ANSI/NFPA 655 An American National Standard June 8, 1988

# NFPA 655 Prevention of Sulfur Fires and Explosions 1988 Edition

National Fire Protection Association Batterymarch Park, Quincy, MA 02269

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### Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

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### Statement on NFPA Procedures

This material has been developed under the published procedures of the National Fire Protection Association, which are designed to assure the appointment of technically competent Committees having balanced representation. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

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**NFPA 655**

**Standard for**

# Prevention of Sulfur Fires and Explosions

**1988 Edition**

This edition of NFPA 655, *Standard for Prevention of Sulfur Fires and Explosions*, was prepared by the Technical Committee on Fundamentals of Dust Explosion Prevention and Control, released by the Correlating Committee on Dust Explosion Hazards, and acted on by the National Fire Protection Association, Inc. at its Annual Meeting held May 16-18, 1988, in Los Angeles, California. It was issued by the Standards Council on June 8, 1988, with an effective date of June 28, 1988, and supersedes all previous editions.

The 1988 edition of this document has been approved by the American National Standards Institute.

## 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 Style Manual.

Due to limited technological changes in this area since 1982, the committee voted to reconfirm the text as it appears in the 1982 version. Editorial changes and changes to allow the document to adhere more closely to the NFPA *Manual of Style* have been incorporated into the 1988 edition.

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*This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.*

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.

## Contents

# NFPA 655

## Standard for

# Prevention of Sulfur Fires and Explosions

## 1988 Edition

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

Information on referenced publications can be found in Chapter 6.

## Chapter 1 General

**1-1 Scope.**

**1-1.1*** This standard shall apply to the crushing, grinding or pulverizing of sulfur and to the handling of sulfur.

**1-1.2** This standard shall not apply to the mining or transportation of sulfur.

**1-2 Purpose.** The purpose of this standard is to provide reasonable requirements to eliminate or reduce the hazards of explosion and fire inherent in the processing and handling of sulfur.

**1-3* Retroactivity.** This standard shall apply to new facilities and major alterations to existing facilities.

**1-4 Definitions.** For the purpose of this standard, the following terms shall have the meanings given below.

**Approved.** Acceptable to the "authority having jurisdiction."

NOTE: The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

**Authority Having Jurisdiction.** The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner since jurisdictions and "approval" agencies vary as do their responsibilities. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, health department, building official, electrical inspector, or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the "authority having jurisdiction." In many circumstances the property owner or his designated agent assumes the role of the "authority having jurisdiction"; at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."

**Labeled.** Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization 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.

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

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

**Shall.** Indicates a mandatory requirement.

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

## Chapter 2 Crushing and Pulverizing

**2-1 General.**

**2-1.1** This chapter shall apply to the production, handling, and processing of finely divided sulfur.

**2-1.2** For the purpose of this standard, machinery for crushing and pulverizing sulfur is grouped into the following categories:

(a) *Type 1.* Slow speed primary crushers, such as jaw and roll crushers.

(b) *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 cu in. (8.2 L).

(c) *Type 3.* Crushers and pulverizers of the Type 2 category, but having an internal volume of more than 500 cu in. (8.2 L).

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

**2-1.3** Operation and maintenance of all crushing and pulverizing machinery shall be under supervision.

**2-2 Location, Construction, and Venting of Buildings and Equipment.**

**2-2.1** The enclosure or semienclosed space in which the crushing or pulverizing machinery is located shall be used for no other purpose during the periods when size reduction of sulfur is in progress.

*Exception: Containers may be filled with the ground product.*

**2-2.1.1*** Containers shall be removed from the area as soon as possible after being filled. Containers shall not be allowed to accumulate in the area.

**2-2.2*** The enclosed or semienclosed space in which the grinding or pulverizing machinery is located shall be separated from other areas by noncombustible construction. The separating walls shall be designed to withstand the force of an explosion.

**2-2.2.1** Openings through floors, walls, and ceilings for necessary pipes, shafts, and conveyors shall be tightly sealed. (*See 2-2.3.1.*)

**2-2.3** All communications between the space used for grinding and the rest of the building shall be from the outside or via indirect means as described below.

**2-2.3.1*** Indirect communications through separating walls by means of vestibules or stairways may be permitted, provided the wall opening to the grinding area is protected by an automatic closing sliding fire door suitable for Class A openings and the opening into the vestibule or stairway is protected by a hinged fire door suitable for Class B openings. The two doors shall be installed at right angles to each other. Both doors shall be installed in accordance with NFPA 80, *Standard for Fire Doors and Windows.*

**2.2.4*** All enclosures in which fine grinding is done shall be constructed of noncombustible materials.

**2-2.5** Buildings housing operations which present a dust explosion hazard shall be provided with explosion venting designed according to information contained in NFPA 68, *Guide for Venting of Deflagrations.*

**2-2.6** All ledges and surfaces on which dust may accumulate shall be avoided in construction. 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.

**2-2.7** Explosion protection shall be provided on all pulverizing equipment. One of the following methods shall be used:

(a) Equipment may be designed to contain the anticipated explosion pressure.

(b) Explosion venting designed according to the information contained in NFPA 68, *Guide for Venting of Deflagrations*, may be provided.

(c) An explosion suppression system meeting the requirements of NFPA 69, *Standard on Explosion Prevention Systems*, may be provided.

(d) Inert gas may be used to reduce the oxygen content within the equipment to below the level prescribed by NFPA 69, *Standard on Explosion Prevention Systems.*

**2-2.7.1** On systems protected by inert gas, explosion vents may be closed at their exit point with suitable covers which will retain the inert atmosphere, but which will open freely to vent explosion pressures.

**2-2.8** Explosion suppression systems may be used to protect equipment from explosion damage. (*See NFPA 69, Standard on Explosion Prevention Systems.*)

**2-3* Electrical Wiring and Equipment.** All electrical wiring and equipment shall comply with NFPA 70, *National Electrical Code®*. In areas where a dust explosion hazard exists, electrical wiring and equipment shall comply with Article 502 of NFPA 70.

**2-4 Inert Gas.**

**2-4.1** Use of inert gas is not required for Type 1 machinery.

**2-4.2** Type 2 machinery may be operated without inert gas protection if the following requirements are met:

(a) The feed and discharge shall be provided with positive chokes, such as a star feed rotary valve or a screw conveyor with the end flights removed, where directly connected to the machine.

(b) The chokes and all machinery between shall be capable of withstanding an overpressure of 100 lb per sq in. (689.4 kPa).

(c) There shall be frequent inspection of the machinery during operation to detect abnormalities in operating conditions.

**2-4.3** Type 3 machinery shall not be operated without the use of an inert gas system meeting the requirements of NFPA 69, *Standard on Explosion Prevention Systems*. Where the pulverized sulfur is removed from the machinery by blower or exhaust systems, inert gas protection shall extend to all piping and collectors.

**2-4.3.1*** Under normal operating conditions, the reduction in oxygen content shall be to 11 percent for carbon dioxide systems and to 8 percent for nitrogen systems.

**2-4.3.2*** The inert gas system shall be equipped with suitable sampling and recording instruments to obtain a reliable and continuous analysis of the inert atmosphere in that part or parts of the machinery where the inert atmosphere is normally weakest.

**2-4.3.3** Provisions shall be made for automatically shutting down the pulverizing machinery if the oxygen content of the inert atmosphere rises above the maximum levels stated in 2-4.3.1.

**2-4.4*** Type 4 machinery may be operated without inert gas protection if the following requirements are met:

(a) Manually operated valves shall be installed at each machine for control of feed and air lines.

(b)* The equipment shall be under supervision during operation and shall be shut down for detailed inspection

and any necessary cleaning when abnormalities in operation indicate the possibility of fire within the machine.

(c) All valves shall be closed before opening the machine.

**2-4.5** Auxiliary dust collectors shall be installed according to the requirements of 2-5.4.

### 2-5 Conveyors and Collectors.

**2-5.1** Only conveyors or spouts with positive seals, such as star feed rotary valves or screw conveyors with the end flights removed, shall be permitted to pass through a fire partition separating crushing or pulverizing rooms from adjacent spaces. The chokes or seals shall be located so as to prevent flame propagation through the wall.

**2-5.2** Conveyors used to feed or discharge sulfur to or from grinding machinery shall be in dusttight housings.

**2-5.3** Nonferrous buckets or bucket elevators shall be used where they are housed in ferrous casings.

*Exception: In cases where the above requirement is not met, steam shall be blown into the elevator boat while the elevator is in operation or an inert gas system meeting the requirements of 2-4.3 shall be used.*

**2-5.4** Pneumatic conveying systems shall be designed in accordance with NFPA 650, *Standard for Pneumatic Conveying Systems for Handling Combustible Material.* Each pulverizer shall have a separate and self-contained system.

### 2-5.5 Dust Collection Systems.

**2-5.5.1** Dust collectors shall be located in any of the following locations:

(a) On the roof;

(b) Outside and adquately detached from buildings;

(c) In separate rooms provided with explosion venting;

(d) In separate buildings provided with explosion venting;

(e) In isolated penthouses provided with explosion venting.

**2-5.5.2** Manifolding of ducts serving dust collection systems shall not be permitted.

*Exception No. 1: Dust collection ducts from a single piece of equipment or from multiple pieces of equipment which are not isolated from each other need not be manifolded.*

*Exception No. 2: Dust collection ducts from single, isolated pieces of equipment may be manifolded if each duct is equipped with a suitable isolation device prior to manifolding.*

**2-5.5.3** Dust collectors shall be constructed of noncombustible materials.

*Exception: Filter media need not be of noncombustible material if provided with tight metal enclosures or their equivalent.*

**2-5.5.4** Recycling of air from dust collectors back to buildings shall not be permitted.

### 2-6 Prevention of Ignition.

**2-6.1*** Approved magnetic separators of the permanent magnet or self-cleaning electromagnetic types or approved pneumatic separators shall be installed ahead of all Types 2, 3, and 4 machines. The installation shall be of sufficient and proper design to ensure removal of all ferrous material from the sulfur.

**2-6.2** All machinery shall be installed and maintained in such a manner that the possibility of frictional sparks is minimized.

**2-6.3** Interlocking controls shall be installed to stop the dust feed if the pulverizer stops or if the fans or blowers stop for any reason.

**2-6.4** All machinery, conveyors, housings, and collectors shall be thoroughly bonded and grounded to prevent the accumulation of static electricity. (*See NFPA 77, Recommended Practice on Static Electricity.*)

**2-6.5** All open flames, smoking, and matches shall be prohibited in enclosures containing crushers and pulverizers. Unprotected hot surfaces, such as steam lines, which may attain temperatures high enough to melt and ignite sulfur dust shall not be exposed in enclosures housing sulfur processing equipment.

*Exception: Repairs involving open flames, such as cutting or welding, heat, or hand or power tools, shall be made only after all operations have ceased and all sulfur has been removed from the vicinity or protected in tight noncombustible containers. Cutting and welding procedures shall be carried out according to the requirements of NFPA 51B, Standard for Fire Prevention in Use of Cutting and Welding Processes.*

**2-6.6** Powder-operated tools shall not be used where combustible dust or dust clouds are present. When the use of such tools becomes necessary, all dust producing machinery in the area shall be shut down, all equipment, floors, and walls shall be cleaned thoroughly, and all accumulations of dust removed.

**2-6.6.1** After such work has been completed, a careful check shall be made to ensure that no cartridges or charges have been left on the premises where they could enter equipment or be accidently discharged after operation of the dust producing or handling machinery is resumed.

### 2-7 Housekeeping.

**2-7.1*** Good housekeeping is of utmost importance. Equipment shall be designed, maintained, and operated in a manner which will minimize the escape of dust. Accumulations of escaped dust shall not be tolerated in the buildings.

**2-7.2*** Bulk accumulations of fine sulfur shall be removed by soft push brooms and nonsparking scoops or shovels before vacuum cleaning equipment is used.

**2-7.3** Cleaning may be done by vacuum sweeping devices. If vacuum apparatus is used, either stationary or portable types shall be properly grounded and regularly checked for electrical continuity from pickup nozzle to pip-

ing system. Such equipment, if electrical, shall be of a class approved for use in atmospheres containing sulfur dust. (*See Section 2-3.*)

**2-7.4** Blowing down of any surfaces by compressed air shall be prohibited.

**2-8 Fire Fighting.**

**2-8.1** The use of straight streams from hoses or extinguishers shall be avoided when fighting fires in finely divided sulfur, as a cloud of dust may be raised which will explode on contact with the fire.

**2-8.2** Fog nozzles shall be used. Finely divided water spray or mists that settle on the sulfur without disturbing it shall be used.

**2-8.3*** Steam and inert gases are excellent extinguishing agents for use in containers that can be closed tightly and may be used, provided that they can be introduced in such a manner that the sulfur dust is not disturbed.

**2-8.4** In all cases, it shall be made certain that the fire is completely extinguished before disturbing the dust and that the sulfur has cooled sufficiently to prevent reignition.

**2-8.4.1*** When grinding or other processing equipment must be opened for cleaning following an ignition, the feed, discharge, and other openings shall first be closed by suitable metal valves or gates. A period of at least 15 minutes shall elapse between closing the valves or gates and opening of the equipments to smother any residual fire in the equipment.

**2-8.5*** At least two self-contained breathing apparatus shall be made available for use in case of sulfur fires. All respiratory equipment shall be inspected at regular intervals and kept in working order at all times.

## Chapter 3 Handling Coarse Sizes of Sulfur in Bulk

**3-1* Handling in the Open or in Semienclosed Spaces.**

**3-1.1** Conveying machinery shall be bonded and grounded to prevent the accumulation of static electricity. (*See NFPA 77, Recommended Practice on Static Electricity.*)

**3-1.2** Flames, smoking, and matches shall be prohibited in such areas. Cutting and welding operations may be permitted for repair work, with due precautions taken against ignition of dust. (*See NFPA 51, Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes.*)

**3-2 Handling in Enclosed Spaces.**

**3-2.1** Handling of bulk sulfur in enclosed spaces shall be done in such a manner that the formation of dust clouds is minimized.

**3-2.2*** All enclosures shall be constructed of noncombustible materials and designed so that ledges on which dust may settle are minimized. Where such surfaces are unavoidable, they shall be roofed at a steep angle.

**3-2.3** Where sulfur is transferred or dumped from one container to another, dusttight housings with sufficient inward air movement to prevent escape of dust shall be provided. Where mechanical exhaust systems are used to provide this air movement, the systems shall comply with NFPA 91, *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying.*

**3-2.4** All elevators and conveyors which agitate the sulfur being transported, such as screw conveyors and bucket elevators, shall be enclosed in dusttight casings and shall be equipped with explosion venting. (*See NFPA 68, Guide for Venting of Deflagrations.*)

**3-2.4.1** Where bucket elevators are housed in ferrous casings, the buckets or bucket conveyors shall be nonferrous.

*Exception: In cases where this is impractical, steam shall be blown into the elevator boot while the elevator is in operation or the elevator shall be protected by an inert gas system.*

**3-2.5** All metal parts of machinery, casings, bins, and spouts shall be bonded and grounded to prevent the accumulation of static electricity. (*See NFPA 77, Recommended Practice on Static Electricity.*)

**3-2.6** All electrical wiring and equipment installed in locations classified as Class II shall comply with Article 502 of NFPA 70, *National Electrical Code.*

**3-2.7** All open flames, smoking, and matches shall be prohibited within enclosures where sulfur is handled. Heating shall be by indirect means. Exposed hot surfaces, such as steam lines, shall be avoided within the enclosure.

**3-2.8** Care shall be taken to minimize static or settled dust within enclosures and semienclosures. Accumulations of static dust shall be removed promptly and in such a manner as to prevent formation of dust clouds.

**3-2.9** Repairs involving the use of flames, heat, or hand or power tools shall be made only after all operations have ceased. Where practical, all sulfur shall be removed or protected in tight containers. Where this is not practical, the sulfur shall be wet down and a hose line with spray nozzle provided.

**3-2.10** Powder-operated tools shall not be used unless all dust-producing machinery is shut down, and all equipment, floors, and walls have been carefully cleaned. All bulk sulfur piles or dust accumulations shall be removed or thoroughly wet down. A careful check shall be made to ensure that no cartridges or charges have been left on the premises where they could enter equipment or be accidentally discharged after operation of the dust-producing or handling machinery is resumed.

**3-3* Fire Fighting.**

**3-3.1** Fires in enclosures may be fought according to the provisions of Section 2-8. Since bulk sulfur contains only

a small proportion of fines, coarser hose streams may be used.

**3-3.2** Incipient fires in storage piles may be smothered by gently shoveling sulfur onto them.

## Chapter 4 Handling of Liquid Sulfur at Normal Handling Temperatures

**4-1* General.** This chapter applies to the handling of liquid sulfur in the temperature range of 119°-154°C (246°-309°F).

### 4-2 Detection of Unsafe Conditions.

**4-2.1*** Devices for measuring the concentration of combustible gas in the atmosphere over liquid sulfur shall be suitable for operation in atmospheres containing hydrogen sulfide. Instruments used for detecting explosive atmospheres shall be capable of measuring the lower explosive limit of hydrogen sulfide, since it is the primary gas evolved from sulfur which can contribute to an explosive atmosphere.

**4-2.2** Operations shall be discontinued whenever instruments show a combustible gas concentration of 35 percent or more of the lower explosive limit in the gas space of liquid sulfur containers. Operations shall not be resumed until the instruments indicate a concentration of 15 percent or less of the lower explosive limit.

### 4-3 Operating Precautions and Equipment Design.

**4-3.1** The use of open flames, electric spark-producing equipment, and smoking materials shall be prohibited in the vicinity of liquid sulfur containers.

**4-3.2** Liquid sulfur storage tanks shall be designed with fill lines which extend to near the tank bottom so that the incoming sulfur enters the tank below the surface of the sulfur in the tank, thereby minimizing agitation and release of hydrogen sulfide.

**4-3.3** Covered storage tanks shall be provided with heated vent systems to provide natural venting of hydrogen sulfide. Vent systems shall be maintained at a temperature above the melting temperature of sulfur.

**4-3.4** Sulfur lines and storage tanks shall be bonded and grounded to prevent accumulation of static electricity. Grounding connections shall be provided for the bonding of liquid sulfur tanks and tank cars being loaded or unloaded. (*See NFPA 77, Recommended Practice on Static Electricity.*)

**4-3.5*** In pits used for melting sulfur from stock piles, the liquid level shall not be permitted to expose the steam coils. The liquid level shall always cover the heating coils in pits used for melting sulfur.

### 4-4 Fire Fighting.

**4-4.1*** Covered liquid sulfur tanks shall be provided with a gaseous fire extinguishing system. (*See Appendix E of NFPA 86, Standard for Ovens and Furnaces and NFPA 69, Standard on Explosion Prevention Systems.*)

**4-4.1.1*** Where a fixed inerting system is used, thin Teflon® rupture discs shall be placed over the inerting nozzles so that sulfur cannot condense within the nozzle.

**4-4.2** Where liquid sulfur containers are small enough, they may be arranged so that they can be rapidly sealed to exclude air in case of fire. The sulfur dioxide produced by the fire will smother the fire. In such cases, the system shall be allowed to cool below 154°C (309°F) before reopening.

**4-4.3** Liquid sulfur stored in open containers may be extinguished with a fine water spray. Use of high pressure hose streams shall be avoided. Quantity of water used shall be kept to a minimum.

## Chapter 5 Handling of Liquid Sulfur and Sulfur Vapor at Temperatures above 154°C (309°F)

### 5-1 General.

**5-1.1** This chapter shall apply to liquid sulfur and its vapors when heated in closed containers to temperatures above 154°C (309°F).

**5-1.2** The requirements of Chapter 4 shall apply.

### 5-2 Operating Precautions and Equipment Design.

**5-2.1** Equipment shall be designed to be closed as tightly as possible to prevent escape of vapor and to exclude air from the system during operation.

**5-2.2** Process equipment shall be provided with adequate explosion rupture discs. The rupture discs shall relieve into vent pipes or ducts which lead directly to the outside of the building or away from the process equipment. The vent pipes or ducts shall be heated to prevent condensation of sulfur vapor.

**5-2.3** An adequate supply of a suitable inerting agent shall be available at all times (*see 4-4.1*). Inert gas may be required for blanketing process equipment during operation or it may only be required for purging equipment after a fire or explosion has occurred. In addition, larger quantities may be required for purging of systems prior to start-up. (*See NFPA 69, Standard on Explosion Prevention Systems.*)

**5-2.4** All buildings or enclosures for such processes shall be constructed of noncombustible materials.

**5-2.5** All electrical wiring and equipment installed in locations classified as Class II shall comply with Article 502 of NFPA 70, *National Electrical Code.*

**5-2.6** Where sulfur is vaporized and subsequently condensed to sulfur dust, handling of the finely divided sulfur from the process shall comply with the requirements of Chapter 2.

## Chapter 6 Referenced Publications

**6-1** The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**6-1.1 NFPA Publications.** National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 51-1987, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*

NFPA 51B-1984, *Standard for Fire Prevention in Use of Cutting and Welding Processes*

NFPA 68-1988, *Guide for Venting of Deflagrations*

NFPA 69-1986, *Standard on Explosion Prevention Systems*

NFPA 70-1987, *National Electrical Code*

NFPA 77-1988, *Recommended Practice on Static Electricity*

NFPA 80-1986, *Standard for Fire Doors and Windows*

NFPA 86-1985, *Standard for Ovens and Furnaces*

NFPA 91-1983, *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying*

NFPA 650-1984, *Standard for Pneumatic Conveying Systems for Handling Combustible Materials*

## Appendix A

*This Appendix is not a part of the requirements of this NFPA standard, but is included for information purposes only.*

**A-1-1.1** Sulfur differs from most other combustible dusts found in industry in that it has relatively low melting and ignition points. Depending on purity, sulfur melts at or slightly below 119°C (246°F). The ignition temperature of a dust cloud is 190°C (374°F); the ignition temperature of a dust layer is 220°C (428°F). Dilution of sulfur with inert solids is not effective in raising the ignition temperature.

Sulfur is handled and processed in the liquid and vapor states in some cases. The liquid is highly combustible and the vapor is explosive when mixed with air in the proper proportions.

The finely divided sulfur produced during crushing and pulverizing is the most hazardous from an explosion standpoint. Also, mixtures containing finely divided elemental sulfur may be just as hazardous if the sulfur is present in sufficient quantity. Some explosion and fire hazards also accompany the handling and processing of sulfur in bulk in coarse sizes due to the fine dust present.

**A-1-3** Although this stardard is not intended to be retroactive, it is recommended as an advisory guide for operators who may wish to avail themselves of the information within to improve existing facilities.

**A-2-1.2(d)** The grinding in Type 4 machines is accomplished by attrition of the particles on themselves. Power for moving the particles is furnished by compressed air or other fluid suitable to the material being pulverized.

**A-2-2.1.1** It is not the intent of this requirement to prohibit interim storage of bags, drums, or filled containers.

**A-2-2.2** The grinding space should preferably be detached. Exterior walls may have to be provided with explosion venting.

**A-2-2.3.1** It is recommended that an emergency escapeway for personnel be provided independently.

**A-2-2.4** Steel frame construction, with light nonbearing exterior walls and light roof, is preferable.

**A-2-3** Although sulfur is not now included in atmospheres classified as Class II, Group G, it has been the experience of the sulfur industry that equipment suitable for Class II, Group G, ~~Division 1 is satisfactor~~y. However, consideration should be given to the melting point of sulfur (112° to 119°C) (233° to 246°F) in the selection of heat-producing electrical equipment.

**A-2-4.3.1** Inerting by oxygen content reduction is usually accomplished by introducing flue gas made by burning a suitable fuel.

The composition of the resulting inert mixture will vary with the kind of fuel used. Control by analysis for carbon dioxide ($CO_2$) is common practice. Therefore, when using flue gas inerting systems, the $CO_2$ content must be over 9 percent if the flue gas is from coal, over 7.5 percent if from fuel oil, and over 6 percent if from natural gas. This will hold the oxygen content below 11 percent.

**A-2-4.3.2** Auxiliary instrumentation should be provided for sampling and recording the quality of the inert atmosphere in other parts of the system.

**A-2-4.4** The large volumes and high velocities of air and the compactness of the Type 4 unit make inerting usually impractical.

**A-2-4.4(b)** Flooding with inert gas or steam, combined with delayed opening to permit smothering of any residual fire, is recommended.

**A-2-6.1** It must be recognized that magnetic separators will not remove nonferrous tramp material, including stones, brick, and concrete. Every care, using other means, should be taken to ensure excluding such materials from the grinding system.

**A-2-7.1** It is recommended that the interior of crushing, pulverizing, and packaging rooms or buildings be painted a color which contrasts with the color of the dust.

**A-2-7.2** Push brooms should have natural bristles.

**A-2-8.3** If a container is closed tightly and the volume of oxygen enclosed is not too large, a fire will be smothered by the sulfur dioxide formed.

**A-2-8.4.1** As an added precaution, the equipment should be flooded with inert gas or steam, if available, prior to opening.

**A-2-8.5** Gas masks approved for acid gases will not provide adequate protection in a serious sulfur fire. Self-contained breathing apparatus of the pressure demand type should be used.

**A-3-1** Clouds of fine sulfur dust arising during the handling of bulk sulfur in the open or in semienclosed spaces are potentially dangerous. Arrangements should be such that they will not contact sources of ignition.

**A-3-2.2** Direct ventilation of enclosed spaces is recommended.

**A-3-3** Automatic sprinkler protection is recommended for enclosures in which sulfur is stored or handled.

**A-4-1** The normal handling temperature of liquid sulfur is 121°-154°C (250°-309°F), which is slightly above the melting point of 119°C (246°F). At this temperature, the vapor concentration above pure sulfur, free of hydrocarbons or hydrogen sulfide, is too low to form an explosive mixture in air. While the flash point of liquid sulfur varies with purity, it is always higher than the normal handling temperature. For pure sulfur, the flash point is about 188°C (370°F); for relatively impure crude sulfur, the flash point may be as low as 168°C (334°F).

The relatively low ignition temperature of sulfur and the possible presence of hydrogen sulfide are the primary fire and explosion hazards of liquid sulfur. Impure sulfur contains hydrocarbons which react slowly with liquid sulfur to form hydrogen sulfide. Recovered sulfurs, such as those produced from hydrogen, often contain dissolved hydrogen sulfide. Hydrogen sulfide is quite soluble in liquid sulfur and will be liberated very slowly from a quiescent body of liquid sulfur. However, agitation of the sulfur can cause rapid evolution of hydrogen sulfide which may create an explosive atmosphere within a storage tank. (In the temperature range at which liquid sulfur is normally handled, the lower explosive limit for hydrogen sulfide in air is about 3.4 percent, compared to 4.3 percent at room temperature.)

Pure sulfur will not generate an explosive atmosphere in the normal temperature range of the liquid.

**A-4-2.1** The sensing elements of some explosimeters are not designed for and are adversely affected by hydrogen sulfide-containing atmospheres.

**A-4-3.5** When steam coils are repeatedly exposed, pyrophoric material may form from impurities in the sulfur.

**A-4-4.1** Since the inert gas must be applied rapidly enough to displace the ventilation air from the vents, steam is usually the most effective and economical choice. On exceptionally large tanks, it may be necessary and desirable to use water supplied through a fog nozzle.

**A-4-4.1.1** Sulfur flour may cause a dust explosion if it is ejected from the nozzles ahead of the inerting agent.

## Appendix B Referenced Publications

**B-1** The following documents or portions thereof are referenced within this standard for informational purposes only and thus should not be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**B-1-1 NFPA Publications.** National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 13-1987, *Standard for the Installation of Sprinkler Systems.*

## Index

# SUBMITTING PROPOSALS ON NFPA TECHNICAL COMMITTEE DOCUMENTS

**Contact NFPA Standards Administration for final date for receipt of proposals on a specific document.**

## INSTRUCTIONS

**Please use the forms which follow for submitting proposed amendments. Use a separate form for each proposal.**

1. For each document on which you are proposing amendment indicate:
   (a) The number and title of the document
   (b) The specific section or paragraph.

2. Check the box indicating whether or not this proposal recommends new text, revised text, or to delete text.

3. In the space identified as "Proposal" include the wording you propose as new or revised text, or indicate if you wish to delete text.

4. In the space titled "Statement of Problem and Substantiation for Proposal" state the problem which will be resolved by your recommendation and give the specific reason for your proposal including copies of tests, research papers, fire experience, etc. If a statement is more than 200 words in length, the technical committee is authorized to abstract it for the Technical Committee Report.

5. Check the box indicating whether or not this proposal is original material, and if it is not, indicate source.

6. If supplementary material (photographs, diagrams, reports, etc.) is included, you may be required to submit sufficient copies for all members and alternates of the technical committee.

NOTE: The NFPA Regulations Governing Committee Projects in Paragraph 10-10 state: Each proposal shall be submitted to the Council Secretary and shall include:

(a) identification of the submitter and his affiliation (Committee, organization, company) where appropriate, and

(b) identification of the document, paragraph of the document to which the proposal is directed, and

(c) a statement of the problem and substantiation for the proposal, and

(d) proposed text of proposal, including the wording to be added, revised (and how revised), or deleted.

## FORM FOR PROPOSALS ON NFPA TECHNICAL COMMITTEE DOCUMENTS

Mail to: Secretary, Standards Council
National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269

Date 5/18/85 Name John B. Smith Tel. No. 617-555-1212

Address 9 Seattle St., Seattle, WA 02255

Representing (Please indicate organization, company or self) Fire Marshals Assn. of North America

1. a) Document Title: Protective Signaling Systems NFPA No. & Year NFPA 72D

   b) Section/Paragraph: 2-7.1 (Exception)

2. Proposal recommends: (Check one) ☐ new text
   ☐ revised text
   ☒ deleted text.

3. Proposal (include proposed new or revised wording, or identification of wording to be deleted):

   Delete exception.



4. Statement of Problem and Substantiation for Proposal:

   A properly installed and maintained system should be free of ground faults. The occurrence of one or more ground faults should be required to cause a "trouble" signal because it indicates a condition that could contribute to future malfunction of the system. Ground fault protection has been widely available on these systems for years and its cost is negligible. Requiring it on all systems will promote better installations, maintenance and reliability.

5. ☒ This Proposal is original material.
   ☐ This Proposal is not original material; its source (if known) is as follows: _____

(Note: Original material is considered to be the submitter's own idea based on or as a result of his own experience, thought, or research and, to the best of his knowledge, is not copied from another source.)

I agree to give NFPA all and full rights, including rights of copyright, in this Proposal and I understand that I acquire no rights in any publication of NFPA in which this Proposal in this or another similar or analogous form is used.

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PLEASE USE SEPARATE FORM FOR EACH PROPOSAL