

NFPA® 61

Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities

2013 Edition



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NFPA® 61

Standard for the

Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities

2013 Edition

This edition of NFPA 61, *Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities*, was prepared by the Technical Committee on Agricultural Dusts, and acted on by NFPA at its June Association Technical Meeting held June 11–14, 2012, in Las Vegas, NV. It was issued by the Standards Council on August 9, 2012, with an effective date of August 29, 2012, and supersedes all previous editions.

This edition of NFPA 61 was approved as an American National Standard on August 29, 2012.

Origin and Development of NFPA 61

The NFPA 61 standard originated in 1923, when standards were developed to prevent dust explosions in grain terminals and flour mills. There were four standards associated with agricultural dusts. In 1969, NFPA 61B was adopted by the Association as a tentative standard to replace three former standards: NFPA 61B, *Code for the Prevention of Dust Explosions in Terminal Grain Elevators*; NFPA 64, *Code for the Prevention of Dust Ignitions in Country Grain Elevators*; and NFPA 661, *Suction and Venting in Grain Elevators*. In addition, NFPA 93, *Standard for Dehydrators and Dryers for Agricultural Products*, was withdrawn in 1968 and its text was incorporated as a chapter in NFPA 61B. The 1969 tentative edition of NFPA 61B was officially adopted at the 1970 NFPA Annual Meeting.

In 1995, the following four agricultural dust standards were combined into a single standard: NFPA 61A, *Standard for the Prevention of Fire and Dust Explosions in Facilities Manufacturing and Handling Starch*; NFPA 61B, *Standard for the Prevention of Fires and Explosions in Grain Elevators and Facilities Handling Bulk Raw Agricultural Commodities*; NFPA 61C, *Standard for the Prevention of Fire and Dust Explosions in Feed Mills*; and NFPA 61D, *Standard for the Prevention of Fire and Dust Explosions in the Milling of Agricultural Commodities for Human Consumption*. The Technical Committee on Agricultural Dusts determined that the four standards were largely duplicative, and it therefore created one comprehensive standard, NFPA 61, *Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities*, covering the full range of requirements for good design, operating practice, and protective features.

In the 2002 edition, the second revised edition after the combination of the four documents, requirements were clarified and additional advisory material was added. The document was also modified to comply with the updated *Manual of Style for NFPA Technical Committee Documents*.

In the 2008 edition, requirements for life safety and construction were clarified. A requirement for safety devices on belt conveyors was added. Requirements for proper head section venting were added, as well as a requirement for all filters to be located outdoors. Clarification on training requirements were provided.

In the 2013 edition, the Committee has updated definitions related to agricultural products handling, conveying, and dust collection. The requirements in Chapter 7 affecting bucket elevators have been revised to reflect current industry practice. The requirements in Chapter 10 affecting dust control systems have been revised to include a written housekeeping program. Requirements for pneumatic conveying system design have been added into Chapter 11. In Chapter 12, the requirement related to standpipes has been revised.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the prevention, control, and extinguishment of fire and explosions resulting from dusts produced by the processing, handling, and storage of grain, starch, food, animal feed, flour, and other agricultural products. The Technical Committee shall also be responsible for requirements relating to the protection of life and property from fire and explosion hazards at agricultural and food products facilities.



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Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex F. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex F.

Chapter 1 Administration

1.1 Scope.

1.1.1* This standard shall apply to all of the following:

- (1) All facilities that receive, handle, process, dry, blend, use, mill, package, store, or ship dry agricultural bulk materials, their by-products, or dusts that include grains, oilseeds, agricultural seeds, legumes, sugar, flour, spices, feeds, and other related materials
- (2) All facilities designed for manufacturing and handling starch, including drying, grinding, conveying, processing, packaging, and storing dry or modified starch, and dry products and dusts generated from these processes
- (3) Those seed preparation and meal-handling systems of oilseed processing plants not covered by NFPA 36, *Standard for Solvent Extraction Plants*

1.1.2 This standard shall not apply to oilseed extraction plants that are covered by NFPA 36, *Standard for Solvent Extraction Plants*.

1.2* Purpose. The purpose of this standard shall be to prescribe requirements for safety to life and property from fire

and explosion and to minimize the resulting damage if a fire or explosion occurs.

1.3 Application. The requirements of Chapter 13 shall apply to all facilities, both new and existing.

1.4 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

1.4.1 Unless otherwise specified, the provisions of this standard shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard. Where specified, the provisions of this standard shall be retroactive.

1.4.2 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.4.3 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

1.5* Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2010 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2013 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2010 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2011 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2012 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 2011 edition.

NFPA 36, *Standard for Solvent Extraction Plants*, 2009 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2009 edition.

NFPA 54, *National Fuel Gas Code*, 2012 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2011 edition.

NFPA 68, *Standard on Explosion Protection by Deflagration Venting*, 2007 edition.

NFPA 69, *Standard on Explosion Prevention Systems*, 2008 edition.



NFPA 70®, *National Electrical Code*®, 2011 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*, 2013 edition.

NFPA 86, *Standard for Ovens and Furnaces*, 2011 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 2010 edition.

NFPA 101®, *Life Safety Code*®, 2012 edition.

NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, 2008 edition.

NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*, 2011 edition.

NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2013 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2011 edition.

NFPA 5000®, *Building Construction and Safety Code*®, 2012 edition.

2.3 Other Publications.

2.3.1 AMCA Publications. Air Movement and Control Association International, Inc., 30 West University Drive, Arlington Heights, IL 60004-1893.

AMCA Standards Handbook, Standard 99-0401-86, *Classifications for Spark Resistant Construction*, 2010.

2.3.2 ASME Publications. American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

ASME *Unfired Pressure Vessel Code*, Section VIII, "Rules for Construction of Pressure Vessels," 2010.

2.3.3 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2009 edition.

NFPA 68, *Standard on Explosion Protection by Deflagration Venting*, 2007 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 2010 edition.

NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*, 2012 edition.

NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2013 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the *Manual of Style for NFPA Technical Committee Documents*.

3.3 General Definitions.

3.3.1* Agricultural Dust. Any finely divided solid agricultural material 420 microns or smaller in diameter (material passing a U.S. No. 40 Standard Sieve) that presents a fire or explosion hazard when dispersed and ignited in air.

3.3.2* Air-Material Separator (AMS). A device designed to separate the conveying air from the material being conveyed. [654, 2013]

3.3.3* Air-Moving Device (AMD). A fan, blower, or other device that establishes an airflow by moving a volume of air per unit time. [91, 2010]

3.3.4* Bulk Raw Grain. Grain materials, such as cereal grains, oilseeds, and legumes, that have not undergone processing or size reduction.

3.3.5* Centralized Vacuum Cleaning System. A fixed-pipe pneumatic conveying system using remotely located hose connection stations to allow the vacuuming of combustible dust accumulations from surfaces and conveying those dusts to an air-material separator (AMS).

3.3.6* Deflagration. Propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium. [68, 2007]

3.3.7* Dust Collection System. A combination of equipment designed to contain, capture, collect, and filter airborne dusts.

3.3.8* Explosion. The bursting or rupture of an enclosure or container due to the development of internal pressure from a deflagration.

3.3.9 Fire Barrier Wall. A wall, other than a fire wall, having a fire resistance rating. [221, 2012]

3.3.10 Fire-Resistant Belting Materials. Belts that meet Mine Safety and Health Administration (MSHA) 2G flame test for conveyor belting.

3.3.11 Hot Work. Work involving burning, welding, or a similar operation that is capable of initiating fires or explosions. [51B, 2009]

3.3.12 Marine Tower. Stationary or movable tower used for supporting equipment to load or unload grain.

3.3.13 Ohms per Square. The term used to define electrical surface resistivity of a material.

3.3.14 Outside Bucket Elevator (Leg). A bucket elevator that has less than 20 percent of the abovegrade leg height inside any enclosed structure.

3.3.15* Pneumatic Conveying System. A material feeder, an air-material separator, an enclosed ductwork system, or an air-moving device in which a combustible particulate solid is conveyed from one point to another with a stream of air or other gases. Pneumatic conveying for product transfer is distinguished from dust collection systems that are designed to handle dust.

Chapter 4 Construction Requirements

4.1 General Requirements.

4.1.1 The construction, renovation, modification, reconstruction, alteration, repair, addition, change of use or change of occupancy classification, demolition, and relocation of all buildings and structures shall comply with the governing building code, except as modified herein.

4.1.2* Enclosures built to segregate dust explosion hazard areas from other areas shall be designed such that they will not fail before the explosion pressure is vented to a safe outside location.

4.1.3 Electrical wiring and power equipment shall meet all applicable requirements of NFPA 70, *National Electrical Code*.

4.1.4* Masonry shall not be used for the construction of exterior walls or roofs of areas classified as Class II, Group G, Division 1 in NFPA 70, *National Electrical Code*.

Exception: Masonry walls that are designed for explosion resistance to preclude failure of these walls before the explosion pressure can be vented safely to the outside.

4.1.5 Facilities that are designed for receiving, shipping, handling, and storing of bulk raw agricultural commodities and are located in a separate structure from grain processing or manufacturing areas and their associated raw material, ingredient, production, and finished product bins shall be located and constructed in accordance with the requirements of 4.1.5.1 through 4.1.5.4.

4.1.5.1 Structures housing personnel-intensive areas not directly involved in operations such as, but not limited to, those involved exclusively in administrative or clerical personnel

groups, grain inspection and weighing supervision, or operations from control rooms shall be constructed in a location remote from storage silos and headhouse structures as specified in 4.1.5.2 through 4.1.5.4.

Exception: Small control rooms contiguous to specific operations such as railcar and truck discharging or loading or to control rooms such as those used in feed mills for mixing operations.

4.1.5.2 Structures housing personnel-intensive areas shall not be constructed directly over subterranean tunnels through which grain-handling equipment or dust control system ductwork passes or over other tunnels that have direct openings into grain-handling areas.

Exception: Small control room structures contiguous to specific operations such as railcar and truck discharging or loading.

4.1.5.3 Where reinforced concrete is used in silos and headhouses, the separation distance from personnel-intensive areas shall be at least 30 m (100 ft).

Exception: Distances less than 30 m (100 ft) but in no case less than 15 m (50 ft) shall be permitted if any of the following conditions exist:

- (1) *The property boundaries or other permanent constraints preclude 30 m (100 ft).*
- (2) *Structures do not have inside legs.*
- (3) *Structures have inside legs that are equipped with explosion suppression systems in accordance with NFPA 69, Standard on Explosion Prevention Systems.*

4.1.5.4 Where the headhouse is constructed of structural steel or reinforced concrete framework with lightweight, explosion-relieving wall panels, or does not contain inside or unprotected bucket elevators, the separation distance from personnel-intensive areas shall be at least 15 m (50 ft).

Exception: Distances less than 15 m (50 ft) shall be permitted if the property boundaries or other permanent constraints preclude 15 m (50 ft), but in no case shall distances less than 9 m (30 ft) be permitted.

4.1.6* Where provided, a lightning protection system shall be designed and installed in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems*.

4.2* Interior Surfaces. Horizontal surfaces shall be minimized to prevent accumulations of dust in all interior structural areas where significant dust accumulations could occur.

4.3 Interior Wall Construction.

4.3.1 Storage areas larger than 465 m² (5000 ft²) and containing packaging, bagging, palletizing, and pelleting equipment shall be cut off from all other areas with fire barrier walls designed for a minimum fire resistance of 2 hours and designed in accordance with NFPA 5000, *Building Construction and Safety Code*, Chapter 8, Fire-Resistive Materials and Construction.

4.3.2 Warehouse areas shall be designed in accordance with NFPA 5000, *Building Construction and Safety Code*.

4.3.3 Necessary openings in fire walls and fire barrier walls shall be kept to a minimum and be as small as practicable. Such openings shall be protected with listed self-closing fire doors, fire shutters, fire dampers, or penetration seals installed in accordance with NFPA 5000, *Building Construction and Safety Code*, Chapter 8, Fire-Resistive Materials and Construction.



4.3.3.1 Fire doors, fire shutters, fire dampers, and fire penetration seals shall be listed and shall have a fire resistance rating complying with NFPA 101, *Life Safety Code*.

4.3.3.2 Hold-open devices, if used, shall be listed and shall activate and allow the door to close upon sensing at least one of the following:

- (1) Heat
- (2) Smoke
- (3) Flames
- (4) Products of combustion

4.4 Means of Egress.

4.4.1 Means of egress shall be in accordance with NFPA 101, *Life Safety Code*.

4.4.2 Where the horizontal travel distance to the means of egress is less than 15 m (50 ft) in normally unoccupied spaces, a single means of egress shall be permitted.

4.4.3 Bin decks shall have two means of egress that are remote from each other such that a single fire or explosion event will not likely block both means of egress.

Exception: Only one means of egress shall be required for bin deck areas where travel distance to the means of egress is less than 15 m (50 ft).

4.5 Bins, Tanks, and Silos.

4.5.1 Construction of bins, tanks, and silos shall conform to applicable local, state, or national codes.

4.5.2* Where explosion relief vents are provided on silos, bins, and tanks, they shall operate due to overpressure before the container walls fail.

4.5.3 Access doors or openings shall meet the following requirements:

- (1) They shall be provided to permit inspection, cleaning, and maintenance and to allow effective use of fire fighting techniques in the event of fire within the bin, tank, or silo.
- (2) They shall be designed to prevent dust leaks.

4.5.4 Where a bin, tank, or silo has a personnel access opening provided in the roof or cover, the smallest dimension of the opening shall be at least 610 mm (24 in.).

4.6 Marine Towers.

4.6.1 Marine towers shall be constructed of noncombustible materials.

4.6.2 Movable marine towers shall be provided with automatic or manually operated brakes.

4.6.2.1 Movable marine towers shall be provided with automatic or manual rail clamps.

4.6.2.2 Equipment to monitor wind velocity shall be installed on movable marine towers.

4.6.2.3 Rail clamps shall operate or be activated when the wind velocity is great enough to cause movement of the tower, even when brakes or gear drives are preventing the rail wheels from turning.

4.6.3 Movable marine towers shall have provisions for emergency tie-downs.

4.6.4 Marine vessel loading equipment, such as conveyors, spouts, or drags, shall have safety devices to prevent the equipment from falling if the operating cable(s) breaks.

Chapter 5 Ventilation and Venting

5.1 General.

5.1.1 In this chapter, ventilation shall refer to natural or mechanical movement of air necessary for normal operation and personnel comfort and safety.

5.1.2 Recirculating or recycling exhaust air ventilation systems for dust explosion hazard areas, if used, shall be equipped with filter systems capable of removing dust from the air.

5.1.3 Dust collection systems used in conjunction with ventilation systems shall comply with the provisions of Chapter 10 of this standard.

5.2 Venting of Bins, Tanks, and Silos.

5.2.1 The requirements for air displacement shall be as follows:

- (1) Each bin, tank, or silo shall be provided with means for air displacement during filling or emptying.
- (2) Displaced air shall not be discharged to the building atmosphere unless it is cleaned with a filter having a minimum efficiency of 0.02 g per dry standard cubic meter of airflow (0.008 grains per dry standard cubic foot of airflow).

5.2.2* Vents shall be designed to prevent plugging due to accumulations of dust.

5.2.3 Inclined vent stacks shall have clean-out doors or panels.

5.2.4 All vents shall be fitted with weather hoods.

5.2.5 Bin vents shall be sized to handle the air displaced by either filling or emptying.

Chapter 6 Explosion Prevention, Relief, and Venting

6.1* General. Explosion prevention, relief, and venting, as used in this standard, shall encompass the design and installation of devices and systems to vent the gases and overpressure resulting from a combustion explosion occurring in equipment, rooms, buildings, or other enclosures so that damage is minimized.

6.2* Enclosure Requirements.

6.2.1* If a dust explosion hazard exists in rooms, buildings, or other enclosures under normal operating conditions, such areas shall be provided with explosion relief venting distributed over the exterior walls (and roof, if applicable) in accordance with NFPA 68, *Standard on Explosion Protection by Deflagration Venting*.

6.2.1.1 The design of such explosion relief venting shall consider the limitations imposed by the structural design of the area.

6.2.1.2 The design shall offer the least possible resistance to explosion pressures.

Exception No. 1: Tunnels and pits where explosion venting is not practical due to confinement by soil, building constraints, or both.

Exception No. 2: Bins and silos where explosion venting is not practical due to bin or silo geometry, building constraints, or both.

6.2.2* Explosion relief panels, windows, or other venting devices shall be designed to prevent reclosing after relieving the explosion pressure and shall be attached to retention cables or restrained by equivalent means such that they will not become a hazardous projectile upon relief.

6.3 Equipment Requirements.

6.3.1 Equipment requiring explosion prevention shall be protected by containment, suppression, inerting, or explosion venting.

6.3.2 Suppression, containment, or inerting systems shall be designed according to NFPA 69, *Standard on Explosion Prevention Systems*.

6.3.3* Explosion venting shall be designed in accordance with NFPA 68, *Standard on Explosion Protection by Deflagration Venting*.

6.3.3.1 Explosion venting shall be directed to a safe, outside location away from platforms, means of egress, or other potentially occupied areas or directed through a listed flame arresting and particulate retention device.

Chapter 7 Equipment

7.1 Bearings.

7.1.1 Antifriction bearings shall be used on all machinery, conveyors, legs, and processing equipment.

Exception: Sleeve and friction-type bearings, plastic bearings, or oil-impregnated wood bearings shall be permitted for equipment operating at 150 rpm or less.

7.1.2 All bearings shall be maintained per manufacturers' recommendations and shall be kept free of dust, product, and excessive lubricant.

7.1.3* All bearings on legs and conveyors shall be located outside of machinery enclosures and isolated from the product stream to minimize exposure to dust and to be more accessible for inspection and service.

Exception: Antifriction support bearings on screw conveyors and similar equipment requiring bearings to be within the product stream shall be of the sealed type. Sleeve and friction-type bearings shall be permitted for equipment operating at 150 rpm or less.

7.2 Drive Belts.

7.2.1 Where drive assemblies involve the use of belts, such as V-belts, timing belts, flat belts, and so forth, they shall be electrically conductive at 1 megohm or less and shall be fire resistant and oil resistant.

7.2.2 Where a drive belt is used, the drive train shall be designed with a minimum service factor of 1.5 or higher if the manufacturer of the drive components recommends a higher service factor for continuous service for the type of equipment to be driven.

Exception: Line shaft drives as used in the milling industry.

7.3* Conveyors, Spouts, and Throws of Material.

7.3.1* Bulk material conveyor belts shall be designed to either relieve or stop if the discharge end becomes plugged.

7.3.2 Bulk material conveyor belts shall have belt alignment and hot bearing sensors at the head and tail.

7.3.3 Screw, drag, or en-masse conveyors shall be fully enclosed in metal housings and shall be designed to either relieve or stop if the discharge end becomes plugged.

7.3.4* Bulk material conveyor belts and lagging shall have a surface resistivity not greater than 100 megohms (MΩ) per square and shall be fire resistant and oil resistant.

7.3.5 Fixed spouts shall be dusttight.

7.3.6* Use of combustible lining shall be permitted in spouts and other handling equipment at impact points and on wear surfaces.

7.3.7 Portable, automatic distributing, and movable spouts shall be permitted in work areas, bin areas, and distribution areas and shall be as dusttight as practicable when in use.

7.3.8* Spouts that direct material into bins, tanks, or silos shall be designed and installed so that any foreign objects, such as metal or stones, in the material stream do not strike the walls of the container, as far as is practicable.

7.4 Bucket Elevator Legs.

7.4.1 All Legs.

7.4.1.1 Casing, head and boot sections, access openings, and connecting spouts shall be as dusttight as practicable and shall be constructed of noncombustible materials.

7.4.1.2* Inspection openings shall be provided in the boot section to allow clean-out of the boot and inspection of the alignment of the boot pulley and belt.

7.4.1.3 Inspection openings shall be provided in the head section to allow complete inspection of the head pulley lagging, the belt and pulley alignment, and the discharge throat of the leg.

7.4.1.4* Each leg shall be independently driven by motor(s) and drive train(s) capable of handling the full-rated capacity of the elevator leg without overloading.

Exception: Line shaft drives shall be acceptable for legs used in the milling industry as long as they are capable of handling the full-rated capacity of all connected equipment without overloading.

7.4.1.4.1 Multiple motor drives shall be interlocked to prevent operation of the leg upon failure of any single motor.

7.4.1.4.2 The drive shall be capable of starting the unchoked leg under full (100 percent) load.

7.4.1.5* Each leg shall be provided with a motion detector device that will cut off the power to the drive motor and actuate an alarm in the event the leg belt slows to 80 percent of normal operating speed. Feed to the elevator leg by mechanical means shall be stopped or diverted.

7.4.1.6 The use of plastic, rubber, and other combustible linings shall be limited to high-impact areas and wear surfaces.

7.4.1.7 The leg head section between the up and down casings shall be sloped at an angle of not less than 45 degrees.



7.4.1.8 All spouts intended to receive grain or dry ingredients directly from any leg shall be designed and installed to handle the full-rated elevating capacity of the largest leg feeding such spouts.

7.4.1.9 Legs shall have lagging installed on the head pulley to minimize slippage.

7.4.1.9.1* Leg belts and lagging shall have a surface resistivity not greater than 100 megohms per square.

7.4.1.9.2 Leg belts and lagging shall be fire resistant and oil resistant.

Exception No. 1: Oil-resistant lagging or belting shall not be required for bucket elevators used in flour mills or for handling inert materials.

Exception No. 2: Line shaft drives as used in the milling industry shall be exempt from the lagging requirement.

7.4.1.10* Inside legs shall have bearing temperature or vibration detection, head pulley alignment, and belt alignment monitors at head and tail pulleys.

Exception: Legs that have capacities less than 106 m³/hr (3750 ft³/hr).

7.4.1.11 All garnerers, bins, or other receptacles into which material is spouted directly from legs, and which are not designed with automatic overflow systems, shall be equipped either with devices to shut down equipment or with high-level indicating devices with visual or audible alarms.

7.4.2 Legs Handling Bulk Raw Grain.

7.4.2.1* Legs handling bulk raw grain shall be installed either as an outside leg or as an inside leg with compliance with one of the following cases:

- (1) Legs are located within 3 m (10 ft) of an exterior wall and are vented as outlined in 7.4.2.2 to the outside of the building and designed so that the explosion pressures will not rupture the ductwork or the leg. Explosion relief panels shall be provided on the leg housing so the ducts will not be a collection point for dust during normal operations.
- (2) Legs are vented in accordance with NFPA 68, *Standard on Explosion Protection by Deflagration Venting*.
- (3) Legs are provided with explosion suppression in accordance with NFPA 69, *Standard on Explosion Prevention Systems*.
- (4)*Legs that have capacities less than 106 m³/hr (3750 ft³/hr).

7.4.2.2* All newly installed outside legs shall be provided with explosion relief panels located at intervals no greater than 6 m (20 ft) along the casings as shown in Figure 7.4.2.2(a) and Figure 7.4.2.2(b). To minimize personnel exposure, explosion venting for outside legs shall start between 2.5 m to 3.5 m (8 ft to 12 ft) above grade, or the bottom of the explosion vent shall be within 0.3 m to 1 m (1 ft to 4 ft) after the leg penetrates the building roof. Head section explosion venting shall be located in the top surface of the head or on the sides using a method to deflect the explosion upward.

Exception No. 1: Legs that have capacities less than 106 m³/hr (3750 ft³/hr).

Exception No. 2: Those portions of outside legs, as defined in this standard, below grade or passing through ground-level buildings.

7.4.2.2.1 Each side vent shall have a minimum area equivalent to two-thirds of the cross-sectional area of the leg casing.

7.4.2.2.2 A single face vent shall be permitted to replace a pair of opposing side vents in those portions of a double-casing leg where either of the following situations exists:

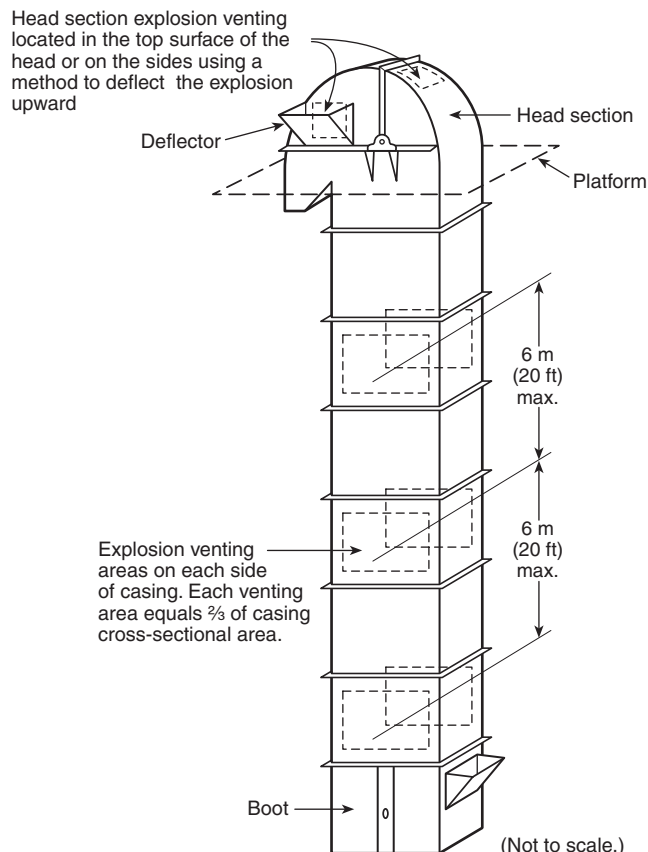


FIGURE 7.4.2.2(a) Typical Elevator Explosion Venting for a Single Casing Leg.

- (1) Side venting could expose personnel on access ladders or platforms.
- (2) Structural interferences are present that would interfere with vent operation.

7.4.2.2.3 Single face vents shall be equal to the area of two side vents [4/3 of the cross-sectional area of the leg casing as indicated in Figure 7.4.2.2(b)].

7.4.2.2.4 The head section of bucket elevators shall be provided with explosion vents in the top surface or on the sides using a method to deflect the explosion upward. The vent area shall be a minimum of 0.14 m² (5 ft²) of vent area per 2.9 m³ (100 ft³) of head section volume. The largest vent area as practicable shall be used in the head section to help minimize the development of explosive pressure. Vents shall deploy when an internal pressure of 3.5 kPa to 6.9 kPa (0.5 psi to 1.0 psi) occurs.

7.4.3 Legs Handling Materials Other Than Bulk Raw Grain That Present an Explosion Hazard.

7.4.3.1 Explosion venting of legs into buildings shall not be permitted.

7.4.3.2* Newly installed outside legs shall be equipped with explosion venting in accordance with 7.4.2.2.

Exception: Those portions of outside legs, as defined in this standard, below grade or passing through ground-level buildings.