounding of the welding machine frame shall be checked. Special attention shall be given to safety grounding connections of portable machines. See NFPA 70, Article 250, Grounding.
- i. Leaks – there shall be no leaks of coolant, shielding gas, or engine fuel that can adversely affect the welder's safety.
- j. Safe Operating Instructions – written rules and instructions covering the safe operation of equipment shall be made available to the welder and shall be strictly followed.
- k. Work Interruptions – when the welder has occasion to leave his work or stop for any appreciable time, the electrode holder shall be de-energized by turning off the welding machine.
- l. Moving the Machine – when the machine is to be moved, the input power supply to the equipment shall be electrically disconnected.

- m. Equipment Not In Use – when not in use, metal and carbon electrodes shall be removed from holders to eliminate danger of electrical contact with persons or conducting objects. When not in use, electrode holders shall be so placed that they cannot make electrical contact with persons, conducting objects, flammable liquids, or compressed gas cylinders. When not in use, guns of semiautomatic welding machines shall be placed so that the gun switch cannot be operated accidentally.
- n. Electric Shock – avoidance of electrical shock is largely within the control of the welder; therefore, it is especially important that the welder be thoroughly instructed in detail how to avoid shock. Safe procedures shall be observed at all times when working with equipment having voltages necessary for arc welding. These voltages can be dangerous to life. Even mild shocks can cause involuntary muscular contraction, leading to injurious falls from high places. Clothing damp from perspiration or wet working conditions may reduce contact resistance and increase current to a value high enough to cause such violent muscular contraction that the welder cannot release contact with the live part. Wearers of pacemakers or other electronic equipment vital to life should check with the life support manufacturers and their clinician to determine whether a hazard exists.
- o. Live Metal Parts – the welder shall never permit the live metal parts of an electrode or holder to touch bare skin or any wet covering of the body.
- p. Insulation – welders shall protect themselves from electrical contact with the work or ground by dry insulating material; they shall be protected against large area contacts by insulation when working in a sitting or prone position.
- q. Gloves – adequately dry gloves in good condition are required.
- r. Electrode Holders – electrode holders shall be well insulated and kept in good repair.
- s. Water Immersion – electrode holders shall not be cooled by immersion in water.
- t. Water-cooled Holders – water cooled holders and guns shall not be used if any water leak or condensation exists which would adversely affect the welder’s safety.
- u. Changing Electrodes – the welding machine that supply power to the arc shall always have the output electrically de-energized when tungsten electrodes are changed in GTA electrode holders.
- v. Other Practices to Avoid – the welder shall not coil or loop welding electrode cable around parts of the body.

### **Maintenance**

1. General – All arc welding equipment shall be maintained and kept in safe working order at all times. The welder or maintenance personnel shall report any equipment defect or safety hazard to the supervisor, and the use of such equipment shall be discontinued until its safety has been assured. Repairs shall be made by qualified personnel only. Periodic inspections are strongly recommended.

2. **Welding Equipment** – Shall be maintained in good mechanical and electrical condition to avoid unnecessary hazards. Commutators shall be kept clean to prevent excessive flashing.
3. **Inspection** – Rectifier welders should be inspected frequently to detect accumulations of dust or lint that would interfere with ventilation. Electrical coil ventilation ducts should be similarly inspected and cleaned. It is good practice to blow out the entire welding machine with clean, dry compressed air using adequate safety precautions. Fuel systems on engine-driven machines should be inspected and checked for possible leaks and accumulations of water that might cause rusting. Rotating and moving components should be kept properly shielded and lubricated. Welding equipment used in the out-of-doors should be protected from inclement weather conditions. Protective covers should not obstruct the ventilation necessary to prevent overheating of the machine. Air filters in the ventilating system of the electrical components are not recommended, unless provided by the manufacturer of the welding machine. The reduction of air flow resulting from the use of an air filter on equipment not so designated can subject internal components to an overheating condition and subsequent failure.
4. **Modifications** – When it is necessary to modify equipment in order to meet noise level requirements, it should be determined that the modifications or additions to the equipment do not cause the electrical or mechanical ratings of the equipment to be exceeded or overloaded.
5. **Wet Machines** – Machines which have become wet shall be thoroughly dried or properly tested before being used. When not in use, the equipment should be stored in a clean, dry place.
6. **Welding Cable** – Welding cable shall be inspected for wear or damage. Cables with damaged insulation or connectors shall be replaced or repaired to achieve the mechanical strength, insulating quality, electrical conductivity, and water tightness of the original cable. Joining lengths of cables shall be done by means specifically intended for the purpose. The connection means shall have insulation adequate for service conditions.
7. **Compressed Gases** – Use of compressed gases for shielding in arc welding operations shall follow the provisions mentioned previously.

#### **Lockout/Tagout Procedure**

All electrical components to be locked out and tagged out with appropriate labeling when necessary.

## ARC WELDER SAFETY

1. Never allow any part of the body to become part of the electrical circuit.
2. Inspect cables, connections, and the amperage setting before starting the welder.
3. Do not mistreat the cables, electrode holder, ground clamp, or welding machine in any way.
4. Stand on dry footing when welding.
5. Do not watch the arc without proper eye protection (head shield with #10 filter lens).
6. The following clothing and equipment should be worn at all times when welding to protect you from electrical shock, radiation and burns: Safety glasses, head shield with a #10 filter lens, leather gloves, welding apron, long sleeves. Beware of clothing that is highly flammable such as windsuits and screenprinted T-shirts.
7. Always guard your eyes and face with a head shield when chipping slag.
8. Always be sure that bystanders are protected from the arc when welding.
9. Do not weld in confined places unless there is adequate ventilation. Always switch on the hood fan when in the welding booth.
10. Do not weld in or around areas which contain flammable materials such as paint, gasoline, oily rags, etc.
11. Do not handle hot metal with gloves. Use tongs to handle hot metal and cool the work in the water barrel before leaving it unattended.
12. Do not allow the electrode holder to rest on or come in contact with the welding table or any grounded metal surface.
13. Keep the area around the welder clean at all times. Place used electrode stubs in the proper container.
14. Secure all welding equipment in its proper place before leaving the area.
15. Do not weld metal, which is directly in contact with a concrete floor.
16. If the electrode freezes, switch off the machine and free the electrode.
17. Never inhale fumes created when welding galvanized metal because they are poisonous.
18. Accidental flashes are a hazard. Viewing the light of the arc, even for a short time without proper eye protection, will cause permanent eye damage.

## ARC WELDING TEST

### True/False

1. T F If you are in doubt as to the proper way of doing a welding exercise, see the instructor.
2. T F Accidental flashes are not a safety hazard.
3. T F The fumes created from welding galvanized metal are poisonous.
4. T F When an electrode freezes to the metal, you should dip it in water.
5. T F Never weld metal that is in contact with concrete floors.
6. T F It is not necessary to put equipment in its proper place because the next class will be using it.
7. T F Used electrode stubs are a safety hazard when left lying on the floor or welding table.
8. T F Do not allow the electrode holder to rest on the welding table.
9. T F Unattended hot metal is a hazard to everyone in the shop.
10. T F Welding in the paint room is permissible if proper ventilation is provided.
11. T F Welding fumes should never be allowed to accumulate in the laboratory.
12. T F When welding in the open, there is no danger to bystanders who are watching.
13. T F When welding, electrical shock, burns, or radiation may injure you if the proper safety procedures are not followed.

### Fill in the Blank

14. When chipping slag, you must be sure to protect your \_\_\_\_\_ and \_\_\_\_\_.
15. A \_\_\_\_\_ with a number \_\_\_\_\_ lens, along with safety glasses, is used to protect your face and eyes when you are welding.

## OXY-ACETYLENE WELDING AND CUTTING

1. Check to insure that cylinders are secure before moving the portable welding cart.
2. The hoses and hardware should be free of dirt, oil, and grease.
3. Keep clothes, hands, and gloves free from grease, oil, and other flammables.
4. Never open the valve of the acetylene cylinder more than one full turn so that it can be closed quickly.
5. If a T-wrench is used to open the acetylene valve, keep it in position on the valve of the cylinder while in use.
6. Do not allow the flame or hot metal to come in contact with clothing, combustible materials, hoses or other parts of the welding equipment.
7. Never leave a lighted torch unattended.
8. Use goggles with a No. 5 filter lens and wear leather gloves and leather apron when oxy-acetylene welding or cutting.
9. Use the oxy-acetylene unit only in well ventilated areas.
10. Never inhale fumes from welding galvanized metal. These fumes are poisonous.
11. Always use a striker-type lighter to start the flame.
12. In case of flashback, fires, or unusual sounds from the torch or hoses, contact the instructor immediately.
13. Always extinguish the flame according to manufacturer specifications.
14. Cutting should be done so that sparks are contained. Do not allow sparks to hit hoses, regulators, or the cylinders.
15. When completing your work, never wrap the hoses around the regulators.
16. Do not use oxygen or acetylene to clean off clothing.

## OXY-ACETYLENE WELDING AND CUTTING TEST

### True/False

- |     |   |   |   |
|-----|---|---|---|
| 1.  | T | F | In case of flashback, dip the torch in water.   |
| 2.  | T | F | Matches may be used to start the flame when a flint lighter is not available.                         |
| 3.  | T | F | When cleaning up, the hoses should be wrapped around the regulators.                                  |
| 4.  | T | F | Galvanized metal fumes are poisonous.   |
| 5.  | T | F | Do not weld in an enclosed area without proper ventilation.   |
| 6.  | T | F | Always turn the torch off before laying it down.  |
| 7.  | T | F | The flame from an acetylene welder will not burn clothing.  |
| 8.  | T | F | The hoses on the acetylene welder are fireproof. Hot metal will not burn them.                        |
| 9.  | T | F | The acetylene valve should be opened no more than one full turn so that it may be turned off quickly. |
| 10. | T | F | The blowpipes should be lightly coated with oil to prevent rust.                                      |
| 11. | T | F | When moving cylinders, be certain they are tied to the cart securely.                                 |
| 12. | T | F | Contain sparks while cutting.   |

### Fill in the Blank

13. Use goggles or face shield with a number \_\_\_\_\_ filter lens when oxy-acetylene welding.

### Short Answer

14. Explain how to safely start the torch and establish a neutral flame.
15. Explain how to extinguish the flame of an oxy-acetylene torch.

## GRINDER SAFETY

1. Check grinding wheels for cracks, chips and balance before grinding.
2. Make certain that the tool rest is not more than 1/8" from the wheel.
3. Do not grind on the side of the wheel.
4. Hold small pieces of metal with vise grip pliers.
5. Hold all stock firmly against the tool rest while grinding.
6. Always wear a face shield and safety glasses when grinding.
7. Avoid standing directly in line with the grinding wheel while it is in motion.
8. Properly cool metal during and after grinding to prevent from destroying the temper.
9. Use caution when wearing gloves while using the grinder.
10. Be sure all guards and shields on the grinder are in place.
11. Never touch a moving grinder wheel with your hand.



## GRINDER TEST

### Fill in the Blank

1. Grinding wheels should be check for \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ before grinding.
2. The maximum clearance between the tool rest and wheel is \_\_\_\_\_.
3. Hold small pieces of metal with \_\_\_\_\_ pliers only.
4. Hold stock against the \_\_\_\_\_ while grinding.
5. Properly \_\_\_\_\_ metal during and after grinding to prevent destroying its temper.
6. Be sure all \_\_\_\_\_ and shields are in place.

### True/False

- |     |   |   |   |
|-----|---|---|---|
| 7.  | T | F | It is acceptable to grind on side of the wheel.                               |
| 8.  | T | F | You should never stand in line with the grinding wheel while it is in motion. |
| 9.  | T | F | It is not necessary to use caution if you wear gloves while grinding.         |
| 10. | T | F | Never touch the grinding wheel while it is running.                           |

### Short Answer

11. List the eye protection equipment that must be used while operating the grinder.

## HOT METAL

1. Always wear leather gloves and leather apron when working with hot metal.
2. Always place unattended hot stock in proper storage area.
3. Never strike the face of the anvil with a hammer.
4. Never use hammer with loose or cracked handle.
5. Use tongs that will fit the stock.
6. Do not allow mushroomed heads to form on chisels, punches, or hammers.
7. Never swing a hammer in line with anyone.
8. Keep the face of an anvil dry and free from scale.
9. Do not offer work for inspection until it is cool.
10. Always make any source of heat safe before leaving.
11. Never start a flame if there is a flammable material nearby.

## HOT METAL TEST

### True/False

1. T F Any source of heat should be made safe before leaving the area.
2. T F When using a hammer you should never swing it in line with anyone.
3. T F One should allow mushroomed heads to form on punches, chisels, and hammers.
4. T F One should not strike the face of an anvil with a hammer.
5. T F Never start a flame if there is flammable material nearby.

### Fill in the Blank

6. When working with hot metal, you should use tongs that will \_\_\_\_\_ the stock.
7. You should not offer work for inspection until it is \_\_\_\_\_.
8. A person should always wear leather \_\_\_\_\_ and leather \_\_\_\_\_ when working with hot metal.
9. Never use hammer with a \_\_\_\_\_ or \_\_\_\_\_ handle.
10. The face of an anvil should be kept \_\_\_\_\_ and free of scale.
11. Before leaving hot stock unattended you should put it in the proper \_\_\_\_\_ area.

## GAS FORGE

1. Never start the forge without removing the top from the forge.
2. Always be sure the gas valve is turned off before leaving the area.
3. Never start the forge if there are flammable materials nearby.
4. Never leave the forge unattended while it is still running.
5. Always wear leather gloves and a leather apron while working with the forge.
6. If the flame should go out, push the stop button, turn off the gas, and notify the instructor.
7. Follow the correct operating procedure for starting and stopping the forge.



## POWER HACKSAW

1. Adjust and position the vise to grip the material securely before using the power hacksaw.
2. Place a support stand under the material.
3. Never add extra weight or press on the saw blade in order to speed up the operation.
4. Never lift the saw blade while the saw is operating.
5. Always turn off the saw before adjusting the saw or positioning the work.
6. Never leave the saw while it is still running.

## POWER HACKSAW TEST

### True/False

1.    T     F     Adjust and position the vise as to securely grip the work.
2.    T     F     It is necessary to press on the saw blade when cutting thick pieces of metal.
3.    T     F     Never lift the saw blade while the saw is operating.
4.    T     F     It is not always necessary to turn off the saw while making adjustments to the saw or work.
5.    T     F     It is not a safe practice to leave the saw unattended while it is in operation.

### Fill in the Blank

1.    Place a \_\_\_\_\_ under the material.

## MILLING MACHINE

1. Always properly secure the work to the milling machine.
2. Keep the machine table free of all tools and other material. Do not remove chips from the table by hand or blow them off with compressed air. Use a brush or vacuum cleaner for that purpose.
3. Before inserting the arbor or adapters into the spindle, be sure both the arbor and spindle hole is clean and free from nicks.
4. Sprung arbors should not be used.
5. To avoid striking hands on the cutter while setting up, do the setup as far away from the cutter as possible.
6. Do not attempt to clean or oil the machine or make any adjustments to the work while the machine is in motion.
7. When the operator has finished an operation, or before he/she leaves his/her machine for any reason, he/she should shut off the power and make sure the machine has stopped.
8. Always wear safety glasses and a face shield when operating the milling machine.
9. Do not wear loose clothing around the milling machine.



## MILLING MACHINE SAFETY TEST

### True/False

1.     T     F     After completing a milling machine operation you can safely leave the machine immediately after you push the "stop" button.
2.     T     F     Safety glasses are optional when working around the milling machine.
3.     T     F     Work should be properly secured to the machine.
4.     T     F     All tools should be kept off the table when the milling machine is in operation.
5.     T     F     It is safe to wear loose clothing when operating the milling machine.
6.     T     F     It is unsafe to clean or oil the milling machine while it is in motion.
7.     T     F     Chips can be safely removed from the milling machine table with your hands.
8.     T     F     Setting up work on the milling machine should be done as far away from the cutter as possible.
9.     T     F     Sprung arbors should not be used.

### Multiple Choice

10. The principle hazard to the operator of a milling machine is contact with the:
  - a. table
  - b. cutter
  - c. handles
  - d. work material.

## ELECTRICAL AND ELECTRONICS

### Safety Statement:

Whenever you work with power tools or on electrical circuits, there is a risk of electrical hazards, especially electrical shock. Electrical trades workers must pay special attention to electrical hazards because they work on electrical circuits. Coming in contact with an electrical voltage can cause current to flow through the body, resulting in electrical shock and burns. Serious injury **or even death** may occur. As a source of energy, electricity is used without much thought about the hazards it can cause. Because electricity is a familiar part of our lives, it often is not treated with enough caution. As a result, an average of one worker is electrocuted on the job every day of every year!

### How is an Electrical Shock Received?

An electrical shock is received when electrical current passes through the body. Current will pass through the body in a variety of situations. Whenever two wires are at different voltages, current will pass between them if they are connected. Your body can connect the wires if you touch both of them at the same time. Current will pass through your body.

#### **Wires carry current**

In most household wiring, the black wires and the red wires are at 120 volts. The white wires are at 0 volts because they are connected to ground. The connection to ground is often through a conducting ground rod driven into the earth. The connection can also be made through a buried metal water pipe.

**If you come in contact with an energized black wire—and you are also in contact with the neutral white wire—current will pass through your body. You will receive an electrical shock. If you are in contact with a live wire or any live component of an energized electrical device—and also in contact with any grounded object—you will receive a shock.** Plumbing is often grounded. Metal electrical boxes and conduit are grounded.

Your risk of receiving a shock is greater if you stand in a puddle of water. But you don't even have to be standing in water to be at risk. Wet clothing, high humidity, and perspiration also increase your chances of being electrocuted. Of course, there is always a chance of electrocution, even in dry conditions.

**Always test a circuit to make sure it is de-energized before working on it.**

You will receive an electrical shock if a part of your body completes an electrical circuit by:

1. touching a live wire and an electrical ground
2. touching a live wire and another wire at a different voltage

## Effects of Electrical Current in the Human Body

### Current Reaction

<b>Below 1 milliamperes</b>	Generally not perceptible.
<b>1 milliamperes</b>	Faint tingle.
<b>5 milliamperes</b>	Slight shock felt; not painful but disturbing. Average individual can let go. Strong involuntary reactions can lead to other injuries.
<b>6–25 milliamperes (women)</b> <b>9–30 milliamperes (men)</b>	Painful shock, loss of muscular control. The freezing current or "let-go" range. Individual cannot let go, but can be thrown away from the circuit if extensor muscles are stimulated.*
<b>50–150 milliamperes</b>	Extreme pain, respiratory arrest (breathing stops), severe muscular contractions. Death is possible.
<b>1,000–4,300 milliamperes</b>	Rhythmic pumping action of the heart ceases. Muscular contraction and nerve damage occur; death likely.
<b>10,000 milliamperes</b>	Cardiac arrest and severe burns occur. Death is probable.
<b>15,000 milliamperes</b>	Lowest overcurrent at which a typical fuse or circuit breaker opens a circuit!

\*If the extensor muscles are excited by the shock, the person may be thrown away from the power source. The lowest overcurrent at which a typical fuse or circuit breaker will open is 15,000 milliamps (15 amps).

The danger from electrical shock depends on:

1. the amount of the shocking current through the body
2. the duration of the shocking current through the body
3. the path of the shocking current through the body

Burns are the most common injury caused by electricity. The three types of burns are:

1. electrical burns
2. arc burns
3. thermal contact burns

All fire extinguishers are marked with a letter(s), which identifies the kinds of fires they put out. Sometimes the label is marked with both a letter and symbol. Be sure to read the label and use the appropriate extinguisher.

## What Should I do if a peer is Shocked or Burned by Electricity?

**Shut off** the electrical current if the victim is still in contact with the energized circuit. While you do this, have someone else call for help. If you cannot get to the switchgear quickly, pry the victim from the circuit with something that does not conduct electricity such as dry wood. **Do not touch the victim yourself if he or she is still in contact with an electrical circuit!** You do not want to be a victim, too!

Do not leave the victim unless there is absolutely no other option. You should stay with the victim while emergency medical services (EMS) are contacted. The caller should come back to you afterwards to verify that the call was made. If the victim is not breathing, does not have a heartbeat, or is badly injured, quick response by a team of emergency medical technicians (EMTs) or paramedics gives the best chance for survival.

The three stages of the safety model are • • •

Stage 1—**Recognize** hazards

Stage 2—**Evaluate** hazards

Stage 3—**Control** hazards

You need to be able to recognize that electrical shocks, fires, or falls result from these hazards:

1. Inadequate wiring
2. Exposed electrical parts
3. Overhead powerlines
4. Defective insulation
5. Improper grounding
6. Overloaded circuits
7. Wet conditions
8. Damaged tools and equipment
9. Improper PPE
10. Control contact with electrical voltages and control electrical currents to create a safe work environment.
11. Lock out and tag out circuits and machines.
12. Prevent overloaded wiring by using the right size and type of wire.
13. Prevent exposure to live electrical parts by isolating them.
14. Prevent exposure to live wires and parts by using insulation.
15. Prevent shocking currents from electrical systems and tools by grounding them.
16. Prevent shocking currents by using GFCIs.
17. Prevent too much current in circuits by using overcurrent protection devices.
18. Prevent against electric shock or arc blast when working live by using proper PPE and protective tools.
19. Control hazards through safe work practices.
20. Plan your work and plan for safety.
21. Avoid wet working conditions and other dangers.
22. Avoid overhead powerlines.
23. Use proper wiring and connectors.
24. Use and maintain tools properly.
25. Wear correct PPE

## ELECTRICAL / ELECTRONIC SAFETY TEST

Name: \_\_\_\_\_

### **True/False**

1. (True or False) Whenever you work with power tools or on electrical circuits, there is a risk of electrical hazards, especially electrical shock.
2. (True or False) When a circuit, electrical component, or equipment is unplugged you are perfectly safe from any type of injury.
3. (True or False) If you work on an electrical circuit, test to make sure that the circuit is de-energized (shut off).
4. (True or False) The severity of injury from electrical shock depends on the amount of electrical current and the length of time the current passes through the body.
5. (True or False) The longer the shock, the lesser the injury.

### **Multiple Choice**

6. If you are injured by high voltage the result will be:
  - a. Burns
  - b. Violent Muscular Contractions
  - c. Damage to internal organs such as heart
  - d. All of the Above
7. If a student is receiving an electrical shock, immediately:
  - a. Make sure the power stays on and in contact with the student
  - b. Smack them away from the live circuit
  - c. Unplug the equipment or kill the voltage, never touch a person getting shocked
  - d. All the above

8. If I touch a victim that is still in contact with the live circuit
  - a. I will be shocked and possibly become part of the circuit myself.
  - b. I will draw the voltage away from the victim
  - c. I will be able to save the victim from the electrical hazard
  - d. All the above
9. If you go to work on a lab and the power cord is frayed
  - a. Look to see if any of the wire is exposed and then use the power cord.
  - b. Check it with a meter and then use the power cord.
  - c. Throw it in the trash
  - d. All of the above
10. If you smell a burning odor while working in lab
  - a. May indicate insulation or component heating, turn off station and call the instructor
  - b. Very carefully touch all the items around you and find the source of heat
  - c. Sit and wait for the item to catch on fire and then call the instructor
  - d. All the above
11. In order to control hazards, you must first create a safe work environment
  - a. By keeping my station free of trash and items that do not belong
  - b. Checking all equipment for broken pieces and frayed cords
  - c. Be aware of your surroundings and ask questions when in doubt
  - d. All the above
12. Who is responsible for your safety?

## SOLDERING SAFETY

### Safety Rules:

Following proper safety practices are a must when working with electronic equipment. Not only is there the danger of electrical shock, but the components can explode if not connected properly. Many of today's electronic components are easily damaged by electrostatic discharge and improper handling.

The test equipment used in the electronic service industry is expensive and easily damaged if proper operating procedures are not followed.

1. ALWAYS wear your SAFETY GLASSES.
2. KEEP soldering irons in their protective STAND when not in use.
3. Always CUT wire LEADS so the clipped wire falls on the table top and not toward others.
4. DO NOT TOUCH the tip end of a soldering iron to check for heat.
5. DO NOT TOUCH any metal surfaces on soldering iron, hot air or DE soldering iron. They are HOT.
6. DO NOT TOUCH and surfaces that have been soldered for at least 60 seconds. These surfaces stay hot for an extended amount of time.
7. AVOID an EARTH GROUND when working with AC powered units.
8. Keep your workstation neat and clean.
9. AVOID SKIN CONTACT with chemicals.
10. REPLACE ALL screws, not just some.
11. Use the CORRECT CLEANING SOLVENTS for the job.
12. Avoid PINCHING wires when putting equipment back together.
13. When using the hot air machine, do not hold in one place. The air will cause damage.
14. NEVER SOLDER a circuit that has the power applied.
15. DOUBLE CHECK circuits for proper connections and polarity prior to applying the power.
16. Observe POLARITY when connecting polarized components or test equipment into a circuit.
17. When soldering a multi-pin component, avoid excessive heating to one area of the component; DO NOT go from pin to pin in a straight line.
18. Make sure TEST instruments are set for proper FUNCTION AND RANGE prior to taking a measurement.
19. When measuring UNCERTAIN qualities, start with the range switch on the HIGHEST setting.
20. ALWAYS REPLACE shields that were removed during service to avoid signal RADIATION.



21. When cutting with an X-Acto knife, AVOID CUTTING TOWARDS yourself.
  22. Apply HEAT from a soldering pencil for no more than a couple of seconds to AVOID HEAT DAMAGE.
  23. Always OBSERVE POLARITY when connecting components into a circuit, especially with electrolytic capacitors.
  24. When in doubt about any situation, call the instructor.
  25. YOU and YOU alone are responsible for your safety and the safety of others.
- Emergency phone numbers are: 911

## SOLDERING SAFETY TEST

Name: \_\_\_\_\_

For the following questions choose the best answer to go with the statement.

1. These should be worn by anyone near where soldering is being performed.
  - a. Safety Glasses
  - b. Asbestos Gloves
  - c. Insulated Rubber Boots
  - d. Welding Helmet
2. The following element in solder can be dangerous to your health.
  - a. Tin
  - b. Copper
  - c. Lead
  - d. Silver
3. The following injury can occur with soldering.
  - a. Laceration
  - b. Amputation
  - c. Abrasion
  - d. Burn
4. When I am not using the soldering iron...
  - a. Place it gently on the table
  - b. Hang it gently off the side of the table
  - c. Place it gently in its holder.
  - d. All the above

5. When cutting leads.
  - a. Shoot them at your neighbor
  - b. Cut the leads so they fall on the table
  - c. Don't concern yourself on how to cut leads
  - d. None of the above
6. I can get burned by
  - a. Soldering Iron
  - b. Desoldering iron
  - c. Solder
  - d. All the above
7. If there is power applied to the board
  - a. Do NOT solder the board
  - b. Solder the board
  - c. Neither A or B
  - d. Both A and B
8. While soldering a wire
  - a. Make sure the wire is secure and will not fall on you
  - b. Do not touch the wire until it has cooled completely
  - c. Do not flick the solder unto the floor if there is excess solder
  - d. All of the above
9. Which of the following should be done in preparation for soldering?
  - a. Tie back loose hair
  - b. Remove loose clothing.
  - c. Create plenty of space to work
  - d. All the above

10. To remove excess solder from the soldering pencil you should
- a. Tap the soldering pencil on the table
  - b. Rub the solder off with your hand
  - c. Wipe the solder off on your shirt
  - d. Wipe the solder off on a wet sponge

## ELECTRICAL SAFETY TEST MEDIUM TO HIGH VOLTAGES

Name: \_\_\_\_\_

### True/False

1. (True or False) Whenever you work with power tools or on electrical circuits, there is a risk of electrical hazards, especially electrical shock.
2. (True or False) When a circuit, electrical component, or equipment is unplugged you are perfectly safe from any type of injury.
3. (True or False) You are not responsible for your own safety.
4. (True or False) The severity of injury from electrical shock depends on the amount of electrical current and the length of time the current passes through the body.
5. (True or False) The longer the shock, the lesser the injury.

### Multiple Choice

6. If you are injured by high voltage the result will be
  - a. Burns
  - b. Violent Muscular Contractions
  - c. Damage to internal organs such as heart
  - d. All of the Above
7. If a student is receiving an electrical shock, immediately
  - a. Make sure the power stays on and in contact with the student
  - b. Smack them away from the live circuit
  - c. Unplug the equipment or kill the voltage, never touch a person getting shocked
  - d. All the above
8. The first step toward protecting yourself is \_\_\_\_\_ the many hazards you face in the lab.
  - a. recognizing
  - b. ignoring
  - c. repairing
  - d. All the above

9. When you work on a high or medium voltage trainer and you are preparing to work on a device, turn off the power and then
- Work on the circuit.
  - Check the circuit breaker or switch several times to make sure it is off
  - Lock out and tag out the switch or breaker
  - All of the above
10. If you smell a burning odor while working in lab
- May indicate insulation or component heating, turn off station and call the instructor
  - Very carefully touch all the items around you and find the source of heat
  - Sit and wait for the item to catch on fire and then call the instructor
  - All the above
11. In order to control hazards, you must first create a safe work environment
- By keeping my station free of trash and items that do not belong
  - Checking all equipment for broken pieces and frayed cords
  - Be aware of your surroundings and ask questions when in doubt
  - All the above
12. Who is responsible for your safety? \_\_\_\_\_
13. Why did they do this to the breaker?  
\_\_\_\_\_



## ELECTRICAL SAFETY TEST

Name: \_\_\_\_\_

1. T or F: Four or more people are allowed in a lab group.
2. The \_\_\_\_\_ must look at the lab before powering any equipment.
3. T or F: It is okay to touch someone when they are getting shocked.
4. All \_\_\_\_\_ must be removed before working on any electrical device.
5. What type of PPE should be worn in the lab?
  - A. \_\_\_\_\_
  - B. \_\_\_\_\_
  - C. \_\_\_\_\_
6. What are the three voltages we use in our lab?
  - A. \_\_\_\_\_
  - B. \_\_\_\_\_
  - C. \_\_\_\_\_
7. T or F: Horse playing is allowed in lab.
8. What should always be connected on the electrical circuit to prevent shock hazard?
9. A \_\_\_\_\_ or \_\_\_\_\_ should be on the end of each wire when wiring up a circuit.
10. T or F: A frayed drop cord may be used in lab.
11. T or F: .001 ampere can cause ventricular fibrillation.
12. T or F: You may work without the instructor present in the lab.

By completing, signing, and dating this test, you acknowledge and understand the safety regulations and guidelines for the Electrical Lab.

## AIR CONDITIONING AND REFRIGERATION

### Tools

Using the proper tools for specific installation, maintenance and adjustment of equipment such as furnaces, air conditioning units, fans, thermostats, chillers and freezers is very important. The right size pliers, wire cutters, wire strippers, wrenches and screwdrivers mean the difference between accurate installation and adjustment of units and parts for optimal operation or incorrect procedures with expensive and dangerous equipment. Safety-conscious HVAC technicians use the right size and kind of tools to make tight connections without stripping threads or breaking screws and bolts, and have accurate refrigerant and electrical reading meters to troubleshoot for repairs and maintenance.

### Personal Protective Equipment

Knowing when and what kind of personal protective equipment to use is as important as using the proper tools. Shoes and boots that protect ankles and feet from dropped equipment, safety glasses for eye protection during cutting and welding tasks and from high-pressure vapor or liquid, and gloves to protect hands during metal cutting or welding operations are common protective items for HVAC technicians. Injuries and accidents are prevented or minimized with protective equipment.

### Understand and Pay Attention to All Safety Information

Incorrect handling of heating and air equipment can result in explosions, electrical shock or fire, all of which can cause injury, fatality or property damage. Pay attention to all equipment manufacturer safety instructions, labels and signs. Always follow original equipment manufacturer instructions, and local building codes and ordinances regarding heating and air units. Understand the four main signal words that may be on labels, signs and manuals: danger, warning, caution and note. Danger conveys the most serious hazards for injury or death. Warning means risk of injury or death. Caution warns of possible minor injury or damage. Note calls attention to work practices that will result in optimal operations.

### Liquids and Chemicals

Liquids and chemicals used in HVAC operations can be dangerous if used incorrectly or if spills or accidents occur. Detergents and solvents for cleaning systems and parts are strong, and should be handled with care to avoid spills and skin burns. Pressurized application of cleaning substances or refrigerants must be done with the correct procedures to ensure the safety of technicians and others, and avoid property damage. Refrigerant cylinders can explode if not handled and stored properly, and technicians and others should not guess when around them.



## Electrical

Many types of refrigeration and heating equipment have switches and regulators with electrical current on even when other parts of the equipment appear to be turned off. Main circuit breakers must be turned off before servicing such equipment to avoid injury, fatality and damage to expensive equipment. Extreme caution must be used when around electrical wiring and electrical connections to avoid high-power shock or electrocution.

## Compressed Gas Cylinders

1. Use of Compressed Gas Cylinders
2. Stand to the side of the regulator when opening the valve.
3. If a cylinder is leaking around a valve or a fuse plug, move it to an outside area away from where work is performed, and tag it to indicate the defect.
4. Do not use compressed gas to clean yourself, equipment or your work area.
5. Do not remove the valve wrench from acetylene cylinders while the cylinder is being used.
6. Open cylinder valves slowly. Open the valves fully when the compressed gas cylinder is being used, in order to eliminate possible leakage around the cylinder valve stem.

## REFRIGERATION SAFETY TEST

Name: \_\_\_\_\_

- List 3 items of PPE that need to be worn in lab.
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
- T or F: You may use a lighter to ignite an acetylene or oxygen/acetylene torch.
- What should you do in case of fire?
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
- How many people are allowed in a lab group?
- If your clothing catches on fire, what 2 things should you do?
  - \_\_\_\_\_
  - \_\_\_\_\_
- When handling refrigerant, what precautions should be taken?
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
- T or F: It's okay to allow skin contact with the alkaline coil cleaners used in lab.
- When troubleshooting electrical problems in lab dealing with the refrigeration cycle, what steps need to be taken to ensure safe working conditions?  
\_\_\_\_\_  
\_\_\_\_\_

9. T or F: You may vent and inhale any refrigerant used in lab.
10. T or F: You may work in the lab without the instructor present.

## PLUMBING

### Safety Procedures

The safety concerns for plumbers are varied. They involve lifting, welding, chemicals, and burst steam pipes. The best premise for any safe operation is to know how to use the machines worked with.

Plumbing operations normally includes the installation, preventive maintenance, and repair of water supply systems, sewage and water disposal systems, natural liquified petroleum gas (LPG) or other gas supply systems (to include gas appliances), and oxygen supply systems. These systems and the maintenance of them contribute to the total well-being Company facilities.

Hazards encountered during plumbing operations include, but are not limited to, entry into an oxygen deficient atmosphere (confined space), fire or explosion (by introducing an ignition or flame source into a hazardous environment), and falls. Cave-in of an excavated area, burns from heat producing equipment, strains and sprains of the back (or other muscle group), and cuts and/or bruises, are also potential dangers.

### General Machine Safety

1. Replace the guards before starting machines, or after making adjustments or repairs to the machine.
2. Do not remove, alter or bypass any safety guards or devices when operating any piece of equipment or machinery.
3. Do not wear loose clothing or jewelry around moving machinery.
4. Long hair must be contained under a hat or hair net, regardless of gender.
5. Read and obey safety warnings posted on or near any machinery.
6. Do not try to stop a workpiece as it goes through any machine. If the machine becomes jammed, unplug it before clearing the jam.
7. Do not use metal working equipment such as grinders, sanders or beveling machines if they do not have safety guards.
8. Clamp work when using saws or cutting tools.

**\*Reference: Hand Tools, Portable Power Tools, Welding, Electrical, & Soldering for further information on Safety Procedures**