

# A Guide to Safety and Health in Feed and Grain Mills



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**Acknowledgments**

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**This guide is intended to be consistent with all existing OSHA standards; therefore, if an area is considered by the reader to be inconsistent with a standard, then the OSHA standard should be followed.**

**To obtain additional copies of this guide, or if you have questions about N.C. occupational safety and health standards or rules, please contact:**

**N.C. Department of Labor  
Education, Training and Technical Assistance Bureau  
1101 Mail Service Center  
Raleigh, NC 27699-1101**

**Phone: 919-807-2875 or 1-800-NC-LABOR (1-800-625-2267)**

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Additional sources of information are listed on the inside back cover of this guide.

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The projected cost of the NCDOL OSH program for federal fiscal year 2012–2013 is \$18,073,694. Federal funding provides approximately 30.5 percent (\$5,501,500) of this total.



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# Foreword

Safety programs help employers and employees to maintain an efficient and productive industry. An effective safety program will improve job performance and reduce the chances of personal injury and property damage. Feed and grain mills can present several hazards, including explosions, fires and entrapment. *A Guide to Safety and Health in Feed and Grain Mills* deals with the hazards specific to feed and grain mill facilities. Much of this guide deals with fire hazards, including ignition sources. In feed and grain mills, fires present the opportunity for devastating explosions. A key aspect of the guide is that it links the reader with information, such as relevant OSHA standards and related written materials. Information in this guide can save lives and preserve the resources of our state.

In North Carolina, the N.C. Department of Labor enforces the federal Occupational Safety and Health Act. NCDOL offers many educational programs to the public and produces publications to help inform people about their rights and responsibilities regarding occupational safety and health.

As you look through this guide, please remember NCDOL's mission is greater than just enforcement. An equally important goal is to help citizens find ways to create safe workplaces. Everyone benefits from working together for safety. Reading and understanding *A Guide to Safety and Health in Feed and Grain Mills* will help you form effective occupational safety and health practices in your work.

Cherie Berry  
Commissioner of Labor

# Introduction

The Occupational Safety and Health Act of North Carolina (OSHANC) holds the employer responsible for the safety and health of its employees. In general, the employer must furnish its employees conditions of employment and a place of employment free from recognized hazards that are likely to cause serious injury.

More specifically, the employer must comply with applicable standards. These standards are published, in part, under the title *North Carolina Occupational Safety and Health Standards for General Industry* and will be referred to in this guide as OSHNC standards or simply as standards. These standards can be obtained through the N.C. Department of Labor, Occupational Safety and Health Division, Education, Training and Technical Assistance Bureau. (See the inside back cover of this publication for the address and telephone number.)

Particular requirements applicable to the feed and grain mill industries are grouped within the OSHNC standards under 29 CFR 1910.272 for "Grain Handling Facilities." Others are dispersed among the various standards. This guide refers by section number to many of the OSHNC standards that are applicable to the feed and grain mill industries.

Though much of the responsibility for the safety and health of employees has been placed on the employer, the employees are also responsible for their safety and health. Employees must know, understand and follow guidelines and standards that reduce their chances of being in an accident. Failure to become an active partner in safety and health will expose the employee to needless accidents and losses.

This guide is intended to outline the more important aspects of employee safety in feed and grain facilities. Information in this guide can also help employers upgrade their accident prevention program.

The information in this publication is general in nature. It should be supplemented by guidance from state agencies, insurance companies and safety organizations. Additionally, the references listed at the end of this guide provide valuable resources.

Management and employees of feed and grain mill facilities must recognize that an effective accident prevention program requires a team effort by all personnel. The employees are the key to program effectiveness, based on their acceptance, compliance and cooperation with the safety program. Management must encourage employees to participate actively in the safety program of the facility. Employees' ideas and methods can improve job tasks and reduce the chances of personal injury and property damage. They contribute meaningfully to a comprehensive safety and health program.

## Planning for Emergencies

Common emergencies in feed and grain mill facilities fall into the following categories:

- Explosion
- Fire
- Entrapment
- Flammable liquid or gas leak
- Chemical release or spill
- Structural failure
- Power failure
- Natural disaster

Emergencies are circumstances that require immediate action. One characteristic of an emergency is a lack of time while the situation exists. Being prepared will not lengthen time during an emergency situation. Rather, preparedness allows employers and employees to accomplish more in less time. That cool-headed approach, in turn, may save lives and property.

Plans for emergency actions should do the following:

- Ensure prompt notification of the emergency
- Reduce losses
- Provide for immediate response
- Result in a speedy recovery
- Promote the well-being of the community

The employer of grain or feed handling facilities must develop and implement an emergency action plan. An emergency action plan, designed in accordance with 29 CFR 1910.38(a), will help ensure safety during fires, explosions, chemical spills and other emergencies.

A comprehensive emergency plan requires the involvement of employers, employees and public agencies such as fire departments and rescue squads. The employer should make the time to invite such agencies to its facilities, to acquaint the agencies with variables such as the location of:

- Fire hydrants and water supplies
- Facility entry and exit points
- Gas and power lines
- Stored chemicals, including the types of chemicals stored and amounts stored
- Confined spaces, including their particular type

### ***Elements of an Emergency Response Plan***

Elements of an emergency response plan include the following:

- Employee alarm systems
- Response duties of each employee
- Evacuation procedures
- Designated safe areas outside the facility
- Plan to communicate with the news media

Emergency escape routes must be clearly shown on floor plans and workplace maps. Employers must know that their employees know the emergency escape routes.

Employees must have access to at least two means of escape from bin decks. Employees working in tunnels or in grain or feed elevators must be provided with at least one means of emergency escape. Grain elevators constructed after March 30, 1988, must provide at least two means of emergency escape.

### ***Training for Emergencies***

The type, amount and frequency of training varies, depending upon the tasks employees are expected to perform. Although training must be provided to employees at least annually, safety meetings and drills should be conducted at more frequent intervals.

Regardless of the specific type of facility, training should include, though not be limited to, the following:

- Hazard recognition and prevention (fire, explosion, etc.)
- Proper use of fire extinguishers
- Emergency reporting procedures
- Personal protective equipment
- Preventive maintenance
- Hazardous spill response
- First aid

### **Drills and Exercises**

Drills and exercises provide a measure for the state of readiness and effectiveness of an emergency response plan. Drills should include the following provisions:

- Audible emergency communications
- Fire response and control
- Spill control and cleanup
- Emergency shutoffs
- Emergency rescue
- Medical first aid response
- Management of off-site personnel
- Monitoring and evaluation

### ***Contractors***

Employers must make contractors aware of the hazards associated with their grain or feed mill facilities, particularly in relation to the work they are to perform. Contractors should also be made aware of the employers' work permit system. In an emergency situation, contractors should be able to take appropriate action as part of the emergency action plan for the overall facility. Careful coordination helps to ensure that work is being performed in a manner that will not endanger employees.

## Explosions and Fires

### *Grain Dust Explosions*

Grain dust explosions are the number one cause of injury, death and property damage in the grain and mill industries. As the number of feed and grain mill facilities has increased, and, as the volume of grains handled in a given facility has increased, the number of dust explosions has also increased.

For a dust explosion to occur in a grain elevator or mill, the four following key elements must exist simultaneously:

1. Grain dusts, as the primary fuel
2. Oxygen
3. An ignition source (see Table 2)
4. A confined space

When the first three elements come together, in an explosive mixture, the rapidly expanding heated gases build until the pressures exceed the strength of the confined space.

Conditions under which a grain dust explosion occurs result from the following:

- A complex combination of dust particle sizes
- The concentration of dust particles in the air
- The energy of the ignition source
- The moisture content of the dust (or percent of relative humidity of the air)
- The actual composition of the dust

When these conditions are present and the concentration of suspended dust exceeds the lower explosive limits of that particular dust, an explosion results.

Table 1 indicates that various grains have different explosive properties. When dusts generated from grains are not properly handled, the conditions for an explosion can develop.

**Table 1**

#### *Explosive Properties of Common Grain Dusts*

Type of Dust	Maximum Pressure (kPA) <sup>1</sup>	Maximum Rate of Pressure Rise (MPa/s) <sup>2</sup>	Ignition Temperature		Minimum Ignition Energy (J) <sup>5</sup>	Lower Explosive Limit (g/m <sup>3</sup> ) <sup>6</sup>
			Cloud (°C) <sup>3</sup>	Layer (°) <sup>4</sup>		
Alfalfa	455	7.6	460	200	0.32	100
Cereal grass	360	3.5	550	220	0.80	200
Corn	655	41.0	400	250	0.04	55
Flax shive	560	5.5	430	230	0.08	80
Grain dust, winter wheat, corn, oats	790	38.0	430	220	0.03	55
Rice	640	18.0	440	220	0.05	50
Soy flour	540	5.5	540	190	0.10	60
Wheat flour	655	26.0	380	360	0.05	50
Wheat straw	680	41.0	470	220	0.05	55

Source: U.S. Bureau of Mines 1961. This table is presented only to illustrate that grains are of varying volatility; it is not offered as a formula for calculations. <sup>1</sup>(kPA) is a symbol representing the maximum pressure rise; <sup>2</sup>(MPa/s) is a symbol representing the rate of pressure rise; <sup>3</sup>(°C) is a symbol for cloud where the auto-ignition in a combustible cloud is measured in degrees Celsius; <sup>4</sup>(°) is a symbol for layer where the layer ignition temperature is measured in degrees Celsius; <sup>5</sup>J is the symbol for the minimum ignition energy of a combustible mixture; <sup>6</sup>(g/m<sup>3</sup>) is the symbol for the lower explosive limit of a given dust.

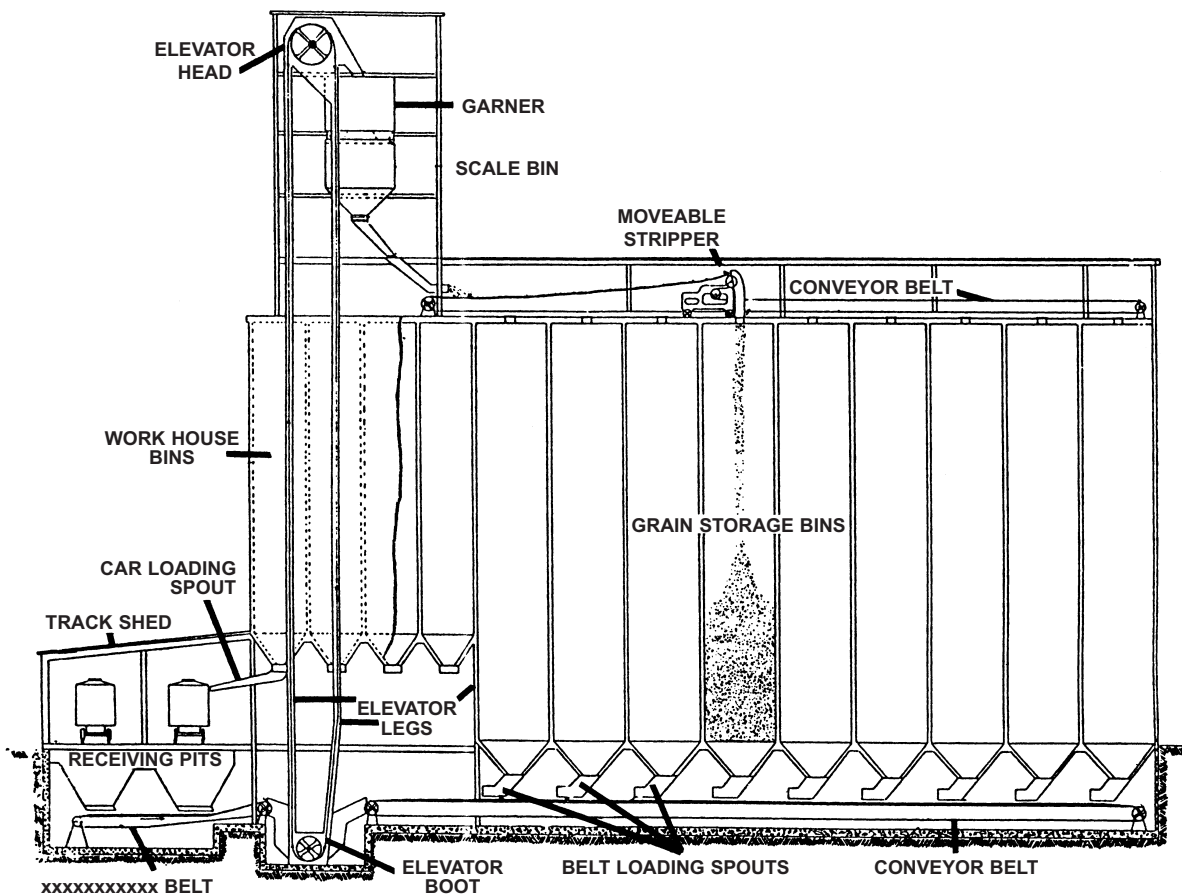


When grain is moved, grain dust is produced. The more that grain is handled, the more dust is produced. The more dust produced in a confined space, the greater the chance of exceeding the lower explosive limit of the dust. As shown in Table 1, each type of grain and the dust it produces has its own lower explosive limit. The more the lower explosive limit is exceeded, the greater the likelihood of an explosion.

Figure 1 illustrates the physical construction of a typical elevator. As grains move from input to output, there are several points where the grain is subjected to mechanical stress. Each of these points leads to the production of grain dust. The black dots in Figure 1 identify major dust generation sites. Without proper precautions, each major dust site will permit the formation of a dust cloud. All dust clouds have the potential to reach explosive levels.

**Figure 1**

*Section View of a Typical Grain Elevator*



Source: U.S. Department of Agriculture

**Sources of Ignition**

To produce a grain dust explosion, there must be a source of ignition. Table 2 presents typical sources of ignition that have been identified in previous grain elevator explosions.

**Table 2**

*Dust Cloud Ignition Sources*

High Probability of Occurrence	Low Probability of Occurrence
Hot bearings	Electrical
Welding and cutting	Static electricity
Belt slippage and misalignment	Lightning
Foreign objects caught in machinery	Metal and stone sparks
	Spontaneous combustion

To address grain dust explosion potential, OSHA has established a number of requirements that must be met by all relevant facilities. One of the most important requirements regards training.

### **Training**

In accordance with 29 CFR 1910.272 Appendix A-3, the employer must provide each employee initial and, at least, annual training. In addition, the employer must provide training when changes in job tasks expose the employee to new hazards. The training must address the following topics:

- Safety precautions associated with the facility
- Hazard recognition related to dust accumulation and common ignition sources
- Preventive measures related to dust accumulation and common ignition sources
- Specific safety procedures and practices appropriate to the employee's job, including, but not limited to, the following:
  - Cleaning procedures for grinding equipment
  - Clearing procedures for choked legs
  - Housekeeping procedures (see Housekeeping, below)
  - Hot work procedures (see Hot Work, below)
  - Preventive maintenance procedures (see Preventive Maintenance Program, below)
  - Lockout/tagout procedures (see Lockout/Tagout, below)

All employees assigned to special tasks such as bin entry or handling of flammable substances must be provided training to perform these special tasks before being permitted to do so.

Though this section has primarily addressed grain elevators, grain mills are subject to the same dust explosion hazards. In mills the grinding operation, the movement of grains along pneumatic conveyors and the transporting of materials by bucket conveyors produce the same problems found in grain elevators. Since problems are similar, employees in grain mills need to follow the same safety precautions.

### ***Fire Prevention and Protection***

Fires represent a major concern to grain and feed mills. Fires result from many different causes. The end result of a fire, however, is always the same—personal injury, death or loss of property. In the grain industry, the primary concern is not that the facility will burn, but that the fire may initiate an explosion.

#### **Get Prepared for Fires**

The first and most important step in preparing for fires is establishing a program to prevent fires from starting. This is particularly important in the feed and grain industries because of the potential for explosions and the track record of this industry for fires. A comprehensive fire prevention program addresses all work activities in which the conditions for starting a fire are present such as hot work, electrical machinery, belts and drives, and grain dryers.

The fire prevention and protection program must address the following topics:

- *Prevention*—policies, practices and procedures designed to keep the conditions necessary for a fire from coming together
  - Hot work permits
  - Lockout/tagout policies
  - Design specifications for storage of flammable materials
- *Severity reduction*—policies, practices and procedures designed to reduce the spread of fire and bring the fire to a quick end
  - Emergency plans
  - Alarm systems
  - Portable fire extinguishers
- *Cleanup*—policies, practices and procedures designed to return the affected area to an operational level and reduce other losses created by improper cleanup
  - First aid
  - Recharging portable extinguishers
  - Removal of debris to an appropriate waste site
  - Equipment and facility repair

The success of such a comprehensive fire prevention and protection program has been demonstrated in many industries, such as the oil industry, in which fire is a serious threat. In each successful program, responsibilities rest primarily with management but are shared with the employees. Employee involvement in the design, implementation and evaluation stages of the program is a central element in a successful program.

The description of a comprehensive fire prevention and protection program is beyond the scope of this section. However, you can obtain additional information by contacting the National Fire Protection Association (NFPA), any major insurance company or your local fire fighting officials. Also, see the references listed at the end of this guide.

## **Fire Protection Equipment**

### **Explosion Suppression Systems**

Explosion suppression systems should be used in unusually hazardous areas such as elevator legs, boots and head, or in areas such as bins, distributors and tanks. When such systems are made available, they must comply with 29 CFR 1910.160 and 29 CFR 1910.162.

### **Portable Fire Extinguishers**

All buildings within a facility must have fully charged and operable portable fire extinguishers. If employees are expected to use portable extinguishers or other fire fighting equipment against incipient fires, they must be trained to use the equipment. Training must include the following:

- Correct type of extinguisher to use on different classes of fire
- Proper techniques for use of the equipment to extinguish a fire

If employees are not expected to fight fires and are not trained to do so, they must be instructed to evacuate the facility in accordance with 29 CFR 1910.157(b) rather than fight fires.

### **Standpipes and Hoses**

All areas within a facility that are above 75 feet from ground level and in which combustible materials other than grain are stored should have wet or dry standpipes and hoses installed. Since freezing weather creates problems with wet standpipes, dry standpipes are recommended for cold climates. They must meet the requirements in 29 CFR 1910.158.

### **Automatic Sprinkler Systems**

Automatic sprinkler systems are recommended in areas containing combustible materials. The automatic sprinkler systems must meet the requirements in 29 CFR 1910.159.

### **Fire Hydrants**

All grain and feed mill facilities should have adequate public or private fire hydrants on site. Each fire hydrant should have an adequate water supply.

## **ABCs of Firefighting**

In a grain dust fire, it is critical to avoid the use of extinguishing methods that will spread the dust into suspension or dust cloud. The formation of a dust cloud during a fire could result in an explosion. Water from a hose under high pressure can throw up large quantities of dust. Water under low pressure, such as a fog or fine mist, is less likely to create a dust cloud.

The first steps in fighting a fire are determining the contents or materials burning in the fire and the extent (size) of the fire. The following are basic considerations for firefighting:

- Equipment that is operating should be shut down.
- Portable extinguishing equipment should be available in areas where the potential for fire is high.
- Employees must be trained in the use of any fire fighting equipment that they are expected to use.
- Appropriate alarm systems should be in place in accordance with 29 CFR 1910.165.
- A fire should be isolated. If personnel cannot isolate the fire, they should evacuate the area.
- Extinguishing methods must be appropriate for the fire.
- Warm or burning materials must be removed as soon as possible.
- Equipment should be restarted only after the fire area has been inspected and cleared by qualified personnel.

# 3

## Housekeeping, Hot Work and Electrical Hazards

### *Housekeeping*

A crucial key to the reduction of fires and explosions in grain and feed mill facilities is housekeeping. Housekeeping, however, relates to hazards in addition to fires and explosions. Research has shown that facilities that are well maintained experience fewer fires, explosions and other accidents, and are more profitable as well.

#### **Dust Control**

Reducing dust accumulations is a major concern in every grain handling facility. A good housekeeping program depends upon a combination of methods to control dust. The methods used in a given facility will depend upon the type of facility and the volume of grain handled.

In accordance with 29 CFR 1910.272(j), employers must develop, implement and maintain a written housekeeping program that reduces accumulations of fugitive dust on ledges, floors, equipment and other surfaces. Fugitive dust is defined as combustible particles of a particular size. For grain elevators, the housekeeping program must address fugitive dust accumulations in the following *priority* areas:

- Floor areas within 35 feet of inside bucket elevators
- Floors of enclosed areas containing grinding equipment
- Floors of enclosed areas containing grain dryers located inside the facility`

In *priority* areas, fugitive grain dust accumulations may not exceed 1/8 inch. The removal of fugitive grain dust by use of compressed air (to blow dust from equipment, ledges, etc.) is not permitted when machinery that presents an ignition source is energized. The use of compressed air for cleaning is not permitted unless all potential ignition sources are removed from the area.

Additionally, the housekeeping program must address proper procedures for removing grain dust spills from the work area. However, a grain dust spill is not considered fugitive grain dust.

#### **Dust Control Methods**

Methods for controlling grain dust accumulations include the following:

- Vacuums—especially in areas where dust accumulation is constant due to the job task being performed
- Wash down procedures—where hoses and water can be used to remove accumulated dust
- Choke feeds to control the flow of grain and grain dust
- Dust control systems such as filters or cyclones
- Compressed air (also known as blow down)

*Compressed Air (Blow Down) Procedures.* When you use compressed air to control or reduce grain dust accumulations, the following guidelines can reduce the chances of an explosion or fire and improve housekeeping:

- Use a blow down permit that establishes the date, the time and the work area to be cleaned.
- Shut down all operations in the housekeeping area during the blow down.
- Provide employees conducting the blow down with proper dust masks and goggles.
- Use only a pressure-relief type of air gun or wand.
- Change clothing after housekeeping. Do not use an air gun to remove dust from any person's body or clothing.

#### **Managing the Housekeeping Program**

Safety specialists believe the success of a housekeeping program depends upon both management and employees sharing responsibility.

## **Employer Responsibilities**

The following are housekeeping tasks for which the employer is responsible:

- Documentation of general policies including:
  - Schedules for cleaning
  - Checklists for cleaning procedures
  - Instructions and discipline regarding cleaning
- Staffing, including the identification of the:
  - Individual(s) in charge of housekeeping each shift
  - Major areas to which the housekeeping staff is assigned
- Program implementation, including:
  - Frequency and scope of inspections
  - Procedures for follow-up inspections
  - Training
  - Supervision

## **Employee Responsibilities**

Employees are responsible for day-to-day housekeeping tasks. Employees should do the following:

- Keep the work area neat.
- Dispose of scrap and waste in the proper receptacles.
- Keep floors free from spills and debris.
- Return tools to their proper storage place when finished with the tools.
- Make sure racks, bins and storage areas do not become overfilled.
- Keep tools in proper working condition or report when tools need repair or replacement.
- Keep aisles and walkways clean and open.

### **Remember These Housekeeping Considerations**

The following housekeeping considerations can make your housekeeping program even more effective:

- All trip hazards (objects in travel paths) should be removed from the flooring.
- Once identified, all substances that make the floor slippery should be immediately removed from the floor.
- Storage facilities should be designed and located in areas where tools need to be stored.
- Materials stored on shelves or platforms should be left in a position where the materials will not fall off the shelf or platform.

## ***Hot Work (Welding Operations)***

A major source of fires in grain and feed mills is hot work or welding operations. Hot work, by definition, means work involving electric or gas welding, cutting, brazing, or similar flame producing operations (29 CFR 1910.272(c)).

Research has shown that had employees followed standard operating procedures for hot work more than 90 percent of all related fires and explosions could have been prevented. Since hot work has both fire and explosion potential, grain and feed mill employers must pay particular attention to Subpart Q—Welding, Cutting and Brazing, 29 CFR 1910.251 and 29 CFR 1910.252.

### **Management Responsibilities for Hot Work**

The following list of minimum management responsibilities regarding hot work was drawn from 29 CFR 1910.252(a)(2)(xiii):

- Management must recognize its responsibility for the safe use of cutting and welding equipment on its property and:
  - Based upon fire potentials of plant facilities, establish procedures and areas for cutting and welding
  - Designate an individual responsible for authorizing cutting and welding operations in areas not specifically designed for such processes

- Insist that cutters or welders and their supervisors are suitably trained in the safe operation of their equipment and the safe use of the process
- Advise all contractors about flammable materials or hazardous conditions of which they are not be aware

### **Supervisory Responsibilities for Hot Work**

This list of supervisor responsibilities regarding hot work was drawn from 29 CFR 1910.252(a)(2)(xiv). The supervisor must do the following:

- Be responsible for the safe handling of the cutting or welding equipment and the safe use of the cutting or welding process
- Determine the combustible materials and hazardous areas present or likely to be present in the work location.
- Protect combustibles from ignition:
  - Have the work moved to a location free from dangerous combustibles
  - When the work cannot be moved, have the combustibles moved a safe distance from the work or properly shielded against ignition
  - Ensure that cutting and welding are scheduled so that plant operations that might expose combustibles to ignition are not started during cutting or welding
- Secure authorization for the cutting or welding operations from the designated management representative
- Determine that the cutter or welder secured assurance that conditions are safe before proceeding
- Determine that fire protection and extinguishing equipment are properly located at the site for hot work
- Make certain that fire watches are available at the site, where required

### **Rules for Hot Work**

Except under those conditions that require that hot work be conducted inside the facility, hot work should be conducted outside the facility. When hot work must be conducted at your grain or feed mill facility, enforce these important rules:

- Keep welding or cutting equipment clean and in good operating condition.
- Shut down all equipment in the work area.
- Sweep floors clean for a 35-foot radius from the hot work operation; wet down combustible floors or cover them with an approved fire-retardant material.
- Watch for fire in the hot work area for at least 30 minutes after the hot work is complete.
- Supply the firewatcher with a proper fire extinguisher.
- Conduct welding in the cooler morning hours, whenever possible.
- Ensure that a hot work permit system is in place.
- Keep equipment on which hot work is being performed:
  - Cleared of all combustible materials
  - Protected by shields in flammable areas
  - Purged of all flammable vapors
- Remove combustible materials from the opposite side of all heat-conducting materials receiving hot work.
- Use sheet metal or other approved shields to protect all combustible materials in hot work areas.
- Close off all spouts, conveyors and elevator legs so that slag and sparks do not fall into other locations.
- Use metal containers to catch molten metal from welding or cutting.
- Maintain proper oxygen pressure when cutting to reduce the production of extra sparks and slag.
- Do not conduct hot work in a building where the sprinkler system is not working.
- Recheck the hot work area daily before plant shutdown.

## ***Electrical Hazards***

There are two major concerns involving the use of electricity in feed and grain mills. The primary concern is the potential for ignition of suspended grain dust by improperly selected, installed or maintained electrical equipment. A second concern is employee contact with electrical energy that may result in injury or death.

### **Ignition Potential**

The proper mixture of suspended grain dust represents a potential explosive atmosphere that may result in a catastrophe. The only missing ingredient is a source of ignition. Any electrical equipment that is improperly selected, installed or maintained can present that source of ignition.

Only electrical equipment that is specifically approved for use in atmospheres that may contain dust in explosive or ignitable mixtures should be used. The National Electrical Code (NEC) (NFPA 70) defines these areas as Class II, Division 1 or 2. The specifications outlined by the NEC for electrical equipment selection, installation and maintenance should be followed. Use properly trained and certified electricians to ensure that all NEC requirements are met.

### **Contact by Employees**

Electricity follows the path of least resistance. The human body offers little resistance to electricity. Electrical injury, including electrocution, can result from contact with electricity. Even low voltage can cause serious injury or death, depending upon the amperage and the path that the current takes through the body.

Electricity must be respected. Since a variety of electrical equipment is present in grain elevators, **only qualified, certified electricians should install and maintain electrical equipment**. Such electrical equipment includes motors, controls, tools and lighting. Employees without proper training and supervision by a knowledgeable person should not attempt to perform any electrical work.

Employers are responsible for training employees on the proper skills and knowledge necessary to work safely around electrical equipment. Training should include basic electrical safety tips and steps for performing duties, such as changing fuses or performing basic maintenance on electrically operated machinery. Employees must also be trained in the use of lockout/tagout procedures in accordance with 29 CFR 1910.272(e) and 29 CFR 1910.147. (See Lockout/Tagout.)

The following general guidelines can help employees and employers avoid injuries and property damage from electrical energy:

- Employers should establish and enforce a lockout/tagout program to eliminate the potential for start up of equipment being serviced or repaired.
- Employers should establish a preventive maintenance program to ensure that electrical equipment is properly maintained.
- Employees should report broken or defective electrical equipment to their employer immediately; for example, broken conduits, exposed electrical conductors, missing covers or bolts in controls, and improper electrical equipment.
- Reset a circuit breaker only once; if it trips a second time, consult a qualified electrician to determine the cause of the overload.
- **Do not bypass fuses**; if a fuse blows, replace it with a fuse of the same (proper) size.
- **Do not use metal ladders around electrical equipment**; use only nonconductive ladders, such as wood or fiberglass.
- Ground all electrical equipment and systems properly.
- **Do not run extension cords under rugs, across walkways, through walls, etc.**
- Use extension cords rated for the service required.
- Extension cords should be inspected before use for nicks, cuts or breaks in the insulation; the ground prong on the extension cord should never be removed.
- Electrical tools may provide a source of ignition and should not be used in ignitable or explosive atmospheres. Electrical tools should be inspected before use for cracks in the housing or cord. Double-insulated electrical tools are preferred.
- **If you are wet or standing in water, never touch any electrical equipment.**

- **Do not overload electrical circuits.**
- **Stay away from power lines.** Pay particular attention to moving equipment that may contact these lines. Remember that these lines are not insulated and current may arc to equipment that comes in close proximity to them.
- Label electrical circuits and fuses to indicate the equipment they control.



## Other Safety Considerations

### *Confined Spaces: Bins, Silos and Tanks*

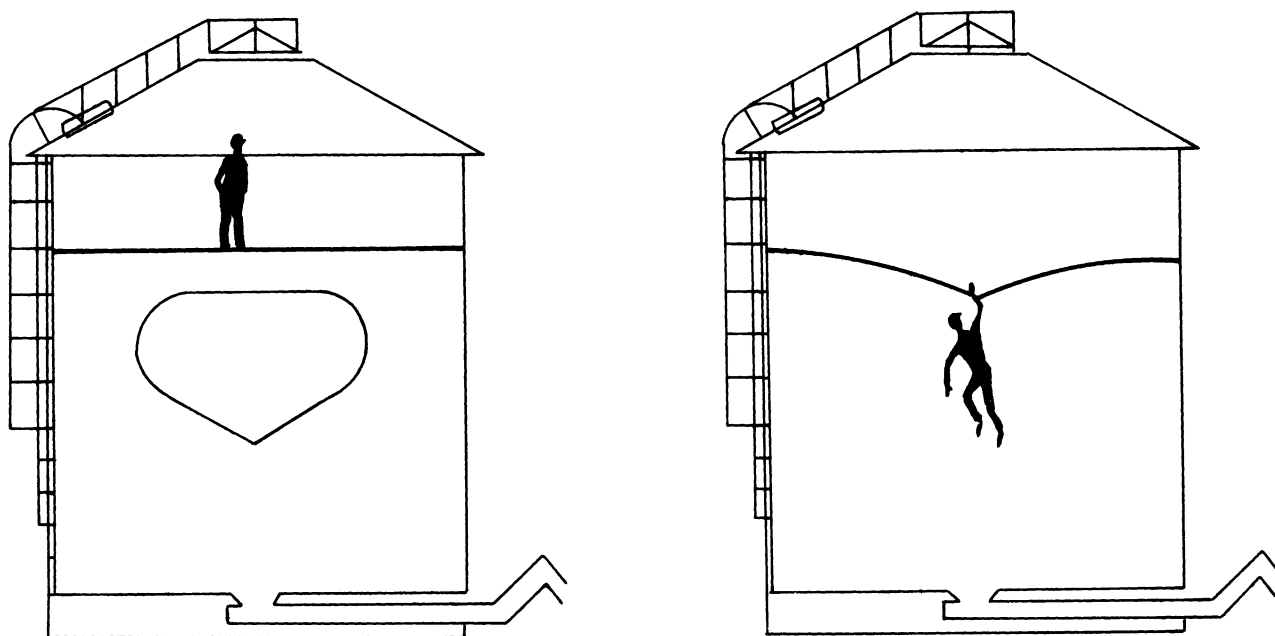
Entry into bins, silos and tanks is extremely hazardous, as is entry into any confined space. Often these spaces contain harmful substances or represent oxygen deficient environments. These environments can present serious respiratory problems. In addition to respiratory problems, the potential for employees to become engulfed or buried in shifting grain can be present.

According to the Occupational Safety and Health Administration (OSHA), most fatalities suffered by employees who have entered bins, silos or tanks, resulted when:

- Employees entered bins, silos or tanks without proper personal protective equipment.
- Employees entered bins, silos or tanks without following proper safety procedures.
- Employees were in bins, silos or tanks while grain was flowing and equipment was running, and were sucked under the grain.
- Employees were in bins or silos and fell through bridged grain (see Figure 2).

**Figure 2**

*Feed Bin Entrapment*



### **Confined Space Entry Permit Programs**

To reduce the number of fatalities that result from entry into bins, silos and tanks, employers must reduce the number of entries allowed. Only those entries that are necessary to perform the job should be allowed. Alternate means should be used whenever possible. If entry into confined spaces is necessary, the employer should have in place a confined space entry permit program. This program should be established in accordance with standard 29 CFR 1910.272(g); also see 1910.146(d) as applicable. Entry permits must be used to ensure that the provisions of this standard have been carried out. These precautions must be carried out before employees enter bins, silos and tanks. A permit is the written certification by the employer, authorizing employees to perform confined space entry, subject to specified precautions.

The confined space entry permit program should include, among other things, the following:

- Written standard operating practices for entering confined spaces
- Employee training (documented)
- Use of permits before entry
- Disconnecting, blocking off, locking out and tagging all mechanical, electrical, hydraulic, pneumatic and other energy sources that can present a danger to employees in confined space (see Lockout/Tagout)
- Atmospheric testing for:
  - Oxygen content
  - Combustible gas or vapor
  - Toxic agents
- Adequate precautions against fire and explosions
- Use of body harnesses with a lifeline or boatswain's chair, if entering from the top
- Appropriate respirator use as needed (see Respiratory Protection Program)
- An observer to maintain communication and provide assistance
- Rescue equipment
- A rescue plan for each entry

No employee should ever enter bins, silos or tanks under a bridging condition. Similarly, no employee should enter bins, silos or tanks where a buildup of grain products on the sides of the confined space could fall and bury the employee. Grain stuck to the sides of bins, silos or tanks should always be dislodged from above. If a boatswain's chair is used, it should never be positioned so that collapsing grain could engulf the employee.

## ***Manlifts***

A common piece of equipment in grain elevators for carrying an employee from one level to another is a manlift. This endless powered belt with steps or platforms and handholds is used to carry employees from floor to floor within a facility. Manlifts can be used safely when the manlift is properly constructed and well maintained, and the employee using the manlift is following standard safe operating procedures.

### **Operation**

Employers must enforce these basic guidelines when allowing employees to use a manlift:

- All employees should be given operating instructions and training in the use of manlifts.
- Only tools that fit in a pocket or tool belt should be allowed on the manlift.
- Loose tools, shovels, boards or other freight should not be allowed on the manlift.
- Employees should be trained to grasp the handholds with both hands and face the belt.
- Employees using the manlift must alert others that they are starting or stopping the manlift.

### **Installation**

Manlifts should be installed in conformity with 29 CFR 1910.68 and American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME A 90.1).

### **Inspection**

Manlifts should be inspected every 30 days. If a defect is discovered, the equipment should be taken out of operation until repaired. Employers should keep a written record of all malfunctions and maintenance work done on each manlift.

A daily inspection should be made for proper operation of emergency controls. Emergency exit ladders must be available.

## ***Mechanical Equipment***

Various types of mechanical equipment are present in grain and feed handling facilities. Examples of such equipment include dryers, grain steam processing equipment, dust collection equipment, bucket elevators and belt conveyors. Two concerns basic to the operation or use of mechanical equipment in feed and grain mills are that each piece of mechanical equipment:

- Is a source of ignition which could result in a fire or explosion
- Has moving parts and becomes a source by which an employee may become caught, which usually results in serious injury or death.

### **Preventive Maintenance Program**

A preventive maintenance program can reduce the potential for mechanical equipment to become a source of ignition for fires and explosions. The program should be developed in accordance with 29 CFR 1910.272(m). The program must implement procedures to:

- Document regularly scheduled inspections of at least the mechanical and safety control equipment
- Lubricate and maintain equipment as recommended by the manufacturer or as determined necessary by prior operating records

In addition, the employer must provide adequate training for employees on the preventive maintenance procedures.

Sources of ignition from mechanical equipment include electrical motors, electrical connections, overheated bearings and belt slippage. Employees should report any mechanical problems to the employer immediately so that the problems can be solved in a timely manner. Employers should immediately shut down any equipment that poses a source of ignition until the equipment can be properly repaired.

### **Guarding**

The mechanical equipment present in feed and grain mills contain many moving parts. Examples include pulleys, sheaves, belts and rotating shafts. Each of these can become a source of serious injury or death. All mechanical equipment should be properly guarded according to 29 CFR 1910, Subpart O—Machinery and Machine Guarding. These guards should prevent accidental contact with moving parts. Guards should never be removed while equipment is operating. Employees should ensure that all guards are in place before starting any machinery.

## ***Lockout/Tagout***

Employees are often injured while conducting routine maintenance on equipment when the equipment is accidentally started. Employers must develop a lockout/tagout program, which provides training for employees who clean grinding equipment, clear choked legs, and conduct preventive maintenance and other related job tasks.

The employer's lockout/tagout procedures must be established in accordance with 29 CFR 1910.272 as well as the principal regulation, 29 CFR 1910.147. The latter regulation requires commercial feed and grain mills to develop a lockout/tagout program. The program must consist of energy control procedures, employee training and periodic inspections to ensure that employees are safe from the unexpected release of energy when they are servicing or maintaining any machine.

Key points to remember concerning lockout/tagout include the following:

- Lockout/tagout procedures apply to all energy sources— electrical, mechanical, hydraulic, pneumatic, etc.
- After equipment is locked out and tagged, test the controls to ensure that the equipment cannot be started.
- Except under specified conditions, only the authorized employee who installed the locks and tags may remove them.
- The lockout/tagout procedures of the employer must always be followed.

# 5

## Health Hazards

This section addresses only the most prominent health hazards associated with the grain and feed mill industries.

### Noise

Employees at grain and feed handling facilities are exposed to many sources of loud noise that could result in a loss of hearing. These sources of noise include conveyors, grain dryers, tractors, motors and augers.

Excessive noise is one of the most commonly overlooked hazards in the grain and feed mill industries. It can cause permanent hearing loss. It is important to measure the descriptors of noise—intensity, frequency and duration.

#### Intensity

The pressure that noise exerts on the ear or the loudness of sound is its intensity. Decibels (dB) are units for measuring intensity (see Table 3).

**Table 3**  
*Noise Intensity Limits*

Decibels	Source of Noise
140	Pain threshold
135	Jet airplane take-off
120	Chain saw
100	Power saw; tractor
<b>90</b>	<b>OSHA limit for 8 hours</b>
<b>85</b>	<b>OSHA action limit</b>
85	Milling machine
75	Radio; vacuum cleaner
60	Normal conversation
45	Soft music; leaves rustling
40	Whispering
15	Threshold of hearing

When noise exposure is measured by the A scale of a standard sound level meter, it yields what is known as an A-weighted value. Standard 29 CFR 1910.95 sets the permissible level of noise exposure at 90 dBA for an eight-hour exposure. Higher noise levels are permitted only for correspondingly fewer hours. Thus, an exposure of up to four hours to a sound level of 95 dBA is permissible. A sound level of 100 dBA for two hours is permissible, if exposure for the remainder of the workday (six hours) is less than 90 dBA. Yet, even at these noise exposure levels, hearing damage can be expected.

At the exposure level of 90 dBAs for an eight-hour work shift, all employees must follow these directives:

- Wear protective hearing devices
- Be included in a hearing conservation program

At the “action level” of 85 dBAs to 89 dBAs, for an eight-hour period, all employees must follow these directives:

- Be included in a hearing conservation program
- Have a choice of hearing protective devices available to them

Hearing protectors must be properly fitted and employees must be trained in their use.

## Frequency

The frequency of a noise is measured by counting the number of sound waves produced by the noise source for one second. Cycles of sound per second are reported as Hertz (Hz) units. Sounds that have a high frequency and a high intensity present the greatest hazard to employees.

The human voice has a range of about 200 to 4,000 Hz. Once hearing loss drops below the 500 to 3,000 Hz range, a range crucial to understanding conversation, the damage is irreversible.

## Duration

The amount of time that someone is exposed to a noise is called the duration of the noise. As the dBAs go up, permissible duration goes down (see Table 4).

Table 4

### *Permissible Noise Exposure*

<b>Duration</b> (hours per day)	<b>Sound Level</b> (decibels)
8	90
4	95
2	100
1	105
½	110
¼	115

When employees are subjected to sounds exceeding the standard, the employer must adopt a hearing loss conservation program. Engineering controls and administrative controls must be used to reduce the intensity (noise levels) or duration (exposure times) of the source of the noise.

## Engineering Controls

The most effective way to reduce noise levels is to eliminate the source. For example, a noisy grinding operation might be controlled through the use of acoustic materials to dampen the noise level. Many items of equipment now have a rated noise output. Employers should consider noise-producing characteristics when purchasing new or replacement equipment.

Employees can also help reduce noise by checking for the following conditions:

- Unbalanced machines or motors
- Lack of lubrication or improper maintenance of machines
- Vibration
- Broken, cracked or missing mufflers on compressed air equipment

If engineering controls to lower exposures to acceptable levels prove infeasible, administrative controls, such as separating employees from the noise source and personal protective equipment, must be implemented.

Earplugs and earmuffs are common types of personal protective equipment. Since some are more useful than others, depending on the noise level, frequency, duration and comfort for the individual, qualified consultants should be contacted for selecting and fitting hearing protective devices. Following a noise survey, they will be able to make recommendations regarding engineering and administrative controls.

## ***Respiratory and Other Nonpulmonary Hazards***

Substances commonly found in the grain and feed mill industries that can be harmful both to the pulmonary and non-pulmonary systems include, but are not limited to, the following:

- |               |                 |
|---------------|-----------------|
| 1. Grain dust | 6. Fertilizers  |
| 2. Pesticides | 7. Insecticides |
| 3. Fungicides | 8. Molds        |
| 4. Fumigants  | 9. Fungi        |
| 5. Herbicides |                 |

Additionally, oxygen deficient atmospheres require the use of appropriate respirators, maintained according to 29 CFR 1910.134.

### **Grain Dust**

A potential hazard that must be singled out for wider discussion is grain dust. The composition of grain dust differs widely depending on many variables, such as contamination, humidity and age. Contaminants may include insects, mites, rodents, birds and chemicals. In addition, various types of fungi and bacteria may be present in the grain depending on the age and amount of moisture present. Health disorders from excessive exposure to grain dust depend upon the composition of the grain, the level of grain dust exposure and the duration of the exposure.

The American Conference of Governmental and Industrial Hygienists classifies grain dust as a nuisance dust. OSHA has set grain dust exposure limits for employees at 10 milligrams per cubic meter of air (10 mg/m<sup>3</sup>) (see 29 CFR 1910.1000(a), Table Z-1). This means that in any eight-hour work shift in a 40-hour workweek, the employee's average exposure to airborne grain dust must not exceed 10 mg/m<sup>3</sup>.

Grain industry employers must monitor the workplace to determine the levels of grain dust present. This monitoring should be documented. Based on the results of monitoring, employers should take appropriate action to protect employees from dust exposures that exceed the level permitted by OSHA.

Appropriate action means using engineering controls, where feasible, to reduce the level of grain dust in the air. If dust levels cannot be reduced to below 10mg/m<sup>3</sup>, the employer must provide employees with proper respiratory equipment. In addition, the employer must require and validate its proper use by all employees in areas with elevated grain dust levels. Whenever respiratory protection is present in the workplace, the employer should have a respiratory protection program as required by 29 CFR 1910.134.

### **Health Disorders Associated With Grain Dust**

The majority of health disorders associated with exposure to grain dust or grain handling are respiratory in nature.

- *Pulmonary health disorders* include the following:
  - Acute respiratory symptoms (coughing, wheezing and shortness of breath)
  - Acute and/or chronic airway obstruction
  - Asthma
  - Chronic bronchitis
  - Pulmonary fibrosis
  - Allergic alveolitis
- *Nonpulmonary health disorders* include the following:
  - Grain fever (flu-like symptoms)
  - Dermatitis (grain itch—inflammation of the skin)
  - Conjunctivitis (inflammation of the mucous membranes that line the eyelids and cover the front of the eyeball)
  - Rhinitis (inflammation of the nose and nasal mucous membranes)
  - Chemical poisoning

An employee who experiences health disorder symptoms for any of the disorders above should report the symptoms to the employer. The employer, in turn, should ensure that the employee receives medical attention.

### **Controls**

Initially all harmful substances in the workplace must be identified. After identification of hazards, implement controls, where feasible, to prevent employee exposure to the harmful substances. For example, the employer can do the following:

- Reduce or eliminate a harmful substance from the atmosphere
- Enclose or confine harmful substances
- Install adequate ventilation to reduce or eliminate the amount of harmful substances from the atmosphere
- Substitute less toxic substances

### **Respirator Protection Program**

Whenever exposure levels of harmful substances exceed the OSHA permissible exposure limits, employers must provide appropriate respirators to protect employees from such exposure (see 29 CFR 1910.1000(a), Table Z-1, Limits for Air Contaminants). Properly selected respirators reduce the chances of harmful substances from affecting the body during breathing and ensure an adequate supply of air to the user.

There are many types of respirators. It is critical that the proper respirator be selected to protect the employee. ANSI Z88.2-1969, Practices for Respiratory Protection, must be referenced to determine the proper respirator to protect employees from harmful substances.

The employer is responsible for developing an effective respiratory protection program in accordance with 29 CFR 1910.134. The program must be in writing and include the following:

- Written standard operating procedures
- Selection of proper respirators
- Adequate employee training, including respirator use and limitations
- Appropriate fit testing
- Respirator cleaning and maintenance
- Proper respirator storage
- Routine respirator inspections
- Work area condition surveillance
- Grade D breathing air for air supplied respirators

Additionally the employer must enforce the program. This includes requiring employees to wear the respirators provided. Employees must follow the respiratory protection program as developed by the employer. Employees should not try to use respirators without adequate training because using inadequate respirators in the presence of harmful substances can result in serious injury or death.

### ***Hazardous Chemicals***

Increasingly in the workplace, it is precisely what you don't know, can't see, can't smell and don't understand that hurts the most. Hazardous chemicals fall into such categories. Furthermore, hazardous chemicals are multiplying and appearing in work environments at an astonishing rate.

The standard 29 CFR 1910.1200 is designed to address the hazards of chemicals in the workplace. The purpose of the standard is to ensure that hazards of chemicals produced or imported are evaluated and that the information from such evaluations is transmitted to employees in such a manner that they can use it to protect themselves. This section outlines the standard.

In evaluating the hazards of chemicals and communicating the information to employees, the employer must do the following:

- Develop a written hazard communication program
- Label containers of chemicals in the workplace
- Make safety data sheets (SDSs) concerning hazardous chemicals in the workplace easily accessible to employees
- Inform and train employees about the hazardous chemicals in their working environment

Since chemical manufacturers and importers must evaluate the chemicals they produce or import, employers may rely upon those evaluations. However, if the employer chooses not to rely upon those evaluations, then the employer must make its own evaluations.

### **Written Hazard Communication Program**

The written hazard communication program must, among other things, include the following:

- List all hazardous chemicals in the workplace
- Describe how the employer complies with the requirements for:
  - Labeling hazardous chemicals
  - Providing SDSs
  - Furnishing information to and training for employees

The written program must be available upon request to employees and their representatives.

### **Labels**

The chemical manufacturer, importer or distributor must label each container with the identity of the hazardous chemical(s), appropriate warnings, and name and address of the manufacturer of the chemical. The employer must, in turn, label each container of hazardous chemicals in its workplace similarly.

If the container is stationary, the employer may use signs, placards, etc., in lieu of labels. The important thing is that there be clear understanding as to what is in each container. If the container is portable and used only to transfer a chemical from its stationary container, the portable container does not have to be labeled.

### **Safety Data Sheets**

The chemical manufacturer and importer must provide employers with an SDS for each chemical they produce or import. Employers must ensure that the SDSs are readily accessible to the employees on every work shift.

Among other things, the SDS for each chemical must identify the chemical with the name used on the label of its container and must provide information such as, but not limited to, the following:

- Chemical and common names of ingredients that present a known health hazard, particularly carcinogens
- Chemical and common names of ingredients that present a physical hazard
- Characteristics such as the vapor pressure and flash point
- The potential for fire, explosion and reactivity
- Signs and symptoms that may indicate that an employee has been exposed to the hazardous chemical
- Primary routes of entry (how the chemical could enter the body)
- Permissible exposure limits from OSHA and other agencies
- Precautions for safe handling, such as:
  - Hygienic practices
  - Protective measures for equipment repair
  - Cleanup of spills and leaks
- Control measures such as:
  - Engineering controls
  - Work practices
  - Personal protective equipment
- Emergency and first aid procedures
- The name, address and telephone number of the manufacturer, importer or other party who can provide information on the chemical and relevant emergency procedures

### **Employee Information and Training**

Employees must be *informed* about any operations in their work area where hazardous chemicals are present. They must also be informed about the locations and availability of the hazard communication program, list of chemicals and SDSs.



Employees must receive *training* on the following:

- Methods for detecting the presence or release of a hazardous chemical, such as monitoring devices and the visual appearance or odor of the chemical
- Physical and health hazards of chemicals in their work area
- How to protect themselves using work practices, emergency procedures and personal protective equipment
- How to interpret the information on the labels and SDSs

# 6

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