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1.0. General: Operations in the machine shop provide many potential hazards because of the nature of metal and wood working machinery such as lathes, drill presses, milling machines, grinders, sanders, presses and power-operated saws. All machinery and power equipment used in the shop should be fully equipped with guards according to the standards of machine guarding described in this manual. Electrical equipment should be grounded to prevent shock or sparks that could start a fire and all shop equipment should be maintained in good operating condition. Equipment that is in disrepair or missing guards should be tagged out of service until repairs are completed. Machine operators should wear safety glasses, goggles or face shields while performing operations with the potential to produce flying particles.

A. Basic Guidelines:

1. Only fully trained and authorized personnel should be permitted to operate machinery.
2. Machine guards should not be removed, defeated or blocked while the equipment is in operation or when power is on prior to operating.
3. Machinery should not be cleaned, lubricated or repaired while in motion. Before any maintenance work is attempted, the machine should be completely shut down, the control switch should be locked to prevent accidental starting and power should be disconnected prior to repairs.
4. Oily rags, waste and other materials saturated with combustible substances should be disposed of in metal containers equipped with self-closing lids. These cans should be clearly marked for the disposal of oily waste materials only.
5. Personnel should not wear loose clothing, long sleeves or neckties while working in the shop. Long hair should be tied back to prevent entanglement in moving parts. Gloves, rings and other jewelry should not be worn while working on moving machinery.

B. Specific Pieces of Machinery:

1. Drill presses are used for countersinking, drilling, reaming, boring, routing and similar operations. Most drill press injuries are caused when the operator comes in contact with the drill or its chuck during operation. Other accidents are caused when drills break or fly out of the chuck.

The following precautions should be taken:

- a. Stock should be properly secured to the press table to prevent accidental movement during drilling.
- b. When holes are to be bored beyond the flutes of the drill, the drill should be removed frequently and the hole cleaned out to prevent jamming or freezing.
- c. The drill should be stopped before attempting to clear the work that has become jammed.

- d. The drill press should be grounded to prevent electrical shock.
 - e. The drill press should be mounted to a permanent or oversized base to prevent tipping or walking during operation.
2. Metal lathe machines are available in several different types, but all have common hazards. The following precautions are necessary to prevent injury:
- a. All lathes should be equipped with safety type dogs instead of projecting setscrews.
 - b. The cutting tool on all lathes should be kept sharp and the lathe centers true.
 - c. Operators should allow lathes to stop of their own accord. Hand pressure should never be used to stop spinning chucks after power has been turned off.
 - d. Stock should not be filed by hand while the lathe is turning. Fine finishing can be done by holding a long strip (5- 6") of abrasive cloth across the stock while the lathe is rotating.
 - e. Tools should not be set while the lathe is in operation or while the power is on. Tools and chucks should be checked for defects before each operation. A chip breaker may be ground into the tips of cutting tools to keep long curled chips from forming.
 - f. Stock should not be measured or calibrated while the lathe is in motion.
 - g. Tool ways should be kept clean and clear of other tools.
 - h. Operators should wash their hands frequently to help prevent dermatitis.
 - I. Each exposed power transmission part should be guarded for operator protection.
 - j. Goggles or other suitable eye protection should be worn while working on equipment used for milling.
 - k. Lathes must be electrically grounded.
3. Milling machine tools have multiple cutting edges which can cause injury if the following precautions are not observed:
- a. Milling cutters should be kept sharp at all times.
 - b. Shims, blocks and clamps should be used to hold stock in place on the machine. This will help prevent stresses that may cause the metal to spring or snap.

- c. Before setting up a job, operators should make certain that the machine is clean and that the work is free of chips, nicks or burrs. Each job should be set as close as possible to the machine column.
 - d. Cutters should be selected to ensure they are sized for the job.
 - e. No adjustments should be made to the speed of the machine, the rate of feed or other function while the machine is in operation.
 - f. The table should be lowered before backing work under a revolving cutter.
 - g. Hand tools should not be left on the table at any time.
 - h. Operators should not reach around cutters to remove metal chips or debris. Hand brushes or counter brushes should be used to clean machines.
 - i. Operators should be careful not to extend the feed table too far in any direction. Particular care should be taken to prevent the table knee from being fed too far up or down.
 - j. Milling machine operators should make certain that clamps or bolts attached to stock are low enough to clear the arbor and cutter.
 - k. Safety glasses or other suitable eye protection should be worn while operating machines.
 - l. The machine must have electrical service grounded.
4. Metal Shapers are single-edge cutting machines for cutting gear teeth, key way slotting, spinning and similar operations that create hazards for the operator unless the following procedures are observed:
- a. The ram should have adequate clearance before starting the machine.
 - b. All work to be shaped should be securely clamped to a rotary table or held in a swivel vise. Protective guards or shields should be placed around the work cutting.
 - c. The handle or stroke change screw should be removed before the shaper is started. A soft metal mallet, not a machinist's hammer, should be used to set work in the shaper. Vise swivel bolts should be tightened and adjusted before starting the machine.
 - d. Operators should wear safety glasses or goggles while operating shapers.
 - e. Machinists should not attempt to change cutting tools while the shaper is in motion. Operators should set cutting tools to rise away from the job to prevent damaging the work if the cutter drifts.

- f. Safety stops should be securely bolted to the shaper table.
 - g. The machine electrical service must be grounded.
5. Abrasive grinding wheels present many hazards and strict attention to the following safety practices is essential for injury prevention:
- a. Local exhaust ventilation is recommended to control excessive dust accumulation.
 - b. Mechanics should always wear safety glasses or goggles or face shields when using grinders.
 - b. Grinding wheels should be thoroughly inspected for any defect before each operation. Aluminum, brass, copper or other soft metals should not be ground on abrasive grinding wheels unless the wheel is specifically designed for that purpose. The grinding wheel RPM rating should be checked against the machine RPM rating before it is installed. Only non-silica abrasive wheels should be used.
 - c. Abrasive wheels should never be forced onto spindles. New wheels should be properly fitted and rotated by hand to make sure they clear work rests and hoods before the wheels are operated under power.
 - d. Flanges and compression washers should be at least one-third of the diameter of wheels used with protective hoods. Only tapered wheels with protective flanges at least one-half the diameter of the wheels, should be operated without protective hoods. Excessive tension should not be applied to fastening components. Wheels with damaged or missing compression washers should not be used.
 - e. Operators should stand to one side when grinding wheels are first started. Wheels bursting because of unknown defects can cause serious injuries.
 - f. Excessive chatter in grinding wheels is dangerous and when it occurs the wheel should be stopped immediately and inspected to determine the cause.
 - g. Stock thin enough to be pulled between the tool rest and the wheel should not be ground. The tool rest should be adjusted to within 1/8" of the wheel to prevent work from slipping through and catching the operator 's hand. The wheel periphery should have the top of the tongue adjusted to 1/4".
 - h. The sides of the abrasive wheels should not be used for grinding.
 - i. Grinding wheels should never be operated above the RPM rating specified on each wheel.

- j. Before starting the wheel, it should be dressed with approved tools. The bottom lug under the dresser head should be held tight against the edge during wheel dressing.
6. Buffing and Wire Brushing Wheels:
- a. Safety glasses, goggles or face shields should be worn while operating buffing wheels.
 - b. Operators should not wear fabric gloves while polishing or buffing because a glove may catch and drag the operator's hand against the wheel.
 - c. Personnel protective equipment is especially important in the operation of wire-brush wheels because the wires tend to break off. Operators should wear aprons of leather, canvas or other heavy material, leather gloves and face shields.
7. Hydraulic presses used for pressing pinion gears and pulleys, stamping collars and other similar work create pinch-point hazards for the operator unless the following are observed:
- a. All pipes, hoses and hose connections should have a safety-rating factor of 8 to 1.
 - b. All work should be carefully placed in presses to ensure it is straight and even. If necessary, machined shims should be used to square and true the stock so the work will be flat and even.
 - c. Auxiliary safety stops should be installed to prevent the ram from traveling closer than 1/2" to the die.
 - d. Two-hand, dead-man controls should be on presses to prevent accidental operation.
 - e. Hydraulic pressure should be bled off and switches locked out before maintenance is performed.
8. Power-driven metal saws are usually circular, hack or band type. The following precautions should be observed to prevent injury:
- a. Metal-cutting saws should be equipped with a substantial guard that covers the entire length of the blade. This guard should be adjusted to the thickness of the stock before the saw is activated.
 - b. Power-operated hacksaws should be equipped with an adjustable clamp and support for securely holding stock on the machine. A cut-off switch or clutch shall be installed on this type of saw to automatically stop the blade after the cut has been made.

- c. Both the upper and lower wheels of metal band saws must be completely enclosed by a guard. The portion of the blade between the upper guide wheel and the saw table should be protected by a sliding guide that leaves only the cutting point of the blade exposed.
 - d. Power driven metal saws should be operated at speeds recommended or as specified by the manufacturer. The type of blade being used and the kind of metal being cut will also help to determine safe cutting speeds.
 - e. Operators of metal cutting circular and band saws should wear face shields or safety goggles.
 - f. Circular saws should be periodically inspected with non-destructive methods to verify the integrity of the blade.
 - g. All saws must have the electrical service grounded.
9. The general safety standards covering the use of compressed air and its mechanical equipment are covered in Section 1.9. The following precautions pertain to the use of compressed air in machine shops:
- a. All pipes, hoses and fittings must have a rating equal to the maximum pressure of the compressor. Compressed air pipelines should be identified as to maximum working pressure (psi).
 - b. Air supply shutoff valves should be located (as near as possible) at the point-of-operation.
 - c. Air hoses should be kept free of grease and oil to reduce the possibility of deterioration.
 - d. Hoses should not be strung across floors or aisles where they can cause tripping hazards. Air supply hoses should be suspended overhead or otherwise located to afford efficient access and protection against damage.
 - e. Hose ends must be secured to prevent whipping if an accidental cut or break occurs.
 - f. Pneumatic impact tools, such as riveting guns, should never be pointed at a person.
 - g. Before a pneumatic tool is disconnected (unless it has quick disconnect plugs), the air supply must be turned off at the control valve and the tool bled.
 - h. Compressed air must not be used under any circumstances to clean dirt and dust from clothing, hair or skin. Shop air used for cleaning should be regulated to 15 psi unless equipped with diffuser nozzles to provide less pressure.

- i. Safety glasses, goggles, face shields or other eye protection must be worn by personnel using compressed air for cleaning machine parts.
- j. Static electricity can be generated through the use of pneumatic tools. This equipment must be grounded or bonded if it is used where fuel, flammable vapors or explosive atmospheres are present.

1.1. Woodworking Shop Safety: Power operated woodworking tools and machines can be dangerous if not handled and operated properly. The following practices should be utilized to minimize the potential for injury:

- A. Personnel Training: Only personnel who have been thoroughly trained should be authorized to operate power saws and other woodworking machinery. Shop supervisors are responsible for constant observation of shop practices to ensure all safety regulations are being followed. When unsafe acts are noted, it is the responsibility of the supervisor to see they are corrected.
- B. Use of Personal Protective Equipment: Safety glasses, goggles or face shields should be worn while operating power tools. Personnel should not wear loose clothing or other articles that may become entangled in the machine or on the stock being cut.
- C. Safe Operating Methods for Wood Saws: all authorized saw operators should carefully observe the following operating standards:
 - 1. Hands should be kept out of the line of cut while stock is being fed into the saw.
 - 2. Stock should be held against a gauge or fence and never sawed freehand. A push stick should always be used when short or narrow stock is being ripped.
 - 3. The operator should stand out of the line of the stock being cut, making sure the hands or fingers are out of the cutting area.
 - 4. Long stock should never be crosscut on a table saw.
 - 5. The saw should not be left on while unattended.
 - 6. Sawdust and shavings should be cleaned from the saw with a brush, not with the hands or a rag.
 - 7. The saw guard or fence gauge should never be adjusted while the saw is operating.
 - 8. Saw tables 36" above the floor, offer the most efficient working height.
 - 9. Generally, circular saws should not be operated at speeds of more than 10,000 peripheral feet per minute, measured at the blade. However, if blades have been tensioned for higher rates such speed is authorized.

- D. Precautions for Using Compressed Air: Complete safety standards for using compressed air and its generating equipment are given in Section 1.9. The precautions set forth here pertain particularly to the use of compressed air in woodworking shops and should be strictly observed by all shop personnel:
1. Shop personnel should not use compressed air for removing dust and wood chips from their hair, bodies or clothing.
 2. Air hoses laid across aisles, floors or doorways should be guarded by an appropriate bridge, securely fastened to the floor or properly suspended over-head to prevent tripping hazards or hose damage.
 3. Eye protection should be worn while using compressed air to clean equipment.
- E. Proper Machine Locations:
1. Circular saws should be located with sufficient space to allow free movement and easy handling of long pieces of lumber. Minimum clearance at either end of the saw should be at least three feet more than the longest piece of stock normally used. Long stock should be placed on either a table addition or support stands to ensure the safe operation.
 2. Circular saws should be fastened securely to floors or individual mountings.
 3. Rip saws should be so located that they will not be directly in line with other equipment. This will prevent nearby workers from being hit by material that might kickback from the rip saw. If space does not permit this type of positioning, a metal or plank barricade should be placed between the rip saw and other machinery or between the saw and other personnel.
- F. Electrical switches: Each saw should be equipped with a master switch that can be locked and tagged during repair or maintenance operations.
1. Operating switches should be located so the operator can reach them without moving from his normal working position.
 2. Power saws should have a trip device in the switch to prevent the machine from operating when electric service is restored after a power failure.
- G. Saw Blade Collars: Only outer edges of collars should be allowed to bear on saw blades. Before use, the saw should be tested for blade trueness.
- H. Table Saw Feedrolls: Feedrolls should be effectively guarded with a half cylinder blocking device to prevent the operator 's hands from being caught between the rollers and stock. A clearance of no more than 3/8" should be left between the plane of the feedrolls and the blocking device.

- I. Table Saw Power Brakes: Each circular saw should be equipped with a power brake so the blade can be safely stopped after the motor is turned off.
- J. Floors: Floors around woodworking machines should be kept clean, in good repair and covered with non-slip materials as necessary.
- K. Radial Arm Saws:
 - 1. Saws should be equipped with a mechanical device to prevent the front edge of the saw from traveling beyond the front edge of the table.
 - 2. A return mechanism should also be provided to automatically return the saw to the back of the table when it is released at any point in its travel.
 - 3. A self-locking device should be installed to keep the saw from rebounding when released.
 - 4. The upper hood guard should completely enclose the upper portion of the blade down to a point that includes the end of the saw arbor. The hood should be constructed to protect the operator from flying splinters, broken saw teeth and to deflect sawdust away from the operator.
 - 5. The sides of the lower exposed portion of the blade should be guarded to the full diameter of the blade by a device that will automatically adjust to the thickness of the stock and remain in contact with the stock.
 - 6. Saws used for ripping should be provided with non-kickback fingers or dogs on both sides to oppose the thrust or tendency of the saw to pick up material and throw it back toward the operator. They should provide adequate holding power for all the thicknesses of stock being used.
- L. Circular Saws: Circular saws must not be used without guards. The operator should observe the following before starting daily operations:
 - 1. Blades should be inspected before each use to make certain that there are no defects or cracks.
 - 2. Most cracks begin in teeth gullets. If a cracked blade is used, the crack can grow larger and the blade may break. The following precautions should be taken to prevent blades from cracking:
 - a. The blade should be tensioned for the speed at which it is to operate. If the blade is too loose, it can vibrate, heat up, expand and crack.
 - b. The teeth should have enough clearance to prevent burning. If the blade becomes hot, it will expand and can crack.
 - c. The saw should be perfectly rounded. Inspect to see that the rim is concentric with the eye.

- d. The saw should be perfectly balanced or it will wobble and can crack.
 - e. Saw blades should be kept sharp. If the blade is not cutting properly, it will pound on the wood and eventually crack.
 - f. A spreader should be used to prevent stock from kicking back.
 - g. The side of the spreader facing the blade should be shaped to follow the approximate curve of the saw. It should not be less than 3 2" wide at the tabletop. In unusual cases where this width cannot be obtained, the spreader should be at least 2@ wide where it rests on the cutting table.
 - h. The portion of the blade below the cutting table should be completely enclosed or guarded by a rigid exhaust hood.
3. Adequate supervision is necessary to ensure that guards are being used.
 4. Rip saws should be equipped with anti-kick-back dogs. The points of the dogs should ride on the stock to keep it from being forced up and back toward the operator. Kickbacks on ripsaws usually result from one of the following:
 - a. Failure to use a spreader.
 - b. Improperly conditioned blade, allowing stock to pinch and rise off the table.
 - c. Improperly aligned gauge or fence.
 - d. Improperly designed or mounted kickback dogs. On a saw where the arbor is above the table, the rotation of the blade is reversed. On this type saw it is necessary to locate the anti-kick-back fingers ahead of the blade to prevent the stock from rising.
 5. On rabbeting and dadoing jobs, it is impossible to use a spreader. Often it may be necessary to remove the blade hood. This type of operation should be guarded by a jig that slides in the grooves of the transverse guide. The work should be locked in the jig and the operator ' s hands should be kept clear of the blade. The standard blade hood guard should be replaced immediately after rabbeting or dadoing work is completed.
 6. All machine guards should be constructed and installed so they continue to function properly when the cutting table or blade is tilted.
 7. Push sticks should be used to prevent injury when sawing short or narrow pieces of work. Guards should be securely in place when push sticks are used.
- M. Wood Band Saws: Both upper and lower driving wheels should be completely enclosed by solid metal, woven wire mesh or expanded sheet metal and securely

fastened to the metal framework. The enclosure should be at least 4" from the upper wheel to avoid contacting and breaking the blade. Band saws should be securely anchored to the floor or machine foundation to prevent vibration and the following should also be observed:

1. Band saw drive wheels should be checked periodically for defects requiring repair or replacement.
2. The cutting edge of the blade should be completely enclosed except at the point of operation.
3. The return part of the blade should be completely guarded along its full length between the upper and lower drive wheels.
4. Self-fed band saws should be safeguarded by a half-cylinder device to prevent the operator's hands from contacting the feedrolls.
5. Defective blades should not be used and should be immediately rejected. Operators should only use a blade designed for the job at hand.
6. Every band saw should be equipped with an automatic blade tension control. This device compensates for blade contraction after cooling and ensures proper operating tension at all times.
7. Band saw operators should be required to wear safety goggles or face shields to protect their eyes while working at the saws.
8. To avoid ultraviolet radiation burns, operators should use adequate eye protection when using a butt welder to slice broken saw blades.

N. Wood Jointers: The following precautions should be observed:

1. All jointers should be equipped with cylindrical cutting heads. Square cutting heads should not be used.
2. Throats of cutting heads should not be larger than 3/8" deep and 1/2" wide.
3. Operators should wear safety glasses, goggles or face shields to protect their eyes from flying wood chips.
4. Self-adjusting guards should cover cutting heads on both sides of the guide fence. These guards should be adjustable both vertically and horizontally.
5. The guide fence should be located as close to the front of jointer table as the width of the work will permit.
6. Only sharp, balanced knives should be used on jointer cutting heads. Before each operation, the knives should be inspected for defects and to be certain they are securely fastened.

7. Push sticks or push blocks with handles should be used on all work as a general safety precaution. They should be mandatory on work shorter than 18" or less than 1/2" thick.
 8. Unusually deep cuts should be avoided to avoid kickback.
- O. Wood Shapers: Various spindles may be used to make different types of cuts. The following safety precautions should be utilized to minimize injury:
1. Each cutting head and spindle end should be enclosed in a cage or adjustable guard to prevent operator contact with the cutting edge.
 2. Jigs, fixtures and templates should be used to hold work in the shaper.
 3. If one blade must be removed from a shaper spindle, all others should also be removed. Starting switches should be locked-out to prevent accidental start-up during blade changing.
 4. Short blades that are not bearing along the entire area of the collar should not be used in shaping operations.
 5. Collar surfaces should be smooth and free of burrs to ensure a secure bearing surface for cutting blades.
 6. Double spindle shapers should be equipped with individual starting and stopping devices for each spindle.
 7. Only sharp knives of the same length and balance and free from defects should be used in shaper spindles.
 8. Shaper operators should not "back up" on a cut. It is extremely dangerous to run stock in the same direction as the spindle 's rotation.
 9. Stock should not be fed too quickly.
 10. Deep cuts should be avoided.
 11. Operators should wear safety glasses, goggles or face shields for eye protection.
- P. Wood Lathes:
1. Flying chips are a common hazard of lathe operations. The tool rest should be adjusted so as to be reasonably close to the work piece.
 2. Personnel working on lathes should not wear loose clothing, untied long hair or jewelry that may become tangled in the lathe.
 3. Lathe cutting heads should be enclosed in adjustable case iron or other metal guards. An exhaust hood may form part of the guard if it is also made of metal.

4. Operators should avoid taking deep cuts. Deep cuts can result in the cutting tool being forcibly ejected.
5. Operators of back-knife lathes should not reach under the lathe to place stock in the centering frame. Instead, they should lower the knife far enough to reach over it.
6. Heads set along the rear of the machine should be covered by a hinged metal guard, that will not interfere with the lathe's operation.
7. Treadle-operated lathes should be effectively guarded to prevent accidental tripping of the treadle.
8. Exposed gears, sprockets and chains should be properly guarded.
9. Operators should wear safety glasses, goggles or face shields for eye protection.

Q. Wood Sanders: This equipment should be completely guarded both below and above the worktable. The only exposed part of the machine should be the actual point of operation. The following should also be observed:

1. Adequately designed exhaust hoods are an essential part of sanding machines because of the rapid rate of dust production. The exhaust hood may also serve as a machine guard.
2. The feedrolls of a self-feeding sander should be guarded by a blocking device. It should consist of half-cylinder guards that come within 3/8" of the plane formed by the face of the feedrolls and the stock material.
3. Both pulleys of a belt sander and the entire run of the sanding belt, except the working portion, should be completely enclosed.
4. The space between the sanding disk and the edge of the opening on table sanders should only be enough to allow free movement of the disk. Under no circumstances should the clearance be more than 1/2".
5. When performing finishing work on a belt, disk or drum sander operators should use work forms.
6. Operators should wear safety glasses, goggles or face shields for eye protection.

R. Wood Tenoning Machines: The cutting heads or saws of all tenoning machines should be enclosed in adequate guards except for the working portion. When an exhaust system is used, the hood may form all or part of the guard. Always observe the following:

1. Feed chains and sprockets of double-end tenoning machines shall be completely enclosed for the stock conveying parts. The sprockets and chains for the conveyor should also be guarded by plates extending beyond the edge of the sprockets and lugs.

2. Hand-fed machines should be equipped with clamping devices to prevent stock from moving out of position.
 3. Operators should wear safety glasses, goggles or face shields for eye protection.
- S. Wood Planers, Molders, Stickers and Matchers: These machines should have their cutting heads or saws covered by guards. It is also necessary to observe the following:
1. Machines should be completely stopped before attempting to clear jammed work or remove debris.
 2. Cases should be used to carry knives and assembly cutting heads to and from tool rooms.
 3. Feedrolls should be guarded by a hood or semi-cylindrical guard. The guard should be fastened to the roller frame so it will remain in adjustment for any thickness or stock.
 4. Sectional feed rollers should be used on planers. Where solid feed rollers are used, sectional finger devices should be used to prevent stock from kicking back.
 5. Operators should wear safety glasses, goggles or face shields for eye protection.
- 1.2. Paint Shop Safety: Painting operations using flammable and combustible materials shall be constructed and operated in compliance with the State Fire Marshal and NFPA 33 code requirements. Commonly used paints often contain toxic substances, such as lead or benzol and may be harmful if inhaled. Supervisors must rigidly enforce such standards. Contact EH&S for assistance in the design and operation of paint shops. At a minimum, the following precautions should be observed:
- A. Good Housekeeping: This is essential to safe operations in paint shops. Paint rooms and equipment should be kept clean and stored in an orderly manner.
 - B. Proper Locations: Paint shops should ordinarily be located in separate buildings from other activities or in specially constructed, fire resistant rooms.
 - C. Using Spray Booths: Spray booths should be used in all paint shops to localize the fire and explosion hazards. The walls of these booths should be made of a fire-resistant material that can be easily and frequently cleaned. Walls and floors of spray booths may be covered with paper to protect them from paint deposits. This paper should be removed and destroyed when contaminated. Protective paper wall coatings should not be used for dry or dusty painting operations.
 - D. Providing Adequate Ventilation: Forced air ventilation should be provided in all paint spray booths to prevent the accumulation of flammable and potentially harmful vapors. The booth should have an exhaust system with a linear velocity

across the face of the booth of 100 feet per minute (fpm) and the following basic rules should be observed:

1. Personnel should always spray paint toward the exhaust portal to minimize the accumulation of harmful mists in the booth. Spray guns should never be pointed toward other personnel.
 2. Adequate exhaust ventilation should be provided in booths when hand spray painting is being accomplished. When forced ventilation is impractical, such as during minor touch up painting, personnel shall wear approved respirators.
- E. Eliminating Fire Hazards: All sources of ignition should be removed from paint shops. Electrical equipment and fixtures should be explosion-proof and effectively grounded at all times. Exhaust fans should be made of nonferrous metal and the air ducts should be bonded and grounded. Smoking should not be permitted in the paint shop. In addition, the following should be observed:
1. All metal and fabric covered objects that could produce static charges should be effectively grounded or bonded before spray painting is authorized.
 2. Suitable fire extinguishers should be provided at all painting and paint removing locations. When practical, overhead sprinkler systems should be installed in permanent paint shops.
 3. Rags, waste and other materials saturated with paint should be disposed of in covered metal cans. Waste cans should be emptied daily.
- F. Taking Personal Health Safeguards: Detailed instructions for safeguarding painting activities should be developed and observed by all paint shop workers. The following are basic rules:
1. To avoid ingesting paint, shop personnel should wash thoroughly before eating and wear single use, disposable respirators when spray painting.
 2. Food should not be brought into or eaten in paint shops.
 3. Protective clothing should be worn by paint shop personnel during painting operations to prevent work clothes from becoming saturated with harmful paint deposits. When protective clothing is not being worn, it should be stored in ventilated metal lockers conveniently located outside the painting areas.
- G. Storing Painting Materials Safely: Paint storage should be isolated from the spray booths. Containers of no more than five-gallon capacity should be used for storing paints. The paint materials should be stored in approved fire rated metal cabinets when not in use.
1. Combustible paints should be mixed in a fire-resistant mixing room. This room should be provided with a floor drain connected to a separator to wash down spills quickly and effectively. These paints should not be

stored in spray booths. Storage containers must be grounded when pouring from/into metal containers.

2. Actions relating to the use, storage and mixing of water-base latex paints are exempt from the above requirements.
3. Accumulation of flammable or toxic paint wastes (i.e. oil based paint, mineral spirits, lacquer thinner, etc.) must be within a designated satellite area. Container must be labeled, grounded and disposed of before 55 gallons are accumulated.

H. **Supervising Use of Pressure Equipment:** The use of compressed air for spraying operations should be closely supervised and the equipment properly used. The following precautions outline safe use conditions:

1. A relief valve should be installed in the main air tank and a pressure-reducing regulator installed in the air line between the compressor and the paint container.
2. A pressure gauge should be placed between the reducing regulator and the paint container.
3. All equipment should be inspected before use. Particular attention should be given to pressure reducing regulators to make certain they are functioning properly.
4. Spray equipment should be thoroughly cleaned at the end of each use.
5. Steps should be taken to prevent paint from drying on pressure valves.
6. Pressure gauges should be closely observed for positive indication that the regulator is working properly.
7. Only enough pressure should be placed on spray equipment to do the job effectively. The use of minimum pressure should prevent accumulation of hazardous mists.
8. Gravity feed tanks should not exceed a capacity of 10 gallons. Tanks should be tightly covered with non-combustible lids, equipped with screened vents. Suspended gravity feed tanks should be held by strong wire cables.
9. Electrically heated paint pressure pots should be periodically inspected by qualified personnel to ensure that thermostatic controls are within permitted heat ranges. Pots should not be tipped or otherwise positioned to expose the heating element at any time.

I. **Removing Paint Safely:** The same safety precautions covering painting should apply to paint removing. Flammable and toxic solvents may be used which require adequate ventilation to keep vapors from accumulating.

- 1.3. Battery Maintenance: Operating personnel are often exposed to the possibility of painful chemical burns, explosive gases and toxic chemicals when servicing batteries. The following precautions are essential in preventing personal injury:
- A. Nickel-cadmium and silver-zinc batteries should be serviced in an area isolated from lead-acid batteries.
 - B. The area must be ventilated to prevent accumulation of acid fumes that may be harmful and can contaminate the nickel-cadmium or silver-zinc battery shop area.
 - C. When acid and potassium hydroxide electrolyte type batteries are handled in the same shop, the specific equipment for the two kinds of batteries should be kept separate and carefully labeled.
 - D. Tools or metal parts should not be placed on a battery or stored in such a position that they may fall on a battery.
 - E. Workers should not wear rings or other hand jewelry.
 - F. Lifting devices and hand trucks should be provided for handling heavy batteries.
 - G. When charging batteries:
 - 1. Lead-acid battery charging equipment should be located in properly ventilated rooms. Excessive charging of lead-acid batteries should not be permitted as explosive hydrogen gas can be generated.
 - 2. Charging benches and tables should be constructed of or coated with acid-impervious coatings.
 - H. When handling electrolyte, shop personnel should wear protective chemical goggles or full-face shields, rubber gloves and aprons. A safety shower and eyewash should be within 100', tested and tagged at least twice a year.
 - I. When mixing acid solutions the following should be observed:
 - 1. Always pour electrolyte into water. Never pour water into electrolyte as the heat of dilution will cause water to boil and spatter.
 - 2. Have water immediately available during diluting operations.
 - 3. Use tilter to pour acid from a carboy.
 - 4. Siphon acid by a rubber suction ball.
 - 5. Acid burns should be treated with baking soda and water.
 - K. Battery Charging Rooms and Areas: All of the following criteria apply to rooms or areas with battery banks whose aggregate capacity at the eight-hour discharge rate exceeds five kilowatt hours (KWH). Only items 2, 4, 10, 12 and 13 apply to smaller KWH facilities.

1. The room or area should be well ventilated to prevent accumulation of explosive gases or toxic vapors.
 2. Racks and trays must be resistant to the electrolyte and they must be designed to permit free access for servicing batteries.
 3. Floors should be resistant to or protected from electrolyte accumulations.
 4. Materials or equipment should be provided for neutralizing or flushing spilled electrolyte.
 5. Eye protection that provides side and frontal protection, aprons and rubber gloves should be utilized by employees.
 6. Emergency shower and eye wash facilities should be provided for any area where batteries are filled with electrolyte. These units should be flow tested and tagged at least twice a year.
 7. The battery bank should be located in an area of minimal personnel and vehicular traffic. Separate rooms are desirable.
 8. No smoking signs should be posted in the area.
 9. Fire extinguishers should be provided and inspected monthly.
 10. Cells of the unsealed, jar type should not be used.
 11. Employees assigned to work with batteries should be instructed in emergency procedures such as coping with electrolyte spills.
 12. Electrolyte should be mixed in a well ventilated area. Acid or alkaline shall be poured gradually while stirring into the water. Never pour water into acid.
 13. Electrolyte should never be poured into metal containers or stirred with metal objects.
 14. When taking specific gravity readings, an electrolyte resistant gloved finger should be placed over the end of the hydrometer while moving it from cell to cell to avoid splashing or dripping the electrolyte.
- 1.4. Welding Safety Practices: Also see University of North Florida Hot Work Policy (section 1.5). Radiation from welding flares and arcs can seriously injure eyes and burn skin. Splashing metal and hot sparks can cause other burns. The welding operation must meet the State Fire Marshal and NFPA 51B codes. For further assistance call EH&S.
- A. Only qualified personnel should be authorized to perform welding operations.
 - B. Employees should be provided with protective equipment that includes welding helmets, shields, aprons, gloves and gauntlets.

- C. Arc welders should ensure that fireproof screens are placed around the work area to prevent eye flash burns to personnel in the area.
- D. Welders should wear eye protection when chipping scarf metal fragments.
- E. Forced ventilation should be used in welding operations when natural ventilation is insufficient to prevent the accumulation of gases and fumes. In confined areas, local exhaust ventilation will be required.
- F. Welding Fire Hazards: Welding or cutting near flammable or explosive materials requires close attention to the following safety requirements:
 - 1. A fire extinguisher must be available within 100'.
 - 2. Welders working near combustible materials should be provided a watch person to stand by with suitable fire suppression equipment.
 - 3. Flammable materials should be removed from the immediate area. Wooden floors and other combustible surfaces should be protected. When it is impractical to remove flammable materials from the area, they should be protected by a suitable fire resistant shield.
 - 4. After welding operations have been completed, the area should be thoroughly inspected for smoldering material.
 - 5. Welding is prohibited where flammable gases or liquids are present until their presence has been eliminated.
 - 6. In confined spaces, welding itself may produce flammable and explosive gases. Refer to the UNF Confined Space Entry Program.
 - 7. When a fire hazard still exists after precautionary measures have been taken, the decision to weld or cut should be made by the supervisor. A fireguard should stand by the welding operation.
 - 8. Compressed gases: The precautions for the handling and storage of compressed gases are contained in Chapter 4.
- G. Welding Containers: Before welding or cutting any tank, cylinder or other container, personnel should make certain containers are free from any trace of explosive material. The following procedures will minimize accidents:
 - 1. Containers which contain or have contained flammable substances should be purged or made inert prior to the welding operation. Refer to the UNF Confined Space Entry Program.
 - 2. Containers should be vented during welding operation. Adequate venting is necessary to prevent containers from exploding or rupturing.
- H. Oxyacetylene Welding/Cutting: Careful handling of the gases and equipment used in oxyacetylene welding is essential. In addition, observe the following:

1. Oil or grease should not be allowed to come in contact with welding equipment.
 2. Acetylene should not be used at pressures exceeding 15 psi.
 3. Leaking and creeping regulators should be removed from service.
 4. Control valves should never be opened more than 1 1/2 turns; 1/2 turn is sufficient for most welding operations.
 5. The special T-wrench used to open cylinders should be left in place during welding operations to permit quick shutdown in emergencies.
 6. Control valves should be unobstructed and immediately accessible to the welder.
 7. Control valves of cylinder not in use should be covered by protective caps.
 8. Acetylene cylinders should be stored and used in an upright position to prevent loss of acetone. This will also minimize external corrosion of the cylinder.
 9. Welding-torch hoses should be protected from damage by contact with hot metal, open flames or other destructive agents.
 10. Inspect hoses periodically for leaks.
 11. Only standard ferrules or clamps should be used to secure hoses to cylinders and torches. Makeshift tape or wine connections should not be used.
 12. The oxygen hoses should always be green in color.
 13. Hoses should be released of pressure at the end of each workday.
- I. Gas Welding Flame: The flame should always be kept within the welder 's field of vision and not be allowed to contact any part of the welding equipment. The following additional procedures should be observed:
1. The torch should be extinguished when not in use and its control valves turned off.
 2. The torch should not be pointed at concrete surfaces because a miniature explosion could occur and result in flying concrete fragments.
 3. If a flashback occurs, the operator should turn off both torch valves.
 4. If a hose burst or escaping gas ignites at the tank regulator, the control valves should be immediately turned off.
 5. On manifold cylinder systems, each fuel-gas cylinder should be provided with a backflow check valve.

- J. Electric Arc Welding: Eye injury can occur while operating arc welders. Be sure to use fire-resistant curtains or screens during the welding operation and post warning signs. In addition:
1. Always deenergize electrical circuits before testing or checking.
 2. Rotary and polarity switches should not be operated while the equipment is under an electrical load.
 3. Motors, generators and other electrical welding equipment should be grounded.
 4. Arc welding equipment should undergo careful inspection before each day's use.
 5. Arc-generating equipment should be repaired by qualified electricians only.
- K. Cadmium Welding Hazards: When cadmium plated or cadmium-bearing metals are being welded, local exhaust ventilation should be provided. In addition:
1. The exhaust hood should be kept as close to the point of generation as possible and should never be more than 8" away.
 2. If local ventilation cannot be supplied and welding is being done in small, confined spaces the operator should wear an approved air-line type respirator.
 3. Welding should never be performed on a metal or alloy of unknown identity. Cadmium-plated metals can easily be confused with other electroplated metals. When there is any doubt about the composition of a metal to be welded, a sample should be submitted to a metallurgical or chemical laboratory for analysis.
 - a. Oxides commonly generated in welding processes may originate from the material being welded, the surface coating or the electrodes of the arc equipment. Cadmium oxide is extremely poisonous, particularly in the vapor form. Heavy concentrations cause rawness in the throat, irritation of the mucous membranes and edema (fluid) in the lungs. Death or permanent lung damage can result from prolonged breathing of cadmium oxide. Unless the welder is familiar with the differences between cadmium containing metals and others similar in appearance, exposure to toxic concentrations of cadmium oxide can occur when welding cadmium bearing or plated metals.
 - b. Protective measures against harmful gases, fumes and dust should be taken by providing adequate ventilation and respiratory protective equipment. Refer to the UNF Respiratory Protection Program.

1.5. UNIVERSITY OF NORTH FLORIDA HOT WORK POLICY

OBJECTIVE

To establish requirements for fire safety and the safe performance of all tasks involving welding, cutting, brazing and soldering.

APPLICABILITY

This policy applies to all maintenance activities on campus. The project manager will provide contractors working on University facilities a copy of this policy.

MINIMUM REQUIREMENTS

Fire hazards: If the object to be welded, cut, brazed or soldered cannot be readily moved, all movable fire hazards in the vicinity shall be taken to a safe place.

Guards: If the object cannot be moved and all fire hazards cannot be removed, then guards shall be used to confine the heat, sparks and slag and protect the immovable fire hazards.

Combustible material: Whenever there are floor openings or cracks in the floor that cannot be closed, precautions shall be taken so that no readily combustible materials on the floor below will be exposed to sparks which may drop through the floor. The same precautions will be taken with regard to cracks or holes in walls, open doorways and open windows.

Fire extinguishers: Suitable fire extinguishing equipment shall be available within 100' of the work area and inspected monthly.

Fire watch: Fire watches shall be required whenever tasks are performed in locations where: Appreciable combustible material, in building construction or contents, are closer than 35' to the point of operation; Appreciable combustibles are more than 35' away but are easily ignited by sparks; Combustible materials are adjacent to the opposite side of metal partitions, walls, ceilings or roofs and are easily ignited by conduction or radiation (radiant heat).

Prohibited areas: Welding, cutting, brazing and soldering shall not be permitted in the following situations:

In sprinklered buildings while such protection is impaired.

In the presence of explosive atmospheres (mixtures of flammable gases, vapors, liquids or dust with the air).

Where adequate ventilation cannot be provided.

On piping or ducts that may permit sparks or fumes to be transferred to other areas of the facility.

Soldering: Soldering of metals affixed to combustible materials shall be performed using an electric iron rather than gas flame.

Personal Protective Equipment: The individual performing the task shall wear the appropriate protective devices. All observers and individuals assisting in the performance of the job shall wear appropriate protective devices.

Authorization: Before cutting, welding, brazing or soldering is permitted, the area shall be inspected by the individual responsible for authorizing the operation. They shall designate precautions to be followed in granting authorization to proceed. They shall also ensure that the person performing the operation is properly trained and qualified.

Special Exemption: When a task cannot be conducted under the restrictions of this policy, EH&S should be contacted to assist in the development of alternate procedures.

References: Code of Federal Regulations 29, Part 1910 and National Fire Protection Association (NFPA) 51B.

- 1.6. Safety in Vehicle Maintenance Shops: Supervisors should ensure that daily inspections are made on all shop equipment. The following precautions should also be observed:
- A. Motor vehicle maintenance activities, such as painting, welding and battery work should be carried out in separate parts of the shop.
 - B. Adequate general illumination should be provided in all areas of shop and where necessary, additional lighting supplied.
 - C. A fire prevention program should be implemented to ensure that care is taken in the storage and handling of flammable fuels and lubricants. The following precautions are essential:
 - 1. Flame-producing equipment should not be used in the shop except in areas such as the welding shop, where required safety controls exist.
 - 2. Smoking should be forbidden except in areas designated by the maintenance superintendent.
 - 3. Fire extinguishers should be located within 100' of the maintenance shop. They should be inspected monthly, tagged and their locations should be clearly marked and free of obstructions.
 - 4. Vehicles should never be fueled inside maintenance shops. The supervisor however, may make exceptions under controlled conditions.
 - D. Shop ventilation should be adequate to prevent accumulation of gases and vapors. Special exhaust systems should be provided in battery rooms, painting booths and for confined welding jobs.
 - E. Shop floors should be kept clean and free of oil, grease, gasoline, water and other hazardous or slippery materials. Drip pans under vehicles and mechanized equipment are essential. In addition :
 - 1. Special precautions should be made to prevent drainage of flammable liquids into floor drains or sanitary systems.

2. Boxes of suitable absorbent materials should be provided in vehicle maintenance shops to be used on spills.
 3. Oily rags and contaminated absorbent materials should be disposed of on a daily basis in approved containers for laundering.
- F. Shop personnel should wear appropriate protective equipment when performing any hazardous maintenance operation. This equipment should be available in the shop for immediate use.
- G. Automatic shop machinery such as lathes, abrasive wheels and portable electric tools should be guarded and grounded according to requirements outlined by the manufacturer and this manual.
- H. Guard rails should be placed around grease or repair pits. All pits should be equipped with steps, handrails, and approved lighting. Additionally:
1. Pits should be built with drains equipped with oil separators to prevent drainage into the sanitary sewers.
 2. Repair areas and grease pits should be cleaned regularly with soap and water or a caustic solution. Flammable solvents should not be used due to fire hazard.
 3. Each automotive lift should be marked with the name of the manufacturer, lift capacity and date of installation. These markings should be stamped or etched on a metal plate permanently attached to the lift in a position where the operator can see it.
 4. Vehicle lifts should be equipped with control devices of the "dead man" type which automatically return to neutral or off when released by the operator. Controls should be conveniently located near the lift in a position that provides an unobstructed view of the lift area.
 5. Chassis and axle supports should be designed to transfer the load to the lift rails without putting torsion stress in the rails. Make shift devices should not be used for chassis and axle supports.
- I. Tire Mounting: When mounting tires shop personnel should use mechanical devices such as dollies to help them mount or remove large, heavy tires. The following precautions should also be taken:
1. Personnel should use guard cages when inflating tires. When wheels with lock rings or split rims are repaired, several lengths of chain that are equipped with positive catches can also be used to pass through the wheel openings and around the tire rim before inflating.
 2. Personnel should use extreme caution when inflating low pressured tires on large trucks or heavy construction equipment.
- J. Contaminated Clothing: Mechanics should keep their clothing free from grease and oil and observe the following:

1. If the clothing is contaminated with gasoline, the mechanic should immediately shower and put on clean clothing.
 2. Clothing that is saturated with flammable substances should be stored in approved containers.
- K. Jacks: The rated load should be legibly and permanently marked in a prominent location on the jack by casting, stamping or other suitable means and operators should observe the following:
1. Make sure that the jack used has a rating sufficient to lift and sustain the load.
 2. Inspect jacks frequently.
 3. After a vehicle has been raised by a jack, it should be securely blocked to prevent falling.
 4. All hand and portable power tools in the shop should be used and maintained according to the requirements prescribed in this manual.
 5. Tool kits should be inspected periodically and defective tools replaced immediately.
- L. Electrical Equipment Cables and Cords:
1. The insulation of power cables and cords on electrical equipment should be resistant to damage from oil or grease.
 2. Power cables and cords on all electrically operated equipment should have a three-wire plug with a ground lug. This requirement does not apply to double insulated tools.
 3. Cables should be constructed to provide automatic grounding of equipment through integral conductors.
 4. Employees who are using portable electrical tools and lights should not string cables across shop floors.
- M. Fuel Tanks: Gasoline tanks and other fuel containers should not be welded. If necessary all welding shall be performed in compliance with the safety requirements outlined in the welding section of this manual.
- N. Shop Entrances: Shop entrances and exits should be clearly lighted and marked to prevent accidents. Appropriate traffic control signs should be posted at entrances and exits and the following should be observed:
1. Vehicles entering or leaving shops should signal with their horns to warn shop personnel and other vehicular traffic.

2. A maximum speed limit of five miles per hour should be enforced in and around shops.
- O. Dangers of Compressed Air: Compressed air should not be used to clean workbenches, vehicle chassis and other parts. This practice is extremely dangerous because metal parts, dirt and debris can cause eye injury or be forced through clothing into the flesh. The following guidelines should also be observed:
1. Employees should never engage in horseplay with compressed air. Compressed air should always be used according to safety requirements outlined in this manual.
 2. Pressure gages should be equipped with safety glass lens and blowout plugs.
 3. Hoses should be adequately secured at all times.
 4. Compressed air may be used as a cleaning acid on non-moving machinery provided that air output at the nozzle does not exceed 15 psi. When cleaning moving machinery air output should not exceed 5 psi.
 5. Eye protection should be used at all times when cleaning equipment with compressed air.
- 1.7. Hand Tool Safety: Preventing accidents involving hand tools is a matter of proper instruction and adequate training. The following guidelines should be observed:
- A. The tools should be of good quality and adequate for the job at hand.
 - B. All tools should be kept in good repair and maintained by qualified personnel.
 - C. Racks, shelves or toolboxes should be provided for storing tools.
 - D. Supervisors should frequently inspect all hand tools used in operations under their supervision and remove defective tools from the service immediately.
 - E. Tool handles should be carefully selected to ensure that the materials are free from flaws and it is essential to observe the following:
 1. When the handles of hammers, axes, picks or sledges become cracked, split, broken or splintered they should be immediately replaced.
 2. Tool handles should be well fitted and securely fastened by wedges or other acceptable means. Wedges, always in pairs, should be driven with a sledgehammer or maul. Wedges with mushroomed edges should not be used until properly dressed.
 3. If tool heads can be drilled, a steel pin should be driven through the head and handle to prevent the head from accidentally flying off the handle.
 4. Files, wood chisels and other tools with tangs should be fitted with suitable handles which cover the end of the tang.

5. Handles should be kept free of grease and other slippery substances.
 6. Ends of handles should not be used for pounding or tapping.
 7. Improvised extension handles such as pipes or bars should not be used.
 8. Wood tool handles should not be painted except by the manufacturer.
- F. Cold chisels, punches, hammers, drift pins and other similar tools which have a tendency to mushroom from repeated poundings, should be dressed down as soon as they begin to split and curl. The following safety precautions should also be observed:
1. When dressing tools, a slight bevel of about 3/16" should be ground around the head. This will prevent the heads from mushrooming.
 2. Safety glasses or face shields should be worn by all personnel when work may produce flying chips or debris.
- G. Cutting tools should be kept sharp and stored in safe manner.
1. Knives and similar hand tools should be equipped with guards at the hilt to prevent the employee 's hand from slipping down on the blade.
 2. Sharp or pointed tools should always be carried in sheaths not in clothing pockets.
- H. Machinery should be completely stopped before repairs or adjustments are attempted. When absolutely necessary to work on operating machines, personnel should use only the tools designed and approved for the repairs. Only personnel qualified to repair or adjust the machinery should perform this work.
- I. Small objects should be held in vises while work is performed because injuries can result from trying to hold a small object in one hand while working on it.
- J. Select the proper type hammer for the job. No hammer should be used that has a cracked or defective head and it is important to remember the following:
1. The sides of hammer heads are not case hardened and should never be used for pounding.
 2. Hammers with tightly tempered steel heads should not be used on hard steel objects. Hammers with heads made of soft materials should be used.
- K. Wrenches: The proper size and type of wrench should be selected to do only the jobs for which it was designed and employees should observe the following:
1. Place wrenches on nuts or bolts so the pulling force will tend to push the jaws against the work. To prevent the wrench from slipping, the handle should be pulled not pushed.

2. Avoid over straining small wrenches and no wrench should be subjected to side strain.
 3. Shims should not be used to make wrenches of an improper size fit the work at hand.
 4. A pipe wrench should not be used as a substitute for other types of wrenches.
 5. A wrench should never be used as a hammer.
 6. Hammering on wrench handles to free frozen nuts should not be permitted unless specifically designed striking-wrenches are used.
- L. Screwdrivers: The proper type screwdriver should be selected for each job. The wrong size or type tool is responsible for many injuries. Always observe the following :
1. Conventional type drivers should not be used on Phillips or cross-slotted head-type screw slots.
 2. Objects should not be held by hand, under the arm or on the lap when being worked on with a screwdriver. Work should be secured to a flat surface or held in a vise.
 3. Employees should make certain that they are well braced before applying force to a screwdriver. A firm foothold is particularly necessary when using a screwdriver on a ladder or stand.
 4. A screwdriver should never be used as a punch, wedge, chisel, pinch bar, pry or nail puller.
 5. Only use screwdrivers that are designed and approved for electrical work. However, insulated screwdrivers should never be utilized as the primary protection against electrical shock.
 6. Worn screwdriver blades should be dressed by grinding or filing so the bottoms are flat and the sides almost parallel. Blades that are ground with too much taper and will tend to rise out of the screw when pressure is applied.
- M. Knives: All knives, except folding pocket types, should be equipped with hand shields or sure-grip handles to keep the user 's hand from slipping down onto the blades. Non-folding knives carried on a person should be kept in leather sheaths.
1. When using a knife always cut away from your body, but be careful not to endanger fellow employees.
 2. Knife blades should be kept as sharp as possible.
 3. When not in use, knives should be kept in racks or stored safely so that they will not be a hazard.

- N. Pliers and Nippers: Be careful using nippers or pliers on electrically energized circuits. The equipment should be approved for electrical work. If possible, the electrical circuits should be turned off.
- O. Vises: When clamping or holding heavy objects, a block of wood or metal should be used to brace the object and prevent it from accidentally falling or slipping from the vise. It is also important to observe the following:
1. Vises should not be opened beyond the limit of screw travel.
 2. Vises should never be used as anvils nor should metal work be placed in wood vises.
- P. Punches, cold chisels and similar tools that are hand-held should be kept free of slippery substances. Hand guards and tool holders should be used if practical. The following rules should also be observed:
1. Tools that have become mushroomed should not be used until they have been properly dressed.
 2. Employees should wear safety glasses, goggles or face shields when striking tools such as chisels or punches.
 3. When work is being chipped in a vise, the force of the chisel should be toward the solid jaw of the vise.
 4. Suitable safety shields or screens should be used when chipping is performed in the vicinity of other personnel.
- Q. Hatchets, Axes, Adzes, and Wedges: Woodcutting tools should be kept as sharp as possible at all times. The most common hazard with this type equipment is the handle separating from the blade while in use. Always observe the following:
1. Make certain all personnel in the area are at a safe distance before using an adze, axe or hatchet.
 2. Never swing or cut toward a fellow employee.
 3. Use short, choppy strokes to ensure better control.
 4. Keep blades of woodcutting tools free of chips or other debris to prevent deflection of the blow.
 5. Always pass this equipment to a fellow employee with the handle first, be sure to keep a firm hold on the head until the other person has a secure grip of the handle.
 6. Woodcutting tools should be stored with the sharp edge of the blade protected.
- R. Blow Torches:

1. Blow torches should not be used in unventilated areas or near flammable or explosive materials.
2. The torch should be inspected before use to make sure it is in safe working condition.
3. A gasoline blowtorch should not be used until the instructions have been read.
4. Torches should be filled with fuel while out-of-doors and away from sources of ignition.
5. Blow torches should be set on a firm surface before they are lighted.
6. Never light a torch that has had fuel accidentally spilled on the unit until the surface has been thoroughly cleaned.
7. Never move a torch when fuel is still burning in the priming bowl.

S. Soldering Irons:

1. Metal racks placed in safe areas should be used for resting hot irons.
2. The iron should be checked before each use to make certain the copper is securely fastened to the shaft and the handle should be checked to make sure it is not loose.
3. Electric soldering irons should never be left plugged-in when not in use.
4. Cords and plug connections should be kept in good repair. Replace wires with frayed or broken insulation.
5. Personnel should avoid breathing the fumes from soldering fluxes and acids. Dripping, hot solder may cause burns or damage the work.
6. Small jobs being soldered should be held with pliers or clamps to prevent burns.
7. Rags used to clean excess solder from hot irons should be placed on a fire resistant surface. A rag should not be held by bare hand to perform this cleaning operation.

T. Hand Saws:

1. Saws should be checked before each use to ensure that they are sharp and properly set.
2. The proper saw should be chosen for the job at hand, such as a crosscut saw for cutting across the grain or a rip saw for cutting with the grain.
3. Do not force a saw that is binding in the stock.

4. If a saw sticks in damp or gummy wood, a small amount of oil or paraffin can be applied to the blade to make it cut smoothly. Wedges may also be used to hold open the cut.

U. Crowbars and Wrecking bars:

1. Bars of sufficient size and weight should be chosen for each job at hand. Makeshift bars, such as pipes or other metal objects should never be used in place of a crowbar or wrecking bar.
2. To prevent crowbars and wrecking bars from slipping, a block of wood can be placed under the bar. This technique will also provide more leverage.
3. Case hardened steel tools should never be used to strike crowbars or wrecking bars. Only use plastic, wood or soft metal tools to hammer on these types of pry-bars.

- 1.8. Safety Principles in Using Portable Power Tools: The improper use of portable power tools can cause electrical shock, burns, cuts or eye injuries. The employee using these types of tools should be thoroughly trained in safe operating practices and should observe the following:

- A. The switch should be shielded against accidental operation. To provide greater operator safety, these tools should be equipped with a constant-pressure switch that will shut off the power supply if the pressure is released.
- B. To prevent tripping hazards, cords, hoses and cables should not be run on the floor.
- C. Special type cords (rubber covered or plastic) should be used in areas that may be contaminated with oils or solvents.
- D. Projections on shafts or revolving parts of hand power tools should be removed, countersunk or ground smooth with the tool surface and provided a suitable metal cover.
- E. The worker should wear suitable work clothes to operate these tools. Loose sleeves, neckties, rings, clothing or jewelry that could become tangled in a hand power tool should never be worn.
- F. Operators should wear protective eyeglasses, goggles or face shields.
- G. Power tools should be inspected regularly by qualified personnel to ensure they are in safe operating condition. Equipment with broken or worn parts, defective and frayed electrical cords or other damages should be immediately taken out of service.
- H. Portable grinders should be completely guarded on the top, sides and bottom of the wheel. Wheels should be secured to spindles by flange nuts and all mountings firmly fixed to the tool.

- I. Portable circular saws should be checked before each use for cracked or defective blades. Damaged blades should be immediately discarded. Permanent, self-adjusting guards should be provided on all portable saws.
- J. Scratch brushes used on portable power tools should be permanently guarded in the same manner as grinding wheels.
- K. Personnel who use electric power tools should be trained in the following safe operating procedures:
 - 1. Electric powered tools should not be used near flammable materials or in explosive atmospheres unless they meet the requirements of the National Electrical Code for the type of area and atmosphere in which the tool is to be used.
 - 2. All portable electrical tools with exposed metal parts should be grounded or double insulated to meet the requirements of the National Electrical Code.
 - 3. When electric-powered tools are used in damp or wet locations such as in tanks or boilers, effective grounding is mandatory.
 - 4. Workers should avoid abusing power cords by excessive scraping, kinking, stretching or exposure to grease and oils. Damage to cables can cause premature failures, possible shock and burns.
 - 5. Heavy duty plugs, clamped securely to the cords, should be used on all power tools. Personnel should not attempt to unplug power cords by jerking the cord from the receptacle.
- L. Tools powered by compressed air should have the hose secured with couplings. Complete instructions for the safe use of compressed air are outlined in Section 1.9 of this chapter. Operators should also observe the following:
 - 1. Air supply hoses should be suspended over aisles and walkways.
 - 2. Air supply control valves should not be locked open.
 - 3. Air-powered tools should be inspected before each use.
 - 4. Grind bit attachments so that the flukes are uniform in size and shape.
 - 5. Employees should never point pneumatic equipment at other personnel.
 - 6. Each air-supplied tool should be equipped with safety locks to prevent accidental operation.
 - 7. Air valves should be inspected on daily basis to make sure they are operating properly.

8. Operators should turn off air at the main control valve before changing or disconnecting any pneumatic tool unless the supply hose has an automatic quick disconnect.
 9. Hoses should be connected to the tool housings by safety chains. Tools that have hoses with quick disconnects are exempt from this requirement.
- M. Explosive-Actuated Tools: Before being permitted to use an explosive-actuated tool, personnel should be instructed in the safety precautions of this equipment. Prior to each use the supervisor should evaluate the job to determine the kind of materials encountered, the size and strength of explosive charges needed and possible dangers associated the operations.
1. Only power-driven tools bearing the manufacturer 's label and number approved by the Industrial Code of Explosive Powered Tools should be used.
 2. Each tool should be equipped with a steel muzzle guard at least 3 1/2" in diameter, mounted perpendicular to the barrel.
 3. If a standard shield or guard cannot be used or the guard does not cover all possible paths of flying particles, a special shield, guard, fixture or jig that provides equal protection may be used instead of the standard steel guard.
 4. To use the tool inside boxes or recessed areas, the guard should be secured to the muzzle so it can be adjusted.
 5. Cartridge-powered tools should be constructed to prevent operation if they are not fitted with a muzzle guard, shield, fixture or jig.
 6. This type equipment should have a built-in safety that will prevent firing unless the muzzle is pressed against a firm surface with a minimum force that is at least five pounds greater than the total weight of the tool.
 7. Power-actuated tools equipped with standard muzzle guards will be built so the equipment will not fire if the guard is tilted more than 8E from solid contact with the working surface.
 8. Fasteners should not be driven into masonry closer than 3" to a corner or edge unless jigs or special guards are used to stop flying particles.
 9. Fasteners should not be fired into steel closer than 1/2" to an edge, corner or joint.
 10. This type equipment should have a safety device to prevent accidental discharge if dropped.
 11. Power-actuated tools should be designed to facilitate breech inspection and detect any debris or obstruction that may cause malfunction.

12. Tools of this type should not be used to fire a projectile into hardened steel, high-tensile steel, cast iron, glazed brick tile, hard brick, terra cotta, marble, granite, slate, glass or any other extra hard or brittle material.
13. These tools should be designed with the capability of altering the amount of power so that the operator can select a specific charge necessary to perform different types of work.
14. Each operator should be provided and required to wear safety goggles, eyeglasses or face shields while operating power-actuated tools.
15. Tools of this type should not be used in explosive or flammable atmospheres.
16. Tools should be inspected on a daily basis for safe operating condition and defective equipment should be taken out of service.
17. Tool and Explosive Charge Storage: Tools and explosive charges should be stored separately. The explosives should be in locked boxes or cabinets and it is essential to observe the following:
 - a. Once an operator has been issued a power-actuated tool they are responsible for its safe use.
 - b. Power-actuated tools and explosive materials should be kept in separate containers while they are being transported.
 - c. Power-actuated tools should not be left unattended at any time.
 - d. The operators should not permit unauthorized personnel to handle or use the equipment.
 - e. Explosive charges should be removed when tools are not in use.
18. The following standard system of power-loaded identification has been developed to enable positive selection of the desired power load:

<u>Colors</u>	<u>Charges</u>
Brown	extra light
Green	light
Yellow	medium
Red	heavy
Purple	extra heavy
Black	magnum

Additional safe operating requirements can be found in the manufacturer's instructions and appropriate commercial industrial codes.

- 1.9. Safety Requirements for Operating and Maintaining Compressed Air Machinery: All components of compressed air systems should be inspected regularly by qualified and trained employees. Maintenance superintendents should check with the state

insurance department to determine if they require inspection of this equipment. Operators need to be aware of the following:

- A. Air receivers: The maximum allowable working pressures of air receivers should never be exceeded except when being tested. Only hydrostatically tested and approved tanks shall be used as air receivers.

Metal receivers should be hydrostatically tested in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section VIII.

1. Air tanks and receivers should be equipped with inspection openings, and tanks over 36" in diameter should have a manhole. Pipe lug openings should be provided on tanks with volumes of less than 5 cu. feet.
2. The intake and exhaust pipes of small tanks, similar to those used in garages, should be made removable for interior inspections.
3. No tank or receiver should be altered or modified by unauthorized personnel.
4. Air receivers should be fitted with a drain cock that is located at the bottom of the receiver.
5. Receivers should be drained frequently to prevent accumulation of liquid inside the unit. Receivers having automatic drain systems are exempt from this requirement.
6. Air tanks should be located so that outside surfaces can be easily inspected. Air tanks should not be buried or placed where they cannot be seen for frequent inspection.
7. Each air receiver shall be equipped with at least one pressure gauge and an ASME safety valve.
8. A safety (spring loaded) release valve shall be installed to prevent the receiver from exceeding the maximum allowable working pressure.
9. Only qualified personnel should be permitted to repair air tanks and all work must be done according to established safety standards.

- B. Air Distribution Lines:

1. Air lines should be made of high quality materials fitted with secure connections.
2. Only standard fittings should be used on air lines.
3. Operators should avoid bending or kinking air hoses.
4. Air hoses should not be placed where they will create tripping hazards.

5. Hoses should be checked to make sure they are properly connected to pipe outlets before use.
6. Air lines should be inspected frequently and any defective equipment repaired or replaced immediately.
7. Compressed air lines should be identified as to maximum working pressures (psi) by tagging or marking pipeline outlets.

C. Pressure regulation Devices:

1. Only qualified personnel should be allowed to repair or adjust pressure regulating equipment.
2. Valves, gauges and other regulating devices should be installed on compressor equipment in such a way that cannot be made inoperative.
3. Air tank safety valves should be set no less than 15 psi or 10% (whichever is greater) above the operating pressure of the compressor but never higher than the maximum allowable working pressure of the air receiver.
4. Air lines between the compressor and receiver should usually not be equipped with stop valves. Where stop valves are necessary and authorized, ASME safety valves should be installed between the stop valves and the compressor.
5. The safety valves should be set to blow at pressures slightly above those necessary to pop the receiver safety valves.
6. Blow-off valves should be located on the equipment and shielded so sudden blow-offs will not cause personal injury or equipment damage.
7. Cast iron seat or disk safety valves should be ASME approved and stamped for intended service application.
8. If the design of a safety or a relief valve is such that liquid can collect on the discharge side of the disk, the valve should be equipped with a drain at the lowest point where liquid can collect.
9. Safety valves exposed to freezing temperatures should be located so water cannot collect in the valves. Frozen valves must be thawed and drained before operating the compressor.

D. Air Compressor Operation:

1. Air compressor equipment should be operated only by authorized and trained personnel.
2. The air intake should be from a clean, outside, fresh air source. Screens or filters can be used to clean the air.

3. Air compressors should never be operated at speeds faster than the manufacturers recommendation.
4. Equipment should not become overheated.
5. Moving parts such as compressor flywheels, pulleys and belts should be effectively guarded.

E. Compressed Air Equipment Maintenance:

1. Only authorized and trained personnel should service and maintain air compressor equipment.
2. Exposed, noncurrent-carrying metal parts of compressor should be effectively grounded.
3. High flash point lubricants should not be used on compressors because of its high operating temperatures.
4. Equipment should not be over lubricated.
5. Gasoline or diesel fuel powered compressors shall not be used indoors.
6. Equipment placed outside but near buildings should have the exhausts directed away from doors, windows and fresh air intakes.
7. Soapy water or lye solutions can be used to clean compressor parts of carbon deposits, but kerosene or other flammable substances should not be used. Frequent cleaning is necessary to keep compressors in good working condition.
8. The air systems should be completely purged after each cleaning.
9. During maintenance work the switches of electrically operated compressors should be locked open and tagged to prevent accidental starting.
10. Portable electric compressors should be disconnected from the power supply before performing maintenance.

1.10. Lifting Devices: Operators of mechanical lifting devices must be qualified and trained in the safe operation of this equipment.

- A. Hazards of overloading, dropping and slipping of the load are caused by improper hitching, slinging, clearance or misuse of the machine. Strict observance to the following standards will reduce this type of accident.
1. The rated load of the vehicle should be plainly marked on each side.
 2. The operator should be informed of the weight of each load.

3. Hooks, ropes, chains, brakes and other mechanical operations should be inspected for defects daily. All defective equipment must be immediately repaired or replaced.
 4. Hand signals to operators should be those prescribed by the applicable ANSI standard for each type of crane.
 5. Hoisting, lowering, swinging or traveling is not permitted while anyone is on the load or hook. Loads must not be carried over the heads of people without adequate and prior warning.
 6. The operator must not leave his position at the controls while the load is suspended.
 7. The lift machine, particularly the boom or its load, should not be permitted to come within 10' of any energized electrical power line. A permanent warning sign should be placed on the lifting device to indicate this requirement.
 8. When making a hook up, the hook must be centered over the load to prevent swinging. Tag lines should be used on free-swinging loads to help guide them.
 9. The hoist must be equipped with a self-setting brake on the shaft or some part of the gear train. For powered hoists, holding brakes must be applied automatically when the power is off.
- B. Rigging Equipment: The following are precautions for avoiding hazards in using rigging equipment:
1. Hooks must have no cracks or other deformation.
 2. The rated capacity of the hooks must be equal to the rating of the chain. Job hooks or makeshift fasteners constructed from bolts, rods, etc., must not be used.
 3. Rope slings, including end connections must be in good condition without broken strands, kinks or twists in the line.
 4. Manila rope must be used in accordance with manufacturer's recommendations. Knots may not be used in lieu of splices.
 5. All hoisting equipment, slings, webbing and rope cable must be inspected visually every day for unusual wear and serviceability. All defective equipment must be immediately taken out of service.
 6. Protruding ends of strands in splices or slings and bridles must be coffered or blunted.
 7. Wire rope must not be tied or secured with knots.

8. An eye splice made in any wire rope may not have less than three full tucks.
9. When used for eye splices, the 'U' bolt must be applied so that the 'U' section is in contact with the dead end of the wire rope.
10. Synthetic webbing (nylon, polyester and polypropylene) must be coded to show the name or trademark of manufacturer, rated capacities for the type of hitch and the type of material. (The rated capacity must not be exceeded.)

CHAPTER 2

MACHINE GUARDING

- 2.0. General: Injuries resulting from contact with moving machine parts may be severe and often result in permanent disability. Two methods of machine guarding are: power transmission machinery guarding which includes all equipment from the prime mover to the point of operations; and point-of-operation guarding where the actual work of the machine takes place.
- 2.1. Optimum Machinery Locations: For maximum safety, machines should be located to provide sufficient space for the operator to handle materials and perform most job operations without interference from his own equipment or from other operators nearby. When possible, machines designed for fixed locations should be securely anchored. Those machines using shock mounting pads should be installed according to manufacturer's recommendations. Top heavy machines should be firmly secured to prevent tipping. Lights should be at the point of operation and in the immediate area. Lights that create a stroboscopic effect should not be used for illumination around moving machinery elements. Antiskid material, mats, etched floor, etc., are encouraged to prevent slips and falls.
- 2.2. Principles of Safe Machine Design: The most effective means of machine guarding is by safe design and construction. For safety and economy, machinery should be purchased with "built in" safeguards that meet OSHA requirements. They should be designed to give maximum operator protection without interfering adjustments or lubrication, machine guards should be designed with hinged or removable sections.
- 2.3. Mechanical Guards: When machinery and powered transmission equipment are not guarded as part of their design suitable mechanical guards such as enclosure or barricades should be installed. Machinery should not be used until made safe.
 - A. Construction Materials: Machine guards constructed locally should be made of screening, expanded, perforated or latticed metal, reinforced as needed with maximum opening of 1/4". Wooden or plastic guards should normally not be used because of their lack of durability. Where fumes or manufacturing conditions cause rapid deterioration of steel guards, other metals or materials should be used. Guards should not have sharp edges, burrs or projections.

- B. **Removal of Permanently Installed Guards:** Guards should not be removed from any machine without proper authorization. The machine should be turned off, power supply disconnected and the switch padlocked. When a machine is equipped with removable guards, it should also be equipped with an interlock control device that will stop the machine if the guard is removed.
- 2.4. **Machine Controls:** Machine controls should be conveniently located for the operator. Stop switches should never be made inaccessible by covering or blocking off. Power controls should be of a type that can be locked in the off position when necessary. Suitable identification signs should be posted at control switches. Machine operators should not leave machinery running unattended.
- 2.5. **Mechanical Power Transmission Equipment:** Guarding power transmission equipment involves providing adequate protection from the prime mover to the point of operation.
- A. **Flywheels:** When any portion of a flywheel is less than 7' above the floor or work platform, it should be completely enclosed in a suitable metal guard. If a flywheel is unusually large, or protrudes through a work floor, it should be guarded by complete metal enclosures or guardrails and toe boards. Flywheel rotations (RPM) should be maintained within the manufacturer's rated limits at all times.
 - B. **Shafting:** Exposed shafting less than 7' above the floor should be completely enclosed in a stationary metal guard. Suitable trough guards should be used to cover exposed parts of shafts to ensure enclosure on all sides.
 - C. **Pulleys:** Pulleys should be rigged at a distance exceeding the width of the belt being used. Where circumstances make this impossible, guides should be provided to prevent the belt from jumping the sheave. When pulleys are exposed to possible contact by personnel or installed less than 7' above the floor, the hazard points must have a cover.
 - D. **Belt, Rope and Chain Drives:** These devices should be guarded when located less than 7' above the floor or at any height over work areas and passageways where material can come into contact with the hazard points.
 - E. **Gears, Sprockets, and Chains:** These items located less than 7' above the floor or work area should be enclosed by guards. When gears, sprockets or chains are more than 7' above a work area they should also be enclosed.
 - F. **Shaft Ends and Shaft Keys:** Shaft ends projecting within 7' of the floor should be rounded smooth. Shaft ends should not be allowed to protrude a distance greater than 1/2 of the diameter of the shaft beyond the end of the bearing unless protected by non-rotating casings. Exposed keyways, less than 8' above the floor, should be covered or filled.
 - G. **Collars and Couplings:** Revolving collars should be cylindrical, with no projections beyond the periphery of the collar. Any projection on the couplings should be covered with safety sleeves when it extends beyond the coupling flange.

- H. Clutches: Clutches and moving clutch parts closer than 7' to a working surface, should be enclosed in an approved stationary guard.

2.6. Point of Operation Guarding: This method of guarding involves safeguarding the point(s) where cutting, shaping, drilling or forming is performed on the machine. Built-in safety devices are the most effective point-of-operation guards. Machinery not equipped with proper safeguards to provide the type of operator protection defined in this manual should not be purchased. When machine design does not give this type of operator protection, locally produced safeguards should be provided. Each locally designed point-of-operation safety device should be simple in design and reliable in operation. It should be installed as a permanent part of the machine. The device should be so designed and constructed that the operator will not be able to place any part of the body into the hazard points of the machine. The guard should be attached so that essential inspections and adjustments can be performed without hazard to the operator.

- A. Mechanical Guards: Protective metal barriers or enclosures should be used at the points-of-operation. Adequate guards should be placed on all sides of the hazard points where the operator can come into contact with moving parts.
- B. Feeding Devices: Machine operators should use mechanical feeding devices when possible, to avoid contact with moving parts. Stock feeding should be done by conveyor, revolving disk, gravity or separate piece of stock from a safe loading point. Blanking dies should be equipped with spring clips strong enough to hold materials on the dies. Jigs and fixtures should be adequately secured to prevent slipping, turning or tipping.
- C. Interrupting Devices: For operations where any part of the operator's body has to be placed in a dangerous position to the machine, interrupting devices should be provided to automatically stop the machine when safety guards are bypassed or the operator moves from the normal operating position.
- D. Remote Controls: Ram-type machinery, such as power presses and drop hammers, should be provided with two-hand controls. Remote controls that require the operator to run the equipment at a distance from the point-of-operation may also be used. The machine should be mechanically fed or loaded by hand, then put into operation by a remote control that is at a safe distance from the actual machining.

CHAPTER 3

PROTECTIVE EQUIPMENT AND CLOTHING

- 3.0. General: Faculty and supervisors are responsible for ensuring that approved personal protective clothing and equipment are worn by students and employees under their supervision. This equipment must be adequate to protect against potential hazards normally encountered in the work areas. For specific requirements contact EH&S.

Where employees provide their own protective equipment, the supervisor shall be responsible for ensuring that it is an approved type and that employees perform the proper maintenance and sanitation requirements for their equipment.

- 3.1. Eye and Face Protection: Suitable protectors must be provided where machines or operations present the hazard of flying objects, glare, liquids, injurious radiation or a combination of these hazards.
- 3.2. Head Protection: A hard hat must be worn by all employees when there is potential for impact and penetration from falling objects.
- 3.3. Foot protection: Appropriate footwear must be worn by all employees. The particular task being performed dictates the type of protection necessary.
 - A. When working with chemicals that are caustic or that can be absorbed through the skin, employees should use footwear that protects the feet and ankles and is resistant to the chemicals being worked with.
 - B. Safety-toe shoes should be worn to prevent or reduce the severity of injury to the toes of those exposed to such hazards of material handling, operating lawn mowers, construction and building maintenance.
 - C. Rubber boots should be worn in wet areas.
- 3.4. Respiratory Protection: EH&S has instituted a separate Respiratory Protection Program. This program impacts personnel who are **required to wear respiratory protection as part of their routine employment**. Where feasible, engineering controls will be utilized to prevent exposures and preclude the need for respiratory protection.

Contents of the program include the following:

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|---|---------------------------------------|---|---------------------|
| § | written standard operating procedures | § | program evaluation |
| § | respirator selection criteria | § | emergency use |
| § | training | § | fit testing |
| § | inspection, cleaning and maintenance | § | medical evaluations |
| § | work area surveillance. | | |

The program has been distributed to and is directly enforced by departmental supervisors and throughout UNF where respiratory protection is utilized.

The use of respiratory protection places unusual stresses on the wearer. These are inherent in the devices and can restrict the abilities of the wearer by taxing the cardiovascular and pulmonary systems. Therefore, respiratory protection shall be issued only to those employees that have undergone physical examination according to the guidelines provided and as determined by the examining physician. The examination includes physiological and psychological parameters. Furthermore, these evaluations shall be made on a periodic basis as recommended by a competent, licensed physician with knowledge of pulmonary disease and respiratory protection. Once the examination is concluded, a medical surveillance record shall be completed. Copies of the form are available from EH&S. Once completed, the record shall be retained by the employee department and Human Resources or EH&S.

The purpose of the exam will be to screen employees for pre-existing conditions not conducive to respirator use, confirm that the individual can handle the additional stresses caused by the devices and to periodically re-evaluate for changes in health and abilities.

Frequency of the medical examinations shall be baseline within 30 days of employment, periodically as recommended by the physician, upon suspicion of overexposure to hazardous material and upon termination of employment.

The employer is required to maintain medical records and air monitoring data for the duration of employment and 30 years following. The examining physician shall provide a copy of the individual's medical record to the employee who is responsible for bringing a copy to their supervisor. The supervisor should keep a copy and, in turn, forward a copy to EH&S.

For more detailed information pertaining to medical monitoring and respiratory protection, see the University of North Florida's Respiratory Protection Program.

- 3.5. Hand Protection should be provided: Employees should be provided approved gloves for protection from cuts, abrasions, burns and other potential job hazards. Neoprene type gloves are approved for handling chemicals and heavy-duty leather gloves are approved for handling abrasive materials.
- 3.6. Hearing Protection: The Occupational Safety and Health Administration (OSHA) has promulgated regulations limiting employee exposure to noise. These regulations have been adopted by the State of Florida, Division of Safety. The principal requirements of these regulations are as follows:
 - A. Noise surveys must be conducted where employees may be exposed to an eight-hour time-weighted average (TWA) of 85 dBA or greater (dBA is a sound level reading in decibels made on the A-Weighted network of a sound level meter).
 - B. A hearing conservation program must be instituted for all employees exposed to TWA of 85 dBA or greater. This consists in part of:
 1. Baseline and annual audiograms performed by an otolaryngologist, audiologist, qualified physician or certified technician.
 2. An annual training program that explains the purpose and major components of the hearing conservation program. This includes discussing with employees the hazardous effects of noise, the various types of hearing protection and how to wear them, as well as the purpose of the audiogram. The training is completed at the time of the audiogram.

- 3 .All employees exposed to a TWA of 85 dBA, must be provided a choice of hearing protection (either earplug or earmuff) without charge. It is the responsibility of the various departmental supervisors to identify potential areas of high noise. EH&S will then conduct noise surveys to determine which work areas require participation in a conservation program.

Once a particular job is identified as being noise-related, the department shall inform Human Resources that a baseline audiogram and participation in a training program is required for all future appointments to this position.

The examining physician will provide audiograms and training. EH&S shall notify each department when the exam is due. The department shall be responsible for scheduling individual exams. Results of the tests shall be reported to the employee, department, EH&S and Human Resources.

It shall be the responsibility of the department to provide a choice of hearing protection devices to those employees requiring them and to insure that they are being worn.

Please note that the cost of testing is borne by EH&S and the cost of training is borne by the department. Hearing protection device costs shall be the responsibility of the department employing the worker.

CHAPTER 4

STORAGE AND USE OF COMPRESSED GAS CYLINDERS

- 4.0. General: Compressed gas cylinders are found in many of the laboratories and shops throughout the University. Their storage and use pose a serious potential hazard for all employees and students who may be in the vicinity of or who may handle gas cylinders.
 - A. Supervisor's Responsibility: It is the responsibility of supervisory personnel where gas cylinders are used to see that the following safety rules are observed. They are also responsible to see that all employees and students under their supervision who use gas cylinders have been trained in the safe methods for storage, handling and use of compressed gas cylinders.
 - B. Federal and State Codes and Regulations: Sections 4.4, 4.5 and 4.6 of this chapter deal with rules based on current OSHA and Division of Safety regulations and NFPA codes. They are practical and essential if compressed gases are to be used safely.
- 4.1. Handling and Use of Compressed Gas Cylinders:

- A. All compressed gas cylinders (regardless of size) shall be secured to racks, walls, work benches or hand trucks by a strong chain or strap, or secured by any other approved method capable of preventing the cylinder from falling or being knocked over.
- B. All questionable gas cylinders or equipment shall be reported immediately to the supplier for correction or replacement.
- C. All cylinders shall be clearly labeled to identify the contents.
- D. Only personnel trained in the proper transportation and safe use of gas cylinders should handle cylinders.
- E. Compressed gases shall be used only in areas with adequate ventilation for the gas being used.
- F. Cylinders shall not be intentionally dropped, struck or permitted to violently strike each other and shall be reasonably protected from violent impact of any kind.
- G. All cylinders shall be kept far enough away or shielded while in the work area in order to prevent contact with sparks, flame or radiant heat.
- H. Valve protection caps are required on all cylinders that are threaded to accommodate a cap unless the cylinder valve is actually connected to a regulator or manifold.
- I. All gas cylinders shall be equipped with a functioning gas regulator while in use.
- J. No one shall attempt to connect a regulator or accessory equipment by the use of improvised hookups or adapters.
- K. When personnel have finished using a compressed gas cylinder for the day, the cylinder valve shall be closed and the pressure in the regulator and associated equipment released.
- L. If a compressed gas is used to maintain a static pressure on a closed system, a clearly visible warning sign shall be posted indicating the approximate pressure the system is under and the gas involved.
- M. All empty cylinders shall have their valves closed.
- N. All empty cylinders shall be handled with the same care as full cylinder.
- O. Compressed gas or compressed air shall not be used for cleaning purposes (to blow dust and debris away) without appropriate reduction valves (30 psi. maximum).
- P. Under no conditions shall high-pressure gas be directed at another person.
- Q. While in use, all cylinders of flammable gases shall be protected by an approved flashback protection device.

- R. Cylinders of flammable gas shall not be opened more than 1-1/2 turns of the cylinder valve to allow for quick closing. If a special wrench is required, the wrench shall be left in position on the stem of the valve while the cylinder is in use. This allows the gas flow to be shut off quickly in case of an emergency.
- S. All oxygen, hydrogen and nitrous oxide cylinders and manifolds shall be at least 20' away from or separated by a one-hour rated fire resistant partition from all flammable gases and materials (such as oil, grease, and all petroleum products in general) in the area of use.
- T. All manifold enclosures for oxygen, hydrogen and nitrous oxide in excess of 2000 cu. feet of manifold capacity shall be vented to the outside and the cylinder or manifold shall be protected with check valves or alarms.
- U. Due to the possibility of an explosion, all regulators and other equipment used for oxygen shall be identified as being "OXYGEN ONLY" and the equipment used for other gases shall not be used for oxygen.
- V. Due to the possibility of an explosion, all oxygen regulators, tubing, etc., shall be kept clean and free of all organic materials such as oil and lint.
- W. In the event a particularly hazardous gas (e.g., phosgene, hydrogen chloride, hydrogen cyanide) is used, a procedure shall be established for evacuating, sealing and isolating the area of use. EH&S shall be notified prior to procuring such hazardous gases.
- X. Only personnel properly instructed in the chemical hazards of a corrosive or toxic gas are to release or use the gas or operate any equipment using the particular gas.
- Y. All supervisory personnel are to have available the necessary emergency treatment and first aid supplies and be able to administer the necessary first aid that may be required as a result of any hazardous gas being used.

4.2. Transportation of Compressed Gas Cylinders:

- A. Only personnel of sufficient physical strength should move gas cylinders so as to minimize injury any potential hazard resulting from the size and weight of the cylinders.
- B. When cylinders are moved, they shall be disconnected from any regulators or manifolds and where threaded to accept protective valve caps, the valve caps shall be secured in place before the cylinders are released from their securing device.
- C. Cylinders shall be moved only on a hand truck or other cart designed for handling gas cylinders.
- D. No more than one cylinder shall be handled at a time except on carts designed to transport more than one cylinder.

4.3. Storage of Compressed Gas Cylinders:

- A. Compressed gas cylinder storage areas must be in a fire resistant enclosure located away from emergency exits and must be kept well-drained, well-ventilated, cool and protected from the weather. Regardless of size, all cylinders shall be provided with supports (straps, chains or other similar devices) capable of preventing the cylinders from falling.
- B. Under no condition shall the temperature of gas cylinders exceed 50 degrees C (125 degrees F). When Type E gas cylinders are used, they shall not exceed 34 degrees C (93 degrees F) since the relief valves of Type E cylinders are set to release above 35 degrees C.
- C. Excessive storage time shall be prevented by the use of the smallest practical size cylinder for a particular gas application.
- D. Corrosive gases shall not be stored for more than six (6) months. Usually after this period of time, there is a deterioration of the gas purity which increases the possibility of cylinder valve malfunction.
- E. Oxygen, hydrogen or nitrous oxide shall not be stored in the same area with flammable gases unless separated by at least 20' or by a one-hour rated fire resistant partition. Cylinders stored in an area outside a building must be a minimum distance of 20' from flammable gases or combustible material.
- F. All storage rooms that contain in excess of 2000 cu. feet of oxygen, hydrogen or nitrous oxide shall be vented to the outside.