

## Section 17

# Hand Tools, Power Tools, Pressure Vessels, Compressors, and Welding

This section sets forth the requirements for using hand tools, pressure vessels, compressors, and for welding. It specifically addresses hand and power tools; pneumatic tools; airless spray guns; grinding tools; woodworking tools; power saws; hydraulic-powered tools; powder-actuated tools; hand-powered winches and hoists; lever and ratchet, screw, and hydraulic jacks; boilers and unfired pressure vessels; compressors; compressed gas cylinders; gas welding and cutting; arc welding and cutting; and inert gas metal-arc welding.

### 17.1 General Requirements for Hand and Power Tools

**17.1.1 Maintenance.** Maintain hand tools, power tools, and jacks in safe operating condition. Immediately remove damaged and defective tools from service and repair or replace them.

**17.1.2 Proper Use.** Use tools only for their designed purpose. Do not use electrical cords, air hoses, and hydraulic hoses to raise or lower tools.

**17.1.3 Storage.** Do not leave tools on scaffolds or elevated work spaces. Provide containers on the jobsite for hand tools.

**17.1.4 Guarding.** If a tool accommodates guards, operate the tool with the guards in place. Safeguard moving part hazards as set forth in the current edition of the American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) B15.1, "Safety Standard for Mechanical Power Transmission Apparatus."

**17.1.5 Point of Operation Guarding.** Point of operation is the area on a machine where work is actually performed. Provide guards at the point of operation on machines that expose the operator to injury. The guards must meet all applicable specific standards. If no standards exist, the guards must prevent the operator from having any body part in the danger zone during the operating cycle.

**17.1.6 Grounding.** Double insulate or effectively ground electric tools.

**17.1.7 Switches.** On-off switches controlling the operation of hand-held power tools must conform to the following requirements:

- a. Equip hand-held power platen sanders, grinders with 2-inch or less diameter wheels, routers, planers, laminate trimmers, nibblers, shears, scroll saws, jigsaws with blade shanks 0.25 inch wide or less, concrete vibrators, and power tampers with only positive on-off switch.

b. Equip hand-held power drills, tappers, fastener drivers, horizontal, vertical, and angle grinders with wheels more than 2 inches in diameter, disk sanders, belt sanders, reciprocating saws, and similar tools with a momentary contact "on-off" control. These may have a lock-on control if the operator can shut off the power with a single motion of the same finger or fingers that turn it on and if the switch is adequately guarded to prevent accidental operation.

c. Equip jackhammers and similar pneumatic-powered hand tools and other hand-held power tools, including chain saws, circular saws, and percussion tools, with a constant pressure switch that shuts off power when pressure is released.

**17.1.8 Personal Protective Equipment.** Provide hand tool and power tool operators with personal protective equipment and ensure its use as set forth in the section on "Personal Protective Equipment." Original equipment guards or manufactured guards must be used on all grinders, drills, lathes, sanders, and other equipment to prevent injury to the operator.

**17.1.9 Anchoring Fixed Machinery.** Securely anchor machines designated for fixed locations to prevent movement.

**17.1.10 Hazardous Conditions.** Use only nonsparking or intrinsically safe tools where sources of ignition may cause an explosion or fire. Do not use gasoline-powered tools underground, in buildings, or in partially enclosed locations where toxic exhaust gases can accumulate. Place gasoline powered portable compressors, generators, and pressure washers outdoors and away from air intakes to prevent drawing engine exhaust indoors.

## **17.2 Requirements for Pneumatic Tools**

**17.2.1 Impact Tools.** Operate pneumatic impact tools with safety clips or retainers installed to prevent accidental discharge from the chuck.

**17.2.2 Air Hoses.** For air lines more than one-half inch inside diameter, provide whip-check devices attached to the hose at each connection or splice. As a substitute, provide a safety device at the source of supply or branch line that will automatically reduce pressure in case of a line failure if the device effectively prevents whipping.

**17.2.3 Operating Pressures.** Do not exceed the manufacturer's safe operating pressure for hoses, pipes, valves, and fittings. Remove defective hoses, valves, and fittings from service.

**17.2.4 Compressed Air Used for Cleaning.** Never direct compressed air at any part of the body. Use compressed air for cleaning purposes only if the pressure is less than 30 pounds per square inch, and then only with effective

chip guarding and personal protective equipment. The 30-pound-per-square-inch requirement does not apply to sandblasting, green cutting, removing mill scale, cleaning concrete forms, and similar cleaning operations.

**17.2.5 Care of Air Hoses.** Protect pneumatic hoses from physical damage while they are in use and in storage.

**17.2.6 Nailers and Staplers.** Pneumatic nailers, staplers, and similar equipment with an automatic fastener feed that operates at more than 100 pounds per square inch must have a single-action trigger and a safety device on the muzzle to prevent the ejection of the fasteners unless the muzzle is in contact with the work surface.

### 17.3 Requirements for Airless Spray Guns

**17.3.1 Airless Spray Guns.** Equip airless spray guns that atomize fluids at pressures of 1,000 pounds per square inch or greater with one of the following safety systems to prevent accidental fluid injection into the operator.

- a. Automatic or Visible Manual Safety Device.** The safety device must prevent pulling of the trigger to release the paint or fluid until the operator manually releases the safety device.
- b. Diffuser Nut and Nozzle Guard.** The diffuser nut must prevent high-pressure high-velocity release when the nozzle tip is removed. The nozzle tip guard must prevent the tip from contacting the operator.
- c. Other Equivalent Protection.** Any system that provides an equivalent level of protection as above is acceptable.

### 17.4 Requirements for Using Grinding Tools

**17.4.1 General.** Installing, guarding, using, and caring for grinding tools must comply with the standards set forth in the current standard ANSI B7.1, "The Use, Care and Protection of Abrasive Wheels" and manufacturer's instructions. Use grinding tools only if the safety guards and protective flanges are installed and properly adjusted.

**17.4.2 Power Supply.** Supply all grinding machines with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation.

**17.4.3 Guarding.** Safety guards must cover the spindle end, nut, and flange projections. Mount guards to maintain proper alignment with the wheel. Where the work provides a suitable measure of protection to the worker, the safety guards may expose the spindle end, nut, and outer flange. Where the work entirely covers the side of the wheel, the side covers of the guard may be omitted. The spindle end, nut, and outer flange may be exposed on portable saws.

**17.4.4 Abrasive Wheels.** Do not operate abrasive wheels faster than their rated safe speed. Inspect wheels according to manufacturer's instructions before mounting and, periodically, to ensure the abrasive wheel is not cracked or otherwise defective. Remove cracked or defective abrasive wheels from service immediately and destroy them.

**17.4.5 Grinding Wheels.** Grinding wheels must fit freely on the spindle. Do not force them on. Tighten the spindle nut only enough to hold the wheel in place.

**17.4.6 Bench and Pedestal Grinders.** Provide bench-mounted and pedestal grinders with safety guards that are strong enough to withstand the effect of a bursting wheel. The guard must not expose more than 90 degrees of the grinding wheel periphery and sides. However, if the work must contact the wheel below the horizontal plane of the spindle, the angular exposure must not exceed 125 degrees. The guard must have a readily adjustable toolrest that is maintained within one-eighth inch of the wheel and an adjustable tongue maintained within one-fourth inch of the periphery of the wheel to prevent injury to the operator by containing the wheel failure inside the housing.

**17.4.7 Cup-Shaped Wheels.** Protect cup-shaped wheels used for external grinding by either a revolving cup guard or a band guard.

#### 17.4.8 Special Conditions

**a. Safety Flanges.** Use a wheel equipped with safety flanges when work location prevents the use of guarding. Use only safety flanges with wheels designed to fit the flanges. Use only safety flanges of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of accidental breakage.

**b. Small Diameter Wheels.** Wheels 2 inches or less in diameter that are securely mounted on the end of a steel mandrel do not require guards.

**c. Internal Grinding.** Guarding is not required if a grinding wheel is entirely within the work being ground while in use.

**17.4.9 Side Grinding.** Do not permit side grinding unless the abrasive wheel is specifically designed for this purpose.

### 17.5 Requirements for Woodworking Tools

**17.5.1 Requirement.** Installing, guarding, using, and caring for power-operated woodworking tools must comply with the standards set forth in 29 CFR Part 1910.213, "Woodworking Machinery Requirements."

**17.5.2 Switches.** Locate switches so the operator is able to shut off the power without leaving the operating position. Provide fixed power-driven tools with a disconnect switch that can be locked in the off position.

**17.5.3 Automatic Feed.** Whenever the nature of the work permits, install automatic feeding devices on fixed, power-driven woodworking tools. Feeder attachments must have the feed rolls and other moving parts guarded to protect the operator.

**17.5.4 Electrical Equipment.** When automatic restarting would create a hazard, control electrically driven equipment with a device to prevent automatic restarting following a power failure.

**17.5.5 Push Sticks.** Use a push stick, block, or similar safe means for all operations close to high-speed cutting edges.

**17.5.6 Combs.** Provide combs (featherboards) or suitable jigs when standard guards cannot be used.

**17.5.7 Planers and Joiners.** Equip planers and joiners with cylindrical cutting heads and fully guard them.

**17.5.8 Cleanup.** Keep work areas clean. Provide a brush or vacuum system near each machine to remove sawdust, chips, and shavings.

**17.5.9 Portable Belt Sanding Machines.** Provide belt sanding machines with guards at each nip point where the sanding belt runs onto a roller. These guards must prevent the operator's hands or fingers from coming in contact with the nip points. Guard the unused run of the sanding belt against accidental contact.

## **17.6 Requirements for Power Saws**

**17.6.1 Circular Saws.** Equip bench saws with spreaders, anti-kickback devices, and guards that automatically enclose the exposed cutting edges. Equip portable hand-held circular saws with guards above and below the baseplate or shoe. The upper guard must cover the saw to the depth of the teeth, except for the minimum arc required to permit tilting the base for bevel cuts. The lower guard must cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. As the blade is withdrawn, the lower guard must automatically and instantly return to the covering position.

**17.6.2 Operating Speeds.** Permanently mark the operating speed on all circular saws that are more than 20 inches in diameter or that operate at speeds of more than 10,000 peripheral feet per minute. Use only blades designed for use at the marked operating speed. When the saw is retensioned for a different speed, change the marking to indicate the new speed.

**17.6.3 Radial Arm Saws.** Equip radial arm saws and swing cutoff saws with: (1) limit stops that prevent the leading edge of the blade from traveling beyond the edge of the table, (2) hoods or guards that protect the operator from flying material, direct the sawdust toward the back of the blade, and enclose all parts of the blade not in contact with the material being cut, and (3) automatic brakes or automatic return devices. Install nonkickback fingers or dogs and a spreader when ripping.

**17.6.4 Bandsaws.** Fully enclose bandsaw blades except at the point of operation. Adjust the adjustable guide within one-half inch of the work.

**17.6.5 Unattended.** Never leave running power saws unattended.

**17.6.6 Sawdust Collectors.** Equip bench-type circular saws and radial saws used for production work with sawdust collectors.

**17.6.7 Cleanup.** Clean up scrap and sawdust. Clean up the shop area as needed to maintain safe working conditions and at the end of each shift.

**17.6.8 Defective Blades.** Remove cracked, bent, or otherwise defective blades from service and destroy them.

## **17.7 Requirements for Hydraulic-Powered Tools**

**17.7.1 Safe Operating Pressures.** Adhere to the manufacturer's safe operating pressure for hoses, valves, pipes, filters, and fittings.

**17.7.2 Hydraulic Fluid.** Ensure fluid in hydraulic-powered tools is fire resistant and approved by a nationally recognized testing laboratory.

**17.7.3 Stationary Hydraulic-Powered Presses.** Presses must have guards that adequately contain flying particles forcibly expelled from the compressed material.

## **17.8 Requirements for Powder-Actuated Tools**

Design, maintain, and use powder-actuated tools in accordance with the standards set forth in the current edition of ANSI A10.3, "Safety Requirements for Powder-Actuated Fastening Systems"; the tool manufacturer's instructions; and the requirements of this subsection. These standards cover three types of tools: high velocity, low-velocity piston, and hammer-operated piston—low-velocity.

**17.8.1 Operator Qualification.** Allow only employees trained and certified in the safe use of powder-actuated tools to operate and service them. Operators must possess an operator's card issued by a firm or person authorized to issue such cards.

**17.8.2 Unauthorized Use.** Take safeguards to prevent unauthorized persons from possessing or using these tools and their charges.

**17.8.3 Flammable Atmospheres.** Do not use powder-actuated tools in explosive or flammable atmospheres.

**17.8.4 Studs and Fasteners.** Use only the powder charges, studs, or fasteners specified by the manufacturer for the specified tool.

#### 17.8.5 Safety Features

**a. All Tools.** All powder-actuated tools must have the following safety features:

1. The firing mechanism design must prevent the tool from firing during loading or preparation to fire or if it is dropped while loaded.
2. Firing of the tool must depend on at least two separate and distinct operations of the operator. The final firing movement must be separate from the movement to bring the tool into the firing position.
3. The tool design must allow all breeching parts to be reasonably visible to allow a check for any foreign matter that may be present.
4. The tool design must allow the operator to select a power level adequate to perform the desired work without excessive force.

**b. High-Velocity Tools.** High-velocity tools must have the following features in addition to the common features listed above.

1. The muzzle end of the tool must have a protective shield or guard at least 3-1/2 inches in diameter, mounted perpendicular to and concentric with the barrel, and designed to confine any flying fragments or particles that might otherwise create a hazard at the time of firing.
2. The tool design must not allow firing unless the guarding or shielding device is in place.
3. The tool design must not allow operation unless the operator is holding the tool against the work surface with a force at least 5 pounds greater than the total weight of the tool.
4. The tool design must not allow operation when equipped with the standard guard indexed to the center position if any bearing surface of the guard is tilted more than 8 degrees from contact with the work surface.

**c. Low-Velocity Piston.** Low-velocity-piston tools must have the following features in addition to the common features listed in the subparagraph on safety features.

1. The muzzle end of the tool design must allow mounting, perpendicular to the barrel, suitable protective shields, guards, jigs, or fixtures, designed and built by the manufacturer. Supply a standard spall shield with each tool. Choose and use the proper shields, guards, jigs or fixtures in accordance with the manufacturer's instructions.
2. The tool design must not allow operation unless the operator is holding the tool against the work surface with a force at least 5 pounds greater than the total weight of the tool.

**d. Hammer-Operated Piston Tools - Low Velocity.** In addition to the common safety features, hammer operated tools must have suitable protective shields, guards, jigs, or fixtures, designed and built by the tool manufacturer, that can be mounted perpendicular to the barrel. Supply a standard spall shield with each tool. Choose and use the proper shields, guards, jigs, or fixtures according to the manufacturer's instructions.

**17.8.6 Materials.** Drive fasteners into soft or easily penetrated material only if the material is backed to prevent complete penetration. Do not use tools on very hard or brittle materials such as cast iron, glazed tile, surface-hardened steel, glass block, live rock, face brick, or hollow tile. Never drive a fastener into a spalled area caused by an unsatisfactory fastening.

**17.8.7 Safe Use.** Load tools just before firing. Always attend loaded tools. Never point a tool at anyone. Keep all body parts clear of the muzzle.

**17.8.8 Inspection and Testing.** Inspect and test tools each day before loading to ensure that the safety devices are in proper working order. Conduct the inspection in accordance with the manufacturer's recommended inspection procedures.

**17.8.9 High-Velocity Tools.** Use high-velocity tools only for those applications in which low-velocity tools will not meet the job requirements.

## **17.9 Requirements for Hand-Powered Winches and Hoists**

**17.9.1.** Use hand-powered winches and hoists within the manufacturer's rated capacity, and legibly mark the capacity on the winch or hoist. Hand-powered hoists must have worm gear drives or with positive self-locking dogs. Handwheels must not have projecting spokes or knobs.

**17.9.2** Legibly mark the manufacturer's rated capacity on all come-alongs. Do not exceed the rated capacity. Remove come-alongs from service when they have worn or kinked cables or links, deformed hooks, or defective

ratcheting devices. Take care not to overstress structures or structure supporting systems when using come-alongs for leveling, plumbing, or positioning structures.

## **17.10 Requirements for Lever and Ratchet, Screw, and Hydraulic Jacks**

**17.10.1 Capacity.** Legibly mark the manufacturer's rated capacity on all jacks. Do not exceed the rated capacity.

**17.10.2 Overtravel.** Jacks of any type must have a positive stop to prevent overtravel.

**17.10.3 Footing and Blocking.** Set jacks on a stable and firm footing, and crib or block where necessary to prevent settlement or dislodgement. If slippage is possible, place a wood block between the jack and the load.

**17.10.4 Operation.** After a load has been raised, crib, block, or otherwise secure it at once.

**17.10.5 Maintenance.** Properly lubricate all jacks at regular intervals. Supply adequate antifreeze liquid to hydraulic jacks exposed to freezing temperatures. Examine for possible defects and repair or replace defective parts as necessary.

**17.10.6 Inspection.** Thoroughly inspect jacks periodically, depending on how they are used. Inspect jacks according to the manufacturer's instructions, but no less frequently than the following:

- a. For constant or intermittent use at one locality, once every 6 months.
- b. For jacks sent out of shop for special work, when sent out and when returned.
- c. Before returning to service after a jack is subjected to abnormal loads.

## **17.11 Requirements for Hand Tools**

Hand tools must be inspected periodically, maintained in a safe condition, and replaced and removed from service when worn, defective, broken, or cracked.

**17.11.1 Wrenches.** Do not use wrenches, including adjustable, pipe, and socket wrenches, when jaws are sprung to the point that slipping occurs.

**17.11.2 Wood Handles.** Keep the wooden handles of tools free of splinters or cracks, and keep tool handles tight.

**17.11.3 Impact Tools.** Keep impact tools, including drift pins, wedges, and chisels, in a dressed condition or equipped with nonmushrooming heads.

## **17.12 General Requirements for Boilers and Unfired Pressure Vessels**

**17.12.1 Applicable Codes and Regulations.** Design, construct, install, test, and maintain boilers and unfired pressure vessels according to all of the following:

- The current ASME "Boiler and Pressure Vessel Code"
- The current National Board Inspection Code, ANSI/NB 23
- The current codes or regulations of the State

**17.12.2 Inspection and Testing.** Inspect and test boilers and unfired pressure vessels before placing them in service and after any alteration or major repair. Perform subsequent inspections within 24 months for the first inspection, followed by inspections no more than 60 months apart (providing deterioration is shown to be low and at a predictable rate). When any part of a vessel rapidly deteriorates, the interval between inspection and testing must be according to the National Board Inspection Code or every 24 months, whichever is less. Make hydrostatic or State acceptable tests when the qualified person performing the inspection recommends them.

**17.12.3 Inspector Qualifications.** To perform inspections, use qualified personnel who meet Federal or State certification requirements or personnel who satisfy the "Owner-User Inspector" education and experience of the National Board Inspection Code, issued by the National Board of Boiler and Pressure Vessel Inspectors.

**17.12.4 Posting Reports.** Post a copy of the inspector's approval or certification reports near or on the boiler or unfired pressure vessel.

## **17.13 Requirements for Unfired Pressure Vessels**

**17.13.1 Installation.** Install pressure vessels so that all drains, handholes, and manholes are easily accessible. Do not bury them underground or locate them in inaccessible places. Locate pressure vessels used to store compressed air in a cool place to facilitate condensation of moisture and oil vapors.

**17.13.2 Drain Valves.** Install a readily accessible drain valve on the lowest point of every air receiver to remove accumulations of oil and water. Operate the valve as recommended by the manufacturer or as determined by experience to remove accumulations of oil and water.

**17.13.3 Piping.** Install piping with traps or other effective means of removing liquid from the lines. Properly design and install air discharge piping to eliminate possible oil pockets.

**17.13.4 Stop Valves.** Install a stop valve between the receiver and each piece of stationary utilization equipment and also at each outlet to which an airhose may be attached.

**17.13.5 Hose Connections.** Hose connections must withstand the pressure and service to which they are subjected.

**17.13.6 Safety Relief Valves.** Equip each pressure vessel with a readily visible indicating pressure gauge and with one or more spring-loaded safety relief valves. The total relieving capacity of such safety relief valves must prevent pressure in the receiver from exceeding the maximum allowable working pressure of the receiver by more than 10 percent.

## **17.14 Requirements for Compressors**

**17.14.1 Air Intake.** The design and location of compressor intakes must prevent any flammable or toxic gas, vapor, or dust from being drawn into the compressor. Never install a valve in the air intake pipe to an air compressor with an atmospheric intake.

**17.14.2 Governors.** Install a speed governor, independent of the unloaders, on all compressors except those driven by electric synchronous motors. Equip engine- or turbine-driven compressors with an auxiliary control to the governor to prevent racing when the unloader operates.

**17.14.3 Limit and Bypass.** Every air compressor must automatically stop compressing before the discharge pressure exceeds the maximum allowable working pressure of the weakest portion of the system. The design and installation of electrical contacts must prevent locking or fusing in a position that would permit the compressor to continue compressing when the allowable pressure is exceeded. As a substitute, install an air bypass and alarm for the automatic stop system.

**17.14.4 Safety Relief Valves.** Equip each stage of a multistage compressor with a safety relief valve.

**17.14.5 Discharge Piping.** The diameter of air discharge piping between the compressor and the receiver must be at least as large as the discharge opening on the compressor. If you install a stop valve between the compressor and the receiver, install spring-loaded safety valves between the stop valve and the compressor. The total capacity of the safety valves must be sufficient to limit pressures in the air discharge piping to less than 10 percent or 3 pounds per square inch, whichever is greater, above the working pressure of the piping.

## 17.15 Requirements for Gas Cylinders

Construct, inspect, and test compressed gas cylinders in accordance with Department of Transportation requirements.

**17.15.1 Cylinder Storage.** Onsite storage of gas cylinders must conform to the following requirements:

- a. Separation.** Store cylinders containing the same gas in segregated groups. Do not intermingle with other gas cylinders. Store empty gas cylinders in the same manner. Protect cylinders from damage or tipping by chains or other security means.
- b. Confined Spaces.** Store cylinders in well-ventilated spaces. Do not store or take cylinders containing oxygen, acetylene, or fuel gases into confined spaces.
- c. Flammable or Combustible Material.** Separate cylinders in storage from flammable or combustible material by at least 20 feet or by a fire-resistive partition of at least 1-hour fire-resistive rating and at least 5 feet high.
- d. Oxidizing Gases.** Separate cylinders containing oxygen or oxidizing gases from fuel gas cylinders by at least 20 feet or by a fire-resistive partition of at least 1-hour fire-resistive rating and at least 5 feet high.
- e. Smoking Restrictions.** Do not permit smoking or open flame where cylinders are stored. Post the area with "DANGER—NO SMOKING OR OPEN FLAME" signs.
- f. Toxic Gas.** Post areas containing toxic gas in storage with signs warning of the danger.

**17.15.2 Upright Position.** Secure compressed gas cylinders in an upright position at all times except when hoisting them or using them in special services or arrangements approved in writing by the manufacturer or gas supplier.

**17.15.3 Cylinder Valves.** Close cylinder valves when cylinders are in storage, in transit, or not in use.

**17.15.4 Valve Caps.** Ensure cylinder valve caps are securely in place when they are in storage, in transit, and at all times when the regulator is disconnected from the cylinder. Cylinders may be moved secured on specialty trucks within a jobsite without removing the regulators when you adequately protect the regulators and cylinder valves.

**17.15.5 Transporting.** Transport compressed gas cylinders by crane, hoist, or derrick in cradles, nets, or skips. Never transport them by slings, chains, or magnets.

**17.15.6 Valve Wrenches.** The valve wrench or wheel must be in the operating position when the cylinder is in use.

**17.15.7 Restricted Use.** Use cylinders only for the designated purpose of containing a specific compressed gas for which they were designed. Only authorized entities may refill them.

**17.15.8 Handling.** Handle cylinders in a manner that will not weaken or damage the cylinder or valve. Do not expose cylinders to extremes of temperature, physical damage, or electrical current.

**17.15.9 Oxygen.** Keep oxygen cylinders and fittings free of oil or grease and do not handle them with oily hands or gloves. Do not direct oxygen at oily surfaces, greasy cloths, or into a container, storage tank, or vessel. Do not use oxygen or other compressed gases as a substitute for compressed air.

**17.15.10 Defective Cylinders.** Move leaking cylinders to an isolated location out of doors, away from personnel and sources of ignition. Then, open the valve, allowing the gas to escape slowly. Tag the cylinder "DEFECTIVE" and return it to the supplier. Only qualified personnel, protected by appropriate personal protective equipment, may handle leaking cylinders containing toxic gas.

## **17.16 Standards for Welding and Cutting**

All welding and cutting apparatus, equipment, and operations must be according to the standards and recommendations set forth in the current edition of ANSI Z49.1, "Safety in Welding, Cutting, and Allied Processes," and the requirements of this section. Provisions of the current NFPA Standard 51B, "Fire Prevention During Welding, Cutting, and Other Hot Work," also apply.

**17.16.1 Responsibility.** The facility management is responsible for ensuring the safety of hot work operations and establishing the following controls:

- a. Based on fire potentials of plant facilities, establish areas for cutting and welding, and establish procedures for cutting and welding, in other areas.
- b. Designate an individual who is responsible for authorizing cutting and welding operations in areas not specifically designed for such processes. This person must not be the hot work operator.
- c. Ensure that cutters or welders and their supervisors are suitably trained in the safe operation of their equipment and the safe use of the process.

These individuals must be aware of the inherent risks and understand the emergency procedures in the event of a fire.

- d. Ensure use of only approved apparatus, such as torches, manifolds, regulators or pressure reducing valves, and acetylene generators.
- e. Advise all contractors of flammable materials or hazardous conditions they may be unaware of.

**17.16.2 Hot Work Permit.** Before hot work operations begin in a nondesignated location, obtain a written hot work permit from the authorizing individual. Before issuing the hot work permit, the authorizing individual must ensure that the equipment is in satisfactory condition and in good repair and that all fire protection measures are followed.

**17.16.3 Daily Inspection.** Inspect welding apparatus and equipment daily before use. Remove defective apparatus and equipment from service, replace it, or repair it and reinspect it before using it again.

**17.16.4 Fire Extinguishers.** Fire extinguishers rated 2-A:40-B:C units or larger must be immediately available wherever welding, gouging, or cutting is being carried out.

**17.16.5 Fire Protection.** Take the following precautions, as applicable, when welding or cutting:

**a. Flammable Material.** Confine welding, whenever possible, to areas free of combustible materials. When this is not possible, remove all combustible material within 35 feet horizontally from the work site or protect it from fire, sparks, and slag.

**b. Fireguards.** The fireguards must be on duty when hot work is performed in a location where other than a minor fire might develop, or where the following conditions exist:

1. Combustible materials are closer than 35 feet to the point of operation.
2. Combustible materials are more than 35 feet away, but are easily ignited by sparks.
3. Wall or floor openings within a 35-foot radius expose combustible materials in adjacent areas, including concealed spaces in wells and floor.
4. Combustible materials are adjacent to the opposite side of partitions, walls, ceilings, or roofs and are likely to be ignited.

The fireguards must be on duty during the operations and for a sufficient period of time following the completion of the work to ensure that no possibility of fire exists. Provide fireguards with necessary fire protection equipment and instruct them in its use. They must watch for fires in all exposed areas, try to extinguish them only when obviously within the capacity of the equipment available, or otherwise sound the alarm.

**c. Tests.** Test for flammability before welding, cutting, or heating any material covered by a preservative coating with unknown flammability. Do not weld or cut in any area that could contain flammable vapors or gases until the atmosphere has been tested and found safe.

**d. Shafts.** Install noncombustible barriers below welding or burning operations in or over a shaft or raise.

**e. Flammable and Combustible Liquids.** Do not weld, cut, or burn in areas containing flammable or combustible liquid, vapor, or dust.

**f. Walls.** When welding or cutting on walls, floors, or ceilings where direct penetration of sparks or heat transfer may cause a fire in an adjacent area, take the same precautions on both sides of the wall, floor, or ceiling. Precautions include keeping the floor wet, covered with damp sand, or protected with a fire-retardant shield or guard.

**17.16.6 Warning Sign.** After completing welding operations, the welder must mark the hot metal or provide some other means of warning other workers.

**17.16.7 Goggles, Protective Clothing, and Screens.** Welders and helpers must wear protective clothing and eye protection as specified in the "Personal Protective Equipment" section, subsections on "Eye and Face Protection" and "Protective Clothing." Protect other people near welding and cutting from exposure to welding rays, flashes, sparks, molten metal, and slag. Use welding screens in repair shops and other areas where welding is regularly performed.

**17.16.8 Preservative Coatings.** When preservative coatings are highly flammable, remove them from the area to be heated to prevent ignition. Take the following precautions when the coatings are determined to be toxic:

**a. Enclosed Spaces.** Strip the coating of all coated surfaces for a distance of at least 4 inches on each side of the cut or weld.

**b. Open Air.** Protect employees in open air with either an air line respirator, an appropriate respirator meeting the requirements of the "Respiratory Protection" subsection or adequate local ventilation.

**17.16.9 Confined Spaces.** Ventilation and protection of employees welding, cutting, or heating in confined spaces must conform to requirements contained or referenced in the "Confined Spaces" section, including the use of an outside attendant and a preplanned written rescue procedure.

**a. Ventilation.** Ventilation is a prerequisite to work in confined spaces. Adequately ventilate all welding and cutting operations conducted in confined spaces to prevent: (1) the accumulation of toxic materials or (2) oxygen deficiency. This requirement applies not only to the welder but also to helpers and other nearby personnel. All replacement air must be clean and respirable.

**b. Airline Respirators.** When you cannot provide such ventilation, use airline respirators approved for this purpose by the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR part 84.

**c. Self-Contained Units.** In areas immediately dangerous to life and health (IDLH) or where hazards are unknown, use a full-facepiece, pressure-demand, self-contained breathing apparatus or a combination full-facepiece, pressure-demand supplied-air respirator with an auxiliary, self-contained air supply approved by NIOSH under 42 CFR part 84.

**d. Securing Cylinders and Machinery.** When welding or cutting in any confined spaces, leave the gas cylinders and welding machines outside the space. Before operations begin, securely block heavy portable equipment mounted on wheels to prevent accidental movement.

**e. Gas Cylinder Shutoff.** To prevent gas from escaping through leaks of improperly closed valves during gas welding or cutting whenever the torch is not used for a substantial period of time, such as during the lunch hour or overnight, close the torch valves and positively shut off the gas supply to the torch at some point outside the confined area. Where practicable, also remove the torch and hose from the confined space.

**f. Accidental Contact.** When suspending arc welding for any substantial period of time, such as during lunch or overnight, remove all electrodes from the holders and carefully locate the holders to prevent accidental contact and disconnect the machine from the power source.

**17.16.10 Toxic Materials.** Protect employees who are welding, cutting, heating, or brazing, or using fluxes, coatings, and filler products containing any of the following materials in accordance with the requirements in subsections on Job Hazard Analysis, Exposure Limits, Respiratory Protection, and ANSI Z49.1 Section 5, "Ventilation."

- Cadmium
- Fluorides
- Mercury
- Chlorinated hydrocarbons
- Stainless steel
- Zinc or galvanized materials
- Beryllium
- Lead

Other materials or compounds determined to be toxic by the manufacturer or a nationally recognized source referenced in 29 CFR Part 1910.1000

**17.16.11 Flammable Liquid Containers.** When it is necessary to cut or weld closed containers or hollow structures that have contained flammable materials, follow the recommendations in the pamphlet, F4.1, "Recommended Safe Practices for Preparation of Welding and Cutting of Containers and Piping," published by the American Welding Society.

## **17.17 Requirements for Gas Welding and Cutting**

**17.17.1 Equipment.** Gas welding and cutting equipment must be as listed by a nationally recognized testing laboratory.

**17.17.2 Gas Cylinders.** Transport, handle, store, use, and maintain gas cylinders required in this section and with DOT requirements. Only DOT stamped or labeled gas cylinder are permitted.

**17.17.3 Regulators.** Use pressure-reducing regulators only for the gas for which they were designed. Except for cracking the valve slightly to remove dust or dirt, do not release gas from a cylinder under pressure without attaching the pressure-reducing regulator to the cylinder valve. Do not adjust acetylene regulators to permit a discharge greater than 15 pounds per square inch (gauge).

**17.17.4 Torches.** Close torch valves and shut off the gas supply when suspending work. Check torch valves for leaks at the beginning of each shift. Light torches with friction lighters or other approved devices and not with matches or hot work.

**17.17.5 Check Valves and Flash-Back Protection.** Equip all oxygen, acetylene, or other fuel gas-oxygen combinations used in cutting or welding with an approved device to prevent oxygen from flowing into the fuel-gas system or fuel from flowing into the oxygen system. Use an approved device to provide flash-back protection to prevent flame from passing into the fuel-gas system. Install these protective devices according to the manufacturer's instructions.

**17.17.6 Welding Hose.** Use only properly marked and identified hose in good condition and specifically manufactured for oxyacetylene service for gas welding and cutting. Remove from service a hose that has been subjected to flashback or that demonstrates severe wear or damage. Ventilate containers used to store fuel gas hose.

## **17.18 Requirements for Arc Welding and Cutting**

**17.18.1 Applicable Standards.** Electric arc welding apparatus must comply with the National Electrical Manufacturer's Association EW1 "Electric Arc Welding Power Sources." Install, operate, and maintain this apparatus in accordance with ANSI Z49.1, "Safety in Welding, Cutting, and Allied Processes."

**17.18.2 Power Circuits.** Install and maintain power circuits for electric arc welding equipment in accordance with applicable provisions of the current National Electrical Code (NEC).

**17.18.3 Grounding.** Effectively ground frames of all electric welding machines operated from power circuits according to current NEC standards. The current carrying capacity of grounding conductors and clamps must equal or exceed the maximum output of the welder they serve. Do not use pipelines containing flammable gases or liquids, electrical conduits, chains, wire rope, cranes, hoists, or similar devices for grounding.

**17.18.4 Cables.** Do not allow splices or repaired insulation within 10 feet of the electrode holder. Position cables so as not to obstruct walkways, scaffolds, stairs, or ladders.

**17.18.5 Gasoline-Driven Arc Welders.** Do not use gasoline-driven arc welders in confined spaces or underground in tunnels, shafts, or conduits.

## **17.19 Requirements for Inert-Gas Metal-Arc Welding**

**17.19.1 Chlorinated Solvents.** Do not apply chlorinated solvents within 200 feet of the exposed arc. Thoroughly dry surfaces prepared with chlorinated solvents before permitting welding on such surfaces.

**17.19.2 Arc Protection.** Employees exposed to the arc must wear goggles with filter lenses. When two or more welders are exposed to each other's arc, they must wear filter lens goggles of suitable design under their welding helmets. Welders must use hand shields designed to dissipate radiant energy when the welder either lifts the helmet or removes the shield.

**17.19.3 Radiation.** Welders and people exposed to radiation must wear protective clothing completely covering the skin to prevent the harmful effects of ultraviolet rays.