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[Title 29](#) → [Subtitle B](#) → [Chapter XVII](#) → [Part 1910](#) → [Subpart R](#) → §1910.272

[Browse Previous](#)

Title 29: Labor
PART 1910—OCCUPATIONAL SAFETY AND HEALTH STANDARDS
Subpart R—Special Industries

§1910.272 Grain handling facilities.

(a) *Scope.* This section contains requirements for the control of grain dust fires and explosions, and certain other safety hazards associated with grain handling facilities. It applies in addition to all other relevant provisions of part 1910 (or part 1917 at marine terminals).

NOTE TO PARAGRAPH (a): For grain-handling facilities in the marine-terminal industry only, 29 CFR 1910.272 is to be enforced consistent with the interpretations in OSHA Compliance Directive 02-00-066, which is available on OSHA's Web page at www.osha.gov.

(b) *Application.* (1) Paragraphs (a) through (n) of this section apply to grain elevators, feed mills, flour mills, rice mills, dust pelletizing plants, dry corn mills, soybean flaking operations, and the dry grinding operations of soycake.

(2) Paragraphs (o), (p), and (q) of this section apply only to grain elevators.

(c) *Definitions.*

Choked leg means a condition of material buildup in the bucket elevator that results in the stoppage of material flow and bucket movement. A bucket elevator is not considered choked that has the up-leg partially or fully loaded and has the boot and discharge cleared allowing bucket movement.

Flat storage structure means a grain storage building or structure that will not empty completely by gravity, has an unrestricted ground level opening for entry, and must be entered to reclaim the residual grain using powered equipment or manual means.

Fugitive grain dust means combustible dust particles, emitted from the stock handling system, of such size as will pass through a U.S. Standard 40 mesh sieve (425 microns or less).

Grain elevator means a facility engaged in the receipt, handling, storage, and shipment of bulk raw agricultural commodities such as corn, wheat, oats, barley, sunflower seeds, and soybeans.

Hot work means work involving electric or gas welding, cutting, brazing, or similar flame producing operations.

Inside bucket elevator means a bucket elevator that has the boot and more than 20 percent of the total leg height (above grade or ground level) inside the grain elevator structure. Bucket elevators with leg casings that are inside (and pass through the roofs) of rail or truck dump sheds with the remainder of the leg outside of the grain elevator structure, are not considered inside bucket elevators.

Jogging means repeated starting and stopping of drive motors in an attempt to clear choked legs.

Lagging means a covering on drive pulleys used to increase the coefficient of friction between the pulley and the belt.

Permit means the written certification by the employer authorizing employees to perform identified work operations subject to specified precautions.

(d) Emergency action plan. The employer shall develop and implement an emergency action plan meeting the requirements contained in 29 CFR 1910.38.

(e) Training. (1) The employer shall provide training to employees at least annually and when changes in job assignment will expose them to new hazards. Current employees, and new employees prior to starting work, shall be trained in at least the following:

(i) General safety precautions associated with the facility, including recognition and preventive measures for the hazards related to dust accumulations and common ignition sources such as smoking; and,

(ii) Specific procedures and safety practices applicable to their job tasks including but not limited to, cleaning procedures for grinding equipment, clearing procedures for choked legs, housekeeping procedures, hot work procedures, preventive maintenance procedures and lock-out/tag-out procedures.

(2) Employees assigned special tasks, such as bin entry and handling of flammable or toxic substances, shall be provided training to perform these tasks safely.

NOTE TO PARAGRAPH (e)(2): Training for an employee who enters grain storage structures includes training about engulfment and mechanical hazards and how to avoid them.

(f) Hot work permit. (1) The employer shall issue a permit for all hot work, with the following exceptions:

(i) Where the employer or the employer's representative (who would otherwise authorize the permit) is present while the hot work is being performed;

(ii) In welding shops authorized by the employer;

(iii) In hot work areas authorized by the employer which are located outside of the grain handling structure.

(2) The permit shall certify that the requirements contained in §1910.252(a) have been implemented prior to beginning the hot work operations. The permit shall be kept on file until completion of the hot work operations.

(g) Entry into grain storage structures. This paragraph applies to employee entry into bins, silos, tanks, and other grain storage structures. Exception: Entry through unrestricted ground level openings into flat storage structures in which there are no toxicity, flammability, oxygen-deficiency, or other atmospheric hazards is covered by paragraph (h) of this section. For the purposes of this paragraph (g),

the term "grain" includes raw and processed grain and grain products in facilities within the scope of paragraph (b)(1) of this section.

(1) The following actions shall be taken before employees enter bins, silos, or tanks:

(i) The employer shall issue a permit for entering bins, silos, or tanks unless the employer or the employer's representative (who would otherwise authorize the permit) is present during the entire operation. The permit shall certify that the precautions contained in this paragraph (§1910.272(g)) have been implemented prior to employees entering bins, silos or tanks. The permit shall be kept on file until completion of the entry operations.

(ii) All mechanical, electrical, hydraulic, and pneumatic equipment which presents a danger to employees inside grain storage structures shall be deenergized and shall be disconnected, locked-out and tagged, blocked-off, or otherwise prevented from operating by other equally effective means or methods.

(iii) The atmosphere within a bin, silo, or tank shall be tested for the presence of combustible gases, vapors, and toxic agents when the employer has reason to believe they may be present. Additionally, the atmosphere within a bin, silo, or tank shall be tested for oxygen content unless there is continuous natural air movement or continuous forced-air ventilation before and during the period employees are inside. If the oxygen level is less than 19.5%, or if combustible gas or vapor is detected in excess of 10% of the lower flammable limit, or if toxic agents are present in excess of the ceiling values listed in subpart Z of 29 CFR part 1910, or if toxic agents are present in concentrations that will cause health effects which prevent employees from effecting self-rescue or communication to obtain assistance, the following provisions apply.

(A) Ventilation shall be provided until the unsafe condition or conditions are eliminated, and the ventilation shall be continued as long as there is a possibility of recurrence of the unsafe condition while the bin, silo, or tank is occupied by employees.

(B) If toxicity or oxygen deficiency cannot be eliminated by ventilation, employees entering the bin, silo, or tank shall wear an appropriate respirator. Respirator use shall be in accordance with the requirements of §1910.134.

(iv) "Walking down grain" and similar practices where an employee walks on grain to make it flow within or out from a grain storage structure, or where an employee is on moving grain, are prohibited.

(2) Whenever an employee enters a grain storage structure from a level at or above the level of the stored grain or grain products, or whenever an employee walks or stands on or in stored grain of a depth which poses an engulfment hazard, the employer shall equip the employee with a body harness with lifeline, or a boatswain's chair that meets the requirements of subpart D of this part. The lifeline shall be so positioned, and of sufficient length, to prevent the employee from sinking further than waist-deep in the grain. Exception: Where the employer can demonstrate that the protection required by this paragraph is not feasible or creates a greater hazard, the employer shall provide an alternative means of protection which is demonstrated to prevent the employee from sinking further than waist-deep in the grain.

NOTE TO PARAGRAPH (g)(2): When the employee is standing or walking on a surface which the employer demonstrates is free from engulfment hazards, the lifeline or alternative means may be disconnected or removed.

(3) An observer, equipped to provide assistance, shall be stationed outside the bin, silo, or tank being entered by an employee. Communications (visual, voice, or signal line) shall be maintained between the observer and employee entering the bin, silo, or tank.

(4) The employer shall provide equipment for rescue operations which is specifically suited for the bin, silo, or tank being entered.

(5) The employee acting as observer shall be trained in rescue procedures, including notification methods for obtaining additional assistance.

(6) Employees shall not enter bins, silos, or tanks underneath a bridging condition, or where a buildup of grain products on the sides could fall and bury them.

(h) Entry into flat storage structures. For the purposes of this paragraph (h), the term "grain" means raw and processed grain and grain products in facilities within the scope of paragraph (b)(1) of this section.

(1) Each employee who walks or stands on or in stored grain, where the depth of the grain poses an engulfment hazard, shall be equipped with a lifeline or alternative means which the employer demonstrates will prevent the employee from sinking further than waist-deep into the grain.

NOTE TO PARAGRAPH (h)(1): When the employee is standing or walking on a surface which the employer demonstrates is free from engulfment hazards, the lifeline or alternative means may be disconnected or removed.

(2)(i) Whenever an employee walks or stands on or in stored grain or grain products of a depth which poses an engulfment hazard, all equipment which presents a danger to that employee (such as an auger or other grain transport equipment) shall be deenergized, and shall be disconnected, locked-out and tagged, blocked-off, or otherwise prevented from operating by other equally effective means or methods.

(ii) "Walking down grain" and similar practices where an employee walks on grain to make it flow within or out from a grain storage structure, or where an employee is on moving grain, are prohibited.

(3) No employee shall be permitted to be either underneath a bridging condition, or in any other location where an accumulation of grain on the sides or elsewhere could fall and engulf that employee.

(i) Contractors. (1) The employer shall inform contractors performing work at the grain handling facility of known potential fire and explosion hazards related to the contractor's work and work area. The employer shall also inform contractors of the applicable safety rules of the facility.

(2) The employer shall explain the applicable provisions of the emergency action plan to contractors.

(j) Housekeeping. (1) The employer shall develop and implement a written housekeeping program that establishes the frequency and method(s) determined best to reduce accumulations of fugitive grain dust on ledges, floors, equipment, and other exposed surfaces.

(2) In addition, the housekeeping program for grain elevators shall address fugitive grain dust accumulations at priority housekeeping areas.

(i) Priority housekeeping areas shall include at least the following:

(A) Floor areas within 35 feet (10.7 m) of inside bucket elevators;

(B) Floors of enclosed areas containing grinding equipment;

(C) Floors of enclosed areas containing grain dryers located inside the facility.

(ii) The employer shall immediately remove any fugitive grain dust accumulations whenever they exceed $\frac{1}{8}$ inch (.32 cm) at priority housekeeping areas, pursuant to the housekeeping program, or shall demonstrate and assure, through the development and implementation of the housekeeping program, that equivalent protection is provided.

(3) The use of compressed air to blow dust from ledges, walls, and other areas shall only be permitted when all machinery that presents an ignition source in the area is shut-down, and all other known potential ignition sources in the area are removed or controlled.

(4) Grain and product spills shall not be considered fugitive grain dust accumulations. However, the housekeeping program shall address the procedures for removing such spills from the work area.

(k) Grate openings. Receiving-pit feed openings, such as truck or railcar receiving-pits, shall be covered by grates. The width of openings in the grates shall be a maximum of $2\frac{1}{2}$ inches (6.35 cm).

(l) Filter collectors. (1) All fabric dust filter collectors which are a part of a pneumatic dust collection system shall be equipped with a monitoring device that will indicate a pressure drop across the surface of the filter.

(2) Filter collectors installed after March 30, 1988 shall be:

(i) Located outside the facility; or

(ii) Located in an area inside the facility protected by an explosion suppression system; or

(iii) Located in an area inside the facility that is separated from other areas of the facility by construction having at least a one hour fire-resistance rating, and which is adjacent to an exterior wall and vented to the outside. The vent and ductwork shall be designed to resist rupture due to deflagration.

(m) Preventive maintenance. (1) The employer shall implement preventive maintenance procedures consisting of:

(i) Regularly scheduled inspections of at least the mechanical and safety control equipment associated with dryers, grain stream processing equipment, dust collection equipment including filter collectors, and bucket elevators;

(ii) Lubrication and other appropriate maintenance in accordance with manufacturers' recommendations, or as determined necessary by prior operating records.

(2) The employer shall promptly correct dust collection systems which are malfunctioning or which are operating below designed efficiency. Additionally, the employer shall promptly correct, or remove from service, overheated bearings and slipping or misaligned belts associated with inside bucket elevators.

(3) A certification record shall be maintained of each inspection, performed in accordance with this paragraph (m), containing the date of the inspection, the name of the person who performed the inspection and the serial number, or other identifier, of the equipment specified in paragraph (m)(1)(i) of this section that was inspected.

(4) The employer shall implement procedures for the use of tags and locks which will prevent the inadvertent application of energy or motion to equipment being repaired, serviced, or adjusted, which could result in employee injury. Such locks and tags shall be removed in accordance with established procedures only by the employee installing them or, if unavailable, by his or her supervisor.

(n) Grain stream processing equipment. The employer shall equip grain stream processing equipment (such as hammer mills, grinders, and pulverizers) with an effective means of removing ferrous material from the incoming grain stream.

(o) Emergency escape. (1) The employer shall provide at least two means of emergency escape from galleries (bin decks).

(2) The employer shall provide at least one means of emergency escape in tunnels of existing grain elevators. Tunnels in grain elevators constructed after the effective date of this standard shall be provided with at least two means of emergency escape.

(p) Continuous-flow bulk raw grain dryers. (1) All direct-heat grain dryers shall be equipped with automatic controls that:

(i) Will shut-off the fuel supply in case of power or flame failure or interruption of air movement through the exhaust fan; and,

(ii) Will stop the grain from being fed into the dryer if excessive temperature occurs in the exhaust of the drying section.

(2) Direct-heat grain dryers installed after March 30, 1988 shall be:

(i) Located outside the grain elevator; or

(ii) Located in an area inside the grain elevator protected by a fire or explosion suppression system;
or

(iii) Located in an area inside the grain elevator which is separated from other areas of the facility by construction having at least a one hour fire-resistance rating.

(q) Inside bucket elevators. (1) Bucket elevators shall not be jogged to free a choked leg.

(2) All belts and lagging purchased after March 30, 1988 shall be conductive. Such belts shall have a surface electrical resistance not to exceed 300 megohms.

(3) All bucket elevators shall be equipped with a means of access to the head pulley section to allow inspection of the head pulley, lagging, belt, and discharge throat of the elevator head. The boot section shall also be provided with a means of access for clean-out of the boot and for inspection of the boot, pulley, and belt.

(4) All the employer shall:

(i) Mount bearings externally to the leg casing; or,

(ii) Provide vibration monitoring, temperature monitoring, or other means to monitor the condition of those bearings mounted inside or partially-inside the leg casing.

(5) All the employer shall equip bucket elevators with a motion detection device which will shut-down the bucket elevator when the belt speed is reduced by no more than 20% of the normal operating speed.

(6) All the employer shall:

(i) Equip bucket elevators with a belt alignment monitoring device which will initiate an alarm to employees when the belt is not tracking properly; or,

(ii) Provide a means to keep the belt tracking properly, such as a system that provides constant alignment adjustment of belts.

(7) Paragraphs (q)(5) and (q)(6) of this section do not apply to grain elevators having a permanent storage capacity of less than one million bushels, provided that daily visual inspection is made of bucket movement and tracking of the belt.

(8) Paragraphs (q)(4), (q)(5), and (q)(6) of this section do not apply to the following:

(i) Bucket elevators which are equipped with an operational fire and explosion suppression system capable of protecting at least the head and boot section of the bucket elevator; or,

(ii) Bucket elevators which are equipped with pneumatic or other dust control systems or methods that keep the dust concentration inside the bucket elevator at least 25% below the lower explosive limit at all times during operations.

NOTE: The following appendices to §1910.272 serve as nonmandatory guidelines to assist employers and employees in complying with the requirements of this section, as well as to provide other helpful information.

No additional burdens are imposed through these appendices.

APPENDIX A TO §1910.272 GRAIN HANDLING FACILITIES

Examples presented in this appendix may not be the only means of achieving the performance goals in the standard.

1. Scope and Application

The provisions of this standard apply in addition to any other applicable requirements of this part 1910 (or part 1917 at marine terminals). The standard contains requirements for new and existing grain handling facilities. The standard does not apply to seed plants which handle and prepare seeds for planting of future crops, nor to on-farm storage or feed lots.

2. Emergency Action Plan

The standard requires the employer to develop and implement an emergency action plan. The emergency action plan (§1910.38) covers those designated actions employers and employees are to take to ensure employee safety from fire and other emergencies. The plan specifies certain minimum elements which are to be addressed. These elements include the establishment of an employee alarm system, the development of evacuation procedures, and training employees in those actions they are to take during an emergency.

The standard does not specify a particular method for notifying employees of an emergency. Public announcement systems, air horns, steam whistles, a standard fire alarm system, or other types of employee alarm may be used. However, employers should be aware that employees in a grain facility may have difficulty hearing an emergency alarm, or distinguishing an emergency alarm from other audible signals at the facility, or both. Therefore, it is important that the type of employee alarm used be distinguishable and distinct.

The use of floor plans or workplace maps which clearly show the emergency escape routes should be included in the emergency action plan; color coding will aid employees in determining their route assignments. The employer should designate a safe area, outside the facility, where employees can congregate after evacuation, and implement procedures to account for all employees after emergency evacuation has been completed.

It is also recommended that employers seek the assistance of the local fire department for the purpose of preplanning for emergencies. Preplanning is encouraged to facilitate coordination and cooperation between facility personnel and those who may be called upon for assistance during an emergency. It is important for emergency service units to be aware of the usual work locations of employees at the facility.

3. Training

It is important that employees be trained in the recognition and prevention of hazards associated with grain facilities, especially those hazards associated with their own work tasks. Employees should understand the factors which are necessary to produce a fire or explosion, i.e., fuel (such as grain dust), oxygen, ignition source, and (in the case of explosions) confinement. Employees should be made aware that any efforts they make to keep these factors from occurring simultaneously will be an important step in reducing the potential for fires and explosions.

The standard provides flexibility for the employer to design a training program which fulfills the needs of a facility. The type, amount, and frequency of training will need to reflect the tasks that employees are expected to perform. Although training is to be provided to employees at least annually, it is recommended that safety meetings or discussions and drills be conducted at more frequent intervals.

The training program should include those topics applicable to the particular facility, as well as topics such as: Hot work procedures; lock-out/tag-out procedures; bin entry procedures; bin cleaning procedures; grain dust explosions; fire prevention; procedures for handling "hot grain"; housekeeping procedures, including methods and frequency of dust removal; pesticide and fumigant usage; proper use and maintenance of personal protective equipment; and, preventive maintenance. The types of work clothing should also be considered in the program at least to caution against using polyester clothing that easily melts and increases the severity of burns, as compared to wool or fire retardant cotton.

In implementing the training program, it is recommended that the employer utilize films, slide-tape presentations, pamphlets, and other information which can be obtained from such sources as the Grain Elevator and Processing Society, the Cooperative Extension Service of the U.S. Department of Agriculture, Kansas State University's Extension Grain Science and Industry, and other state agriculture schools, industry associations, union organizations, and insurance groups.

4. Hot Work Permit

The implementation of a permit system for hot work is intended to assure that employers maintain control over operations involving hot work and to assure that employees are aware of and utilize appropriate safeguards when conducting these activities.

Precautions for hot work operations are specified in 29 CFR 1910.252(a), and include such safeguards as relocating the hot work operation to a safe location if possible, relocating or covering combustible material in the vicinity, providing fire extinguishers, and provisions for establishing a fire watch. Permits are not required for hot work operations conducted in the presence of the employer or the employer's authorized representative who would otherwise issue the permit, or in an employer authorized welding shop or when work is conducted outside and away from the facility.

It should be noted that the permit is not a record, but is an authorization of the employer certifying that certain safety precautions have been implemented prior to the beginning of work operations.

5. Entry Into Bins, Silos, And Tanks

In order to assure that employers maintain control over employee entry into bins, silos, and tanks, OSHA is requiring that the employer issue a permit for entry into bins, silos, and tanks unless the employer (or the employer's representative who would otherwise authorize the permit) is present at the entry and during the entire operation.

Employees should have a thorough understanding of the hazards associated with entry into bins, silos, and tanks. Employees are not to be permitted to enter these spaces from the bottom when grain or other agricultural products are hung up or sticking to the sides which might fall and injure or kill an employee. Employees should be made aware that the atmosphere in bins, silos, and tanks can be oxygen deficient or toxic. Employees should be

trained in the proper methods of testing the atmosphere, as well as in the appropriate procedures to be taken if the atmosphere is found to be oxygen deficient or toxic. When a fumigant has been recently applied in these areas and entry must be made, aeration fans should be running continuously to assure a safe atmosphere for those inside. Periodic monitoring of toxic levels should be done by direct reading instruments to measure the levels, and, if there is an increase in these readings, appropriate actions should be promptly taken.

Employees have been buried and suffocated in grain or other agricultural products because they sank into the material. Therefore, it is suggested that employees not be permitted to walk or stand on the grain or other grain product where the depth is greater than waist high. In this regard, employees must use a full body harness or boatswain's chair with a lifeline when entering from the top. A winch system with mechanical advantage (either powered or manual) would allow better control of the employee than just using a hand held hoist line, and such a system would allow the observer to remove the employee easily without having to enter the space.

It is important that employees be trained in the proper selection and use of any personal protective equipment which is to be worn. Equally important is the training of employees in the planned emergency rescue procedures. Employers should carefully read §1910.134(e)(3) and assure that their procedures follow these requirements. The employee acting as observer is to be equipped to provide assistance and is to know procedures for obtaining additional assistance. The observer should not enter a space until adequate assistance is available. It is recommended that an employee trained in CPR be readily available to provide assistance to those employees entering bins, silos, or tanks.

6. Contractors

These provisions of the standard are intended to ensure that outside contractors are cognizant of the hazards associated with grain handling facilities, particularly in relation to the work they are to perform for the employer. Also, in the event of an emergency, contractors should be able to take appropriate action as a part of the overall facility emergency action plan. Contractors should also be aware of the employer's permit systems. Contractors should develop specified procedures for performing hot work and for entry into bins, silos, and tanks and these activities should be coordinated with the employer. Contractors are responsible for informing their own employees.

This coordination will help to ensure that employers know what work is being performed at the facility by contractors; where it is being performed; and, that it is being performed in a manner that will not endanger employees.

7. Housekeeping.

The housekeeping program is to be designed to keep dust accumulations and emissions under control inside grain facilities. The housekeeping program, which is to be written, is to specify the frequency and method(s) used to best reduce dust accumulations.

Ship, barge, and rail loadout and receiving areas which are located outside the facility need not be addressed in the housekeeping program. Additionally, truck dumps which are open on two or more sides need not be addressed by the housekeeping program. Other truck dumps should be addressed in the housekeeping program to provide for regular cleaning during periods of receiving grain or agricultural products. The housekeeping program should provide coverage for all workspaces in the facility and include walls, beams, etc., especially in relation to the extent that dust could accumulate.

Dust Accumulations

Almost all facilities will require some level of manual housekeeping. Manual housekeeping methods, such as vacuuming or sweeping with soft bristle brooms, should be used which will minimize the possibility of layered dust being suspended in the air when it is being removed.

The housekeeping program should include a contingency plan to respond to situations where dust accumulates rapidly due to a failure of a dust enclosure hood, an unexpected breakdown of the dust control system, a dust-tight connection inadvertently knocked open, etc.

The housekeeping program should also specify the manner of handling spills. Grain spills are not considered to be dust accumulations.

A fully enclosed horizontal belt conveying system where the return belt is inside the enclosure should have inspection access such as sliding panels or doors to permit checking of equipment, checking for dust accumulations and facilitate cleaning if needed.

Dust Emissions

Employers should analyze the entire stock handling system to determine the location of dust emissions and effective methods to control or to eliminate them. The employer should make sure that holes in spouting, casings of bucket elevators, pneumatic conveying pipes, screw augers, or drag conveyor casings, are patched or otherwise properly repaired to prevent leakage. Minimizing free falls of grain or grain products by using choke feeding techniques, and utilization of dust-tight enclosures at transfer points, can be effective in reducing dust emissions.

Each housekeeping program should specify the schedules and control measures which will be used to control dust emitted from the stock handling system. The housekeeping program should address the schedules to be used for cleaning dust accumulations from motors, critical bearings and other potential ignition sources in the working areas. Also, the areas around bucket elevator legs, milling machinery and similar equipment should be given priority in the cleaning schedule. The method of disposal of the dust which is swept or vacuumed should also be planned.

Dust may accumulate in somewhat inaccessible areas, such as those areas where ladders or scaffolds might be necessary to reach them. The employer may want to consider the use of compressed air and long lances to blow down these areas frequently. The employer may also want to consider the periodic use of water and hoses to wash down these areas. If these methods are used, they are to be specified in the housekeeping program along with the appropriate safety precautions, including the use of personal protective equipment such as eyewear and dust respirators.

Several methods have been effective in controlling dust emissions. A frequently used method of controlling dust emissions is a pneumatic dust collection system. However, the installation of a poorly designed pneumatic dust collection system has fostered a false sense of security and has often led to an inappropriate reduction in manual housekeeping. Therefore, it is imperative that the system be designed properly and installed by a competent contractor. Those employers who have a pneumatic dust control system that is not working according to expectations should request the engineering design firm, or the manufacturer of the filter and related equipment, to conduct an evaluation of the system to determine the corrections necessary for proper operation of the system. If the design firm or manufacturer of the equipment is not known, employers should contact their trade association for recommendations of competent designers of pneumatic dust control systems who could provide assistance.

When installing a new or upgraded pneumatic control system, the employer should insist on an acceptance test period of 30 to 45 days of operation to ensure that the system is operating as intended and designed. The employer should also obtain maintenance, testing, and inspection information from the manufacturer to ensure that the system will continue to operate as designed.

Aspiration of the leg, as part of a pneumatic dust collection system, is another effective method of controlling dust emissions. Aspiration of the leg consists of a flow of air across the entire boot, which entrains the liberated dust and carries it up the up-leg to take-off points. With proper aspiration, dust concentrations in the leg can be lowered below the lower explosive limit. Where a prototype leg installation has been instrumented and shown to be effective in keeping the dust level 25% below the lower explosive limit during normal operations for the various products handled, then other legs of similar size, capacity and products being handled which have the same design criteria for the air aspiration would be acceptable to OSHA, provided the prototype test report is available on site.

Another method of controlling dust emissions is enclosing the conveying system, pressurizing the general work area, and providing a lower pressure inside the enclosed conveying system. Although this method is effective in controlling dust emissions from the conveying system, adequate access to the inside of the enclosure is necessary to facilitate frequent removal of dust accumulations. This is also necessary for those systems called "self-cleaning."

The use of edible oil sprayed on or into a moving stream of grain is another method which has been used to control dust emissions. Tests performed using this method have shown that the oil treatment can reduce dust

emissions. Repeated handling of the grain may necessitate additional oil treatment to prevent liberation of dust. However, before using this method, operators of grain handling facilities should be aware that the Food and Drug Administration must approve the specific oil treatment used on products for food or feed.

As a part of the housekeeping program, grain elevators are required to address accumulations of dust at priority areas using the action level. The standard specifies a maximum accumulation of $\frac{1}{8}$ inch dust, measurable by a ruler or other measuring device, anywhere within a priority area as the upper limit at which time employers must initiate action to remove the accumulations using designated means or methods. Any accumulation in excess of this amount and where no action has been initiated to implement cleaning would constitute a violation of the standard, unless the employer can demonstrate equivalent protection. Employers should make every effort to minimize dust accumulations on exposed surfaces since dust is the fuel for a fire or explosion, and it is recognized that a $\frac{1}{8}$ inch dust accumulation is more than enough to fuel such occurrences.

8. Filter Collectors

Proper sizing of filter collectors for the pneumatic dust control system they serve is very important for the overall effectiveness of the system. The air to cloth ratio of the system should be in accordance with the manufacturer's recommendations. If higher ratios are used, they can result in more maintenance on the filter, shorter bag or sock life, increased differential pressure resulting in higher energy costs, and an increase in operational problems.

A photohelic gauge, magnehelic gauge, or manometer, may be used to indicate the pressure rise across the inlet and outlet of the filter. When the pressure exceeds the design value for the filter, the air volume will start to drop, and maintenance will be required. Any of these three monitoring devices is acceptable as meeting paragraph (l)(1) of the standard.

The employer should establish a level or target reading on the instrument which is consistent with the manufacturer's recommendations that will indicate when the filter should be serviced. This target reading on the instrument and the accompanying procedures should be in the preventive maintenance program. These efforts would minimize the blinding of the filter and the subsequent failure of the pneumatic dust control system.

There are other instruments that the employer may want to consider using to monitor the operation of the filter. One instrument is a zero motion switch for detecting a failure of motion by the rotary discharge valve on the hopper. If the rotary discharge valve stops turning, the dust released by the bag or sock will accumulate in the filter hopper until the filter becomes clogged. Another instrument is a level indicator which is installed in the hopper of the filter to detect the buildup of dust that would otherwise cause the filter hopper to be plugged. The installation of these instruments should be in accordance with manufacturer's recommendations.

All of these monitoring devices and instruments are to be capable of being read at an accessible location and checked as frequently as specified in the preventive maintenance program.

Filter collectors on portable vacuum cleaners, and those used where fans are not part of the system, are not covered by requirements of paragraph (l) of the standard.

9. Preventive Maintenance

The control of dust and the control of ignition sources are the most effective means for reducing explosion hazards. Preventive maintenance is related to ignition sources in the same manner as housekeeping is related to dust control and should be treated as a major function in a facility. Equipment such as critical bearings, belts, buckets, pulleys, and milling machinery are potential ignition sources, and periodic inspection and lubrication of such equipment through a scheduled preventive maintenance program is an effective method for keeping equipment functioning properly and safely. The use of vibration detection methods, heat sensitive tape or other heat detection methods that can be seen by the inspector or maintenance person will allow for a quick, accurate, and consistent evaluation of bearings and will help in the implementation of the program.

The standard does not require a specific frequency for preventive maintenance. The employer is permitted flexibility in determining the appropriate interval for maintenance provided that the effectiveness of the maintenance program can be demonstrated. Scheduling of preventive maintenance should be based on manufacturer's

recommendations for effective operation, as well as from the employer's previous experience with the equipment. However, the employer's schedule for preventive maintenance should be frequent enough to allow for both prompt identification and correction of any problems concerning the failure or malfunction of the mechanical and safety control equipment associated with bucket elevators, dryers, filter collectors and magnets. The pressure-drop monitoring device for a filter collector, and the condition of the lagging on the head pulley, are examples of items that require regularly scheduled inspections. A system of identifying the date, the equipment inspected and the maintenance performed, if any, will assist employers in continually refining their preventive maintenance schedules and identifying equipment problem areas. Open work orders where repair work or replacement is to be done at a designated future date as scheduled, would be an indication of an effective preventive maintenance program.

It is imperative that the prearranged schedule of maintenance be adhered to regardless of other facility constraints. The employer should give priority to the maintenance or repair work associated with safety control equipment, such as that on dryers, magnets, alarm and shut-down systems on bucket elevators, bearings on bucket elevators, and the filter collectors in the dust control system. Benefits of a strict preventive maintenance program can be a reduction of unplanned downtime, improved equipment performance, planned use of resources, more efficient operations, and, most importantly, safer operations.

The standard also requires the employer to develop and implement procedures consisting of locking out and tagging equipment to prevent the inadvertent application of energy or motion to equipment being repaired, serviced, or adjusted, which could result in employee injury. All employees who have responsibility for repairing or servicing equipment, as well as those who operate the equipment, are to be familiar with the employer's lock and tag procedures. A lock is to be used as the positive means to prevent operation of the disconnected equipment. Tags are to be used to inform employees why equipment is locked out. Tags are to meet requirements in §1910.145(f). Locks and tags may only be removed by employees that placed them, or by their supervisor, to ensure the safety of the operation.

10. Grain Stream Processing Equipment

The standard requires an effective means of removing ferrous material from grain streams so that such material does not enter equipment such as hammer mills, grinders and pulverizers. Large foreign objects, such as stones, should have been removed at the receiving pit. Introduction of foreign objects and ferrous material into such equipment can produce sparks which can create an explosion hazard. Acceptable means for removal of ferrous materials include the use of permanent or electromagnets. Means used to separate foreign objects and ferrous material should be cleaned regularly and kept in good repair as part of the preventive maintenance program in order to maximize their effectiveness.

11. Emergency Escape

The standard specifies that at least two means of escape must be provided from galleries (bin decks). Means of emergency escape may include any available means of egress (consisting of three components, exit access, exit, and exit discharge as defined in §1910.35), the use of controlled descent devices with landing velocities not to exceed 15 ft/sec., or emergency escape ladders from galleries. Importantly, the means of emergency escape are to be addressed in the facility emergency action plan. Employees are to know the location of the nearest means of emergency escape and the action they must take during an emergency.

12. Dryers

Liquefied petroleum gas fired dryers should have the vaporizers installed at least ten feet from the dryer. The gas piping system should be protected from mechanical damage. The employer should establish procedures for locating and repairing leaks when there is a strong odor of gas or other signs of a leak.

13. Inside Bucket Elevators

Hazards associated with inside bucket elevator legs are the source of many grain elevator fires and explosions. Therefore, to mitigate these hazards, the standard requires the implementation of special safety precautions and procedures, as well as the installation of safety control devices. The standard provides for a phase-in period for many of the requirements to provide the employer time for planning the implementation of the requirements. Additionally,

for elevators with a permanent storage capacity of less than one million bushels, daily visual inspection of belt alignment and bucket movement can be substituted for alignment monitoring devices and motion detection devices.

The standard requires that belts (purchased after the effective date of the standard) have surface electrical resistance not to exceed 300 megohms. Test methods available regarding electrical resistance of belts are: The American Society for Testing and Materials D257-76, "Standard Test Methods for D-C Resistance or Conductance of Insulating Materials"; and, the International Standards Organization's #284, "Conveyor Belts-Electrical Conductivity-Specification and Method of Test." When an employer has a written certification from the manufacturer that a belt has been tested using one of the above test methods, and meets the 300 megohm criteria, the belt is acceptable as meeting this standard. When using conductive belts, the employer should make certain that the head pulley and shaft are grounded through the drive motor ground or by some other equally effective means. When V-type belts are used to transmit power to the head pulley assembly from the motor drive shaft, it will be necessary to provide electrical continuity from the head pulley assembly to ground, e.g., motor grounds.

Employers should also consider purchasing new belts that are flame retardant or fire resistive. A flame resistance test for belts is contained in 30 CFR 18.65.

APPENDIX B TO §1910.272 GRAIN HANDLING FACILITIES

National Consensus Standards

The following table contains a cross-reference listing of current national consensus standards which provide information that may be of assistance to grain handling operations. Employers who comply with provisions in these national consensus standards that provide equal or greater protection than those in §1910.272 will be considered in compliance with the corresponding requirements in §1910.272.

Subject	National consensus standards
<i>Grain elevators and facilities handling bulk raw agricultural commodities</i>	ANSI/NFPA 61B
<i>Feed mills</i>	ANSI/NFPA 61C
<i>Facilities handling agricultural commodities for human consumption</i>	ANSI/NFPA 61D
<i>Pneumatic conveying systems for agricultural commodities</i>	ANSI/NFPA 66
<i>Guide for explosion venting</i>	ANSI/NFPA 68
<i>Explosion prevention systems</i>	ANSI/NFPA 69
<i>Dust removal and exhaust systems</i>	ANSI/NFPA 91

APPENDIX C TO §1910.272 GRAIN HANDLING FACILITIES

References for Further Information

The following references provide information which can be helpful in understanding the requirements contained in various provisions of the standard, as well as provide other helpful information.

1. Accident Prevention Manual for Industrial Operations; National Safety Council, 425 North Michigan Avenue, Chicago, Illinois 60611.
2. Practical Guide to Elevator Design; National Grain and Feed Association, P.O. Box 28328, Washington, DC 20005.
3. Dust Control for Grain Elevators; National Grain and Feed Association, P.O. Box 28328, Washington, DC 20005.

4. *Prevention of Grain Elevator and Mill Explosions; National Academy of Sciences, Washington, DC. (Available from National Technical Information Service, Springfield, Virginia 22151.)*
5. *Standard for the Prevention of Fires and Explosions in Grain Elevators and Facilities Handling Bulk Raw Agricultural Commodities, NFPA 61B; National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.*
6. *Standard for the Prevention of Fire and Dust Explosions in Feed Mills, NFPA 61C; National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.*
7. *Standard for the Prevention of Fire and Dust Explosions in the Milling of Agricultural Commodities for Human Consumption, NFPA 61D; National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.*
8. *Standard for Pneumatic Conveying Systems for Handling Feed, Flour, Grain and Other Agricultural Dusts, NFPA 66; National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.*
9. *Guide for Explosion Venting, NFPA 68; National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.*
10. *Standard on Explosion Prevention Systems, NFPA 69; National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.*
11. *Safety-Operations Plans; U.S. Department of Agriculture, Washington, DC 20250.*
12. *Inplant Fire Prevention Control Programs; Mill Mutual Fire Prevention Mutual Fire Prevention Bureau, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.*
13. *Guidelines for Terminal Elevators; Mill Mutual Fire Prevention Bureau, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.*
14. *Standards for Preventing the Horizontal and Vertical Spread of Fires in Grain Handling Properties; Mill Mutual Fire Mutual Fire Prevention Bureau, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.*
15. *Belt Conveyors for Bulk Materials, Part I and Part II, Data Sheet 570, Revision A; National Safety Council, 425 North Michigan Avenue, Chicago, Illinois 60611.*
16. *Suggestions for Precautions and Safety Practices in Welding and Cutting; Mill Mutual Fire Prevention Bureau, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.*
17. *Food Bins and Tanks, Data Sheet 524; National Safety Council, 425 North Michigan Avenue, Chicago, Illinois 60611.*
18. *Pneumatic Dust Control in Grain Elevators; National Academy of Sciences, Washington, DC. (Available from National Technical Information Service, Springfield, Virginia 22151.)*
19. *Dust Control Analysis and Layout Procedures for Grain Storage and Processing Plants; Mill Mutual Fire Prevention Bureau, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.*
20. *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal, NFPA 91; National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.*
21. *Standards for the Installation of Direct Heat Grain Driers in Grain and Milling Properties; Mill Mutual Fire Prevention Bureau, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.*
22. *Guidelines for Lubrication and Bearing Maintenance; Mill Mutual Fire Prevention Bureau, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.*

23. *Organized Maintenance in Grain and Milling Properties*; Mill Mutual Fire Prevention Bureau, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.

24. *Safe and Efficient Elevator Legs for Grain and Milling Properties*; Mill Mutual Fire Prevention Bureau, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.

25. *Explosion Venting and Suppression of Bucket Elevators*; National Grain and Feed Association, P.O. Box 28328, Washington, DC 20005.

26. *Lightning Protection Code, NFPA 78*; National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.

27. *Occupational Safety in Grain Elevators*, DHHS (NIOSH) Publication No. 83-126; National Institute for Occupational Safety and Health, Morgantown, West Virginia 26505.

28. *Retrofitting and Constructing Grain Elevators*; National Grain and Feed Association, P.O. Box 28328, Washington, DC 20005.

29. *Grain Industry Safety and Health Center—Training Series (Preventing grain dust explosions, operations maintenance safety, transportation safety, occupational safety and health)*; Grain Elevator and Processing Society, P.O. Box 15026, Commerce Station, Minneapolis, Minnesota 55415-0026.

30. *Suggestions for Organized Maintenance*; The Mill Mutuals Loss Control Department, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.

31. *Safety—The First Step to Success*; The Mill Mutual Loss Control Department, 1 Pierce Place, Suite 1260 West, Itasca, Illinois 60143-1269.

32. *Emergency Plan Notebook*; Schoeff, Robert W. and James L. Balding, Kansas State University, Cooperative Extension Service, Extension Grain Science and Industry, Shellenberger Hall, Manhattan, Kansas 66506.

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