

NFPA 655

Standard for Prevention of Sulfur Fires and Explosions

2007 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA 655
Standard for
Prevention of Sulfur Fires and Explosions
2007 Edition

This edition of NFPA 655, *Standard for Prevention of Sulfur Fires and Explosions*, was prepared by the Technical Committee on Handling and Conveying of Dusts, Vapors, and Gases. It was issued by the Standards Council on July 28, 2006, with an effective date of August 17, 2006, and supersedes all previous editions.

This edition of NFPA 655 was approved as an American National Standard on August 17, 2006.

Origin and Development of NFPA 655

This standard was first presented to the Association as a progress report in 1938 by the Committee on Dust Explosion Hazards. It was tentatively adopted in 1939. After some revision, it was officially adopted in 1940. Amendments were adopted in 1946, 1947, 1959, 1968, and 1971.

In 1976, responsibility for the document was transferred to the Technical Committee on Fundamentals of Dust Explosion Prevention and Control. The Technical Committee completely revised the 1971 edition to effect minor technical amendments and to editorially revise the document to comply with the NFPA *Manual of Style*.

Due to limited technological changes in this subject area between 1982 and 1988, the Committee reconfirmed the text as it had appeared in the 1982 version. Editorial changes and changes to allow the document to adhere more closely to the 1986 edition of the NFPA *Manual of Style*, were incorporated into the 1988 edition.

For the 1993 edition, the Committee made minor revisions to Chapter 2 for handling finely divided sulfur in bulk and minor revisions to the fire-fighting procedures to be used when fighting fires involving sulfur.

The 2001 edition contained editorial changes associated with incorporation of the 2000 edition of the *Manual of Style for NFPA Technical Committee Documents*. The Committee also made minor revisions to Chapter 6 to address operating precautions for pits and tank sections and to clarify protection for covered liquid sulfur storage tanks.

The 2007 edition includes a complete revision of the standard, which is highlighted by the addition of three new chapters and the revision of Chapter 4, which combines the requirements applicable to both finely divided and coarse sulfur. These chapters reflect the Committee's efforts to expand the dust hazard control requirements within the standard. The new chapters — Chapter 7, Fugitive Dust Control and Housekeeping; Chapter 8, Training and Procedures; and Chapter 9, Inspection and Maintenance — are based upon dust hazard evaluation and control processes found in NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2006 edition. This edition also contains new requirements applicable to intermediate bulk containers (IBCs).

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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 fires and explosions in the design, construction, installation, operation, and maintenance of facilities and systems processing or conveying flammable or combustible dusts, gases, vapors, and mists.



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NFPA 655**Standard for****Prevention of Sulfur Fires and Explosions****2007 Edition**

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

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 B. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. 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 B.

Chapter 1 Administration**1.1 Scope.**

1.1.1* This standard shall apply to the crushing, grinding, or pulverizing of sulfur and to the handling of sulfur in any form.

1.1.2 This standard shall not apply to the mining of sulfur, recovery of sulfur from process streams, or transportation of sulfur.

1.2 Purpose. The purpose of this standard shall be to provide requirements to eliminate or reduce the hazards of explosion and fire inherent in the processing and handling of sulfur.

1.3 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.

1.3.1 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.

1.3.2 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.

1.3.3 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.

1.3.3.1 This standard shall apply to facilities on which construction is begun subsequent to the date of publication of the standard. When major replacement or renovation of existing facilities is planned, provisions of this standard shall apply.

1.4 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.

1.4.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.4.2 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 17, *Standard for Dry Chemical Extinguishing Systems*, 2002 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2003 edition.

NFPA 69, *Standard on Explosion Prevention Systems*, 2002 edition.

NFPA 70, *National Electrical Code*®, 2005 edition.

NFPA 72®, *National Fire Alarm Code*®, 2007 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2007 edition.

NFPA 101®, *Life Safety Code*®, 2006 edition.

NFPA 220, *Standard on Types of Building Construction*, 2006 edition.

NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*, 2006 edition.

NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, 2003 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2004 edition.

2.3 Other Publications.

2.3.1 ISA Publications. The Instrumentation, Systems, and Automation Society, 67 Alexander Drive, Research Triangle Park, NC 27709.

ISA S84.01, *Application of Safety Instrumented Systems for the Process Industries*, 2004 edition.

2.3.2 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2006 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 shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Dust Collector. Any device designed to separate the conveying gas stream from the solid being conveyed.

3.3.2* Dust Explosion Hazard. Areas where dust accumulations exceed $\frac{1}{32}$ in. (0.8 mm) or areas where dust clouds of a hazardous concentration exist.

3.3.3 Intermediate Bulk Containers.

3.3.3.1 Flexible Intermediate Bulk Container (FIBC).

3.3.3.1.1 Type A FIBC. A standard insulating flexible intermediate bulk container (FIBC). [654, 2006]

3.3.3.1.2 Type B FIBC. A flexible intermediate bulk container (FIBC) where the fabric or the combination of the fabric shell, coating, and any loose liner has a breakdown voltage of less than 6000 volts. [654, 2006]

3.3.3.1.3 Type C FIBC. A flexible intermediate bulk container (FIBC) where the fabric is interwoven with an electrically interconnected conductive fiber and provided with a tab for connection to grounding systems. [654, 2006]

3.3.3.1.4 Type D FIBC. A flexible intermediate bulk container (FIBC) constructed from fabric and/or threads with special static properties designed to control electrostatic discharge incendivity, without grounding. [654, 2006]

3.3.3.2* Rigid Intermediate Bulk Container (RIBC). An intermediate bulk container (IBC) that can be enclosed in or encased by an outer structure consisting of a steel cage, a single-wall metal or plastic enclosure, or a double wall of foamed or solid plastic. [654, 2006]

3.3.3.2.1 Insulating RIBC. An RIBC constructed entirely of solid plastic or solid plastic and foam composite that cannot be electrically grounded. [654, 2006]

3.3.4 Machinery.

3.3.4.1 Type 1. Low-speed primary crushers, such as jaw and roll crushers.

3.3.4.2 Type 2. High-speed primary crushers, such as disk and hammer mills, pulverizers, and fine grinding equipment of all kinds, except Type 4, having a net internal volume of not more than 500 in.³ (8193 cm³).

3.3.4.3 Type 3. Crushers and pulverizers of the Type 2 category, but having an internal volume of more than 500 in.³ (8193 cm³).

3.3.4.4 Type 4. Pulverizers that do not depend on moving parts for their disintegrating action, such as attrition mills.

3.3.5* Sulfur Dust. Finely divided sulfur that presents a fire or deflagration hazard when suspended in air or other oxidizing medium over a range of concentrations regardless of particle size or shape.

Chapter 4 Handling Solid Sulfur in Bulk

4.1 General.

4.1.1 This chapter shall apply to handling and processing of solid sulfur at grinding facilities.

4.1.2 For the purpose of this standard, machinery for crushing and pulverizing sulfur shall be grouped into the following categories:

- (1) *Type 1.* Low-speed primary crushers, such as jaw and roll crushers
- (2) *Type 2.* High-speed primary crushers, such as disk and hammer mills, pulverizers, and fine grinding equipment of all kinds, except Type 4, having a net internal volume of not more than 500 in.³ (8193 cm³)
- (3) *Type 3.* Crushers and pulverizers of the Type 2 category, but having an internal volume of more than 500 in.³ (8193 cm³)
- (4)* *Type 4.* Pulverizers that do not depend on moving parts for their disintegrating action, such as attrition mills

4.1.3 Operation and maintenance of all crushing and pulverizing machinery shall be under supervision.

4.2 Location, Construction, and Venting of Buildings and Equipment.

4.2.1 Building Construction.

4.2.1.1 All buildings shall be of Type I or Type II construction, as defined in NFPA 220, *Standard on Types of Building Construction*.

4.2.1.2 Where local, state, and national building codes are more restrictive, modifications shall be permitted for conformance to these codes.

4.2.1.3* Interior surfaces where dust accumulations can occur shall be designed and constructed so as to facilitate cleaning and to minimize combustible dust accumulations.

4.2.1.4 Spaces inaccessible to housekeeping shall be sealed in order to prevent dust accumulation.

4.2.1.5 Interior walls erected for the purpose of limiting fire spread shall have a minimum 1-hour fire resistance rating and shall be designed in accordance with NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*.

4.2.1.6 Fire Doors.

4.2.1.6.1 Openings in fire walls and in fire barrier walls shall be protected by self-closing fire doors that have a fire resistance rating equivalent to the wall design.

4.2.1.6.2 Fire doors shall be installed according to NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, and shall normally be in the closed position.

4.2.1.7 Egress. Means of egress shall comply with NFPA 101, *Life Safety Code*.

4.2.1.8 Penetrations. Where floors, walls, ceilings, and other partitions have been erected to control the spread of fire or deflagrations, penetrations in these structures shall be sealed to maintain their fire endurance rating and maintain physical integrity in a deflagration.

4.2.1.9 Fire Resistance Rating.

4.2.1.9.1 Interior stairs, elevators, and manlifts shall be enclosed in dusttight shafts that have a minimum fire resistance rating of 1 hour.

4.2.1.9.2 Doors that are the automatic-closing or self-closing type and have a fire resistance rating of 1 hour shall be provided at each landing.

4.2.1.9.3 Stairs, elevators, and manlifts that serve only open-deck floors, mezzanines, and platforms shall not be required to be enclosed.

4.2.1.10* Floors and load-bearing walls that are exposed to dust explosion hazards shall be designed so as to preclude failure during an explosion.

4.2.2 Location of Crushing or Pulverizing Machinery and Containers.

4.2.2.1 Where crushing or pulverizing machinery is located in an enclosed or partially enclosed space, that space shall be used only for the size reduction process and the filling of containers with the reduced material when size reduction of sulfur is in progress.

4.2.2.2* Containers shall be removed from the area as soon as possible after being filled.

4.2.3 Building Construction Requirements for Housing Grinding or Pulverizing Machinery.

4.2.3.1 Where Type 1 equipment is located outdoors, it shall be permitted to transfer reduced material in enclosed downstream equipment, provided either of the following conditions exists:

- (1) The transferred material is continuously wetted with water sufficient to prevent ignition.
- (2) An inert gas isolation system is provided between the Type 1 equipment and the enclosed downstream equipment.

4.2.3.2* Where grinding or pulverizing machinery is located in an enclosed or partially enclosed space, that space shall be separated from other areas by noncombustible construction.

4.2.3.3 The separating walls shall be designed to withstand the force of a sulfur dust explosion.

4.2.3.4 Openings through floors, walls, and ceilings for necessary pipes, shafts, and conveyors shall be sealed dusttight. (See 4.2.4.1.)

4.2.4 Protection of Openings.

4.2.4.1 All pathways between the space used for grinding and the rest of the building shall be from the outside or via indirect means as described in 4.2.4.2.

4.2.4.2* Indirect pathways through separating walls by means of vestibules or stairways shall be permitted, provided the wall opening to the grinding area is protected by an automatic-closing fire door suitable for 3-hour openings, and the opening into the vestibule or stairway is protected by an automatic-closing fire door suitable for 2-hour openings.

4.2.4.2.1 The two automatic-closing fire doors shall be installed at right angles to each other.

4.2.4.2.2 Both fire doors shall be installed in accordance with NFPA 80, *Standard for Fire Doors and Other Opening Protectives*.

4.2.5* Buildings housing operations that present a dust explosion hazard shall be designed with explosion venting.

4.2.6 Horizontal Surfaces.

4.2.6.1 All ledges and surfaces on which dust can accumulate shall be avoided in construction.

4.2.6.2 Where such surfaces cannot be avoided, they shall be filled in or roofed with noncombustible material at an angle of not less than 45 degrees.

4.2.7 Explosion Protection for Equipment. The design of explosion protection for equipment shall incorporate one or more of the following methods of protection:

- (1) Oxidant concentration reduction in accordance with NFPA 69, *Standard on Explosion Prevention Systems*, and Section 4.4 of this standard.
 - (a) Where oxygen monitoring is used, it shall be installed in accordance with ISA S84.01, *Application of Safety Instrumented Systems for the Process Industries*.
 - (b)*When the chemical properties of the material being conveyed require a minimum concentration of oxygen to control pyrophoricity, that level of concentration shall be maintained.
- (2)*Deflagration venting

