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Safety

SAFE PRACTICE GUIDELINES FOR OPERATING AND  
MAINTAINING MACHINERY AND EQUIPMENT

Elimination of accidents is vital to the department's interest. Accidents produce economic and social loss, impair individual and group productivity, cause inefficiency and retard the advancement of standards of living. This pamphlet provides guidance to department employees so as to ensure safe practices in operating and maintaining agency machinery and equipment. The primary safety program is established in CFOP 215-1. The guidelines contained in this pamphlet are consistent with the U.S. Department of Labor's Occupational Safety and Health Standards, the State of Florida Department of Labor Industrial Safety Regulations, the State of Florida Fire Marshal's Rules and Regulations and the National Safety Council's Accident Prevention Manual for Industrial Operations.

BY DIRECTION OF THE SECRETARY:

*(Signed original copy on file)*

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for Administration

SUMMARY OF REVISED, DELETED, OR ADDED MATERIAL

This pamphlet has been updated to reflect the department's current organizational structure and current industry practices

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## INTRODUCTION

Safety program organization may be defined as a method employed by management to share and to assign responsibility for accident prevention and to ensure performance under that responsibility. A safety program is not something that is imposed on the district or institutional organization. Safety must be built into every process, design and operation. It must be an integral part of the district operations.

The prevention of accidents and injuries is basically achieved through control of the working environment and control of people's actions. Only management can implement such control. An institution that has an effective safety program will have a working environment in which operations can be conducted economically, efficiently and safely.

Accident prevention and efficient operations go hand-in-hand. All levels of management have a primary responsibility for the safety and well-being of all employees. This responsibility can be met only by working continually to promote safe work practices among all employees and to maintain property and equipment in safe operating condition.

The supervisor is the key person in the safety program because the supervisor is in constant contact with employees. No foreman, supervisor or operating head may ever be relieved of any part of his/her responsibility for safety. Safety is an operating function and cannot be transferred to a staff organization.

Safe practices on the part of employees must be part of all operations. No job shall be considered efficiently completed unless the worker has followed every precaution and safety rule to protect him/herself and fellow workers.

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## SAFE PRACTICE GUIDELINES FOR OPERATING AND MAINTAINING MACHINERY AND EQUIPMENT

1. Machine Guarding. Injuries resulting from contact with moving machine parts, may be severe and often result in permanent disability. Two principles of machine guarding are: power transmission machinery guarding which includes all equipment from the prime mover to, but excludes, the point of operations; and point-of-operation guarding, the area where the actual work of the machine takes place.

a. Optimum Machinery Locations. For maximum safety, machines will 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 will be securely anchored. Those machines using shock mounting pads will be installed according to manufacturer's recommendations. Top heavy machines will be firmly secured to prevent tipping. Lights will be at the point of operation and in the immediate area. Lights that create a stroboscopic effect will not be used for illumination around moving machinery elements. Maximum use of anti-skid materials such as rough texture material, mats, etched floor, and so forth, is encouraged.

b. Principles of Safe Machine Design. The most effective means of machine guarding is by safe design and construction. For safety and economy, machinery will be procured with "built in" safeguards. They will be designed to give maximum operator protection without interfering with the normal equipment operation. To permit changing drive belts, making adjustments, or lubrication, machine guards will be designed with hinged or removable sections.

c. Mechanical Guards. When machinery and powered transmission equipment are not guarded as part of their design, suitable mechanical guards such as enclosure or barricades will be temporarily or permanently installed. Such equipment will not be used until made safe.

d. Construction Materials. Machine guards constructed locally will be made of screening, expanded, perforated, or latticed metal reinforced as needed. Wooden or plastic guards will 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 will be used. Guards will not have sharp edges, burrs, or projections.

e. Removal of Permanently Installed Guards. Guards will not be removed from any machine. If guards must be removed temporarily with proper authorization, the machine will be turned off, power ends disconnected and the switch padlocked. When a machine is equipped with removable guards, it will also be equipped with an interlock control device that will stop the machine if the guard is removed.

f. Machine Controls. Machine controls will be conveniently located for the operator. Stop switches will never be made inaccessible by covering or blocking off. Power controls will be of a type that can be locked in the "off" position when necessary. Suitable identification signs will be posted at control switches. Machine operators will not leave machinery running unattended.

g. Mechanical Power Transmission Equipment. Guarding power transmission equipment involves providing adequate protection from the prime mover to the point of operation.

(1) Flywheels. When any portion of a flywheel is less than seven feet above the floor or work platform, it will be completely enclosed in a suitable metal guard. If a flywheel is unusually large, or protrudes through a work floor, it will be guarded by complete metal enclosures or guard rails and toeboards. Flywheel rotations, (RPM) will be maintained within recommended limits at all times.

(2) Shafting. Exposed shafting less than seven feet above floor levels will be completely enclosed in a stationary metal guard. Suitable trough guards will be used to cover exposed parts of shafts that are not open on all sides or are located in isolated areas .

(3) Pulleys. Pulleys will be rigged at distances exceeding the width of the belt being used. Where circumstances make this impossible, guides will be provided to prevent the belt from jumping the sheave. When pulleys are exposed to possible contact by personnel, or are less than seven feet above the floor, cover them with adequate guards.

(4) Belt, Rope and Chain Drives. These drivers will be guarded when located less than seven feet above the floor or at any height over work areas and passageways.

(5) Gears, Sprockets and Chains. These items when located less than seven feet above the floor or work area will be enclosed by guards. When gears, sprockets or chains are more than seven feet above a work area and are an obvious hazard to personnel, they will also be enclosed.

(6) Shaft Ends and Shaft Keys. Shaft ends projecting within seven feet of the floor will be rounded smooth. Shaft ends will not be allowed to protrude into an area 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 eight feet above the floor, will be covered or filled as appropriate.

(7) Collars and Couplings. Revolving collars will be cylindrical, with no projections beyond the periphery of the collar. Any projection on couplings will be covered with safety sleeves when it extends beyond the coupling flange.

(8) Clutches. Clutches and moving clutch parts, closer than seven feet to a working surface, will be enclosed in an approved stationary guard.

h. Point-of-Operation Guarding. This guarding involves safeguarding the particular machine at the point where cutting, shaping or forming work is done. 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 pamphlet will not be purchased. When machine design does not give this type of operator protection, locally-produced safeguards will be provided. Each locally-designed point-of-operation safety device will be simple and functional in design and reliable in operation. Preferably, it will be installed as a permanent part of the machine. The device will be so designed and constructed that the operator will be unable to place any part of his body in a hazardous area of the machine or to operate the machine if his fingers or hands are in a dangerous zone. Also, the safeguard will be attached to the machine in such a way that essential parts can easily be inspected and adjusted without hazard to the operator.

(1) Mechanical Guards. Protective metal barriers or enclosures will be used at points-of-operation. Adequate guards will be placed at the sides, rear, top and bottom or work points where the operator may be endangered by moving parts or the stock being finished.

(2) Feeding Devices. Machine operators will use mechanical feeding devices, when possible, to avoid contact with moving parts. Ideally, stockfeeding will be done by conveyor, revolving disk, gravity, or air pressure from a safe loading point. Blanking dies will be equipped with spring clips strong enough to hold materials on the dies. Jigs and fixtures will be adequately secured to prevent slipping, turning or tipping.

(3) 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 will be provided to automatically stop the machine when safety guards are moved by the operator's actions.

(4) Remote Controls. Ram-type machinery, such as power presses and drop hammers, will 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. Preferably, the machine will be mechanically feed, or loaded by hand and then put into operation by remote control at a safe distance from the actual machining.

2. Machine Shop Safety. Operations in the machine shop provide many hazards because of the nature of metal working machinery. Lathes, drill presses, milling machines, grinders, hydraulic presses and power-operated metal saws are all potentially dangerous. All machinery and power equipment used in the shop will be fully equipped with guards according to the standards of machine guarding described in this chapter. Electrical equipment will be effectively grounded to prevent shock or cause sparks that could start a fire. Machine shop equipment will be maintained in good operating condition at all times. Machine operators will wear protective goggles or face shields while performing metal-cutting operations.

a. Only fully trained authorized operators will be permitted to operate metal working machinery.

b. Machine guards will not be removed or blocked while the equipment is in operation or when power is connected and not in operation.

c. Metal working machinery will not be cleaned, lubricated or repaired while in motion. Before any maintenance work is attempted, the machine will be completely shut down and the control switch locked to prevent accidental starting before repairs are completed.

d. Oily rags, waste and other materials saturated with flammable substances will be disposed of in metal containers equipped with self-closing lids. These cans will be clearly marked for the disposal of oily wastes only.

e. Personnel will not wear loose clothing, long sleeves or neckties while working in the shop. Gloves, rings and other jewelry can be hazardous and will not be worn while working on moving machinery.

f. When heavy stock cannot be safely handled by the operator a suitable mechanical aid will be employed.

g. Operators will use brushes to remove chips, burrs and metal particles from machines and never use their hands for this purpose. Compressed air to remove debris from equipment may be used according to safe practices in this manual.

h. The accidental movement of stock can cause serious injuries. All movable work will be secured by jigs, clamps or vices.

i. Personnel will remove chuck keys, wrenches and drifts from the machine and place in tool trays or a safe location before starting operations. Adjustments will not be attempted, using these devices, while machinery is in motion or when power source is turned on.

j. Where the possibility of flying particles exists, machinists will wear goggles or face shields.

k. Operators will not leave operating metal working machinery running unattended.

l. Drill presses are used for countersinking, drilling, reaming, boring, routing and similar operations. Most drill press injuries are caused by coming in contact with the drill or its chuck during operations. Other accidents are caused by drills breaking or flying out of the chuck.

(1) Stock will be properly secured to the press table to prevent accidental movement during drilling.

(2) When holes are to be bored beyond the flutes of the drill, the drill will be removed frequently and the hole cleaned out to prevent jamming or "freezing."

(3) The drill will be stopped before attempting to clear work that has become jammed.

(4) Parts of the drill press which present an electrical hazard will be effectively grounded.

m. Metal lathes are machines that turn the stock, shaping it by stationary cutting tool. Several types of lathes are used in machine shops, but the same hazards are common to all.

(1) All lathes will be equipped with safety type dogs instead of projecting set screws.

(2) The cutting tool on all lathes will be kept sharp and the lathe centers true.

(3) Operators will allow lathes to stop of their own accord. Hand pressure will never be used to stop spinning chucks after power has been turned off.

(4) Stock will not be filed right-handed nor while the lathe is turning too slowly to keep the work steady. Fine finishing can be done safely by using a long strip of abrasive cloth. A strip 2 or 3 inches wide will be held full-length at both ends, while rotation of the lathe does the finishing.

(5) Tools will not be set while the lathe is in operation after its power is turned on. Tools and chucks will be checked for defects before each operation. A chip breaker, to keep long curled chips from forming, may be ground into the tips of cutting tools as an added safety feature.

(6) Stock will not be measured or calibrated while the lathe is in motion.

(7) Toolways will be kept clean and clear of other tools.

(8) Operators will wash their hands and arms frequently. This will help prevent dermatitis caused by irritating cutting oils entering the skin pores.

(9) Each exposed power transmission part will be effectively guarded for complete operator protection.

(10) Goggles or other suitable eye protection will be worn while working on equipment used for milling surfaces.

(11) Lathe parts that present an electrical hazard will be effectively grounded.

n. Milling Machines. This equipment is used for milling surfaces of different shapes, although they are often used for general cutting operations and special jobs. Milling machine tools may have several cutting edges, creating hazards to operators.

(1) Milling cutters will be kept sharp at all times.

(2) Shims, blocks and clamps will be used to hold stock in place on the machine and to prevent stresses that may cause the metal to spring or snap apart.

(3) Before setting up a job, operators will make certain that the machine is clean and the work is free of chips, nicks or burrs. Each job will be set up as close as possible to the machine column.

(4) Cutters will be carefully selected to make sure they are of the proper diameter for the job. The use of cutters too large for the work will be avoided.

(5) The speed of the machine and rate of feed will not be changed while work is being cut.

(6) The table will be lowered before backing work under a revolving cutter. Hand tools will not be left on the table at any time. Operators will not reach around cutters to remove metal chips or debris. Hand brushes or counter brushes will be used to clean machines.

(7) Operators will be careful not to feed tables too far in any direction. Particular care will be taken to prevent the table knee from being fed too far up or down.

(8) Milling machine operators will make certain that clamps or bolts attached to stock are low enough to clear the arbor and cutter.

(9) Adjustments will not be made on milling machines while they are in operation.

(10) Goggles or other suitable eye protection will be worn while operating milling machines.

(11) Attached light fixtures will be effectively grounded to reduce electrical hazard to operators.

o. Metal Shapers. Shapers are specialized metal working machines. They employ a reciprocating single-edge cutting tool used for machining small surfaces, cutting gear teeth, keyway slotting, spinning and similar operations.

(1) The ram will have adequate clearance before starting the machine.

(2) All work to be shaped will be securely clamped to a rotary table or held in a swivel vise. Protective guards or shields will be placed around periphery of work (cutting) area.

(3) The handle or stroke change screw will be removed before the shaper is started. A soft metal mallet, not a machinist's hammer, will be used to set work in the shaper. Vise swivel bolts will be tightened and adjusting cranks removed before starting the machine.

(4) Operators will wear goggles at all times while operating shapers.

(5) Machinists will not attempt to change cutting tools while the shaper is in motion. To avoid damaging work, operators will set cutting tools so they will rise away from the job if the cutter will start to drift.

(6) Safety stops will be securely bolted to the shaper table.

p. Abrasive Grinding Wheels. Grinders remove metal from machinings through abrasive action. Many hazards are present in grinding operations and strict attention to accepted safety standards is essential. Local exhaust ventilation is recommended for grinders to control excessive dust accumulation.

(1) Mechanics will always wear goggles or face shields when using grinders, even though the machine may be equipped with a transparent guard.

(2) Grinding wheels will be thoroughly inspected for any defect before each operation. Aluminum, brass, copper or other soft metals will not be ground on abrasive grinding wheels, unless the wheel is specifically designed for that purpose. The grinding wheel RPM rating will be checked against the machine RPM rating before it is installed. Only non-silica abrasive wheels will be used.

(3) Abrasive wheels will never be forced onto spindles. New wheels will be properly fitted and rotated by hand to make sure they clear work rests and hoods before the wheels are operated under power.

(4) Flanges and compression washers will 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, will be operated without protective hoods. Excessive tension will not be applied to fastening components. Wheels with damaged or missing compression washers will not be used.

(5) Operators will stand to one side when grinding wheels are first started. Serious injuries can be caused by wheels bursting because of unknown defects.

(6) Excessive chatter in grinding wheels is dangerous and when it occurs the wheel will be stopped immediately and inspected to determine the cause.

(7) Stock thin enough to be pulled between the tool rest and the wheel will not be ground. The tool rest will be as close as possible to the wheel to prevent work from slipping through and catching the operator's hand. At no time will the tool rest be more than one-eighth inch away from the wheel. The distance between the wheel periphery and the adjustable tongue or the end of the peripheral member at the top, will never exceed 1/4 inch.

(8) Work will not be ground on the sides of abrasive wheels. Not only is this practice dangerous, but it will weaken and damage the wheel. Use face of wheel only and use entire face of the wheel to avoid grooving it.

(9) Grinding wheels, will always be operated within specified speeds of the wheels at all times.

(10) Grinding wheels will be dressed with approved tools. Before starting wheel dressing operations, tool rests will be moved as far back as possible and firmly secured. The bottom lug under the dresser head will be held tight against the edge, not the top, of the tool rest during wheel dressing.

(11) Buffing and Wire Brushing Wheels. Personnel will wear goggles or face shields while buffing wheels. Operators will not wear fabric gloves while polishing or buffing because a glove may catch and drag the operator's hand against the wheel. Personnel protective equipment is especially important in the operation of wire-brush wheels because the wires tend to break off. Operators will wear aprons of leather, canvas or other heavy materials, close fitting gauntlet leather gloves and a face shield. When work being buffed or polished is rough, hot or has sharp edges, protective hand leathers will also be worn.

q. Hydraulic Presses. Hydraulic presses are used in operations where high compression strength or stamping pressures are needed. Hydraulic presses are used for pressing pinion gears, stamping collars, pressing pulleys on and off drive shafts and so forth.

(1) All pipes, hoses and hose connections will be properly installed and strong enough to withstand the maximum oil pressures applied during pressing operations. When the replacement of original equipment is necessary, only heavy duty pipes, hoses and fittings with a safety factor of 8 to 1 will be used.

(2) All work will be placed in presses carefully to make certain it is straight and even. If necessary, machined shims will be used to square and true the stock so work resting on them will be flat and even. Use saw horses or stands to support long stock.

(3) Auxiliary safety stops will be installed to keep the ram from traveling closer than 1/2 to the die.

(4) Hydraulic pressure will be bled off and switches locked out before maintenance is performed on hydraulic presses. Two-hand deadman controls will be placed on presses when necessary for the protection of operator.

r. Metal Saws. Power-driven metal saws are usually of three types; circular, hack and band. All are used to cut cold metal stock of different thicknesses. The following precautions will be observed when using any type of metal saw.

(1) Metal-cutting saws will be equipped with a substantial guard that covers the blade to the roots of the teeth. This guard will be adjustable to the thickness of the stock to be cut. Circular saws will be periodically inspected, with nondestructive inspection methods being used, to ensure the safety of saw blades and the protection of operation.

(2) Power-operated hack saws will be equipped with an adjustable clamp and support for securely holding stock in the machine. A cutoff switch or clutch, which automatically stops the saw after the cut has been made, shall be installed on this type of hack saw.

(3) Both the upper and lower wheels of metal band saws will be completely enclosed in suitable guards. The portion of the blade between the upper guide wheel and the saw table will be protected by a sliding guide that leaves only the cutting point of the blade exposed.

(4) Power driven metal saws will 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.

(5) Safety goggles or face shields will be worn by operators of metal cutting circular and band saws.

(6) All saws will be grounded to prevent an electrical hazard to operators.

s. Compressed Air in Machine Shops. The general safety standards covering the use of compressed air and its mechanical equipment are covered on page 22. The precautions outlined below pertain primarily to the use of compressed air in machine shops.

(1) All pipes, hoses and fittings will be designed to safely carry the maximum pressure of air supplied by the compressor or supply tank. Compressed air pipelines will be identified as to maximum working pressure (psi).

(2) Air supply shutoff valves will be located as near as possible, to the point-of-operation and will be positioned so they cannot be opened accidentally.

(3) Air hoses will be kept free of grease and oil to reduce the possibility of excessive deterioration. Hoses will not be strung across floors or aisles where they are liable to cause personnel to trip and fall. When possible, air supply hoses will be suspended overhead, or otherwise located to afford efficient access and protection against damage. Hose ends will be secured to prevent whipping, if breakage or fracture occurs.

(4) Pneumatic impact tools, such as riveting guns, will never be pointed toward any person.

(5) Before a pneumatic tool is disconnected or left unattended, the air supply will be turned off at the control valve and the tool bled of air, unless automatic quick disconnects are provided.

(6) Compressed air will not be used under any circumstances to clean dirt and dust from clothing or the body. Shop air used for cleaning will be regulated to 15 psi unless equipped with diffuser nozzles to provide lesser pressures. Goggles or face shields will be worn at all times by personnel using compressed air for cleaning.

(7) Static electricity can be generated through the use of pneumatic tools. Tools of this type will be effectively grounded or bonded if the tools are used where fuel, flammable vapors or explosive atmospheres are present.

3. Woodworking Shop Safety. Power operated wood working tools and machinery can be very effective in accomplishing most wood related jobs. On the other hand, these same tools and machines can be quite dangerous if not handled and operated properly. A listing of the more important types of woodworking tools and machinery and recommended safety tips follows:

a. Circular Saws. Circular saws can be used effectively for many different types of wood cutting jobs. When they are used improperly, or without guards, these saws are extremely dangerous.

(1) Cracked or defective blades will not be used at any time. Circular saws will be sharpened and rounded and straight saws will be sharpened and straightened only by trained mechanics.

(a) Blades will be inspected before each use by the operator to make certain no defects have appeared.

(b) Most cracks begin in teeth gullets. If cracked blades are used, the crack will grow larger and may eventually break apart. The following precautions will be taken to prevent blades from cracking:

1. The blade will be tensioned for the speed at which it is to operate. If it is too loose, blade will vibrate, heat, expand and crack.

2. The teeth will have enough clearance to prevent burning. If the blade becomes hot, it will expand and crack.

3. The saw will be in perfect round, the rim will be concentric with the eye.

4. The saw will be in perfect balance or it will wobble and crack.

5. Saw blades will be kept sharp. If the blade is not cutting properly, it will pound its way through the wood and eventually crack.

(2) Adequate supervision is necessary to assure that guards are used, thus minimizing accident potential.



(a) Circular saws will be provided with a spreader to prevent stock from kicking back. The blades will be guarded by hoods that automatically adjust to the thickness of the stock being cut. The portion of the blade below the cutting table will be completely enclosed or guarded by a rigid exhaust hood.

(b) Rip saws will be equipped with anti-kickback dogs. The points of the dogs will 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 causes:

1. Failure to use a spreader.
2. Improperly conditioned blade, allowing stock to pinch and rise off the table.

3. Improperly aligned gauge or fence.

4. Improperly seasoned or twisted-grain lumber.

5. Improperly designed or mounted kickback dogs.

(c) Properly designed anti-kickback dogs will be used on all circular saw operations. On a saw where the arbor is above the table, the rotation of the blade is reversed. On this type saw, it will be necessary to locate the anti-kickback fingers ahead of the blade to prevent the stock from rising.

(d) On rabbeting and dadoing jobs, it is impossible to use a spreader. Often it will be necessary to remove the blade hood. These operations will be guarded by a jig that slides in the grooves of the transverse guide. The work will be locked in the jig and the operator's hands will be kept clear of the blade. The standard blade hood guard will be replaced immediately after rabbeting or dadoing work is completed.

(e) The side of the spreader facing the blade will be shaped to follow the approximate curve of the saw. It will not be less than 3 1/2 inches wide at the table level. In unusual cases where this width cannot be obtained, the spreader will be at least two inches wide where it rests on the cutting table.

(f) All machine guards will be constructed and installed so they continue to function properly when the cutting table or blade is tilted.

(g) Pusher sticks will be used to prevent injury when sawing short or narrow pieces of work. Guards will be securely in place when pusher sticks are used.

b. Proper Machine Locations. Circular saws will 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 will be at least three feet more than the longest piece of stock normally used. Long stock will be placed on either table addition or support stands to ensure safety of operations.

- (1) Rip saws will 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 will be placed between the rip saw and other machinery or between the saw and the personnel.

- (2) Circular saws will be fastened securely to floors or individual mounting.

c. Electrical Switches. Each saw will be equipped with a master switch that can be locked and tagged during repair or maintenance operations.

- (1) Power switches will be located on saws so the operator can reach them without moving from his normal working position.

- (2) Power saws will be equipped with a safety device to prevent the machine from operating when current is restored after a power failure.

d. Saw Blade Collars. Only outer edges of collars will be allowed to bear on saw blades. Before use, the saw will be tested for trueness of blade run.

e. Table Saw Feedrolls. Feedrolls will 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 inch will be left between the plane of the feedrolls and the blocking device.

f. Table Saw Power Brakes. Each circular saw will be equipped with a power brake so the blade can be quickly and safely stopped after the motor is turned off.

g. Floors around woodworking machines will be kept in good repair and covered with non-slip materials if necessary.

h. Personnel Training. Only personnel who have been thoroughly trained will be authorized to operate power saws and other woodworking machinery. Shop supervisors are responsible for constant observation of shop practices to make certain all safety regulations are being followed. When unsafe acts are noted, it will also be the responsibility of the supervisor to see that workers are properly retrained.

i. Personal Protective Equipment. Goggles or a face shield will be worn while saws are operated. Personnel will not wear loose clothing or other articles that may become tangled in the machine or on the stock being cut.

j. Safe Operating Methods for Wood Saws. The following operating standards will be carefully observed by each authorized saw operator:

- (1) Hands will be kept out of the line of cut while stock is being fed into the saw.
- (2) Stock will be held against a gauge or fence and never sawed freehand. A pushstick will always be used when short or narrow stock is being ripped.
- (3) The operator will stand out of the line of the stock being cut, making sure his hands or fingers are out of the danger area.
- (4) Long stock will never be crosscut on a table saw.
- (5) The saw will not be left running unattended.
- (6) Sawdust and slivers will be cleaned from the saw with a brush, never with the hands or a rag.
- (7) The saw guard or fence gauge will never be adjusted while the saw is operating.
- (8) Saw tables 36 inches above the floor, offer the most efficient working height.
- (9) Generally, circular saws will not be operated at speeds of more than 10,000 peripheral feet per minute. However, if blades have been tensioned for higher rates, such speed is authorized.

k. Radial Arm Saws. Radial arm saws will be equipped with a mechanical device to prevent the front edge of the saw from traveling beyond the front edge of the table. A return mechanism will also be provided to automatically return the saw to the back of the table when it is released at any point in its travel. A self-locking device will be installed to keep the saw from rebounding when released. The upper hood guard will completely enclose the upper portion of the blade down to a point that will include the end of the saw arbor. The upper hood will be constructed in such a manner and of such material that it will protect the operator from flying splinters, broken saw teeth, and so forth and will deflect sawdust away from the operator. The sides of the lower exposed portion of the blade will be guarded to the full diameter of the blade by a device that will automatically adjust itself to the thickness of the stock and remain in contact with stock being cut to give maximum protection possible for the operation being performed. Each radial saw used for ripping will be provided with non-kickback fingers or dogs located on both sides of the saw so as to oppose the thrust or tendency of the saw to pick up the material or to throw it back toward the operator. They will be designated to provide adequate holding power for all the thicknesses of material being cut.

l. Wood Band Saws. Both upper and lower driving wheels will be completely enclosed by solid metal, woven wire mesh, or expanded sheet metal and securely fastened to the metal framework. The enclosure will be at least four inches from the upper wheel to avoid contacting and breaking the blade. Band saws will be securely anchored to the floor or machine foundation to prevent vibration.

(1) Band saw drive wheels will be checked periodically for defects requiring repairing or replacing.

(2) The cutting edge of the blade will be completely enclosed except at the point of operation, by adjustable guard.

(3) The return part of the blade will be completely guarded along its full length between the upper and lower drive wheels.

(4) Self-fed band saws will be safeguarded by a half-cylinder device to prevent the operator's hands from contacting the in-running feedrolls.

(5) Defective blades will not be used and will be immediately rejected. Operators will make certain they use only a blade adequate to do a particular job safely.

(6) Every band saw will 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 will be required to wear safety goggles or face shields to protect their eyes while working at the saws. To avoid ultraviolet radiation burns, operators will use adequate eye protection when using a butt welder to slice broken saw blades.

m. Wood Jointers. All jointers will be equipped with cylinder cutting heads. Square cutting heads will not be used at any time. Throats of cutting heads will not be larger than 3/8 inch deep or 1/2 inch wide. Operators will wear safety goggles or face shields to protect their eyes from flying wood chips.

(1) Self-adjusting guards will cover cutting heads on both sides of the guide fence. These guards will be adjustable both vertically and horizontally.

(2) The guide fence will be located as close to the front of jointer table as the width of the work will allow.

(3) Only sharp, balanced knives will be used on jointer cutting heads. Before each operation, the knives will be inspected for defects and to be certain they are securely fastened.

(4) Pushsticks or pushblocks with handles will be used on all work as a general safety precaution. It is absolutely necessary they be used with work shorter than 18 inches or less than 1/2 inch thick.

(5) Unusually deep cuts will be avoided. Kickbacks can be caused when a deep cut is attempted.

n. Wood Shapers. These are used for trimming and shaping irregular stock. Various spindles may be used to make different types of cuts.

(1) Each cutting head and spindle end will be enclosed in a cage or adjustable guard to prevent operators from touching cutting edges with their hands. The guard will be designed to offer complete protection under any condition.

(2) Jigs, fixtures and templates will be used, when possible, to hold work in the shaper. This will give added protection because the hands will not have to come close to cutting heads.

(3) If one blade must be removed from a shaper spindle, all others will also be removed. Starting switches will be locked to prevent machine from being accidentally started during blade changes or removal. Short blades that are not bearing along the entire area of the collar will not be used in shaping operations.

(4) Collar surfaces will be smooth and free of burrs to ensure a secure bearing surface for cutting blades.

(5) Double spindle shapers will be equipped with individual starting and stopping devices for each spindle.

(6) Only sharp knives of the same length and balance and free from defects will be used in shaper spindles.

(7) Shaper operators will not "back up" on a cut. It is extremely dangerous to run stock in the same direction as the spindle's rotation instead of against it. Feeding stock too quickly or taking deep cuts will also be avoided.

(8) Operators will wear safety goggles or face shields to protect their eyes while operating the machines.

o. Wood Lathes. Because of the high speeds at which wood lathes are usually operated, there is danger of the work or machine parts coming loose and hitting operators. Flying chips are also a common hazard of lathe operations. The tool rest will be adjusted so as to be reasonably close to the work piece. Personnel working on lathes will not wear loose clothing, long hair and jewelry that may become tangled in the revolving parts of the machinery thus causing serious injury.

(1) Lathe cutting heads will 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.

(2) Operators will avoid taking deep cuts. This practice may cause work to come loose and can result in injury to personnel or damage in the shop. Deep cuts can also result in the cutting tool being forcibly ejected from the operator's hand.

(3) Operators of back knife lathes will not reach under the lathe to place stock in the centering frame. Instead, they will lower the knife far enough to reach over it.

(4) Heads set along the rear of the machine will be covered by a hinged metal guard, designed so it will not interfere with the lathe's operations.

(5) Treadle-operated lathes will be effectively guarded to prevent accidental tripping of the treadle.

(6) Exposed gears, sprockets and chains will be properly guarded.

(7) Operators will wear safety goggles or face shields to protect their eyes while operating the lathe.

p. Wood Sanders. This equipment will be completely guarded both below and above the work table. The only exposed part of the machine will be the actual point of operation. The exhaust hood may also serve as a machine guard. Adequately designed exhaust hoods are an essential part of sanding machines because of the rapid rate of dust production.

(1) The feedrolls of a self-feeding sander will be guarded by a blocking device. It will consist of half-cylinder guards that come within 3/8 inch of the plane formed by the face of the feedrolls and in the stock material.

(2) Both pulleys of a belt sander and the entire run of the sanding belt, except the working portion, will be completely enclosed.

(3) The space between the revolving sanding disk and the edge of the table opening of table sanders will be only enough to allow free movement of the disk. Under no circumstances will the clearance be more than 1/2 inch.

(4) When performing finishing work on a belt, disk or drum sander, operators will use work forms when possible.

(5) Operators will wear safety goggles or face shields to protect their eyes.

q. Wood Tenoning Machines. The cutting heads or saws of all tenoning machines will 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.

(1) Feed chains and sprockets of double-end tenoning machines shall be completely enclosed except for the stock conveying parts. The sprockets and chains at the rear ends of frames over which the conveyor runs will be guarded by plates extending beyond the edge of the sprockets and lugs.

(2) Hand-fed machines will be equipped with clamping devices to prevent stock from moving out of position.

(3) Operators will wear safety goggles or face shields to protect their eyes while operating the machines.

r. Wood Planers, Molders, Stickers and Matchers. Each of these woodworking machines will have their cutting heads or saws covered by substantial guards. Exhaust hoods may form all or part of the guards if they are of equal strength and construction.

(1) Machines will be completely stopped before attempting to clear jammed work or remove debris.

(2) Cases will be used to carry knives and assembly cutting heads to and from tool rooms.

(3) Feedrolls will be guarded by a hood or semicylindrical guard to prevent operator's hands from coming in contact with the in-running rollers. The guard will be fastened to the roller frame so it will remain in adjustment for any thickness of stock. Sectional feedrollers will be used on planers. Where solid feedrollers are used, sectional finger devices will be used to prevent stock from kicking back.

(4) Operators will wear safety goggles or face shields to protect their eyes while operating the machines.

s. Precautions for Using Compressed Air. Complete safety standards for using compressed air and its generating equipment are given on page 22. The precautions set forth here pertain particularly to the use of compressed air in woodworking shops and will be strictly observed by all shop personnel.

(1) Shop personnel will never use compressed air for removing dust and wood chips from their bodies or clothing.

(2) Air hoses laid across aisles, floors, or doorways will be guarded by an appropriate bridge, securely fastened to the floor, or properly suspended overhead as needed.

(3) Proper eye protection will be worn when compressed air is being used.

4. Paint Shop Safety. Painting operations presents hazards requiring rigid controls. The mists and vapors produced by spray painting are highly flammable. Violent explosions can result from accidental ignition of these vapors. Commonly used paints often contain toxic substances, such as lead or benzol, which are particularly harmful when inhaled. Skin irritations can also be caused by the toxic contents of paints. For safe and efficient operation, it is essential that all painting activities be done according to accepted safety standards. Supervisor must rigidly enforce such standards.

a. Housekeeping. Good housekeeping is essential to safe operations in paint shops. Paint rooms will be kept clean and painting equipment cleaned after use and stored in an orderly manner.

b. Location. Paint shops will ordinarily be located in separate buildings from other activities or in specially constructed, fire-resistant rooms. When it is impracticable to entirely isolate these shops, they will be satisfactorily separated from other operations by fire-resistant walls.

c. Spray Booths. Spray booths will be used in all paint shops to localize the fire and explosion hazards. The walls of these booths will be made of a fire-resistant material that can be easily and frequently cleaned. All spray booths will be installed to conform to the State Fire Marshal's rules and regulations. Wall and floors of spray booths may be covered with paper to protect them from paint deposits. This paper will be removed and destroyed when contaminated. Oil or other similar materials that can be easily washed down, may be used to protect the walls and floors of spray booths from paint accumulation. Protective paper wall coatings will not be used for dry or dusty painting substances.

d. Ventilation. Forced air ventilation will be provided in all paint spray booths to prevent the accumulation of flammable and injurious vapors in the atmosphere. Waterwash supply facilities provided for small booths will have a linear velocity across the face of the booth of approximately 100 feet per minute.

(1) Personnel will always spray paint toward the exhaust portal to minimize the accumulation of harmful mists in the booth. Spray guns will never be pointed toward other personnel.

(2) Adequate exhaust ventilation will be provided in booths when hand spray painting is being accomplished. When forced ventilation is impractical, such as during minor touchup painting, personnel shall wear suitable respirators.

e. Fire Hazards. All sources of ignition will be removed from paint shops. Electrical equipment and fixtures will be explosion-proof and effectively grounded at all times. Exhaust fans will be made of nonferrous metal and the air ducts will be bonded and grounded. Smoking will not be permitted in the paint shop. State Fire Marshal's rules and regulations apply for all paint operations not covered herein.

(1) All metal and fabric covered objects that could produce static charges will be effectively grounded or bonded before spray painting is authorized.

(2) Suitable fire extinguishers will be provided at all painting and/or paint-removing locations. When practical, overhead sprinkler systems will be installed in permanent paint shops.

(3) Rags, waste and other materials, saturated with paint will be disposed of in covered metal cans. Waste cans will be emptied daily.

f. Personal Health Safeguards. Detailed instructions for safeguarding the health of personnel engaged in painting activities have proved helpful through long experience and will be strictly observed by all paint shop workers.

(1) To avoid swallowing paint particles, shop personnel will wash thoroughly before eating.

(2) Food will not be brought into or eaten in paint shops.

(3) Protective clothing will be worn by paint shop personnel during painting operations to keep clothing ordinarily worn from becoming saturated with harmful paint deposits. When protective clothing is not being worn, it will be stored in ventilated metal lockers conveniently located outside the shop.

g. Painting Materials Storage. Paint storage will be isolated from the spraying booths. Containers of no more than five gallon capacity will be used for storing paints. The containers will be kept in metal cabinets when not in use.

(1) Combustible paints will be mixed in a fire-resistant mixing room. This room will be provided with a floor drain to make it possible to wash down spills quickly and effectively. These paints will not be stored in spray booths.

(2) Actions relating to the use, storage and mixing of waterbase latex paints are exempt from the requirements of paragraph 4g(1) above.

h. Pressure Equipment. Pressure spray equipment is used extensively in painting activities. Because of the many hazards involved in the use of compressed air, spraying operations will be closely supervised and the equipment used properly maintained. On all spraying equipment, a relief valve will be installed in the main air tank and a pressure reducing regulation installed in the air line between the compressor and the paint container. A pressure gauge will be placed between the reducing regulator and the paint container. All equipment will be inspected before use. Particular attention will be given to pressure reducing regulators to make certain they are functioning properly. Spray equipment will be thoroughly cleaned with approved solvents at the end of the day. Precautions will be taken to prevent paint from drying on pressure valves. During buildup periods, pressure gauges will be closely watched for positive indication that the regulator is working properly. Standards covering the safe use of compressed air are given on Page 22.

(1) Only enough pressure will be placed on spray equipment to do the job effectively. The use of minimum pressure will prevent excess accumulations of hazardous mists.

(2) Gravity feed tanks will not exceed a capacity of 10 gallons. Tanks will be tightly covered with non-combustible lids, equipped with screened vents. Suspended gravity feed tanks will be held by strong wire cables.

(3) Electrically heated paint pressure pots will be periodically inspected by qualified personnel to insure that thermostatic controls are within permitted heat ranges. Pots will not be tipped otherwise positioned to expose the heating element at any time.

i. Paint Removal. The same safety precautions covering painting will apply to paint removing. Flammable and toxic solvents are used which require adequate ventilation to keep dangerous accumulations of vapors below maximum limits.

5. Battery Maintenance Facilities. Operating personnel are often exposed to the possibility of painful chemical burns, explosive gases and toxic chemicals when servicing batteries. Nickel-cadmium and silver-zinc batteries will be serviced in an area isolated from lead-acid batteries. Sufficient ventilation will be provided to prevent acid fumes from entering the nickel-cadmium or silver-zinc batter shops. When acid and potassium hydroxide electrolyte type batteries are handled in the same shop, the specific equipment for the two kinds of batteries will be kept separate and carefully labeled. Tools or metal parts will not be placed on a battery or stored in such a position that they may fall on a battery. Workers will not wear rings or other hand jewelry. Lifting devices and hand trucks will be provided for handling heavy batteries.

a. Battery Charging. Lead-acid battery charging equipment will be located in properly ventilated rooms. Excessive charging of lead-acid batteries will not be permitted as hydrogen gas is generated. Charging benches and tables will be constructed of or coated with acid-impervious coatings.

b. Safety Precautions for Handling Batteries and Accessories. When handling electrolyte, shop personnel will wear protective chemical goggles or full-face shields, rubber gloves and aprons.

(1) When mixing acid solutions always pour electrolyte into water. Never pour water into electrolyte. The heat of dilution will cause water to boil and spatter when poured into electrolyte. Running water will be immediately available during diluting operations. Acid burns will be treated with baking soda and water. Hydroxide burns (alkaline batteries) will be treated with vinegar and water.

(2) A tilter will be used to pour acid from a carboy. When acid is siphoned, a rubber suction ball will be used to start the action.

c. 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 will be well ventilated to prevent accumulation of explosive gases or toxic vapors.

(2) Racks and trays must be resistant to the electrolyte. Racks must be designed to permit free access for servicing batteries.

(3) Floors will be resistant to or protected from electrolyte accumulations. Materials or equipment will be provided for neutralizing or flushing spilled electrolyte.

(4) Eye protection which provides side as well as frontal protection, aprons and rubber gloves will be provided for workmen.

(5) Facilities for quick drenching of the eyes and body will be provided for installations with enclosed batteries equipped with explosion-proof vents; a container (approximately one quart) of water equipped with an eye wash cup plus an additional one gallon container of water for drenching purposes will suffice.

(6) The battery bank will be located in an area of minimal personnel and vehicle traffic. Separate rooms are desirable.

(7) No smoking signs will be posted in the area.

(8) Fire extinguishers will be provided.

(9) Cells of the unsealed jar type will not be used.

(10) Employees assigned to work with batteries will be instructed in emergency procedures such as coping with electrolyte spills.

(11) Electrolyte will be mixed in a well-ventilated area. Acid or alkaline shall be poured gradually while stirring into the water. Never pour water into acid solutions.

(12) Electrolyte will never be poured into metal containers or stirred with metal objects.

(13) When taking specific gravity readings, an electrolyte resistant gloved finger will be placed over the end of the hydrometer while moving it from cell to cell to avoid splashing or dripping the electrolyte.

6. Welding Safety Practices. Radiation from welding flames and arcs can seriously injure eyes and burn skin. Other burns can be caused by splashing metal, hot sparks and objects being welded. Fumes and gases generated from welding operations are hazardous and arc equipment present other electrical hazards. The flame and heat produced by welding is done near flammable substances.

a. Only fully qualified personnel will be authorized to perform welding operations.

b. Minimum required protective equipment includes helmets, shields, aprons, gloves and gauntlets. Arc welders will ensure that protective fireproof screens are placed around the work area to prevent eyeflash burns to other personnel in area. Welders will wear eye protection when chipping scarf metal fragments.

c. Forced ventilation will be used in welding operations when natural ventilation is insufficient to prevent the accumulation of dangerous gases and fumes. In confined spaces, local exhaust ventilation will prove most effective. When concentrations of hazardous fumes cannot be kept within safe limits, welding personnel will wear appropriate breathing devices.

d. Welding Fire Hazards. Welding or cutting near flammable or explosive materials requires close attention to safety requirements. Suitable fire extinguishers will be provided and the activity performing or requiring the welding will provide a responsible person to stand by with suitable fire suppression equipment.

(1) Flammable materials will be removed from the immediate area. Wooden floors and other combustible surfaces will be protected when it is impracticable to remove flammable materials from the area, they will be protected by a suitable fire resistant shield. After welding operations have been completed the area will be thoroughly inspected for smoldering material.

(2) Welding is prohibited where flammable gases or liquids are present until their presence has been eliminated. In confined spaces, welding itself may produce flammable and explosive gases.

(3) When a fire hazard still exists after precautionary measures have been taken, the decision to weld or cut will be made by the maintenance superintendent. A fire guard will stand by the welding operation.

e. Compressed Gases. The precautions for the handling and storage of compressed gases are contained on page 22.

f. Welding Containers. Before welding/cutting any tank, cylinder, or other container, personnel will make certain they do not contain or have not contained, any flammable or explosive material. Those containers which contain or which have contained flammable substances will be adequately purged or inerted prior to welding or cutting. Sealed container will not be welded until the contents are known to be nonflammable and the container vented. Adequate venting is necessary to prevent containers from exploding or rupturing during welding because of increased pressure from applied heat.

g. Oxyacetylene Welding/Cutting. Careful handling of the gases and equipment used in oxyacetylene welding is essential.

(1) Oil or grease will not be allowed to come in contact with welding equipment.

(2) Acetylene will not be used at pressures exceeding 15 pounds per square inch. Leaking and creeping regulators will be removed from service. Control valves will never be opened more than 1 1/2 turns; 1/2 turn is sufficient for most welding operations. The special T-wrench used to open cylinders will be left in place during welding operations to permit quick shut down in emergencies. Control valves will be unobstructed and immediately accessible to the welder throughout the operation. Control valves of cylinders not in use will be covered by protective caps. Acetylene cylinders will be stored in an upright position to prevent excessive loss of acetone when the cylinders are used and to minimize external corrosion of the cylinder.

(3) Welding-torch hoses will be protected from damage from contact with hot metal, open flames or destructive agents. Inspect hoses periodically for leaks. Only standard ferrules or clamps will be used to secure hoses to cylinders and torches. Makeshift tape or wire connections will never be allowed. The oxygen hose will always be a green color. Pressure on hoses will be released at end of each workday.

h. Gas Welding Flame. When used incorrectly, welding torches are sources of fire. The flame will always be kept within the welder's field of vision and not be allowed to contact any part of the welding equipment.

(1) When not in use, the torch will be extinguished and its control valves turned off. The torch will not be pointed at concrete surfaces because a miniature explosion could occur and result in flying fragments of concrete.

(2) When a flashback occurs, both torch valves will be immediately closed. If a hose burst or escaping gas ignites at the tank regulator, controls will be turned off at once. On manifold cylinder systems, each fuel-gas cylinder will be provided with a backflow check valve.

i. Electric Arc Welding. Electrical shock is an added hazard of arc welding. Fire-resistant curtains or screens will be used during each arc welding operation. Adequate warning signs will be posted.

(1) Always de-energize electrical circuits before testing or checking.

(2) Rotary and polarity switches will not be operated while the equipment is under an electrical load.

(3) Motor-generator and other electrical welding equipment will be grounded when in use.

(4) Arc welding equipment will be inspected periodically. Power cables and electrode holders will receive careful inspection. Arc-generating equipment will be repaired by qualified electricians only.

j. Cadmium Welding Hazards. Cadmium fumes and dust are serious health hazards. When cadmium-plated or cadmium-bearing metals are being welded, local exhaust ventilation will be provided.

(1) The exhaust hood will be kept as close to the point of generation as possible and will never be more than eight inches away. If local ventilation cannot be supplied and welding is being done in small, confined spaces, the operator will wear an approved air-line type respirator.

(2) Cadmium-plated metals can easily be confused with other electroplated metals. Where there is any doubt about the composition of metal to be welded, a sample will be submitted to a metallurgical or chemical laboratory for analysis. Welding will never be performed on a metal or alloy of unknown identity.



(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 form of vapor. It has a marked effect on the human respiratory system. Heavy concentrations cause rawness on the throat, irritation of the mucous membranes and edema of 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 other similar in appearance, he may become exposed to toxic concentrations of cadmium oxide when welding cadmium-bearing or plated metals.

(b) Protective measures against harmful gases, fumes and dust will be provided by adequate ventilation or individual protective equipment, depending on the nature of the welding operations.

7. Safety in Vehicle Maintenance Shops. The normal activities of motor vehicle repair shops present numerous hazards. It is essential that adequate safety standards be prescribed and observed by all shop personnel. Supervisors will ensure that daily inspections are accomplished on all shop equipment.

a. Motor vehicle maintenance activities, such as painting, welding and battery work, will be carried out in separate parts of the shop where the operations of one kind will not be hazardous to another. Adequate general illumination will be provided for all operations and where necessary, additional artificial lighting supplied.

b. Fire Prevention Program. Fire is one of the major hazards of shop operations due to exposures involving flammable fuels, lubricants and compounds. Vehicle parts, tools, work benches and floors often become saturated with flammable materials. Extreme care must be taken by shop personnel at all times to prevent shop fires.

(1) Flame-producing equipment will not be used in the shop except in areas such as the welding shop, where required safety controls exist. Smoking will be forbidden except in areas designated by the maintenance superintendent.

(2) Fire extinguishers will be conveniently located throughout the maintenance shop. Their locations will be clearly marked and kept free of obstructions. Fire extinguishers will be placed where they can be easily reached, but also where they cannot be accidentally bumped by personnel or equipment.

(3) Vehicles will never be fueled inside maintenance shops except under controlled conditions and then only when approved by the installation fire chief.

c. Shop Ventilation. Shops will be adequately ventilated to prevent accumulation of dangerous gases and vapors. Special exhaust systems shall be provided in battery rooms, painting booths and for confined welding jobs. Carbon monoxide gas is probably the most common personal hazard in shop operations. The building exhaust system or flexible tubing, attached to vehicle pipes, will be used to carry carbon monoxide fumes directly outside the shop. General exhaust ventilation also may be provided to prevent further accumulations of poisonous gases.

d. Shop floors will be kept clean and free of oil, grease, gasoline, water and other hazardous and slippery materials. Good housekeeping is essential to safe motor shop operations. Drip pans under vehicles and mechanized equipment are essential.

(1) Shop operations will be organized and functionally located as to preclude drainage of flammable liquids into floor drain systems. Such liquids will be drained into suitable containers and disposed of safely.

(2) Boxes of sand, or suitable absorbent materials, will be provided in vehicle maintenance shops to be used on grease or oil spills. After absorbent material has been applied to a spill, the floor will be thoroughly cleaned.

e. Shop personnel will wear appropriate protective equipment when performing any hazardous maintenance operation. This equipment will be available in the shop for immediate use.

f. Automotive shop machinery such as lathes, abrasive wheels and portable electric tools, will be guarded according to standards in this pamphlet.

g. Guard rails will be placed around grease or repair pits. All pits will be equipped with steps, hand rails and approved lighting to permit safety of operations.

(1) Pits will be built with drains equipped with oil separators. Do not connect pit drains to sanitary sewers.

(2) Repair and grease pits will be cleaned regularly with soap and water or a caustic solution but not solvents. Pit contamination is a potential health, fire and accident hazard. Personal protective clothing, involving chemical type goggles, rubber boots and gloves and so forth, will be worn during pit cleaning.

(3) Each automotive life will be marked with the name of the manufacturer, life capacity and date of installation. These markings will be stamped or etched on a metal plate permanently attached to the lift in a position where it can be inspected.

(4) Vehicle lifts will be equipped with control devices of the "deadman" type which automatically return to neutral or "off" when released by the operator. Controls will be conveniently located near the lift in a position that provides an unobstructed view of lift area.

(5) Chassis and axle support will be designed to transfer the load to the lift rails without putting torsion stress in the rails. Makeshift devices will not be used for chassis and axle supports.

h. Tire Mountings. Shop personnel will use mechanical devices, such as dollies, to help them mount or remove large, heavy tires.

(1) Personnel will use guard cages when inflating tires. When wheels with lock rings or split rims are mounted on vehicles, several lengths of chain, fitted with positive catches, will be passed through the wheel openings and around the tire rim before inflating.

(2) Personnel will use extreme caution when inflating tires of large trucks or heavy construction equipment.

i. Contaminated Clothing. Mechanics must keep their clothing free from grease and oil. If the clothing is contaminated with leaded fuel, they will immediately strip, shower and put on clean clothing. Clothing that is saturated with flammable substances will never be worn or stored in clothing lockers. Such clothing, if not cleaned immediately, must be stored away from flammable objects in an area offering good air circulation. Personnel will be provided two compartment type metal ventilated lockers for storing street and work clothing. Mechanics will never wear neckties, loose clothing, watches, rings or other jewelry when working on or around equipment or vehicles.

j. Jacks. The rated load will be legibly and permanently marked in a prominent location on the jack by casting, stamping or other suitable means (jacks supplied with vehicles as standard tool equipment are excluded). The operator will make sure that the jack used has a rating sufficient to lift and sustain the load. Jacks will be inspected frequently. After a vehicle has been raised by a jack, it will be securely blocked to prevent it from falling. At no time will mechanics place any part of their bodies directly under the wheels of a jacked vehicle. All hand and portable power tools of vehicle shops will be used and maintained according to the standards prescribed in this pamphlet. Tool kits will be inspected periodically and defective tools replaced immediately.

k. Cables and Cords. The insulative covering of power cables and cords on portable electrical equipment will be in accordance with the requirements of the National Electrical Code to prevent damage from oil or grease and by chafing. Power cables and cords on all portable and fixed electrically operated equipment will be of the three-wire construction with a plug equipped with a ground lug. (Note: This requirement does not apply to double insulated tools.) Cables will be constructed to provide automatic grounding of equipment through integral conductors. Mechanics who are using portable electrical tools and lights will not string cables carelessly across shop floors. Serious injuries can be caused by tripping over power cords and cables.

l. Fuel Containers. Gas tank and other fuel containers will be removed from the vehicle, drained, purged and when practicable filled with water or otherwise rendered safe before welding or other heat-producing work is performed on them.

m. Shop Entrances. Shop entrances and exits will be clearly lighted and marked to prevent accidents. Appropriate traffic control signs will be posted at entrances and exits.

(1) Vehicles entering or leaving shops will signal with their horn to warn personnel and oncoming traffic.

(2) A maximum speed limit of five miles per hour will be enforced in and around shops.

n. Dangers of Compressed Air. Compressed air is used in many vehicle shop operations; spray painting, tire inflation, fuel line cleaning and others. When handled with care and according to

accepted safety standards, compressed air is not hazardous. However, many mechanics are tempted to use air under high pressure to clean work benches, vehicle chassis and other parts. This is extremely dangerous as metal parts, dirt and debris are thrown into the air. If air pressure is strong enough, flying particles can be forced through clothing and into flesh. Air cleaning is particularly dangerous to eyes. Mechanics will never engage in horseplay with compressed air. It may be amusing to some people to direct a jet of air at a fellow worker, but this has been known to produce severe internal injuries, possibly resulting in death. Compressed air will always be used according to safety guidelines in this pamphlet. Pressure gauges will be equipped with safety glass lens and blowout plugs in the reverse of the case. Hoses will be adequately secured at all times. Compressed air may be used as a cleaning aid on non-moving machinery, provided that air output at nozzle does not exceed 15 psi. When cleaning moving machinery, air output will not exceed 15 psi. Eye protection equipment will be used at all times when cleaning with compressed air. Additional safety information relative to compressed air is contained on page 22.

8. Safety in the Use of Hand Tools. Accidents involving hand tools are usually the result of misuse. Many persons are under the impression that hand tools are simple devices that can be used by anyone with little or no training. This idea could not be more untrue. Hand tools are precious instruments, capable of performing many jobs when used properly. Prevention of accidents involving hand tools becomes a matter of proper instruction and adequate training. The first factor of hand tool safety requires that the tools be of good quality and adequate for the job at hand. All tools will be kept in good repair and maintained only by qualified personnel. Racks, shelves, or tool boxes will be provided for storing tools not in use. When hand tools are used on ladders, scaffolds, platforms or work stands, personnel will use carrying bags or belts and be particularly careful not to drop or kick them onto workers below. Supervisors will frequently inspect all hand tools used in the operations under their supervision and remove defective tools from the service immediately.

a. Tool handles will be carefully selected to ensure that the materials are free from weakening flaws. When the handles of hammers, axes, picks or sledges become cracked, split, broken or splintered, they will be immediately replaced. Tool handles will be well-fitted and securely fastened by wedges or other acceptable means. Wedges, always in pairs, will be driven with a sledge hammer or maul. Wedges with mushroomed edges will not be used until properly dressed. If tool heads can be drilled, a steel pin driven through the head and handle will prevent the head from accidentally flying off if the handle shrinks. Files, wood chisels and other tools with tangs will be fitted with suitable handles which cover the end of the tang. Handles will be kept free of grease and other slippery substances. Ends of handles will not be used for pounding or tapping. Improvised extension handles such as pipes or bars, will not be used. Wooden tool handles normally will not be painted; the exception is those painted by the manufacturer.

b. Cold chisels, punches, hammers, drift pins and other similar tools which have a tendency to mushroom from repeated poundings, will be dressed down as soon as they begin to check and curl. When dressing tools, a slight bevel of about three-sixteenths inch will be ground around the head. This will help prevent the heads from mushrooming. When tool heads mushroom, the material is highly crystallized, fragments are likely to break off thus exposing personnel to painful injuries.

c. Cutting tools will be kept sharp at all times and stored in safe location. Knives and similar hand tools, will be equipped with guards at the hilt to prevent the worker's hand from slipping down on the blade. Sharp or pointed tools will always be carried in sheaths on a worker's person, never in his clothing pockets.

d. Normally, hand tools will be used so the working force is away from a person's body in case the tool will slip.

e. Impact goggles or face shields will be worn by all personnel when work may produce flying chips or debris.

f. It has been technically determined that no safety advantage is gained by using nonferrous tools in petroleum vapor atmospheres.

g. Ordinarily, hand-tools will not be used to make adjustments of moving machinery. When absolutely necessary to work on an operating machine, personnel will use only the tools designed for

safety equipment maintenance. Normally, machinery will be completely stopped before repairs or adjustments are attempted. Only personnel qualified to repair or adjust the machinery will do so.

h. Fiber fuse pullers, rules without metal rims, cloth tapes and similar non-conductive items will be used when possible. Insulated handles on hand tools are also recommended.

i. Small objects will be held in vises while being worked on; serious injuries can result from trying to hold a small object in one hand and working on it with a tool in the other. This is particularly true of attempting repairs to a small part using a screw driver or other pointed tool.

j. Hammers. A hammer is one of the most commonly used hand tools.

(1) Shop personnel will be careful to select the proper type hammer for the job. No hammer will be used that has a cracked or defective head.

(2) Personnel, when hammering, will hold the tool so the head is parallel to the face of the material being struck. The sides of hammer heads are not case hardened and will never be used for pounding.

(3) Hammers with tightly tempered steel heads will not be used on hard steel objects. Hammers with heads made of soft materials will be used.

(4) When sledges or other heavy hammers are used to drive chisels or other tools, the worker holding the tool struck shall be provided with a tool holder. Effective hand protection can be achieved by using sponge rubber shields on all tools struck by hammers. Rubber handgrips and shields on hammer handles will help to protect workers' hands from bruising.

(5) Nails can be drawn from objects safely and easily by placing a piece of wood under the hammer head after the nail has been started. This increases hammer leverage and reduced strain on the handle.

k. Wrenches. Many types of wrenches are in daily use. Open end, adjustable, monkey, pipe, box and socket wrenches are the most common types.

(1) The proper size and type of wrench will be selected to do only the jobs for which it was designed.

(2) Workmen will 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 will be pulled - never pushed. Care will be taken to avoid overstraining small wrenches and no wrench will be subjected to serve side strain at any time. Shims will not be used to make wrenches of an improper size fit the work at hand. Under no circumstances will a pipe wrench be used as a substitute for any other wrench.

(a) A wrench will never be used as a hammer. Not only will this weaken the wrench, but the practice can lead to personal injury.

(b) Hammering on wrench handles to free frozen nuts will not be permitted unless specifically designed striking-wrenches are used. These wrenches are designed to absorb hammering safely.

(3) Wrenches showing any defects such as spread or distorted jaws, bent handles, or cracks will be taken out of service immediately.

l. Screwdrivers. Screwdrivers are probably the most commonly used and abused hand tool. They are designed for one purpose: to loosen and tighten screws. However, they are often used for other purposes and become sources of possible accidents. Lack of knowledge in the safe use of screwdrivers is the principal reason personnel misuse them and thus sustain injuries.

(1) The need for proper selection of screwdrivers for each particular job cannot be over emphasized. The use of the wrong size tool is largely responsible for the many injuries caused by screwdrivers. Workmen must be careful to select the size screwdriver that matches the screw slot. Conventional type drivers will not be used on Phillips or cross slotted head-type screw slots.

(2) Objects will not be held by hand, under the arm or on the lap when being worked on with a screwdriver. Work will be secured to a flat surface or held in a vise. This will minimize the danger of personnel injuring their hands if the screwdriver suddenly slips from the screwhead. Workers should make certain that they are well braced before applying force to a screwdriver. Firm footage is particularly necessary when using a screwdriver on a ladder or stand where loss of balance could result in a fall.

(3) A screwdriver will never be used as punch, wedge, chisel, pinch bar, pry and/or nail pulled.

(4) Screwdrivers used for electrical work are equipped with insulated handles. However, insulated screwdrivers will never be utilized as the primary protection against electrical shock. Electricians will always use required electrical workers' protective equipment and hot line tools as primary protection while working on electrical lines, equipment or energized apparatus.

(5) Worn screwdriver blades will be dressed by grinding or filing so the bottoms are flat and the sides almost parallel. For blades that are ground, too much taper will tend to rise out of the screw when pressure is applied.

(6) Files and rasps will be cleaned of filings with a wire brush or by tapping gently against a block of wood. They will never be cleaned by knocking them against hard metal objects.

(7) Old files or rasps will not be machined into chisels, punches or other tools. The hardened, brittle metals of which they are made makes this practice especially dangerous.

(8) Eye protection devices will be worn when overhead filing is necessary.

m. Knives. Personnel using knives in their daily work will be carefully instructed in their safe use. All knives, except folding pocket types, will be equipped with hand shields or sure-grip handles to keep user's hand from slipping down onto the blades. Non-folding knives carried on a person will be kept in leather sheaths.

(1) When using a knife, the worker will always cut away from his body, being careful to cut in a direction that will not endanger his fellow workers if the knife slips.

(2) Knives are designed for and will be used only for cutting. They will never be left lying around where they may become a source of injury.

(3) Knife blades will be kept as sharp as possible at all times. Dull blades cause many accidents and are not efficient.

(4) When not in use, knives will be kept in racks with their edges guarded or stored in other safe places where they will not become hazards.

n. Pliers and Nippers. Both of these tools have numerous uses. Extreme care is necessary when using nippers or pliers around live electrical circuits. In such instances, electricians will wear appropriate hotline equipment including electrical workers' gloves. Electrical circuits will be turned off when possible. Under no circumstances will tools with insulated handles be used in place of appropriate electrical protective equipment. When cutting wire or banding that is springy or under tension, the workman will hold one end securely and turn his body away from the loose end to prevent the wire from whipping into his face and eyes. Safety goggles will be worn so short pieces cut from the end cannot endanger the eyes.

o. Vises. When clamping or holding heavy objects, a block of wood or metal will be used to brace the objects that could accidentally fall or slip down from the vise.

(1) Vise jaws will not be opened beyond the limit of screw travel.

(2) Vises will never be used as anvils, nor will metal work ever be placed in wood vises.

p. Punches, cold chisels and similar tools that are hand-held will be kept free of slippery substances. Hand guards and tool holders will be used if practical. Tools that have become mushroomed will not be used until they have been properly dressed.

(1) Workers will wear safety goggles or face shields when striking tools such as chisels or punches.

(2) When work is being chipped while being held in a vise, the force of the chisel will be toward the solid jaw of the vise, if at all possible.

(3) Suitable safety shields or screens will be used when chipping is directed in the vicinity of other personnel.

q. Hatchets, Axes, Adzes, Wedges. Wood-cutting tools will be kept as sharp as possible at all times. Because of their weight, these tools will be handled with extreme care to avoid dropping them. A common hazard with hatchets, axes and adzes is the handle separating from the blade while in use.

(1) Short, choppy strokes will make the tool easier for the workman to control. Before using an adzes, ax or hatchet, the worker will make certain all personnel in the area are at a safe distance away from the operation. No one will ever swing or cut toward a fellow worker with one of these tools.

(2) While in use, the blades of wood cutting tools will be kept free of chips or other debris which could deflect the blow.

(3) When handing one of these sharp tools to another person, the workmen will pass the handle first, keeping a firm hold on the head until the other man has a secure grip on the handle.

(4) When not in use, wood-cutting tools will be stored where they do not create a hazard.

r. Blow Torches. Blow torches will not be used in unventilated areas or near flammable or explosive materials. Each blow torch will be carefully inspected before use to make certain it is in safe working condition.

(1) Every gasoline blow torch will be provided with a complete set of operating instructions. No one will attempt to use a gasoline torch until he has read and is completely familiar with the instructions.

(2) Torches will be filled with fuel out-of-doors. If absolutely necessary to fill them indoors, it will be done where there are no possible sources of ignition and adequate ventilation time is provided to remove vapors from the room before operation is attempted.

(3) Blow torches will be set on firm, solid surfaces in a safe place before they are lighted.

(4) When fuel has been spilled over a torch, other than in the priming cup, it will not be lighted until fuel has been completely removed. The torch will never be ignited until the fuel in the priming cup is nearly used up.

(5) Personnel will not attempt to move a blow torch when fuel is still burning in the priming bowl below the vaporizing unit.

s. Soldering Irons. Workmen will always treat soldering irons as though they are hot. Metal racks, placed in safe areas, will always be used for resting hot irons.

(1) Before using an iron, the worker will make certain the copper is securely fastened to the shaft and the shaft to its handle.

(2) Electric soldering irons will never be left plugged in when not in use. Irons with warning lights that burn when plugged in, will preferably be used for soldering operations. Cord and plug connections will be kept in good repair. Wires with frayed or broken insulation will be replaced.

(3) Workmen will be careful not to use too much solder; dripping hot solder may cause burns or the work may be damaged. Personnel will avoid breathing the fumes of solder, soldering fluxes and acids. Suitable respiratory equipment and eye protection will be worn.

(4) Small jobs being soldered will be held with pliers or clamps to prevent burns to the workers' hands.

(5) Rags used for cleaning soldering irons will not be held by hand, but will be placed on a safe surface where the hot irons may be wiped across it.

t. Hand Saws. Only saws that are sharp and properly set will be used. If a saw binds while cutting, the worker will not attempt to force it through the stock.

(1) The proper saw will be chosen to do the job at hand-cross-cut saws for cutting across the grain, ripsaws for cutting with the grain.

(2) When a saw sticks in damp or gummy wood, a small amount of oil or paraffin applied to the blade will make it run smoothly. Wedges may be used to hold the cut open if oil or paraffin does not prevent the saw from sticking.

u. Crow Bars and Wrecking Bars. Bars of sufficient size and weight will be chosen to do the job safely and easily. Makeshift bars, such as pipes or other metal objects, will never be used in place of crow bars and wrecking bars.

(1) Persons using crow and wrecking bars will be careful to prevent their tools from slipping and causing injuries to their fellow workers. A block of wood placed under the bar will usually keep it from slipping, while at the same time giving more leverage.

(2) Striking Bars. Case hardened steel tools will never be used to strike crow bars on wrecking bars. Only plastic, wood or soft metal objects will be used to hammer on pry-type bars.

9. Safety Principles in Using Portable Power Tools. Portable power tools are types which receive power from electricity, air pressure, explosive charges or rotating flexible cable. While the portable tool increases mobility and convenience, it is frequently more hazardous to use than its stationary counterpart. The reason for this is that portable tools are small of necessity, making safety guarding

extremely difficult. Typical injuries resulting from the use of portable power tools include electrical shock, burns, cuts, eye injuries from flying particles, muscle strains and some occupational diseases. Personnel who are required to use portable power tools in their work will be thoroughly trained in safe operating practices. Standard operating procedures will be set up for each type of tool.

a. Portable power tool switches and controls will be shielded against accidental operation. To ensure greater operator safety, power tools will be equipped with a constant-pressure switch or control that will shut off the power when pressure is released.

b. Care must be taken to prevent cords, hoses and cables supplying power to portable power tools from becoming tripping hazards. Only rubber sheathed cords approved by the underwriter laboratories which meet the requirements of the National Electrical Safety Code will be used on portable electric tools and extension lamps. All power cables for this application will be of the type that includes a third ground wire in addition to the power wires. Special type cords (rubber covered or plastic) will be used in areas where oils or solvents may be encountered.

c. Projections on shafts or revolving parts of hand power tools should be removed by countersinking, grinding until smooth and flush with the shaft surface or by providing a suitable metal cover.

d. When heavy power tools are continually used in the same location, suitable overhead adjustable sling supports will be installed to suspend and hold the tool.

e. Each portable power tool operator will wear suitable work clothes. Operators will wear caps or other garments to keep their hair from coming in contact with rotating or moving parts of the tools. Loose sleeves, neckties, rings or other clothing or jewelry that could become tangled in a hand power tool will never be worn.

f. Operators will wear protective goggles or face shields for hand power tool operations that may cause flying particles. Overhead work makes this requirement doubly important.

g. Power tools will be inspected regularly by qualified maintenance personnel and kept in safe operating condition. Broken or worn parts, defective and frayed electrical cords and damaged tools will be immediately taken out of service.

h. Portable grinding wheels will be permanently guarded, with only that point of the grinding wheel required for grinding left open. Wheels will be secured to spindles by flange nuts and all mountings firmly fixed to the tool. No grinder, unless designed to do so, will be operated without wheel guards in place. To ensure maximum safety, operators will be sure to hold work tight against wheels during grinding.

i. Portable circular saws will be checked before each use for cracked or defective blades. Damaged blades will be immediately discarded. Permanent, self-adjusting guards will be provided on all portable saws. All exposed areas of the blade will be enclosed during and after cutting operations.

j. Scratch brushes used on portable power tools will be permanently guarded in the same manner as grinding wheels.

k. Electric powered hand tools are widely used throughout maintenance operations because of their convenience, speed and efficiency. However, because of their source of power they often present the same hazards as other electrical machinery and equipment. Personnel who use electric power tools will become familiar with accepted safe operating standards and also with the general hazards of electricity.

(1) Electric powered hand tools will not be used near flammable materials or in explosive atmospheres unless they are approved explosion-proof types that 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 will be grounded according to the requirements of the National Electrical Code. When grounds are not included as part of the power cable, as in approved three-wire cords, an additional wire or polarized plugs and receptacles will be used to effectively ground the tool.

(3) When electric-powered tools are used in damp or wet locations, such as in tanks or boilers, effective grounding is absolutely necessary.

(4) Shop personnel will avoid abusing power cords. Excessive scraping, kinking, stretching and exposure to grease and oils will damage power cables and cause premature failures and possible shock or burns. Heavy duty plugs, clamped securely to the cords, will be used on all power

tools. Personnel will not attempt to unplug power cords by jerking them from their connections by the cord.

l. Tools powered by compressed air require careful handling to avoid accidents. Air is supplied under pressure from either compressors or tanks. Complete instructions for the safe use of compressed air are outlined on page 22 of this pamphlet. Only the best quality air hoses, equipped with secure couplings, will be used with air-powered tools. Because air hoses present a tripping hazard and are susceptible to damage when laid along walkways, they will be suspended over aisles and walks or bridged where possible.

(1) Air supply control valves will not be locked open at any time; they will always be free for immediate hand control.

(2) Air-powered tools will be inspected regularly for defects to make certain they are in top operating conditions. Grind bit attachments on air-powered drills so that the flukes are uniform in size and shape.

(3) Workers will never point pneumatic hammers at other personnel.

(4) Each air-supplied tool will be equipped with safety locks to prevent accidental operation and all air valves on tools will be inspected at frequent intervals for proper operation.

(5) Sufficient personnel will be provided to operate large, heavy-duty compressed air tools to ensure operational safety.

(6) Operators will turn air off with the base control valve before changing or disconnecting any pneumatic tool, unless automatic quick disconnects are provided.

(7) Hoses will be connected by safety chains to tool housings. This will prevent a hose from whipping and causing personnel injuries if a coupling separates. Tools with quick disconnect fittings are exempt from this requirement.

m. Explosive-Actuated Tools. Cartridge-type explosives are the source of power for this group of hand tools. Their use is accompanied by hazards normally encountered when using ammunition and other explosives. In addition, the hazards of regular riveting guns are present when powder-actuated tools are used. These tools are comparatively new in the industrial field and are used primarily to sink fasteners into non-brittle surfaces such as driving studs into steel or concrete and tightening rivets. Before any person is permitted to use any explosive-actuated tool, they will be thoroughly instructed in its safe use. When a tool of this type is suggested for a job, a thorough study of the operation will be made. Kinds of materials encountered, size and strength of explosives needed and possible dangers to associated workmen will be considered before tools are issued to operators.

(1) Only powder-driven tools bearing the manufacturer's label and number and approved by the Industrial Code of Explosive Powered Tools, will be used.

(2) Each tool will be equipped with a steel muzzle guard at least three and one-half inches in diameter mounted perpendicular to the barrel and designed to confine flying fragments or particles that might otherwise create a hazard. When a standard shield or guard cannot be used or when it does not cover all apparent avenues through which flying particles might escape, a special shield or guard, fixture or jig that provides equal protection may be used instead of the standard steel guard. To use the tool inside boxes or recessed areas, the guard will be secured to the muzzle so it can be easily adjusted.

(3) Cartridge-powered tools will be constructed to prevent operation if they are not fitted with a muzzle guard or protective jig of the manufacturer's design.

(4) All tools of this type will be constructed so that they cannot be fired unless the operator is holding the tool against a work surface with a force at least five pounds greater than the total weight of the tool.

(5) Powder-actuated tools equipped with standard muzzle guards will be built so the operation will be prevented if the guard is tilted more than eight degrees from contact with the working surface.

(6) No fastener of any kind will be driven into masonry closer than three inches to a corner or edge. Unless jigs or special guards are used to stop flying particles, fasteners will not be fired into steel closer than 1/2 inch to an edge, corner, or joint.



(7) Projectile firing tools will be constructed to prevent discharge if accidentally dropped. They will be designed to operate only when the muzzle guard is in proper contact with the work surface.

(8) Powder-actuated tools will be designed to facilitate breech inspection to detect any debris or obstruction that may cause malfunction.

(9) No tools of this type will 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 materials,

(10) Powder-actuated tools will so designed that positive means of varying the power are available to make it possible for the operator to select a powder charge level adequate to perform the desired work without excessive force.

(a) Each operator will wear safety goggles or face shields when using powder-actuated tools.

(b) Tools of this type will not be used in explosive or flammable atmospheres unless the area is adequately equipped with positive ventilating systems and the atmosphere is found (through tests) safe.

(c) Defective tools will be taken out of service.

(d) Operators will be briefed on the characteristics of each job so they can select the proper size charges needed to complete the work safely and efficiently.

(11) Tool Storage and Maintenance. Tools and explosive charges will be stored separately; tools in portable containers and explosives in locked metal boxes.

(a) Once an operator has been issued a powder-actuated tool, he will be responsible for its safe use and final return to the issuing tool crib.

(b) All tools will be kept in containers when they are being transported.

(c) Powder-actuated tools will not be left unattended at any time, nor will operators permit unauthorized persons to handle the equipment. When tools are not in use, they will be free of explosive charges. Under no circumstances will loaded tools be returned to tool cribs for storing.

(12) Additional safe operating standards can be found in manufacturer's instructions and appropriate commercial industrial codes.

(13) The following standard system of power loaded identification has been developed to enable positive selection of desired power load:

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

Additional information can be obtained from the Powder Actuated Tool Manufacturer's Institute.

10. Safety Requirements for Operating and Maintaining Compressed Air Machinery and Accessories.

Air compressors are used for confining gases under pressure in tanks, lines and tools. All components of compressed air systems will be inspected regularly by persons who are qualified and trained for this work. Inspectors of compressed air equipment will be conservative in the approval of borderline cases. Maintenance superintendents will check to determine if state or local governing bodies or insurance companies require their own personnel to make periodic inspections of this equipment. The most minute crack in a receiver can be very dangerous as a sudden release of pressures in containers can cause serious injury to personnel and costly damage to equipment.

a. Air Receivers. The maximum allowable working pressures of air receivers will never be exceeded except when being tested. Hot water tanks, or other substitutes, will not be used as

makeshift air receivers at any time. Metal air receivers will be hydrostatically tested in accordance with Federal Standards.

(1) Air tanks and receivers will be equipped with inspection openings and tanks over 36 inches in diameter will be fitted with manholes. Pipeplug openings will be provided on tanks with volumes of less than five cubic feet. The intake and exhaust pipes of small tanks, similar to those used in garages, will be made removable for interior inspections. No tank or receiver will be locally altered or modified.

(2) Air receivers will be fitted with a drain cock, located at the bottom of the receiver, for removing accumulated oil and water. Stencil receivers indicating the location of the drain cock, mark them "Drain Daily" and ensure that they are drained daily. Receivers having automatic drain systems are exempt from these requirements.

(3) Air tanks will be located so that the entire outside surfaces can be easily inspected. Air tanks will not be buried or placed where they cannot be reached by inspectors.

(4) Only qualified personnel will be permitted to repair air tanks and all work must be done according to established safety standards.

(5) Each air receiver shall be equipped with at least one pressure gauge and an ASME safety valve of the proper design.

b. Air Distribution Lines. Air lines will be made of high quality materials, fitted with secure connections. Air powered equipment operators shall avoid bending or kinking air hoses.

(1) Only standard fittings will be used on air lines.

(2) Air hoses will not be placed where they will create tripping hazards. All hoses will be checked to make sure they are properly connected to pipe outlets before use.

(3) Air lines will be inspected periodically and any found to have defects repaired or replaced immediately.

(4) Compressed air lines will be identified as to maximum working pressures (psi). Pipeline outlets will be tagged or marked immediately adjacent to the outlet. Mark in black or white to show maximum working pressure.

c. Pressure Regulation Devices. Only qualified personnel will be allowed to repair or adjust pressure regulating equipment. Valves, gauges and other regulating devices will be installed on compressor equipment in such a way that they cannot be made inoperative by shop personnel.

(1) Air tank safety valves will be set no less than 15 psi or 10 percent (whichever is greater) above the operating pressure of the compressor but never higher than the maximum allowable working pressure of the air receiver.

(2) Air lines between the compressor and receiver will usually not be equipped with stop valves. Where stop valves are necessary and authorized, ASME safety valves will be installed between the stop valves and the compressor. The safety valves will be set to blow at pressure slightly above those necessary to pop the receiver safety valves.

(3) Blowoff valves will be located on the equipment and shielded so sudden blowoffs will not cause personnel injuries or equipment damage.

(4) Cast iron seat or disk safety valves will be ASME approved and stamped for intended service application.

(5) 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 will be equipped with a drain at the lowest point where liquid can collect. Water will be drained off to prevent freezing. Safety valves exposed to freezing temperatures will be located so water cannot collect in the valves. Frozen valves must be thawed before the compressor is operated.

d. Air Compressor Operation. Air compressor equipment will be operated only by authorized personnel who have been thoroughly trained in their jobs.

(1) The air taken into compressor will be from a clean, cool source isolated from the motor exhaust part. Screens or filters may be used to make only clean air enter the equipment. Air intakes will be made to preclude dirt or debris from collecting inside the tank or receiver.

(2) Air compressors will never be operated at speeds faster than the manufacturer's recommendation. Operators will be careful not to allow their equipment to become overheated.

(3) All moving compressor parts that could be hazardous to operators will be effectively guarded such as compressor flywheels, pulleys and belts. If mesh material is used, it will not exceed 1/2 inch nor be less than 1/4 inch for the openings.

e. Compressed Air Equipment Maintenance. Only competent authorized personnel will service and maintain air compressor equipment. Only qualified refrigeration mechanics or electricians will adjust or repair electrically-operated compressor equipment. Exposed noncurrent-carrying metal parts of compressor will be effectively grounded.

(1) High flash point lubricants will be used on compressor equipment because of accompanying high temperatures that could cause fire or explosion. Operators will be careful to avoid over-lubricating their equipment.

(2) The exhausts of gasoline or diesel fuel powered compressors located indoors will be properly vented to eliminate accumulated hazardous carbon monoxide gas. Equipment placed outside near buildings will have the exhausts directed away from doors, windows or air intakes to prevent fumes from being blown inside.

(3) Soapy water or lye solutions may be used to clean compressor parts of carbon deposits but kerosene or other flammable substances will never be used. Frequent cleaning is necessary to keep compressors in good working condition. The air systems will be completely purged after each cleaning.

(4) During maintenance work, the switches of electrically operated compressors will be locked open and tagged to prevent accidental starting. Portable electric compressors will be disconnected from the power source before maintenance is attempted.

11. Lifting Devices. Mechanical lifting devices include a large variety of cranes, derricks, hoists, jacks and slings. Their use is subject to certain hazards that cannot be safe-guarded by mechanical means but only by the exercise of intelligence, care and common sense. It is therefore, essential to have competent and careful operators, physically and mentally fit, thoroughly trained in the safe operations of the lifting devices and the handling of loads.

a. Serious hazards are overloading and dropping or slipping of the load caused by improper hitching or slinging, obstruction to the free passage of the load and misuse of the machine. Strict observance of safety standards will aid in reducing accidents involving the use of lifting devices. Although the information provided below pertains specifically to cranes, these requirements will be applied to all hoisting equipment.

(1) Only personnel designated as qualified operators shall be permitted to operate cranes.

(2) The rated load of the crane must be plainly marked on each side of the crane and be clearly legible to the operator. Employees will be made aware of the weight of the load.

(3) Hooks, ropes, chains, brakes and all functional operating mechanisms must be inspected daily for indications of damage and excessive wear.

(4) Hand signals to operators will be those prescribed by the applicable ANSI standard for the type of crane in use.

(5) The hoist chain or rope must be free from kinks or twists and must not be wrapped around the load.

(6) 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.

(7) The operator must not leave his position at the controls while the load is suspended.

(8) No part of a lifting device, particularly the boom, or its load will be permitted to come within 10 feet of any electrical power line. A permanent sign will be placed on the lifting device to indicate this requirement.

(9) When the hook is in the extreme low position at least two complete wraps of rope must remain on the drum. Rope ends must be safely and securely attached to the drum by means of a clamp or socket arrangement approved by the crane or rope manufacturer.

(10) When making a hook up, the hook must be centered over the load to prevent swinging. Tag lines will be used on free swinging loads to help guide them.

(11) The hoist must be equipped with a self-setting brake applied to the motor 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 cautions for avoiding hazards in using rigging equipment:

(1) Hooks must have no cracks or other deformation. The rated capacity of the hooks must be equal to that of the chain. Job (i.e., shop) hooks or makeshift fasteners constructed from bolts, rods, etc., must not be used.

(2) Rope slings, including end connections, may not have excessive wear, broken wires, kinks or twists.

(3) All hoisting equipment, slings, webbing and rope cable must be inspected visually every day for unusual wear and serviceability.

(4) Protruding ends of strands in splices or slings and bridles must be coffered or blunted.

(5) Wire rope must not be tied or secured with knots.

(6) An eye splice made in any wire rope may not have less than three full tucks.

(7) 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.

(8) Manila rope must be used in accordance with manufacturer's recommendations. Knots may not be used in lieu of splices.

(9) 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).