

Machine Shops Manual



Ohio

Bureau of Workers' Compensation

Introduction

BWC's Division of Safety & Hygiene identified machine shops as one of the most hazardous industries in Ohio. This manual identifies its safety and health workplace concerns and summarizes effective accident-prevention principles and techniques. It also provides management and employers with information to help them work safely, and enables safety teams to meet their goals and obligations.

Machine shop work generally includes all cold-metal work by which an operator, using either power-driven equipment or hand tools, removes a portion of the metal and shapes it to a specified form or size. Machine tools are power-driven equipment designed to drill, bore, grind, or cut metal or other material.

BWC realizes companies within this industry have individual needs and that not all the information presented here is pertinent to every employer. However, by improving safety and preventing accidents, you can protect your work force, and at the same time reduce your workers' compensation costs.

The combination of proactive safety strategies outlined in this manual and a hands-on claims management will help you reduce injuries and lower costs. However, this manual is not all encompassing and is not a document for compliance. You must make safety and health programs individualized to meet your specific needs.

BWC's goal is to help companies eliminate incidents and injuries while reducing workers' compensation expenses. You can learn more about other safety services BWC offers offered by visiting ohiobwc.com or calling 1-800-OHIOBWC to request a Safety Services Catalog.

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Chapter 1

Hand tools

Hand tools are non-powered tools, including wrenches, hammers, chisels and screwdrivers. While hand-tool injuries tend to be less severe than power-tool injuries, hand-tool injuries are more common. Contributing factors that cause the most common hand-tool accidents:

- Failure to use the right tool;
- Failure to use a tool correctly;
- Failure to keep edged tools sharp;
- Failure to replace or repair a defective tool;
- Failure to store tools safely.

Safety guidelines

- Wear safety glasses whenever you hammer or cut, especially when working with surfaces that chip or splinter.
- Do not use a screwdriver as a chisel. The tool can slip and cause a deep puncture wound.
- Do not use a chisel as a screwdriver. The tip of the chisel may break and cause an injury.
- Do not use a knife as a screwdriver. The blade can snap and injure an eye.
- Never carry a screwdriver or chisel in your pocket. If you fall, the tool can cause a serious injury. Instead, use a tool belt holder.
- Replace loose, splintered, or cracked handles. Loose hammer, axe or maul heads can fly off defective handles.
- Use the proper wrench to tighten or loosen nuts. Pliers can chew the corners off a nut.
- Always chip or cut away from yourself when using a chisel. Use a soft-headed hammer or mallet to strike a wooden chisel handle. A metal hammer or mallet may cause the handle to split.
- Do not use a wrench if the jaws are sprung.
- Do not use impact tools, such as chisels, wedges or drift pins, if their heads are mushroom shaped. The heads may shatter upon impact.
- Direct saw blades, knives, and other tools away from aisle areas and other employees.
- Keep knives and scissors sharp. Dull tools are more dangerous than sharp tools.
- Iron or steel hand tools may cause sparks and be hazardous around flammable substances. Use spark-resistant tools made from brass, plastic, aluminum or wood when working around flammable hazards.

Improper tool storage is responsible for many shop accidents, so:

- Have a specific place for each tool;
- Do not place unguarded cutting tools in a drawer;
- Store knives or chisels in their scabbards;
- Hang saws with the blades away from someone's reach;
- Provide sturdy hooks to hang (or storage area for tools) most tools on;
- Rack heavy tools, such as axes and sledges, with the heavy end down.

Chapter 2

Ladders

Ladders come in different styles, including step, straight and extension. They also vary in construction and may consist of wood, aluminum or fiberglass. Choose the correct type and size ladder for the job. Type I or IA ladders are required in the work environment.

All ladders sold within the United States are rated as:

- Type I or IA: Heavy-duty industrial ladder rated to hold up to 50 or 300 pounds, respectively;
- Type II: Medium-duty commercial ladder rated to hold up to 225 pounds;
- Type III: Light-duty household ladder rated to hold up to 200 pounds.

Safety guidelines

- Always inspect a ladder before you climb it. Make sure the steps are sturdy and the locking mechanisms are functional.
- Carry ladders horizontally with the front end slightly higher than the back end.
- To open a stepladder, make sure you lock the spreader and place the pail shelf in position. To open an extension ladder, brace the bottom end and push the rungs or rails out.
- Place ladders on a solid, level surface to ensure safety.
- Watch for overhead obstructions and power lines.
- To prevent ladders from sinking into soft ground, use a large board under the feet of the ladder.
- Position a straight or extension ladder so that its base is 1 foot away from the vertical support for every 4 feet of working ladder height (e.g., if you are working with eight feet of ladder, place the base of the ladder 2 feet from the wall).
- Do not place the top of a ladder against a window or an uneven surface.
- Tie the top of a straight or extension ladder to supports when possible. Stake and tie the feet of the ladder.
- An extension ladder used for access to a roof must extend at least 3 feet beyond the support point.
- Use a wooden or fiberglass ladder if you must work near electrical sources.
- Do not place a ladder in front of a door unless you lock and barricade the door, and post a warning sign on the opposite side of the door.
- Use good judgment when climbing or working on ladders.
- Wear shoes with slip-resistant soles and make sure they are dry before climbing.
- Never allow more than one person on a ladder.
- Face the ladder and firmly grip the rails, not the rungs, with both hands when climbing or descending.
- Keep your body between the rails at all times. Do not shift your weight to one side.
- Have somebody steady the ladder if you cannot secure it otherwise.
- Do not stand on the top four rungs of an extension ladder or the top two rungs of a step ladder.
- Keep two feet and one hand on the ladder at all times when working on a ladder.
- Do not stand on the bucket shelf of a ladder.
- Carry small tools on a tool belt when working on a ladder. Use a rope to raise and lower heavy tools.
- Never leave a raised or open ladder unattended.
- Store ladders away from heat and moisture. Destroy damaged or unsafe ladders.

Chapter 3

Power tools

Common accidents associated with power tools include abrasions, cuts, lacerations, amputations, burns, electrocutions and broken bones. Contributing factors include that often cause these accidents include:

- Touching the cutting, drilling or grinding components;
- Getting caught in moving parts;
- Suffering electrical shock due to improper grounding, equipment defects or operator misuse;
- Particles striking the operator that normally eject during operation;
- Touching hot tools or work pieces;
- Falling in the work area;
- Falling tools striking a worker.

Safety guidelines

- Use the correct tool for the job.
- Select the correct bit, blade, cutter or grinder wheel for the material at hand. This precaution will reduce the chance for an accident and improve the quality of your work.
- Keep all guards in place. Cover exposed belts, pulleys, gears and shafts that can cause injury.
- Always operate tools at the correct speed for the job at hand. Working too slowly can cause an accident just as easily as working too fast.
- Watch your work when operating power tools. Stop working if you are distracted.
- Do not rely on strength to perform an operation. The correct tool, blade and method should not require excessive strength. If you have to use undue force, you may be using the wrong tool or have a dull blade.
- Disconnect from power source before clearing jams or blockages on power tools. Do not use your hand to clear jams or blockages; use an appropriate tool.
- Never reach over equipment while it is running.
- Never disable or tamper with safety releases or other automatic switches.
- Use a push stick to move material through a machine when the chance for operator injury is great.

- Disconnect power tools before performing maintenance or changing components.
- Remove chuck keys or adjusting tools prior to operation.
- Keep bystanders away from moving machinery.
- Do not operate power tools when you are sick, fatigued or taking strong medication.
- Secure work pieces with a clamp or vise to free the hands and minimize the chance of injury when possible. Use a jig for pieces that are unstable or do not lie flat.
- Never wear gloves, loose clothing, jewelry, etc. when working with power tools.

Drill presses

- Securely fasten work materials to prevent spinning. Never use your hands to secure work materials.
- Use a center punch to score the material before drilling.
- Run the drill at the correct speed. Forcing or feeding too fast can break drill bits.
- Never attempt to loosen the chuck unless the power is off.
- Lower the spindle before removing a chuck.
- Never use a regular auger bit in a drill press.
- Frequently back the drill out of deep cuts to clean and cool the bit.
- Secure or anchor portable drills.
- Never wear gloves, loose clothing, jewelry, etc. when working with a drill press.
- Guard the point of operation on all drill presses. This includes the spindle, chuck, and belt and pulley system.

Grinders

- Ensure no combustible or flammable materials are nearby that sparks from the grinder wheel can ignite.
- Ensure a guard covers at least 270 degrees of the grinding wheel on bench-mounted machines.

- Place the upper peripheral guard (tongue guard) one-fourth inch above the grinding wheel for bench or pedestal grinders.
- Place the grinder tool rest one-eighth inch from the wheel and slightly above the center line.
- Allow the grinder to reach full speed before stepping into the grinding position. Faulty wheels usually break at the start of an operation.
- Grind on the face of the wheel, unless otherwise designed.
- Use a vise-grip plier or clamp to hold small pieces.
- Slowly move work pieces across the face of wheel in a uniform manner. This will keep the wheel sound.
- Do not grind non-ferrous materials.
- Periodically check grinder wheels for soundness. Suspend the wheel on a string and tap it. If the wheel rings, it is probably sound.
- Replace badly worn or cracked wheels.
- Never use a dropped wheel or one that received a heavy blow, even if there is no apparent damage.
- Before using a new wheel, run it a few seconds at full speed to ensure it is balanced.
- Secure or anchor in place, pedestal or bench grinders.
- Never wear gloves, loose clothing, jewelry, etc. when working with grinders.
- Use a faceshield in addition to eye protection when using a grinder for any operation.

Lathes

- Examine wood for knots and other defects before placing it in the lathe.
- Ensure that glued materials are set before placing them in the lathe.
- Ensure that appropriate chuck guards and chip guards are in place prior to starting the machine.
- Slowly turn rough materials a few times to ensure they will clear the tool rest before turning the lathe on.

- Keep hands off the chuck rim when the lathe is moving.
- Start jobs at the lowest speed. Ensure materials are in a cylindrical form before advancing to higher speeds. Never turn large diameter materials at a high speed.
- Firmly screw faceplate work to the faceplate. Take care to avoid cutting too deep and hitting the screws.
- Do not cut too deep or scrape too long.
- Remove the T rest when sanding or polishing.

Safety guidelines for metal lathes

- Make sure that all gear and belt guards are in place.
- Never leave a chuck wrench in a chuck.
- Keep your hands off chuck rims when a lathe is in operation.
- Do not attempt to screw the chuck onto the lathe spindle with the power on, as it may get cross-threaded and cause injury. Stop the machine, place a board under the chuck, and then screw on by hand.
- Properly adjust steady rests to conform to the material you are working on.
- Always face the head stock and chuck when filing work in a lathe.
- Properly clamp the tailstock, toolholder and work before turning on power.
- Never attempt to adjust a tool while the lathe is running.
- Never apply a wrench to revolving work or parts.
- Always use a brush to remove chips; never your hands.
- Use pipe sleeves to cover work protruding from the end of the lathe when possible.
- Remove the tool bit before you remove your work from the lathe.

Pneumatic fastening tools

Compressed air powers nail guns and air guns. The main danger associated with pneumatic fastening tools is injury from one of the tool's attachments or fasteners.

- Ensure you equip pneumatic tools that shoot nails, rivets or staples with a device that keeps fasteners from ejecting unless you press the muzzle against a firm surface.

- Never point a tool at items you do not want to fasten.
- Keep your finger off the trigger until you are ready to begin work. Most pneumatic tools have a hair trigger that requires little pressure to activate the gun.
- Treat air hoses with the same care as an electrical cord.
- Do not drive fasteners into hard, brittle surfaces or areas where the fastener may pass through the material and protrude on the other side.
- Train all operators of pneumatic fastening tools according to the manufacturers' guidelines prior to operation of the equipment.

Forging machines

Once activated, you cannot stop punchers, shears and benders, until the end of a cycle. Use extreme care when working with these tools.

- Maintain all forge shop equipment that ensures continued safe operation.
- Position or install all hammers so they remain on or anchored to foundations sufficient to support them according to applicable engineering standards.
- Make die keys and shims from a grade of material that will not unduly crack or splinter.
- Clearly identify and make readily accessible all manually operated valves and switches.
- Make sure every steam or air hammer has a safety cylinder head to act as a cushion if the rod breaks or pulls out of the ram.
- Airlift hammers must have a safety cylinder head. When changing dies or performing maintenance on the press, ensure that the:
 - Lock out and tag out power to the press;
 - Verify that all energy sources are at a zero energy state;
 - Flywheel is at rest;
 - Block ram with a material of the appropriate strength;
- Install upsetters so they remain on their supporting foundations.

Flammable and combustible liquids

Statistics indicate more than 21 percent of industrial fires and 15 percent of office fires start with the ignition of a flammable or combustible liquid. Contributing factors include:

- Lack of a fire prevention program;
- Improper container storage;
- No storage limits;
- Inadequate employee training;
- Inadequate bonding and grounding procedures;
- Lack of interaction with local emergency management agencies;
- No preventive-maintenance program for emergency equipment and devices;
- No procedures to control ignition sources during maintenance and contractor activities;
- No established hot work procedures, and a no smoking policy.

Flammable and/or combustible liquids are substances that catch fire and burn easily. Flammable liquids continue to burn even after you remove the ignition sources. Determine the flammability of a combustible liquid by the following factors:

- Flash point — the lowest temperature at which vapors or gases will ignite;
- Fire point — the temperature at which a combustible liquid gives off vapors that will ignite;
- Minimum concentration of extinguishing agents needed to extinguish the fire;
- Combustion rate;
- Temperature increase during combustion.

Employees need to know the various sources that might ignite flammable liquid vapors. They include, but are not limited to the following:

- Open flames;
- Electrical switches;
- Open motors;
- Static electricity;
- Smoking;
- Friction and mechanical sparks;
- Heat guns;
- Cutting and welding;
- Radiant heat.

Standard operating procedures should limit the amounts of any given flammable liquids stored on-site and in the work area. Develop storage strategies by considering daily usage requirements, storage capacity and delivery time. Permit only a limited amount of flammable liquids outside approved storage areas or containers. Limit the amount of flammable liquids outside an approved storage container or room to the following: 5 gallons of Class IA, 10 gallons of Class IB, IC, Class II, or Class III. Permit no more than one day's supply of combustible/flammable liquids in spraying areas.

Only trained and authorized employees should handle and dispense flammable materials. You must properly label, design for flammable liquids and equip with flame arrestors containers. When dispensing flammable liquids from containers, effectively bond and ground the containers. Place no smoking signs where you store or use flammable liquids for operations.

Incorporate general exhaust ventilation for storage locations housed inside facilities. The ventilation system should include low-level venting, approximately 12 inches above the floor level. Federal safety standards require six room-air changes per hour.

Hazard communication standard

According to the Occupational Safety and Health Administration's (OSHA's) hazard communication standards, employers must conduct an inventory of all chemicals in their facility. They must also obtain material safety data sheets (MSDSs) for each chemical identified. In addition, employers should develop a written plan that identifies specific standard procedures for handling chemicals, storage of chemicals and required protective equipment. Employers and employees should verify all containers are labeled properly. Employers also must provide training for each employee regarding the safety handling of the chemicals in their work environment.

- Follow the instructions on the label and in the MSDS for each chemical product used in your work place.
- Use personal protective clothing or equipment, such as neoprene gloves, rubber boots, shoe covers, rubber aprons and protective eyewear, when using chemicals labeled flammable, corrosive, caustic or poisonous.
- Do not use protective clothing or equipment that has split seams, pin holes, cuts, tears or other signs of visible damage.
- Always wash your hands with soap and water after using cutting fluids or solvents.
- Each time you use your gloves, wash your gloves before removing them, using cold tap water and normal hand washing motion. Always wash your hands after removing your gloves.
- Only dispense liquid labeled flammable from its bulk container located in areas posted flammable liquid storage.
- Do not use chemicals from unlabeled containers.

Do not perform hot work, such as metal cutting or other spark producing operations, within 50 feet of containers labeled flammable or combustible.

Welding and cutting

Welding and cutting are two forms of hot work that require special safety considerations. Unless done in a designated shop area, strictly prohibit welding and cutting without proper authorization. Before conducting welding or cutting operations, make sure:

- Welding leads are completely insulated and in good condition;
- Cutting tools are leak-free and equipped with proper fittings, gauges, regulators and flow and flashback devices;
- You have secured oxygen and acetylene tanks in a safe place.

In addition:

- Conduct welding and cutting operations in a designated area free from flammable materials. When welding or cutting is necessary in an undesignated or hazardous area, obtain a hot work permit from management. Have someone nearby act as a fire attendant. The permit should include a review and inspection of work area by a supervisor, ensure a fire extinguisher is in the vicinity and have a 30-minute fire watch in place during and after work is completed. Remove or cover all combustible/flammable liquids.
- Periodically check welding and cutting areas for combustible atmospheres;
- Take care to prevent sparks from starting a fire;
- Remove unused gas cylinders from the welding and cutting area;
- Keep hoses out of doorways and away from other people. A flattened hose can cause a flashback;
- Mark hot metal with a sign or other warning when welding or cutting operations are complete.

Welding guidelines

Proper selection of personal protective equipment (PPE) is important when welding. Make sure the welding helmet visor is dark enough to provide adequate protection. Wear fireproof apron and gloves. In addition, protect other people from the hazards of welding. For example, use a welding curtain to protect other employees from UV radiation.

There are three types of welders:

- AC welders used for standard welding procedures and are powered by an electrical cord;
- DC welders are portable welders commonly used in manholes. DC welders have their own power supply;
- Wire-feed welders use inert gas for light metalwork (e.g., stainless steel, aluminum, etc.).

Common hazards associated with welding include:

- Electrocutation;
- Burns;
- UV radiation exposure;
- Oxygen depletion;
- Sparking.

In addition to the general guidelines for welding and cutting:

- Make sure the welding area has a non-reflective, noncombustible surface;
- Ensure adequate ventilation and exhaust are available;
- Be aware of electrocution hazards, particularly in damp conditions. Ensure to ground electrical cords properly. Use cords that pull down from an overhead pulley;
- Use welding curtains or welding screens to protect and shield other workers, and visitors from UV rays.

Cutting guidelines

Oxygen or acetylene gas cylinders usually power gas welding and cutting tools. These tanks require special safety precautions to prevent explosions and serious injuries.

- Ensure acetylene/oxygen systems are equipped with flame or flashback arrestors.
- Store acetylene bottles upright and securely.
- Keep cylinder fittings and hoses free from oil and grease.
- Repair or replace defective hoses by splicing. Do not use tape.
- Do not tamper or attempt to repair cylinders, valves or regulators.
- Do not interchange regulators or pressure gauges with other gas cylinders.

Compressed gas cylinders

- Carefully purge hoses and torches before connecting a cylinder.
- Set acetylene pressure at or below 15 psig. Always use the minimum acceptable flow rate.
- Never use a match to light a torch. Use an approved lighter.
- Do not store oxygen and fuel gas together. Safety standards require oxygen and fuel gas to be separated by at least 20 feet or by a noncombustible barrier at least five-feet high having a fire resistance of at least 30 minutes.
- According to the American National Standards Institute (ANSI) Z49.1, cylinder storage refers to cylinders of compressed gas standing by on the site (not those in use or attached ready for use).
- Cylinder in use — refers to cylinders connected for use, a single cylinder for each gas you will use, in the use location, ready to be connected, or a one-day supply of cylinders, in the use location, ready to be connected.
- Separate cylinders in storage from flammable and combustible liquids, and from easily ignited materials. These include wood, paper, packaging materials, oil and grease.

The in-plant handling, storage and use of all compressed gases in cylinders, portable tanks, rail tank cars or motor vehicle cargo tanks must be in accordance with the Compressed Gas Association Pamphlet P-1.

- Do not handle oxygen cylinders if your gloves are greasy or oily.
- Store all compressed gas cylinders in the upright position.
- Place valve-protection caps on stored or not in use compressed gas cylinders.
- Do not lift compressed gas cylinders by the valve-protection cap.
- Do not store compressed gas cylinders in areas where they can meet chemicals labeled corrosive.
- Hoist compressed gas cylinders on the cradle, slingboard, pallet or compressed gas cylinder basket.
- Do not place compressed gas cylinders against electrical panels or live electrical cords where the cylinder can become part of the circuit.

Personal protective equipment

Engineering controls that eliminate the hazard at the source offer the best and most reliable means of safeguarding. However, whenever engineering controls are not available or fully capable of protecting employees, they must wear protective clothing or PPE. Employers must perform a PPE hazard assessment for their work place and determine if PPE is required. If PPE is required, employers must identify each type of PPE required, and the specific task or operations that requires PPE. The employer must certify and date the assessment. In addition, the employer must provide training to each employee on the specific type of PPE required in the work environment.

To provide adequate protection, protective clothing and equipment must always be:

- Appropriate for the particular hazards;
- Maintained in good condition;
- Properly stored when not in use, to prevent damage or loss;
- Kept clean, fully functional, and sanitary.

Eye protection

Make sure that employees use appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially dangerous light radiation.

Ensure each affected employee uses eye protection that provides side protection when there is a hazard from flying objects. Detachable side protectors (e.g. clip-on or slide-on side shields) meeting the pertinent requirements are acceptable.

Employees who wear prescription lenses while engaged in operations involving eye hazards should wear:

- Eye protection that incorporates the prescription in its design; or
- Eye protection that employees can fit over prescription lenses. This eye protection must not disturb the proper position of the prescription lenses or the protective lenses.

Protective eye and face devices must comply with ANSI Z87.1, "American National Standard Practice for Occupational and Educational Eye and Face Protection."

Hearing protection

Administer a continuing, effective hearing conservation program whenever employee noise exposures equal or exceed an eight-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale (slow response) or equivalently, a dose of 50 percent. For a hearing conservation program, compute employee noise exposures in accordance with appropriate references, without regard to any attenuation provided by the use of PPE.

Make hearing protectors available to all employees exposed to an eight-hour TWA of 85 decibels or greater at no cost to the employees. Replace hearing protectors as necessary.

Respiratory protection

The primary objective of controlling atmospheric contamination is to prevent occupational diseases caused by breathing contaminated air. Contaminates can include harmful dusts, fogs, fumes, mists, gases, smoke, sprays or vapors. You should accomplish this as by using accepted engineering control measures. For example, consider the enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials. When effective engineering controls are not feasible or while you are instituting them, use appropriate respirators.

Develop and implement a written respiratory protection program with required work site-specific procedures and elements for required respirator use. A suitably trained program administrator must administer the program. In addition, certain program elements are required for voluntary use of respirators to prevent hazards associated with respirator use. Requirements include fit-testing, employee training, including maintenance, cleaning and care, respirator limitations and verification that the respirator will protect against contaminant of concern.

Head protection

Ensure affected employees wear protective helmets when working in areas where there is a potential for injury to the head from falling objects. Make sure the helmet reduces electrical shock hazard when exposed to electrical conductors that could contact the head.

Foot protection

Make sure affected employees use protective footwear when working in areas where there is a danger of foot injuries. Dangers could include falling or rolling objects, objects piercing the sole and where employees expose their feet to electrical hazards. Purchased protective footwear marked to indicate that they meet ANSI Z41 standard for protective footwear.

Hand and finger protection

Select and require employees to use appropriate hand protection when exposing their hands to hazards. Hazards can include those from skin absorption of harmful substances, severe cuts or lacerations, severe abrasions, punctures, chemical burns and harmful temperature extremes.

Housekeeping

Keep all places of employment, passageways, storerooms, and service rooms clean and orderly and in a sanitary condition.

Maintain every workroom floor in a clean and as far as possible, dry condition. Where using wet processes, maintain drainage and provide false floors, platforms, mats, or other dry standing places where practicable.

To facilitate cleaning, keep every floor, working place and passageway free from protruding nails, splinters, holes or loose boards.

Where you use mechanical handling equipment, allow sufficient safe clearances. You must make a minimum of 3 feet available for aisles, at loading docks, through doorways and wherever turns or passage. Keep aisles and passageways clear and in good repairs with no obstruction across or in aisles that could create a hazard. Appropriately mark permanent aisles and passageways.

Provide covers and/or guardrails to protect personnel from the hazards of open pits, tanks, vats, ditches, etc.

Compressed air used for cleaning

Do not use compressed air for cleaning equipment unless you reduce the pressure for the equipment to 30 psi or less and proper protective equipment is in place. Employees should never use compressed air to clean or blow debris from their person.

Emergency action plans

An emergency action plan should be in writing and cover designated actions employers and employees must take to ensure employee safety from fire and other emergencies. Employers with 10 or fewer employees can communicate the plan orally to employees.

At a minimum, include these elements in the plan:

- Emergency escape procedures and emergency escape route assignments;
- Procedures for employees who remain to operate critical plant operations before they evacuate to follow;
- Procedures to account for all employees after completing emergency evacuation;
- Rescue and medical duties for those employees who are to perform them;
- The preferred means of reporting fires and other emergencies;
- Names or regular job titles of persons or departments who officials can contact for further information or explanation of duties under the plan.

Establish an employee alarm system that complies with appropriate regulations. If you use the employee alarm system for alerting fire brigade members or for other purposes, use a distinctive signal for each purpose.

Establish in the emergency action plan the types of evacuation to use in emergency circumstances. Before implementing the emergency action plan, designate and train a sufficient number of persons to assist in the safe and orderly emergency evacuation of employees.

Means of egress

- Identify all exits.
- Provide emergency lighting in accordance with local building codes.
- Never lock, block, etc., exit access and exits.
- Identify all non-exit doors.

Review the plan with each covered employee under the following circumstances:

- When you develop the plan;
- Whenever the employee's responsibilities or designated actions under the plan change;
- Whenever you change the plan.

Review with employees upon initial assignment those parts of the plan that they must know to protect themselves in an emergency. Keep the written plan at the workplace, and make it available for employee review.

Fire prevention plan

Maintain a written fire prevention plan.

Employers with 10 or fewer employees may orally communicate the plan to employees.

At a minimum, include these elements in the fire prevention plan:

- A list of the major work-place fire hazards and their proper handling and storage procedures, and potential ignition sources (such as welding, smoking and others). Also, include their control procedures and the type of fire protection equipment or systems, which can control a fire involving them;
- Names or regular job titles of those personnel responsible for maintenance of equipment and systems installed to prevent or control ignitions or fires;
- Names or regular job titles of those personnel responsible for control of fuel source hazards.

Control accumulations of flammable and combustible waste materials and residues so they do not contribute to a fire emergency. Include housekeeping procedures in the written fire prevention plan.

Apprise employees of the fire hazards of the materials and processes to which they are exposed. Review with employees upon initial assignment those parts of the fire prevention plan they must know to protect themselves in an emergency.

Regularly and properly, maintain equipment and systems installed on heat-producing equipment. This will help prevent accidental ignition of combustible materials. Include maintenance procedures in the written fire prevention plan. Identify fire extinguishers and free them from obstruction. Inspect extinguishers visually in-house on a monthly basis. Have an outside service company provide an annual inspection. Train any employee designated to use a fire extinguisher on an annual basis.

Exhaust ventilation system

Make sure the system for removing contaminated air from a space comprises two or more of the following elements:

- Enclosure or hood;
- Duct work;
- Dust collecting equipment, exhauster and discharge stack.

The construction, installation, inspection and maintenance of exhaust systems must conform to the principles and requirements in American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2, and ANSI Z33.1.

Materials handling and storage

If using mechanical handling equipment, you must allow sufficient safe clearances for aisles, at loading docks, through doorways and wherever turns or passage. Keep aisles and passageways clear and in good repair, with no obstruction across or in aisles that could create a hazard. Mark permanent aisles and passageways appropriately.

Do not allow storage of material to create a hazard. If you stock bags, bundles and other containers, stack, block and interlock in tiers with limited height so that they are stable and secure against sliding or collapse.

Keep storage areas free from accumulation of materials that constitute hazards from tripping, fire, explosion or pest refuge. Control vegetation when necessary.

Provide signs to warn of clearance limits.

Provide derail and/or bumper blocks on spur railroad tracks where a rolling car can contact other cars, enter a building, work or traffic area.

Provide covers and/or guardrails to protect personnel from the hazards of open pits, tanks, vats, ditches and other hazards.

Chapter 9

Powered industrial trucks

All new powered industrial trucks must meet the design and construction requirements for powered industrial trucks established in the American National Standard for Powered Industrial Trucks, Part II, ANSI B56.1. A label or other identifying mark on approved trucks must indicate approval by the testing laboratory.

Any modifications and additions that affect capacity and safe operation performed by the customer or user must have the manufacturer's prior written approval. Change capacity, operation and maintenance instruction plates, tags or decals, accordingly.

Do not use power-operated industrial trucks in atmospheres containing hazardous concentration of chemicals or dusts. Refer to appropriate standards for a specific list of hazards and for the types (designations) of powered industrial trucks that you can use.

Store and handle liquid fuels, such as gasoline and diesel fuel in accordance with National Fire Protection Association Flammable and Combustible Liquids Code (NFPA No. 30). Store and handle liquefied petroleum gas fuel in accordance with NFPA Storage and Handling of Liquefied Petroleum Gases (NFPA No. 58).

Designate battery-charging installations in areas designed for that purpose. Provide facilities for flushing and neutralizing spilled electrolyte for fire protection. Also, provide facilities for protecting charging apparatus from damage by trucks and for adequate ventilation for dispersal of fumes from gassing batteries. Provide a conveyor, overhead hoist or equivalent material handling equipment for handling batteries. Properly position and secure reinstalled batteries in the truck. Provide a carboy tilter or siphon for handling electrolyte. When charging batteries, pour acid into water, not water into acid.

Properly position trucks and apply brakes before attempting to change or charge batteries. Take care to ensure that vent caps are functioning. Open the battery (or compartment) cover(s) to dissipate heat. Do not permit smoking in the charging area.

Take precautions to prevent open flames, sparks or electric arcs in battery charging areas. Keep tools and other metallic objects away from the top of uncovered batteries.

Provide adequate lighting on the truck.

Make sure concentration levels of carbon monoxide gas created by powered industrial truck operations do not exceed the specified levels.

Set the brakes of highway trucks. Place wheel chocks under the rear wheels to prevent the trucks from rolling during the loading of powered industrial trucks. You may need fixed jacks to support a semi-trailer and prevent upending during the loading or unloading when the trailer is not coupled to a tractor.

Provide wheel stops or other recognized positive protection to prevent railroad cars from moving during loading or unloading operations. Provide protection to prevent railroad cars from moving while dock boards or bridge plates are in position.

Operators must be competent to operate a powered industrial truck safely, as demonstrated by completion of training and evaluations.

Trainees may operate a powered industrial truck only:

- Under the direct supervision of someone who has the knowledge, training and experience to train operators and evaluate their competence;
- Where such operation does not endanger the trainee or other employees.

Training consists of a combination of formal and practical instruction. Formal instruction can include lecture, discussion, interactive computer learning, video tape and written material.

Practical instruction can include demonstrations the trainer performs and practical exercises trainees perform, and evaluation of the operator's performance in the work place. Persons who have the knowledge, training and experience to train powered industrial truck operators and evaluate their competence conduct all operator training and evaluation.

Powered industrial truck operators receive initial training in truck-related topics and work-place-related topics except where the employer can demonstrate topics are not applicable in the employer's work place.

Truck-related topics

- Operating instructions, warnings and precautions for the truck types the employer will authorize the employee to operate
- Differences between the truck and the automobile
- The location of truck controls and instrumentation, what they do and how they work
- Engine or motor operation
- Steering and maneuvering
- Visibility (including restrictions due to loading)
- Fork and attachment adaptation, operation and use limitations
- Vehicle capacity and stability
- Any vehicle inspection and maintenance that the operator must perform
- Refueling and/or charging and recharging of batteries
- Operating limitations
- Any other operating instructions, warnings or precautions listed in the operator's manual for the types of vehicle the employer is training the employee to operate

Work-place-related topics include

- Surface conditions where the employee will operate the vehicle
- Load composition and load stability
- Load manipulation, stacking, and unstacking
- Pedestrian traffic in areas where the employee where operate the vehicle
- Narrow aisles and other restricted places where the employee will operate the vehicle
- Hazardous (classified) locations where the employee will operate the vehicle

- Ramps and other sloped surfaces that could affect the vehicle's stability
- Closed environments and other areas where insufficient ventilation or poor vehicle maintenance can cause a buildup of carbon monoxide or diesel exhaust
- Other unique or potentially hazardous environmental conditions in the work place that might affect safe operation

Conduct refresher training, including an evaluation of the effectiveness of that training. This will ensure the operator has the knowledge and skills needed to operate the powered industrial truck safely. Provide refresher training in relevant topics when:

- You or others observe the employee operating the vehicle in an unsafe manner;
- The operator is involved in an accident or near-miss incident;
- The operator receives an evaluation that reveals he or she is not operating the truck safely;
- You assign the employee to drive a different type of truck;
- A workplace condition changes that could affect safe operation of the truck.

Conduct an evaluation of each powered industrial truck operator's performance at least once every three years. In addition, conduct an evaluation if an employee is involved in an accident or a near miss.

If an operator has already received training in a topic previously specified, and the training is appropriate to the truck and working conditions encountered, no additional training in that topic is required if you evaluate the operator is competent to operate the truck safely.

Employers certify that he or she has trained and evaluated each operator as required. The certification includes the name of the operator, the date of the training, the date of the evaluation and the identity of the person(s) performing the training or evaluation.

General rules

- Do not drive trucks up to anyone standing in front of a bench or other fixed object.
- Do not allow anyone to stand or pass under the elevated portion of any truck, whether loaded or empty.
- Do not permit unauthorized personnel to ride on powered industrial trucks.
- Keep arms or legs from between the uprights of the mast or outside the running lines of the truck.

When leaving a powered industrial truck unattended, fully lower load-engaging means, neutralize controls, shut off power and set brakes. Block the wheels if parking the truck on an incline. A powered industrial truck is unattended when the operator is more than 25 feet away from the vehicle but remains in his view or whenever the operator leaves the vehicle and it is not in his or her view.

Maintain a safe distance from the edge of ramps or platforms while on any elevated dock, or platform or freight car. Do not use trucks for opening or closing freight doors.

Set brakes and put wheel blocks in place to prevent movement of trucks, trailers or railroad cars while loading or unloading. Fixed jacks may be necessary to support a semi-trailer during loading or unloading when you do not have trailer coupled to a tractor. Before driving onto trucks, trailers, and railroad cars, check the flooring for breaks and weakness.

Ensure there is sufficient headroom under overhead installations, lights, pipes, sprinkler system and other overhead obstructions.

Use an overhead guard as protection against falling objects. This guard offers protection from the impact of small packages, boxes, bagged material and other objects the operator might encounter but not the impact of a falling capacity load.

Use a load backrest extension whenever necessary to minimize the possibility of the load or part of it from falling rearward.

Use only approved industrial trucks in hazardous locations.

Whenever a truck is equipped with vertical only, or vertical and horizontal controls that you can elevate with the lifting carriage or forks for lifting personnel, take the following additional precautions to protect personnel:

- Use a safety platform firmly secured to the lifting carriage and/or forks;
- Provide means to allow personnel on the platform to shut off power to the truck;
- Provide protection from falling objects as indicated necessary by the operating conditions.

Keep fire aisles, access to stairways and fire equipment clear.

Observe all traffic regulations, including authorized plant speed limits. Maintain a safe distance, approximately three truck lengths from the truck ahead. Keep the truck under control at all times.

Yield the right of way to ambulances, fire trucks or other vehicles in emergencies. Do not pass other trucks traveling in the same direction at intersections, blind spots or other dangerous locations. Slow down and sound the horn at cross aisles and other locations, which obstruct vision. If the carried load obstructs forward view, travel with the load trailing.

Cross railroad tracks diagonally wherever possible. Do not park closer than 8 feet from the center of railroad tracks.

Look in the direction of and keep a clear view of the path of travel. Ascend or descend grades slowly. When ascending or descending grades in excess of 10 percent, drive loaded trucks with the load upgrade. Tilt back the load and load-engaging means on all grades if applicable, and raise the load only as far as necessary to clear the road surface.

Under all travel conditions, operate the truck at a speed that will permit you to bring the truck to a safe stop. Do not permit stunt driving and horseplay. Slow down for wet and slippery floors.

Properly secure dock boards or bridge plates before driving over them. Drive over dock boards and bridge plates carefully and slowly and do not exceed their rated capacity. Approach elevators slowly, and then enter squarely after leveling the elevator properly. Once on the elevator, neutralize the controls, shut off the power and set the brakes. Enter elevators or other confined areas with motorized hand trucks with load end forward. Avoid running over loose objects on the roadway surface.

Reduce speed to a safe level while negotiating turns by turning the hand steering wheel in a smooth, sweeping motion. Except when maneuvering at a very low speed, turn the hand steering wheel at a moderate, even rate. Handle only stable or safely arranged loads. Exercise caution when handling off-center loads that you cannot center. Handle only loads within the truck's rated capacity. Adjust the long or high (including multiple-tiered) loads that may affect capacity. Operate trucks equipped with attachments as partially loaded trucks when not handling a load.

Place a load engaging means under the load as far as possible; carefully tilt the mast backward to stabilize the load.

Use extreme care when tilting the load forward or backward, particularly when high tiering. Do not tilt forward with load engaging means elevated except to pick up a load. Do not tilt an elevated load forward except when the load is in a deposit position over a rack or stack. When stacking or tiering, use only enough backward tilt to stabilize the load.

If a powered industrial truck needs repair, is defective or in any way unsafe, take it out of service until restored to safe operating condition.

Turn the engine off while filling fuel tanks. Avoid spillage. But, if you spill any fuel or oil, carefully wash it away or make sure it has completely evaporated. Replace the fuel tank cap before restarting engine. Do not operate a truck until you have repaired any leaks in the fuel system. Do not use open flames to check the electrolyte level in storage batteries or gasoline level in fuel tanks.

Remove from service any power-operated industrial truck in unsafe operating condition. Have authorized personnel make all repairs. Repair problems with the fuel and ignition systems of industrial trucks that involve fire hazards only in locations designated for such repairs. If a truck needs repairs to the electrical system, disconnect the battery prior to such repairs.

Replace all parts of any industrial truck requiring replacement only with parts equivalent to those used in the original design. Do not alter industrial trucks so the relative positions of various parts are different from when originally received from the manufacturer; do not add extra parts not provided by the manufacturer or eliminate parts, except as provided in the appropriate standard. Do not add counterweights to fork trucks unless approved by the truck manufacturer.

Examine industrial trucks before placing them in service; if the examination shows any condition affecting the vehicle's safety, keep the vehicle out of service. Make these examinations at least daily. If using industrial trucks on a round-the-clock basis, examine them after each shift. Immediately report and correct any defects found.

Overhead and gantry cranes

A crane lifts and lowers a load, and moves it horizontally with the hoisting mechanism being an integral part of the machine. Cranes, whether fixed or mobile, are driven manually or by power. An overhead crane has a movable bridge carrying a movable or fixed hoisting mechanism and travels on an overhead fixed runway structure. A hoist may be a part of a crane, exerting a force for lifting or lowering. Rope refers to wire rope, unless otherwise specified.

All new overhead and gantry cranes have to meet the design specifications of the American National Standard Safety Code for Overhead and Gantry Cranes, ANSI B30.2.

You may modify and re-rate cranes if a qualified engineer or the equipment manufacturer checks the modifications and the supporting structure thoroughly for the new rated load. Test the crane in accordance with appropriate standards. Typically, you must load test the crane at 125 percent of designed capacity after modifications are completed on the equipment.

Mark the crane's rated load plainly on each side of the crane. If the crane has more than one hoisting unit, have its rated load marked on each hoist or its load block. Make sure this marking is clearly legible from the ground or floor.

Maintain a minimum clearance of 3 inches overhead and 2 inches laterally between crane and obstructions in conformity with Crane Manufacturers Association of America Inc.'s, Specification No. 61.

Inspect all cranes on a regular basis. Prior to initial use, inspect all new and altered cranes to insure compliance with provisions of federal and state safety requirements. Primarily, there are two types of inspections: frequent and periodic.

Perform frequent inspections on daily to monthly intervals. Inspect the following items for defects. Carefully examine all deficiencies and determine whether they constitute a safety hazard.

- Inspect all functional operating mechanisms for maladjustments interfering with proper operation daily.

- Inspect deterioration or leakage in lines, tanks, valves, drain pumps and other parts of air or hydraulic systems daily.
- Inspect hooks with deformation or cracks visually on a daily basis. Perform a documented monthly inspection.
- Inspect hoist chains and wire ropes visually on a daily basis. Perform a documented monthly inspection.

Conduct periodic inspections on one-to-12 month intervals. The periodic inspection should include all items identified in the frequent inspection and also include the following:

- Deformed, cracked or corroded members;
- Loose bolts or rivets;
- Cracked or worn sheaves and drums;
- Worn, cracked or distorted parts, such as pins, bearings, shafts, gears, locking and clamping devices;
- Excessive wear on brake system parts, linings, pawls and ratchets;
- Load, wind and other indicators over their full range for any significant inaccuracies;
- Gasoline, diesel, electrical or other power plants for improper performance or noncompliance with applicable safety requirements;
- Excessive wear of chain-drive sprockets and excessive chain stretch.

Allow only designated personnel to operate a crane. Locate all operating handles within convenient reach of the operator when he or she is facing the area to be served by the load hook, or while facing the direction of travel of the cab. The operator needs a full view of the load hook in all positions and should see clearly enough to perform his or her work with light within the cab. Locate the cab to afford a minimum of three inches clearance from all fixed structures within its area of possible movement.

Use a conveniently placed fixed ladder, stairs or platform requiring no step over any gap exceeding 12 inches to access the cab and/or bridge walkway. Make sure fixed ladders conform to the American National Standard Safety Code for Fixed Ladders, ANSI A14.3.

If sufficient headroom (a minimum of 48 inches) is available on cab-operated cranes, provide a foot walk on the drive side along the entire length of the bridge of all cranes having the trolley running on the top of the girders.

Design foot walks to sustain a distributed load of at least 50 pounds per square foot and have an antislip walking surface, toeboards and handrails in compliance with appropriate standards.

Gantry cranes require ladders or stairways extending from the ground to the foot walk or cab platform. They also must have stairways equipped with rigid and substantial metal handrails and antislip walking surfaces. Ladders must be permanently and securely fastened in place and comply with standards.

Provide cranes with bumpers or other automatic means with equivalent effect, unless the crane:

- Travels at a slow rate of speed and has a faster deceleration rate sleeve bearings;
- Is not operated near the ends of bridge and trolley travel;
- Is restricted to a limited distance by the nature of the crane operation and there is no hazard of striking any object in this limited distance;
- Is used in similar operating conditions.

Mount the bumper so there is no direct shear on bolts, and design and install the bumpers to minimize parts falling from the crane in case of breakage.

Provide trolleys with bumpers or other automatic means of equivalent effect, unless:

- The trolley travels at a slow rate of speed;
- You do not operate the trolley near the ends of a bridge and trolley travel;
- You restrict the trolley to a limited distance of the runway, and there is no hazard of striking any object in this limited distance;
- You use the trolley in similar operating conditions.

When operating more than one trolley on the same bridge, equip each with bumpers or equivalent on their adjacent ends. Design and install bumpers or equivalent to minimize parts falling from the trolley in case of age.

Equip bridge trucks with sweeps extending below the top of the rail and project in front of the truck wheels.

If hoisting ropes run near enough to other parts to make fouling or chafing possible, install guards to prevent this condition. Provide a guard to prevent contact between bridge conductors and hoisting ropes if they can come into contact.

Guard exposed moving parts, such as gears, set screws, projecting keys, chains, chain sprockets, and reciprocating components that can constitute a hazard under normal operating conditions; securely fasten the guards. Guards should support without permanent distortion, the weight of a 200-pound person unless the guard is located where it is impossible for a person to step on it.

Equip each independent hoisting unit of a crane with at least one self-setting brake or holding brake applied directly to the motor shaft or some part of the gear train. In addition, outfit each independent hoisting unit of a crane, except worm-gear hoists, the angle of whose worm prevents the load from accelerating in the lowering direction, with control braking means to prevent speeding.

Make sure holding brakes for hoist motors do not have less than the percentage of the full load hoisting torque at the point where the brake is applied.

- 125 percent when used with a control braking means other than mechanical.
- 100 percent when used in conjunction with a mechanical control braking means.
- 100 percent each if two holding brakes are provided.

Chapter 11

Slings

A sling is an assembly that connects the load to the material handling equipment. Whenever using any sling, observe these practices:

- Do not use damaged or defective slings;
- Do not shorten slings with knots or bolts, or other makeshift devices;
- Do not kink sling legs;
- Do not load slings in excess of their rated capacities;
- Balance the loads to prevent slippage when using slings in a basket hitch;
- Securely attach slings to their loads;
- Pad or protect slings from the sharp edges of their loads;
- Keep suspended loads clear of all obstructions;
- Keep all employees clear of loads you are about to lift and of suspended loads;
- Do not place hands or fingers between the sling and its load while tightening the sling around the load;
- Do not perform shock loading;
- Do not pull a sling from under a load when the load is resting on the sling.

Each day before using a sling, have a competent person designated by the employer inspect it and all fastenings and attachments for damage or defects. Perform additional inspections during sling use, where service conditions warrant. Remove damaged or defective slings from service immediately.

Permanently affix durable identification stating size, grade, rated capacity and reach on alloy steel chain slings.

Make sure hooks, rings, oblong links, pear-shaped links, welded or mechanical coupling links, or other attachments have a rated capacity at least equal to that of the alloy steel chain with which they are used. Do not use the sling in excess of the rated capacity of the weakest component.

Do not use makeshift links or fasteners formed from bolts or rods, or other such attachments.

In addition to the required inspection, make a thorough periodic inspection of alloy steel chain slings in use on a regular basis. Base the timetable on frequency of sling use; severity of service conditions; nature of lifts; and experience gained on the service life of slings used in similar circumstances. Make inspection intervals no longer than once every 12 months.

Create and maintain a record of the most recent month in which you thoroughly inspected each alloy steel chain sling, and have the record available for examination.

Make sure you designate a competent person to perform a thorough inspection of alloy steel chain slings. Make sure you inspect wear, defective welds, deformation and increase in length. If defects or deterioration are present, immediately remove the sling from service.

Ensure before use, the sling manufacturer or equivalent entity proof tests each new, repaired or reconditioned alloy steel chain sling, including all welded components in the sling assembly, in accordance with paragraph 5.2 of the American Society of Testing and Materials Specification A391.

Do not use alloy steel chain slings with loads in excess of the rated capacities prescribed. Use slings not included in tables only in accordance with the manufacturer's recommendations.

Permanently remove alloy steel chain slings from service if they heated above 1,000 degrees. When exposing slings to service temperatures in excess of 600 degrees, reduce the maximum working load limits permitted in accordance with the chain or sling manufacturer's recommendations.

Do not use worn or damaged alloy steel chain slings or attachments until repaired. When welding or heat testing is performed, do not use slings unless repaired, reconditioned and proof tested by the sling manufacturer or an equivalent entity.

Do not use mechanical coupling links or low carbon steel repair links to repair broken lengths of chain. If the chain size at any point of any link is less than that stated in appropriate tables, remove the sling from service.

Remove from service alloy steel chain slings with cracked or deformed master links, coupling links or other components.

Immediately remove wire rope slings from service if any of these conditions are present:

- Five broken wires in one strand in one rope lay or 10 randomly distributed broken wires in one rope lay;
- Wear or scraping of one-third the original diameter of outside individual wires;
- Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure;
- Evidence of heat damage;
- Cracked, deformed or worn end attachments;
- Hooks opened more than 15 percent of the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook;
- Corrosion of the rope or end attachments.

Metal mesh slings

Permanently affix to each metal mesh sling a durable marking stating the rated capacity for vertical basket hitch and choker hitch loadings.

Make sure handles have a rated capacity at least equal to the metal fabric and exhibit no deformation after proof testing.

Join the fabric and handles so that:

- You do not reduce the rated capacity of the sling;
- You evenly distribute the load across the width of the fabric;
- Sharp edges will not damage the fabric.

Do not apply coatings that diminish the sling's rated capacity.

Do not use new and repaired metal mesh slings, including handles, unless proof tested by the manufacturer or equivalent entity at a minimum of one and one-half times their rated capacity. Proof test elastomer impregnated slings before coating.

Do not use metal mesh slings to lift loads in excess of their rated capacities as prescribed. Use slings not included in tables only in accordance with the manufacturer's recommendations.

You may use metal mesh slings not impregnated with elastomers in a temperature range from minus 20 degrees to plus 550 degrees without decreasing the working load limit. You may use metal mesh slings impregnated with polyvinyl chloride or neoprene in a temperature range from zero degrees to plus 200 degrees. For operations outside these temperature ranges or for metal mesh slings impregnated with other materials, follow the sling manufacturer's recommendations.

Do not use repaired metal mesh slings unless a metal mesh sling manufacturer or an equivalent entity repairs them. Once repaired, permanently mark or tag each sling, or maintain a written record to indicate the date and nature of the repairs and the person or organization that performed the repairs. Make records of repairs available for examination.

Immediately remove metal mesh slings from service if any of these conditions are present:

- A weld or brazed joint is broken along the sling edge;
- A reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion;
- A lack of flexibility due to distortion of the fabric;
- A distortion of the female handle so that the depth of the slot is increased more than 10 percent;
- A distortion of either handle so that the width of the eye is decreased more than 10 percent;
- A 15-percent reduction of the original cross sectional area of metal at any point around the handle eye;
- A distortion of either handle out of its plane.

Natural and synthetic fiber rope slings

Do not use fiber rope slings made from conventional three-strand construction fiber rope with loads in excess of the rated capacities prescribed. Fiber rope slings require a diameter of curvature meeting at least the minimums specified. Use slings not included in tables only in accordance with the manufacturer's recommendations.

You may use natural and synthetic fiber rope slings, except for wet frozen slings, in a temperature range from minus 20 degrees to plus 180 degrees without decreasing the working load limit. For operations outside this temperature range and for wet frozen slings, follow the sling manufacturer's recommendations.

Do not use spliced fiber rope slings unless spliced in accordance with the following minimum requirements and in accordance with any additional recommendations of the manufacturer.

- In manila rope, eye splices consist of at least three full tucks, and short splices consist of at least six full tucks, three on each side of the splice center line.
- In synthetic fiber rope, eye splices consist of at least four full tucks, and short splices consist of at least eight full tucks, four on each side of the center line.

Do not trim strand end tails flush with the surface of the rope immediately adjacent to the full tucks. This applies to all types of fiber rope and both eye and short splices. For fiber rope less than 1 inch in diameter, make sure the tail projects at least six rope diameters beyond the last full tuck. For fiber rope 1 inch in diameter and larger, make sure the tail projects at least 6 inches beyond the last full tuck. If a projecting tail interferes with the use of the sling, taper the tail and splice it into the body of the rope using at least two additional tucks (which will require a tail length of approximately six rope diameters beyond the last full tuck).

Fiber rope slings need a minimum clear length of rope between eye splices equal to 10 times the rope diameter.

Do not use knots in place of splices. For splicing, use clamps designed specifically for fiber ropes. For all eye splices, make sure the eye provides an included angle of not greater than 60 degrees at the splice when placing the eye over the load or support.

Do not use fiber rope slings if end attachments in contact with the rope have sharp edges or projections. Immediately remove natural and synthetic fiber rope slings from service if any of these conditions are present:

- Abnormal wear;
- Powdered fiber between strands;
- Broken or cut fibers;
- Variations in the size or roundness of strands;
- Discoloration or rotting;
- Distortion of hardware in the sling.

Use only fiber rope slings made from new rope. Do not use repaired or reconditioned fiber rope slings.

Synthetic web slings

Mark or code each sling to show the rated capacities for each type of hitch and type of synthetic web material.

Make sure synthetic webbing is of uniform thickness and width, and selvage edges are not split from the webbing's width.

Make sure fittings have a minimum breaking strength equal to that of the sling and are free of all sharp edges that could in any way damage the webbing.

The only method to attach end fittings to webbing and to form eyes is stitching. Make sure the thread is in an even pattern and contains a sufficient number of stitches to develop the full breaking strength of the sling.

Do not use synthetic web slings with loads in excess of the rated capacities specified. If slings not listed in rating charts or tables, use them only in accordance with the manufacturer's recommendations. When using synthetic web slings, do not use:

- Nylon web slings where fumes, vapors, sprays, mists or liquids of acids or phenolics are present;
- Polyester and polypropylene web slings where fumes, vapors, sprays, mists or liquids of caustics are present;
- Web slings with aluminum fittings where fumes, vapors, sprays, mists or liquids of caustics are present.

Do not use synthetic web slings of polyester and nylon at temperatures in excess of 180 degrees or polypropylene web slings at temperatures in excess of 200 degrees.

Do not use repaired synthetic web slings unless repaired by a sling manufacturer or an equivalent entity. The manufacturer or equivalent entity should proof test each repaired sling to twice the rated capacity prior to its return to service. Retain a certificate of the proof test and make it available for examination. Do not use slings, including webbing and fittings that you repaired in a temporary manner.

Immediately remove synthetic web slings from service if any of these conditions are present:

- Acid or caustic burns;
- Melting or charring of any part of the sling surface;
- Snags, punctures, tears or cuts;
- Broken or worn stitches;
- Distortion of fittings.

Chapter 12

Hazard communication (HAZCOM)

HAZCOM ensures that all employees who encounter chemicals are aware of the hazards. Jobs requiring a HAZCOM program include manufacturing, warehouse operations, janitorial and laboratory.

OSHA standard

- 29 CFR 1910.1200 (General Industry)
- 29 CFR 1926.59 (Construction - Refers to 1910.1200)

Written program

- Identify responsibilities:
- Who is responsible for training?
- Who is responsible for ordering/maintaining MSDSs?

Container labeling

- Legible
- Chemical name
- Target organs
- Manufacturer's name and address

MSDSs

- Where located?
- How to obtain?

Employee training

- Frequency
- Who conducts training?
- Who needs to be trained?

Chemical inventory

- How much company has on hand/quantity?
- Where located?

Employee training

- New hires
- Transfers
- Temporaries
- New operations
- New products
- After accidents/incidents

Training topics

- Overview of HAZCOM requirements
- Chemicals present in work place
- Location/availability of written program
- Health effects of chemicals
- How to lessen or prevent exposures
- Engineering controls the company is using

MSDSs

- Location
- How to read
- Labeling requirements

Contractors

- Notification procedures
- Training contractors of company hazards
- Training company employees of contractor hazards

Machinery and machine guarding

To prevent injuries, such as crushed hands and arms, severed fingers and blindness, safeguards are essential. Machine parts, functions, or processes that may cause injury must be controlled or eliminated. Affix guards to the machine where possible and secure elsewhere if attachment to the machine is not possible. Make sure the guard is not a hazard in itself.

Safeguarding the point-of-operation

Provide and ensure the use of point-of-operation guards or properly applied and adjusted point-of-operation devices on every operation performed on machinery and equipment. You must guard the point of operation for every type of equipment — not just power presses.

Point-of-operation guards:

- Prevent hands or fingers from entering the point of operation by reaching through, over, under or around the guard;
- Conform to the maximum permissible openings;
- Create no pinch point between the guard and moving machine parts;
- Use fasteners not readily removable by operator, to minimize the possibility of misuse or removal of essential parts;
- Facilitate its inspection;
- Offer maximum visibility of the point of operation consistent with the other requirements.

Point-of-operation guarding

Point of operation is the area on a machine where employees perform work upon the material they are processing. Provide and ensure the use of point-of-operation guards. Make sure to properly apply and adjust point-of-operation devices to prevent entry of hands or fingers into the point of operation. Provide one or more methods of machine guarding (barrier guards, two-hand tripping devices, electronic safety devices, etc.) to protect the operator and other employees in

the machine area from hazards. Hazards can include those created by point of operation, incoming nip points, rotating parts, flying chips and sparks. Make sure the guarding device conforms to appropriate standards. If there is no specific standard, design and construct the guard to prevent the operator from having any body part in the danger zone during the operating cycle.

Use special hand tools for placing and removing material to permit easy handling of material without the operator placing a hand in the danger zone. Do not use these tools in place of other required guarding.

Point-of-operation devices protect the operator by:

- Preventing and/or stopping normal stroking of the press if the operator's hands are inadvertently placed in the point of operation;
- Preventing the operator from inadvertently reaching into the point of operation, or withdrawing his or her hands if they are inadvertently located in the point of operation, as the dies close;
- Preventing the operator from inadvertently reaching into the point of operation at all times;
- Requiring application of both of the operator's hands to machine operating controls and locating the controls at such a safety distance from the point of operation that the slide completes the downward travel or stops before the operator can reach into the point of operation with his hands;
- Enclosing the point of operation before the operator can initiate a press stroke and maintaining this closed condition until the motion of the slide has ceased;
- Enclosing the point of operation before the operator can initiate a press stroke to prevent him or her from reaching into the point of operation prior to die closure or prior to cessation of slide motion during the downward stroke.

Machines that usually require point-of-operation guarding include:

- Guillotine cutters;
- Shears;
- Alligator shears;
- Power presses;
- Milling machines;
- Power saws;
- Jointers;
- Portable power tools;
- Forming rolls and calenders.

Where mechanical hazards occur

Dangerous moving parts in three basic areas require safeguarding:

- The point of operation – that point where employees perform work on the material. This can include cutting, shaping, boring or forming of stock;
- Power transmission apparatus – all mechanical-system components that transmit energy to the part of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks and gears;
- Other moving parts – all machine parts that move while the machine is working. These can include reciprocating, rotating, and transverse moving parts, as well as feed mechanisms and auxiliary parts of the machine.

Guards

Guards are barriers that prevent access to danger areas. Listed below are the four general types of guards.

Fixed

A fixed guard is a permanent part of the machine. It is not dependent upon moving parts to perform its intended function. You may construct it of sheet metal, screen, wire cloth, bars, plastic, or any other material that is substantial enough to withstand whatever impact it may receive and to endure prolonged use.

This guard is usually preferable to all other types because of its relative simplicity and permanence.

A fixed guard on a power press completely encloses the point of operation. Feed stock through the side of the guard into the die area, with the scrap stock exiting on the opposite side.

Interlocked

When employees open or remove this type of guard, the tripping mechanism and/or power automatically shuts off or disengages, and the machine cannot cycle or start until the guard is back in place.

An interlocked guard may use electrical, mechanical, hydraulic or pneumatic power or any combination of these. Interlocks should not prevent inching by remote control if required. Replacing the guard should not automatically restart the machine. To be effective, interlock all movable guards to prevent occupational hazards.

Adjustable

Adjustable guards are useful because they allow flexibility in accommodating various sizes of stock.

Self-adjusting

The movement of the stock determines the openings of these barriers. As the operator moves the stock into the danger area, the guard is pushed away, providing an opening, which is only large enough to admit the stock. After removing the stock, the guard returns to the rest position. This guard protects the operator by placing a barrier between the danger area and the operator. You may construct guards of plastic, metal, or other substantial material. Self-adjusting guards offer different degrees of protection.

Devices

A safety device may perform one of several functions. It may:

- Stop the machine if the operator inadvertently places a hand or any part in the danger area;
- Restrain or withdraw the operator's hands from the danger area during operation;
- Require the operator to use both hands on machine controls; thus, keeping both hands and body out of danger;
- Provide a synchronized barrier with the operating cycle of the machine to prevent entry to the danger area during the hazardous part of the cycle.

Presence sensing

The photoelectric (optical) presence-sensing device uses a system of light sources and controls that can interrupt the machine's operating cycle. If the operator breaks the light field, the machine stops and will not cycle. You must only use this device on machines that can stop before the worker can reach the danger area. The design and placement of the guard depends upon the time it takes to stop the mechanism and the speed at which the employee's hand can reach across the distance from the guard to the danger zone.

The radio frequency (capacitance) presence-sensing device uses a radio beam that is part of the machine control circuit. When the capacitance field is broken, the machine will stop or will not activate. Like the photoelectric device, you should only use this device on machines that can stop before the worker can reach the danger area. This requires the machine to have a friction clutch or other reliable means for stopping.

The electromechanical sensing device has a probe or contact bar that descends to a predetermined distance when the operator initiates the machine cycle. If there is an obstruction preventing it from descending its full, predetermined distance, the control circuit does not actuate the machine cycle.

Pullback

Pullback devices use a series of cables attached to the operator's hands, wrists, and/or arms. Workers primarily use this type of device on machines with stroking action. When the slide/ram is up between cycles, the machine allows the operator access to the point of operation. When the slide/ram begins to cycle by starting its descent, a mechanical linkage automatically assures withdrawal of the hands from the point of operation.

Restraint

The restraint (holdout) device uses cables or straps attached to the operator's hands at a fixed point. The operator must adjust the cables or straps to let his or her hands travel within a predetermined safe area. There is no extending or retracting action involved. Consequently, hand-feeding tools are often necessary if the operation involves placing material into the danger area.

Have the operator inspect all restraints and pullback devices prior to each use of the equipment. This includes prior to the beginning of each shift, after lunch, after breaks, etc. Document each inspection and have a supervisor or member of management verify.

A gate or movable barrier device protects the operator as follows:

- A Type A gate or movable barrier device protects the operator by enclosing the point of operation before a press stroke can be initiated, and maintaining this closed condition until the motion of the slide has ceased;
- A Type B gate or movable barrier device protects the operator by enclosing the point of operation before a press stroke can be initiated, so an operator cannot reach into the point of operation prior to die closure or prior to cessation of slide motion during the downward stroke. Type B gates are not permitted on full revolution clutch presses.

Put a system in place that allows you to inspect properly all machinery for appropriate point-of-operation guards. In addition, have a system in place to train machine operators and other personnel on the importance of machine guarding.

Training

Even the most elaborate guarding system cannot offer effective protection unless the worker knows how to use it and why. Specific and detailed training is a crucial part of any effort to provide guarding against machine-related hazards. Thorough operator training should involve instruction or hands-on training in the following:

- A description and identification of the hazards associated with particular machines;
- The guards themselves, how they provide protection and the hazards for which they are intended;
- How to use the guards and why;
- How and under what circumstances guards can be removed, and by whom (in most cases, repair or maintenance personnel only);
- What to do (e.g., contact the supervisor) if a guard is damaged, missing or unable to provide adequate protection.

This safety training is necessary for new operators and maintenance or setup personnel, when putting into service any new or altered safeguards, or when you assign workers to a new machine or operation.

A gate is a movable barrier that protects the operator at the point of operation before he or she can restart the machine cycle. In many instances, gates operate with each machine cycle.

First-aid equipment

Make first-aid equipment available at all times. Report all injuries as soon as possible. Provide first aid until professionals can provide medical attention. A first-aid responder should be on-site unless the company is within close proximity to emergency medical facilities. We define close proximity as those facilities that can respond to an incident that requires medical treatment.

Lockout/tagout

Employers are required to develop and implement an effective isolation and control program for hazardous energy when personnel perform maintenance and/or service for machinery. Employers must develop specific procedures to isolate and control all energy sources for each piece of equipment in the work place. In addition, employers are required to identify specific authorized employees to perform machine lockout/tagout. The following outline identifies the requirements of an effective lockout/tagout program.

Purpose

To protect employees from unexpected release of stored energy, including:

- Mechanical;
 - Hydraulic;
 - Chemical;
 - Gravity;
 - Electrical;
 - Pneumatic;
 - Thermal;
 - Any other sources of stored energy.
- OSHA standard
- 29 CFR 1910.147 (Lockout/tagout)

Note: The standard does not apply to construction sites, but does apply to yards and fabrication shops.

Written program

- Identify all sources of energy for each piece of equipment.
 - Each employee has his or her own lock and key. The supervisor may have a second key, but well-established procedures must be in place for when he or she can use the second key.
 - Verify employee is not at the facility.
 - Make a reasonable effort to inform the employee that you have removed the lock.
 - Ensure you inform the employee about the action before returning to work in the facility.
 - Review procedures annually (not by person performing lockout/tagout).
 - Notify outside contractors of the program.
- Employee training
- Methods of identifying energy sources
 - Shut down/start-up procedures
 - Lockout procedures

Electrical safety

Share these basic electrical safety issues with all employees.

- Inspect all cord and plug connected equipment on a regular basis.
 - Train employees on the hazards of electricity and importance of electrical safety.
 - Use extension cords on a temporary basis when using portable power tools, maintenance or servicing of machinery.
 - Use three-wire type extension cords with an appropriate grounding conductor.
 - Do not use two-wire extension cords.
 - Provide all equipment that is double insulated with an appropriate grounding conductor.
 - Ground and secure electrical outlets.
 - Do not use damaged or defective equipment.
 - Identify and make accessible all electrical equipment.
- Do not use flexible cords and cables as a substitute for fixed wiring.
 - Do not permit use of extension cords with metal knockout boxes.
 - Provide a ground fault circuit interrupter in damp or wet locations.

Place lighting as to reduce glare and prevent too much contrast between work areas and adjacent areas. Illumination will be sufficient for general safety and ordinary visual needs. Locate and guard lighting fixtures so that there will be no hazard to persons should there be accidental breakage of the lamp or fixture.

Where failure of primary lighting can result in hazards to any person, provide emergency lighting.