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NFPA 1124 Manufacture, Transportation, and Storage of Fireworks 1988 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101

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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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SC-AM-93

Errata

NFPA 1124

Code for the Manufacture, Transportation, Storage of Fireworks

1988 Edition

Reference: 3-1.1.2

The Technical Committee on Pyrotechnics notes the following error on page 13 of the 1988 edition of NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks.*

Paragraph 3-1.1.2 should read as follows:

"Special fireworks, other than bulk salutes, that are not bullet-sensitive and black powder shall be stored only in a Type 1, 2, 3, or 4 magazine."

NFPA 1124

Code for the Manufacture, Transportation, and Storage of Fireworks

1988 Edition

This edition of NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks*, was prepared by the Technical Committee on Pyrotechnics, 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.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

Origin and Development of NFPA 1124

This 1988 edition of NFPA 1124 is the result of a thorough review of and partial revision to the 1984 edition of NFPA 1124 by the Committee on Pyrotechnics, including reference updating and incorporation of the latest separation distances as approved by the Institute of Makers of Explosives in May, 1983. It includes new provisions for salute manufacturing and storage of salute powder.

NFPA 44A was originally developed by the Technical Committee on Explosives of the NFPA Committee on Chemicals and Explosives. It was adopted as a Tentative Code at the 1972 NFPA Annual Meeting. It was further revised and officially adopted at the 1973 NFPA Annual Meeting. A revised edition was adopted in 1974.

In 1980, the Technical Committee on Explosives and the Committee on Pyrotechnics voted to transfer responsibility for NFPA 44A to the Committee on Pyrotechnics. The Correlating Committee on Chemicals and Explosives concurred and petitioned the NFPA Standards Council to effect the change. The Standards Council approved the change in June 1981.

The 1984 edition of NFPA 1124 was the result of a complete review of the 1974 edition of NFPA 44A by the Committee on Pyrotechnics, including the redesignation of the document as NFPA 1124 to be consistent with the numbering of other documents relating to pyrotechnics.

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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 1124

Code for the Manufacture, Transportation, and Storage of Fireworks

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 and, Appendix C.

Chapter 1 General

1-1 Scope.

1-1.1 This Code shall apply to the manufacture, transportation, and storage of fireworks.

1-1.2 This Code shall not apply to the sale and use of fireworks. (*See NFPA 1121L, Model State Fireworks Law, and NFPA 1123, Standard for Public Display of Fireworks.*)

1-1.3 This Code shall not apply to the storage of fireworks at retail stores, nor to the storage of fireworks at the site of a public fireworks display. (*See NFPA 1123, Standard for Public Display of Fireworks.*)

1-1.4 This Code shall not apply to the transportation of fireworks when such transportation is under the jurisdiction of the U.S. Department of Transportation.

1-1.5 This Code shall not apply to the manufacture, transportation, or storage of model rockets and model rocket motors designed, sold, and used for the purpose of propelling recoverable aero models (*see NFPA 1122, Code for Unmanned Rockets*).

1-1.6 This Code shall not apply to the manufacture, transportation, and storage of fireworks by federal and state military agencies.

1-1.7 This code shall not apply to the use of pyrotechnics in the performing arts.

1-2 Purpose.

1-2.1 The purpose of this Code is to provide reasonable safety in the manufacture, transportation, and storage of fireworks.

1-2.2 The purpose of this Code is also to supplement existing federal, state, or local regulations.

1-3 Equivalency. This Code is not intended to prevent the use of systems, methods, or devices which provide equivalent protection to the provisions of this Code, providing equivalency can be demonstrated.

1-4 Definitions. For the purpose of this Code, 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."

Barricade. A natural or artificial barrier that will effectively screen a magazine, building, railway, or highway from the effects of an explosion in a magazine or building containing explosives. To be effective, a barricade must be of such height that a straight line from the top of any sidewall of a magazine or building containing explosives to the eave line of any magazine or building, or to a point 12 ft (3.7 m) above the center of a railway or highway, will pass through the barricade.

Artificial Barricade. An artificial mound or revetted wall of earth of a minimum thickness of 3 ft (0.9 m).

Natural Barricade. Natural features of the ground, such as hills or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the magazine or building containing explosives when the trees are bare of leaves.

Bullet-Sensitive Explosive Material. Explosive material that can be detonated by 150-grain M2 ball ammunition having a nominal muzzle velocity of 2700 fps (824 mps) when fired from a 0.30 caliber rifle at a distance of 100 ft (30.5 m), measured perpendicular. The test material is at a temperature of 70° to 75°F (21° to 24°C) and is placed against a ¼-in. (12.4-mm) steel plate.

Explosive.* Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion. The term includes, but is not limited to, dynamite, black powder, pellet powder, initiating explosives, detonators, safety fuses, squibs, detonating cord, igniter cord, and igniters. The term "explosives" includes any material determined to be within the scope of Title 18, *United States Code*, Chapter 40, Importation, Manufacture, Distribution and Storage of Explosive Materials, and also includes any material classified as a Class A or Class B explosive by the Hazardous Materials Regulations of the U.S. Department of Transportation.

Fireworks. Any composition or device for the purpose of producing a visible or an audible effect by combustion, deflagration, or detonation, and which meets the definition of "common" or "special" fireworks as set forth in the U.S. Department of Transportation's (DOT) Hazardous Materials Regulations, Title 49, *Code of Federal Regulations*, Parts 173.88 and 173.100.

*Exception No. 1:** *Toy pistols, toy canes, toy guns, or other devices in which paper and/or plastic caps, manufactured in accordance with DOT regulations, Title 49, Code of Federal Regulations, Part 173.100(p), and packed and shipped according to said regulations, are not considered to be fireworks and shall be allowed to be used and sold at all times.*

Exception No. 2: Model rockets and model rocket motors designed, sold, and used for the purpose of propelling recoverable aero models are not considered to be fireworks. (See NFPA 1122, Code for Unmanned Rockets.)

Exception No. 3: Propelling or expelling charges consisting of a mixture of sulfur, charcoal, and saltpeter are not considered as being designed for producing audible effects.

Common Fireworks. Any small firework device designed primarily to produce visible effects by combustion and which must comply with the construction, chemical composition, and labeling regulations of the U.S. Consumer Product Safety Commission, as set forth in Title 16, *Code of Federal Regulations*, Parts 1500 and 1507. Some small devices designed to produce audible effects are included, such as whistling devices, ground devices containing 50 mg or less of explosive composition, and aerial devices containing 130 mg or less of explosive composition. Common fireworks are classified as Class C explosives by the U.S. Department of Transportation (DOT) and include the following:

A. Ground and Hand-Held Sparkling Devices.

(1) *Dipped Stick; Sparkler.* Stick or wire coated with pyrotechnic composition that produces a shower of sparks upon ignition. Total pyrotechnic composition may not exceed 100 g per item. Those devices containing any perchlorate or chlorate salts may not exceed 5 g of pyrotechnic composition per item. Wire sparklers which contain no magnesium and which contain less than 100 g of composition per item are not included in this category, in accordance with DOT regulations.

(2) *Cylindrical Fountain.* Cylindrical tube not more than ¾ in. (19 mm) inside diameter, containing up to 75 g of pyrotechnic composition. Upon ignition, a shower of colored sparks, and sometimes a whistling effect, is produced. This device may be provided with a spike for insertion into the ground (spike fountain), a wood or plastic base for placing on the ground (base fountain), or a wood or cardboard handle, if intended to be hand-held (handle fountain).

(3) *Cone Fountain.* Cardboard or heavy paper cone containing up to 50 g of pyrotechnic composition. The effect is the same as that of a cylindrical fountain.

(4) *Illuminating Torch.* Cylindrical tube containing up to 100 g of pyrotechnic composition. Upon ignition, colored fire is produced. May be spike, base, or hand-held.

(5) *Wheel.* Pyrotechnic device attached to a post or tree by means of a nail or string. Each wheel may contain up to 6 "driver" units: tubes not exceeding ½ in. (12.5 mm) inside diameter and containing up to 60 g of pyrotechnic composition. Upon ignition, the wheel revolves, producing a shower of color and sparks and sometimes a whistling effect.

(6) *Ground Spinner.* Small device similar to a wheel in design and effect and placed on the ground and ignited. A shower of sparks and color is produced by the rapidly spinning device.

(7) *Flitter Sparkler.* Narrow paper tube filled with pyrotechnic composition that produces color and sparks upon ignition. This device does not have a fuse for ignition. The paper at one end of the tube is ignited to make the device function.

B. Aerial Devices.

(1) *Sky Rocket.* Tube not exceeding ½ in. (12.5 mm) inside diameter that may contain up to 20 g of pyrotechnic composition. Sky rockets contain a wooden stick for guidance and stability and rise into the air upon ignition. A burst of color or noise or both is produced at the height of flight.

(2) *Missile-type Rocket.* A device similar to a sky rocket in size, composition, and effect that uses fins rather than a stick for guidance and stability.

(3) *Helicopter, Aerial Spinner.* A tube not more than ½ in. (12.5 mm) inside diameter and containing up to 20 g of pyrotechnic composition. A propeller or blade is attached which, upon ignition, lifts the rapidly spinning device into the air. A visible or audible effect is produced at the height of flight.

(4) *Roman Candles.* Heavy paper or cardboard tube not exceeding ⅜ in. (9.5 mm) inside diameter and containing up to 20 g of pyrotechnic composition. Upon ignition, up to 10 "stars" (pellets of pressed pyrotechnic composition that burn with bright color) are individually expelled at several-second intervals.

(5) *Mine, Shell.* Heavy cardboard or paper tube up to 2½ in. (63.5 mm) inside diameter attached to a wood or plastic base and containing up to 40 g of pyrotechnic composition. Upon ignition, "stars" [*see B(4)*], firecrackers [*see C(1)*]), or other devices are propelled into the air. The tube remains on the ground.

C. Audible Ground Devices.

(1) *Firecracker, Salute.* Small paper-wrapped or cardboard tube containing not more than 50 mg of pyro-

technic composition. Upon ignition, noise and a flash of light is produced.

(2) *Chaser.* Small paper or cardboard tube that travels along the ground upon ignition. A whistling effect, or other noise, is often produced. The explosive composition used to create the noise may not exceed 50 mg.

D. Combination Items. Fireworks devices containing combinations of two or more of the effects described in categories A, B, and C.

E. Novelties and Trick Noisemakers.

NOTE: Items listed in this section are not classified as common fireworks by the U.S. Department of Transportation

(1) *Snake, Glow Worm.* Pressed pellet of pyrotechnic composition that produces a large, snakelike ash upon burning. The ash expands in length as the pellet burns. These devices may not contain mercuric thiocyanate.

(2) *Smoke Device.* Tube or sphere containing pyrotechnic composition that, upon ignition, produces white or colored smoke as the primary effect.

(3) *Wire Sparkler.* Wire coated with pyrotechnic composition that produces a shower of sparks upon ignition. These items may not contain magnesium and must not exceed 100 g of composition per item. Devices containing any chlorate or perchlorate salts may not exceed 5 g of composition per item.

(4) *Trick Noisemaker.* Item that produces a small report intended to surprise the user. These devices include:

(a) Party Popper. Small plastic or paper item containing not more than 16 mg of explosive composition that is friction sensitive. A string protruding from the device is pulled to ignite it, expelling paper streams and producing a small report.

(b) Booby Trap. Small tube with string protruding from both ends, similar to a party popper in design. The ends of the string are pulled to ignite the friction-sensitive composition, producing a small report.

(c) Snapper. Small, paper-wrapped item containing a minute quantity of explosive composition coated on small bits of sand. When dropped, the device explodes, producing a small report.

(d) Trick Match. Kitchen or book match that has been coated with a small quantity of explosive or pyrotechnic composition. Upon ignition of the match, a small report or a shower of sparks is produced.

(e) Cigarette Load. Small wooden peg that has been coated with a small quantity of explosive composition. Upon ignition of a cigarette containing one of the pegs, a small report is produced.

(f) Auto Burglar Alarm. Tube which contains pyrotechnic composition that produces a loud whistle and/or smoke when ignited. A small quantity of explosive, not exceeding 50 mg, may also be used to produce a small report. A squib is used to ignite the device.

Special Fireworks. Large fireworks designed primarily to produce visible or audible effects by combustion, deflagration, or detonation. This term includes, but is not limited to, firecrackers containing more than 2 grains (130 mg) of explosive composition, aerial shells containing more than 40 g of pyrotechnic composition, and other display pieces which exceed the limits for classification as "common fireworks." Special fireworks are classified as Class B explosives by the U.S. Department of Transportation.

Fireworks Plant. All land and buildings thereon used for or in connection with the manufacture or processing of fireworks, including storage buildings used with or in connection with plant operation.

Flash Powder. Explosive composition intended for use in firecrackers and salutes. Flash powder produces an audible report and a flash of light when ignited. Typical flash powder composition contains potassium chlorate or potassium perchlorate, sulfur or antimony sulfide, and powdered aluminum.

Highway. Any public street or road.

Inhabited Building. A building regularly occupied in whole or in part as a habitation for human beings, or any church, schoolhouse, railroad station, store, or other structure where people are accustomed to assemble, except any building or structure occupied in connection with the fireworks plant.

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.

Magazine. Any building or structure used exclusively for the storage of explosive materials and which meets the requirements of Chapter 3.

Manufacture. The preparation of fireworks mixes and the loading and assembly of all fireworks.

Exception: The preparation of pyrotechnic devices for immediate use on-site, by qualified personnel, when such manufacture is otherwise legal.

Mixing Building. Any building used primarily for mixing and blending of pyrotechnic compositions.

Exception: This definition does not apply to wet sparkler mix preparation.

Motor Vehicle. Any self-propelled vehicle, truck, tractor, semi-trailer, or truck-trailer combination used for the transportation of freight over public highways.

Nonprocess Building. Any office building, warehouse, or other building in a fireworks plant where no fireworks, pyrotechnic compositions, or explosive compositions are processed or stored.

Person. Any individual, firm, co-partnership, corporation, company, association, joint-stock association, and including any trustee, receiver, assignee, or personal representative thereof.

Process Building. Any mixing building; any building in which pyrotechnic or explosive composition is pressed or otherwise prepared for finish and assembly; any finishing or assembly building; any building in which common fireworks are prepared for shipment.

Public Conveyance. Any railroad car, street car, ferry, cab, bus, airplane, or other vehicle which carries passengers for hire.

Pyrotechnic Composition. A chemical mixture which, upon burning and without explosion, produces visible, brilliant displays, bright lights, or sounds.

Railway. Any steam, electric, diesel-electric, or other railroad or railway which carries passengers for hire on the particular line or branch in the vicinity of a pyrotechnics manufacturing or storage facility.

Salute. A special firework that is designed to produce a loud report.

Salute Powder. A pyrotechnic composition which makes a loud report when ignited and constitutes the sole pyrotechnic mixture in a salute.

Screen Barricade. Any barrier that will contain the embers and debris from a fire or deflagration in a process building, thus preventing propagation of fire to other buildings or areas. Such barriers may be constructed of metal roofing, ¼ to ½ in. (6 to 13 mm) mesh screen, or equivalent material. The barrier extends from floor level to a height such that a straight line from the top of any side wall of the donor building to the eave line of any exposed building intercepts the screen at a point not less than 5 ft (1.5 m) from the top of the screen. The top 5 ft (1.5 m) of the screen is inclined towards the donor building at an angle of 30 to 45 degrees.

Shall. Indicates a mandatory requirement.

Shipping Building. A building used for the packing of assorted special fireworks into shipping cartons or for the loading of the cartons onto vehicles for shipment to purchasers.

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

Squib. A device containing a small quantity of igniting compound in contact with a bridge wire.

Storage Building. Any building, structure, or facility in which Class C fireworks in any state of processing or in which finished Class C fireworks are stored, but in which no processing or manufacturing is actually performed.

Theatrical Flash Powder. A pyrotechnic composition intended for use in theatrical shows. Theatrical flash powder produces a flash of light when ignited. Typical theatrical flash powder burns more slowly than salute powder and may also produce a shower of sparks. Theatrical flash powder is not intended to produce a loud report.

Unoccupied Building. Any building that remains unoccupied during the entire daily period of operations of the facility. An unoccupied building may be used for long term storage of materials acceptable to the authority having jurisdiction provided that no fireworks or pyrotechnic composition is contained within the building.

Warehouse. Any building or structure used exclusively for the storage of materials which are neither combustible materials nor explosive compositions used to manufacture fireworks.

Chapter 2 Manufacturing Operations

2-1 Basic Requirements.

2-1.1 The manufacture of any fireworks, as defined in Section 1-4, shall be prohibited unless it is authorized by federal license, where required, and is conducted in accordance with this Code.

2-2 Permit Requirements.

2-2.1 Any person engaged in the business of importing, manufacturing, or dealing in fireworks shall possess a valid federal license or permit, where required by Title XI, Regulation of Explosives, of the Crime Control Act of 1970 (*18 United States Code*, Chapter 40) and shall comply with all applicable state and local laws and regulations.

2-2.1.1 Copies of all required licenses and permits shall be posted at each fireworks plant.

2-2.1.2 License and permit holders shall take every reasonable precaution to protect licenses and permits from loss, theft, defacement, destruction, or unauthorized duplication. Any such occurrence shall be immediately reported to the issuing authority.

2-2.1.3 Licenses or permits shall not be assigned or transferred.

2-2.2 The issuing authority shall be notified immediately of any change of business address.

2-3 Recordkeeping and Reporting.

2-3.1 Manufacturers shall maintain records in compliance with federal regulations. Such records shall be kept for five years and shall be made available to the authorities having jurisdiction upon request.

Exception: Where only Class C (common) fireworks are handled, records need only be kept for three years.

2-3.2 The loss, theft, or unlawful removal of explosive materials shall be reported immediately to the nearest office of the Bureau of Alcohol, Tobacco, and Firearms, U.S. Dept. of the Treasury, and to local law enforcement authorities.

2-3.3 Manufacturers shall maintain records for all chemicals and chemical mixtures in compliance with the requirements of the Hazard Communication Standard, Title 29, *Code of Federal Regulations*, Part 1910. 1200, "Hazard Communication."

2-4 Applicability. All fireworks plants shall comply with the requirements of this chapter.

Exception: Fireworks plants need not comply with Sections 2-5 and 2-9 if they meet all of the following conditions:

(a) only custom fireworks, not for general sale, are manufactured;

(b) not more than 5 lb (2.3 kg) of explosive composition, of which no more than ½ lb (0.23 kg) may be initiating explosive, is present in any one building at any one time;

(c) all explosive and pyrotechnic compositions are removed to an appropriate storage magazine at the end of each work day.

2-5 Site Security.

2-5.1 All plant buildings shall be securely locked at the end of the work day or whenever plant personnel are not present to provide security.

2-5.2 All roads leading into the plant shall have suitable gates which shall be kept closed and securely locked at all times when not actually in use. Vehicle access into the plant shall be restricted to roadways by means of a fence, natural barriers such as trees, culverts or other appropriate means.

Exception: The main plant entrance may be left open during regular plant operating hours, provided it is in full view of and under observation by an authorized responsible employee or guard.

2-5.3 Conspicuous signs indicating "WARNING—NO SMOKING—NO TRESPASSING" shall be posted at frequent intervals around the plant perimeter.

2-5.4 Only authorized employees or representatives of federal, state, or local agencies having jurisdiction over the plant shall be allowed in the plant without special permission of the person in charge of the plant.

2-6 Separation Distances.

2-6.1 Process buildings and areas shall be separated from other process buildings and areas and from nonprocess buildings according to the distances specified in Table 2-6.1.

2-6.2 Process buildings and areas shall be separated from inhabited buildings, passenger railways, public highways, magazines, special fireworks shipping buildings, and common fireworks storage buildings according to the distances specified in Table 2-6.2.

2-6.3 Magazines for the storage of special fireworks and components for special fireworks (except for salute powder and salutes) shall be separated from inhabited buildings, passenger railways, public highways, and other magazines according to the distances specified in Table 2-6.3. For the purposes of applying this table, a shipping building for special fireworks is considered to be a magazine.

2-6.4 Magazines containing salute powder and salutes shall be separated from each other and from inhabited buildings, public highways, and passenger railways according to the distances specified in Table 2-6.4 (*see p. 10*).

2-6.5 Storage buildings for common fireworks located at fireworks manufacturing facilities shall be separated from inhabited buildings, passenger railways, public highways, and other storage buildings according to the distances specified in Table 2-6.5 (*see p. 11*).

Table 2-6.1
Minimum Separation Distances Between Fireworks Plant Buildings

Net Weight of Fireworks (1)	Distance Between Process Buildings and Areas, and Between Process and Nonprocess Buildings & Areas	
	In-Process Special Fireworks (2,3)	In-Process Common Fireworks (4)
Lb	Ft	Ft
0-100	57	37
100-200	69	37
200-300	77	37
300-400	85	37
400-500	91	37
500-1,000	not permitted (3,4)	37
2,000	"	37
3,000	"	48
4,000	"	60
5,000	"	67

For SI Units: 1 lb = 0.454 kg; 1 ft = 0.305 m

NOTE 1: Net weight is the weight of all pyrotechnic and explosive compositions and fuse only

NOTE 2: The distances in this column apply only with barricades. If barricades are not used, the distances must be doubled.

NOTE 3: A maximum of 500 pounds of in-process composition, either loose or in partially-assembled special fireworks, is permitted in any process building or area. Finished special fireworks may not be stored in a process building. (Reference 2-10.2)

NOTE 4: A maximum of 10 pounds of salute powder, either in loose form or in assembled units, is permitted in any process building or area. Quantities in excess of 10 pounds must be kept in an approved magazine.

Table 2-6.2
Minimum Separation Distances of Process Buildings and Areas from Inhabited Buildings, Passenger Railways, Public Highways, Fireworks Plant Magazines and Shipping Buildings, and Storage Buildings for Common Fireworks

Net Weight of Fireworks (1)	Distance From Passenger Railways, Public Highways, Fireworks Magazines & Shipping Buildings, Storage Buildings, & Inhabited Buildings (3)	
	In-Process Special Fireworks (2)	In-Process Common Fireworks (4,5)
Lb	Ft	Ft
0-100	200	25
100-500	200	50
1,000	not permitted (4,5)	75
2,000	"	100
3,000	"	115
4,000	"	124
5,000	"	130

For SI Units: 1 lb = 0.454 kg; 1 ft = 0.305 m

NOTE 1: Net weight is the weight of all pyrotechnic and explosive compositions and fuse only.

NOTE 2: This table does not apply to the separation distances between process buildings (*see Table 2-6.1*), between magazines (*see Tables 2-6.3 and 2-6.4*), and between storage buildings (*see Table 2-6.5*).

NOTE 3: The distances in this table apply with or without barricades or screen-type barricades. However, the use of barricades is highly recommended.

NOTE 4: A maximum of 500 pounds of in-process composition, either loose or in partially-assembled special fireworks, is permitted in any process building or area. Finished special fireworks may not be stored in a process building.

NOTE 5: A maximum of 10 pounds of salute powder, either in loose form or in assembled units, is permitted in any process building or area. Quantities in excess of 10 pounds must be kept in an approved magazine.

Table 2-6.3
Table of Distances for the Storage of Special Fireworks (Except Salutes) at Fireworks Manufacturing Plants (2,3)

Net Weight of Fireworks (1)	Distance Between Magazine and Inhabited Building, Passenger Railway, or Public Highway	Distance Between Magazines (4)
Lb	Ft	Ft
0-1000	150	100
1,000-5,000	230	150
5,000-10,000	300	200
above 10,000	— Use Table 2-6.4 —	

For SI Units: 1 lb = 0.454 kg; 1 ft = 0.305 m

NOTE 1: Net weight is the weight of all pyrotechnic and explosive compositions and fuse only.

NOTE 2: For fireworks storage magazines in active use prior to the effective date of this code, the distances in this table may be halved *IF* earthen barricades or the equivalent are used between the magazine and potential receptor sites.

NOTE 3: This table does not apply to the storage of bulk salute powder or to the storage of shipping cartons or storage containers containing primarily salutes or salute components. (*See Table 2-6.4 for salute powder & salute storage requirements*).

NOTE 4: For the purposes of applying this table, the term "magazine" also includes shipping buildings for special fireworks.

2-6.6 If any process building is separated from any other process or nonprocess building by less than the distance specified in Table 2-6.1, then such two or more buildings, as a group, must be considered as one building. The total quantity of explosive and pyrotechnic composition in this group of buildings shall not exceed 500 pounds, or 10 pounds of salute powder. Each building in such group must otherwise comply with the separation distances specified in Tables 2-6.1 and 2-6.2.

NOTE: There is no minimum separation distance for buildings within a group.

2-6.7 If any two or more magazines or storage buildings are separated by less than the distance specified in Table 2-6.3, 2-6.4, or 2-6.5, then such two or more structures must be considered as one magazine or storage building. The total quantity of explosive and pyrotechnic composition stored in such a group of buildings shall be used to determine the minimum separation distances of each building in the group from inhabited buildings, passenger railways, public highways, and other magazines and storage buildings.

2-6.8 Unoccupied buildings at manufacturing facilities are exempted from the separation distance requirements present in Section 2-6.

2-7 Process Building Construction.

2-7.1* At least one wall or the roof of each process building in which an explosion hazard exists shall be provided with explosion relief, either by suitable "weakwall" construction or by explosion vents.

2-7.2 Process buildings shall be single story and shall have no basements.

2-7.3 Wall joints and openings for wiring, plumbing and other utilities shall be sealed to prevent entry of dusts.

2-7.4 Horizontal ledges and surfaces upon which dust may settle and accumulate shall be minimized.

2-7.5* Floors and work surfaces shall not have cracks or crevices in which explosives or pyrotechnic compositions may lodge. Floors and work surfaces in mixing and loading buildings for salute powder shall be of conductive materials. Conductive footwear or other grounding techniques for personnel shall be used whenever exposed salute powder is present.

Table 2-6.4
Table of Distances for Storage of Salute Powder and Salutes

This table is completely reproduced from the American Table of Distances for Storage of Explosives as revised and approved by the Institute of Makers of Explosives in May, 1983.

QUANTITY OF EXPLOSIVES		DISTANCES IN FEET							
		Inhabited Buildings		Public Highways Class A to D		Passenger Railways — Public Highways with Traffic Volume of more than 3,000 Vehicles/Day		Separation of Magazines	
Pounds Over	Pounds Not Over	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded
2	5	70	140	30	60	51	102	6	12
5	10	90	180	35	70	64	128	8	16
10	20	110	220	45	90	81	162	10	20
20	30	125	250	50	100	93	186	11	22
30	40	140	280	55	110	103	206	12	24
40	50	150	300	60	120	110	220	14	28
50	75	170	340	70	140	127	254	15	30
75	100	190	380	75	150	139	278	16	32
100	125	200	400	80	160	150	300	18	36
125	150	215	430	85	170	159	318	19	38
150	200	235	470	95	190	175	350	21	42
200	250	255	510	105	210	189	378	23	46
250	300	270	540	110	220	201	402	24	48
300	400	295	590	120	240	221	442	27	54
400	500	320	640	130	260	238	476	29	58
500	600	340	680	135	270	253	506	31	62
600	700	355	710	145	290	266	532	32	64
700	800	375	750	150	300	278	556	33	66
800	900	390	780	155	310	289	578	35	70
900	1,000	400	800	160	320	300	600	36	72
1,000	1,200	425	850	165	330	318	636	39	78
1,200	1,400	450	900	170	340	336	672	41	82
1,400	1,600	470	940	175	350	351	702	43	86
1,600	1,800	490	980	180	360	366	732	44	88
1,800	2,000	505	1,010	185	370	378	756	45	90
2,000	2,500	545	1,090	190	380	408	816	49	98
2,500	3,000	580	1,160	195	390	432	864	52	104
3,000	4,000	635	1,270	210	420	474	948	58	116
4,000	5,000	685	1,370	225	450	513	1,026	61	122
5,000	6,000	730	1,460	235	470	546	1,092	65	130
6,000	7,000	770	1,540	245	490	573	1,146	68	136
7,000	8,000	800	1,600	250	500	600	1,200	72	144
8,000	9,000	835	1,670	255	510	624	1,248	75	150
9,000	10,000	865	1,730	260	520	645	1,290	78	156
10,000	12,000	875	1,750	270	540	687	1,374	82	164
12,000	14,000	885	1,770	275	550	723	1,446	87	174
14,000	16,000	900	1,800	280	560	756	1,512	90	180
16,000	18,000	940	1,880	285	570	786	1,572	94	188
18,000	20,000	975	1,950	290	580	813	1,626	98	196
20,000	25,000	1,055	2,000	315	630	876	1,752	105	210
25,000	30,000	1,130	2,000	340	680	933	1,866	112	224
30,000	35,000	1,205	2,000	360	720	981	1,962	119	238
35,000	40,000	1,275	2,000	380	760	1,026	2,000	124	248
40,000	45,000	1,340	2,000	400	800	1,068	2,000	129	258
45,000	50,000	1,400	2,000	420	840	1,104	2,000	135	270
50,000	55,000	1,460	2,000	440	880	1,140	2,000	140	280
55,000	60,000	1,515	2,000	455	910	1,173	2,000	145	290
60,000	65,000	1,565	2,000	470	940	1,206	2,000	150	300
65,000	70,000	1,610	2,000	485	970	1,236	2,000	155	310
70,000	75,000	1,655	2,000	500	1,000	1,263	2,000	160	320
75,000	80,000	1,695	2,000	510	1,020	1,293	2,000	165	330
80,000	85,000	1,730	2,000	520	1,040	1,317	2,000	170	340
85,000	90,000	1,760	2,000	530	1,060	1,344	2,000	175	350
90,000	95,000	1,790	2,000	540	1,080	1,368	2,000	180	360
95,000	100,000	1,815	2,000	545	1,090	1,392	2,000	185	370
100,000	110,000	1,835	2,000	550	1,100	1,437	2,000	195	390
110,000	120,000	1,855	2,000	555	1,110	1,479	2,000	205	410
120,000	130,000	1,875	2,000	560	1,120	1,521	2,000	215	430
130,000	140,000	1,890	2,000	565	1,130	1,557	2,000	225	450
140,000	150,000	1,900	2,000	570	1,140	1,593	2,000	235	470
150,000	160,000	1,935	2,000	580	1,160	1,629	2,000	245	490
160,000	170,000	1,965	2,000	590	1,180	1,662	2,000	255	510
170,000	180,000	1,990	2,000	600	1,200	1,695	2,000	265	530
180,000	190,000	2,010	2,010	605	1,210	1,725	2,000	275	550
190,000	200,000	2,030	2,030	610	1,220	1,755	2,000	285	570
200,000	210,000	2,055	2,055	620	1,240	1,782	2,000	295	590
210,000	230,000	2,100	2,100	635	1,270	1,836	2,000	315	630
230,000	250,000	2,155	2,155	650	1,300	1,890	2,000	335	670
250,000	275,000	2,215	2,215	670	1,340	1,950	2,000	360	720
275,000	300,000	2,275	2,275	690	1,380	2,000	2,000	385	770

For SI Units: 1 lb = 0.454 kg; 1 ft = 0.305 m.

Notes to American Table of Distances for Storage of Explosives.

NOTE 1: "Explosive materials" means explosives, blasting agents, and detonators.

NOTE 2: "Explosives" means any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion. A list of explosives determined to be within the coverage of 18 U.S.C. Chapter 40, "Importation, Manufacture, Distribution and Storage of Explosive Materials" is issued at least annually by the Director of the Bureau of Alcohol, Tobacco, and Firearms of the Department of Treasury.

NOTE 3: "Blasting agents" means any material or mixture, consisting of fuel and oxidizer, intended for blasting, not otherwise defined as an explosive, provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a No. 8 test blasting cap when unconfined.

NOTE 4: "Detonator" means any device containing a detonating charge that is used for initiating detonation in an explosive; the term includes, but is not limited to, electric blasting caps of instantaneous and delay types, blasting caps for use with safety fuses and detonating-cord delay connectors.

NOTE 5: "Magazine" means any building or structure, other than an explosives manufacturing building, used for the permanent storage of explosive materials.

NOTE 6: "Natural Barricade" means natural features of the ground, such as hills, or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the magazine when the trees are bare of leaves.

NOTE 7: "Artificial Barricade" means an artificial mound or revetted wall of earth of a minimum thickness of 3 ft (0.9 m).

NOTE 8: "Barricaded" means that a building containing explosives is effectually screened from a magazine, building, railway, or highway, either by a natural barricade, or by an artificial barricade of such height that a straight line from the top of any sidewall of the building containing explosives to the eave line of any magazine, or building, or to a point 12 ft (3.7 m) above the center of a railway or highway, will pass through such intervening natural or artificial barricade.

NOTE 9: "Inhabited Building" means a building regularly occupied in whole or in part as a habitation for human beings, or any church, schoolhouse, railroad station, store, or other structure where people are accustomed to assemble, except any building or structure occupied in connection with the manufacture, transportation, storage or use of explosives.

NOTE 10: "Railway" means any steam, electric, or other railroad or railway which carries passengers for hire.

NOTE 11: "Highway" means any street or public road. "Public Highways Class A to D" are highways with average traffic volume of 3,000 or less vehicles per day as specified in American Civil Engineering Practice (Abbott, Vol. 1, Table 46, Sec. 3-7.4, 1956 Edition, John Wiley and Sons).

NOTE 12: When two or more storage magazines are located on the same property, each magazine must comply with the minimum distances specified from inhabited buildings, railways, and highways, and, in addition, they should be separated from each other by not less than the distances shown for "Separation of Magazines," except that the quantity of explosives contained in cap magazines shall govern in regard to the spacing of said cap magazines from magazines containing other explosives. If any two or more magazines are separated from each other by less than the specified "Separation of Magazines" distances, then such two or more magazines, as a group, must be considered as one magazine, and the total quantity of explosives stored in such group must be treated as if stored in a single magazine located on the site of any magazine of the group, and must comply with the minimum of distances specified from other magazines, inhabited buildings, railways, and highways.

NOTE 13: Storage in excess of 300,000 lb (136 200 kg) of explosives in one magazine is generally not required for commercial enterprises.

NOTE 14: This table applies only to the manufacture and permanent storage of commercial explosives. It is not applicable to transportation of explosives or any handling or temporary storage necessary or incident thereto. It is not intended to apply to bombs, projectiles, or other heavily encased explosives.

NOTE 15: All types of blasting caps in strengths through No. 8 cap should be rated at 1½ lb (0.7 kg) of explosives per 1,000 caps. For strengths higher than No. 8 cap, consult the manufacturer.

NOTE 16: For quantity and distance purposes, detonating cord of 50 to 60 grains per ft (10.7 to 12.8 g per m) should be calculated as equivalent to 9 lb of high explosives per 1,000 ft (13 4 kg per 1000 m). Heavier or lighter core loads should be rated proportionately.

Table 2-6.5
Minimum Separation Distances of Common Fireworks Storage Buildings from Inhabited Buildings, Magazines, Passenger Railways, Public Highways, and Other Storage Buildings

Net Weight of Fireworks (1)	Distance from Passenger Railways, Public Highways and Other Storage Buildings (2)	Distance from Inhabited Buildings (2) and Magazines (2)
Lb	Ft	Ft
0-100	25	50
100-200	30	60
200-400	35	70
400-600	40	80
600-800	45	90
800-1,000	50	100
1,000-2,000	58	115
2,000-3,000	62	124
3,000-4,000	65	130
4,000-5,000	68	135
5,000-6,000	70	139
6,000-8,000	73	140
8,000-10,000	75	150
10,000-15,000	80	159
15,000-20,000	83	165
20,000-30,000	87	174
30,000-40,000	90	180
40,000-50,000	93	185
50,000-60,000	95	189
60,000-80,000	98	195
80,000-100,000	100	200
100,000-150,000	105	209
150,000-200,000	108	215
200,000-250,000	110	220

For SI Units: 1 lb = 0.454 kg; 1 ft = 0.305 m.

NOTE 1: Net weight is the weight of all pyrotechnic and explosive compositions and fuse only. For common fireworks approximately 25 percent of the gross weight of the fireworks will be the net weight of composition and fuse.

NOTE 2: This table applies only to the storage of common fireworks at a fireworks manufacturing plant. It is not applicable to the storage of packaged common fireworks at retail, wholesale, or distributing facilities.

2-7.6 A means for discharging static shall be provided at the entrance to all mixing, pressing, and loading buildings. All personnel entering these buildings shall utilize these means.

2-8 Means of Egress.

2-8.1 Means of egress in all buildings shall comply with applicable requirements of NFPA 101®, Life Safety Code®.

2-8.2 Means of egress in process buildings shall also comply with the following requirements:

(a) From every point in every undivided floor area of more than 100 sq ft (9 sq m) there shall be at least two remotely located exits.

(b) Where process buildings are divided into rooms, there shall be at least two means of escape from each room of more than 100 sq ft (9 sq m).

Exception: Toilet rooms need have only one exit, provided they are located away from or suitably shielded from process areas.

(c) Exits shall be so located that every point within the room or undivided floor area is within 25 ft (7.6 m) of an exit. The routes to the exits shall not be obstructed.

(d) Exit doors shall open outward and shall be capable of being\pressure-actuated from the inside.

2-9 Heat, Light, and Electrical Equipment.

2-9.1 Stoves, exposed flames, and portable electric heaters shall be prohibited in any building where fireworks, fireworks components, or flammable liquids are or may be present.

Exception: This does not apply to nonprocess buildings.

2-9.2 Heating shall be provided by steam, hot water, or indirect hot air radiators, or any other means acceptable to the authority having jurisdiction.

Exception: This does not apply to nonprocess buildings.

2-9.2.1 Unit heaters located in buildings which contain or may contain exposed explosive or pyrotechnic composition shall be equipped with motors and electrical devices suitable for use in Class II, Group E, Division 1 locations. (*See Article 502 of NFPA 70, National Electrical Code®.*)

2-9.3 All wiring, switches, and electrical fixtures in process buildings shall be suitable for Class II, Group E, Division 1 locations. (*See Article 502 of NFPA 70, National Electrical Code.*)

2-9.3.1 Portable lighting equipment shall not be used.

Exception: Approved portable lighting equipment may be used during repair operations, provided the area has been cleared of all pyrotechnic or explosive material and all dust or residue has been removed by washing.

2-9.3.2 All presses and other such mechanical devices used in the vicinity of exposed explosive or pyrotechnic composition shall be electrically bonded and grounded.

2-9.4 All artificial lighting shall be electrically powered.

2-10 Maximum Number of Occupants and Maximum Quantity Limitations.

2-10.1* The number of occupants in each process building and in each magazine shall not exceed the number necessary for proper conduct of production operations.

2-10.1.1 The maximum number of occupants permitted in each process building and in each magazine shall be posted in a conspicuous location in each process building or magazine.

2-10.2 No more than 500 lb (227 kg) of pyrotechnic or explosive composition shall be permitted at one time in any process building or area. All compositions not in immediate use shall be kept in covered, nonferrous containers.

Exception: Composition that has been loaded or pressed into tubes or other containers as common fireworks.

NOTE: The maximum quantity of salute powder permitted in any process building or area shall be 10 lb (4.5 kg).

2-10.3 The requirements of the Bureau of Alcohol, Tobacco and Firearms pertaining to the removal of dry explosive powders and mixtures, partially assembled special fireworks, and finished special fireworks from process buildings to magazines at the conclusion of each day's operation shall be complied with.

Exception: Where a variance from this requirement has been issued in writing to a manufacturer by the Bureau of Alcohol, Tobacco and Firearms.

NOTE: Where sufficient separation distances exist, the Regional Director of the Bureau of Alcohol, Tobacco and Firearms may grant a variance from this requirement upon written request.

2-11 Fire and Explosion Prevention.

2-11.1 All buildings shall be kept clean, orderly, and free of accumulations of dust or rubbish.

2-11.1.1 Spills of explosive or pyrotechnic composition shall be immediately cleaned up and removed from the building. The spilled material shall be destroyed by immersion in water or by burning in a manner acceptable to the authority having jurisdiction.

2-11.1.2 Rags, combustible scrap, and paper shall be kept separate from waste explosive or pyrotechnic materials. Both shall be kept in approved, marked containers until removed from the building. All such disposal containers shall be removed from buildings on a daily basis and removed from the plant at regular intervals. Waste explosive or pyrotechnic materials shall be destroyed by means explained in 2-11.1.1.

2-11.2 Smoking materials shall not be carried into or in the vicinity of process buildings. Personnel shall deposit all smoking materials at a suitable location in a nonprocess building immediately upon entering the plant.

2-11.2.1* Smoking shall only be permitted in office buildings or in buildings used exclusively as lunch rooms or rest rooms and in which the presence of explosive or pyrotechnic materials is prohibited.

2-11.2.2 Authorized smoking locations shall be so marked, shall contain suitable receptacles for disposal of smoking materials, and shall be provided with at least one approved portable fire extinguisher suitable for use on Class A fires.

2-11.2.3 Personnel whose clothing may be contaminated with explosive or pyrotechnic composition to a degree that may endanger personnel safety shall not be allowed in smoking locations.

2-11.3 No employee or other person shall be permitted to enter the plant while in possession of or under the influence of alcohol, drugs, or narcotics.

2-11.4 Personnel working at or supervising mixing, pressing, and loading operations shall be provided with and shall wear cotton or other similarly effective clothing. Other protective clothing, eye protection, and respiratory protection shall be worn as needed.

2-11.4.1 Washing and change facilities shall be provided for personnel.

2-11.4.2 Work clothing shall be washed frequently to prevent accumulation of explosive or pyrotechnic composition and shall not be worn outside the plant.

2-11.5 Each plant shall have an employee designated as safety officer who shall be responsible for general safety, fire prevention and protection, and employee safety training.

2-11.5.1 The safety officer shall give formal instruction regarding proper methods and procedures, safety requirements, and procedures for handling explosive and pyrotechnic compositions and devices to all employees upon commencing employment and at least annually thereafter.

2-11.6* Oxidizers shall not be stored in the same building with combustible powdered materials such as charcoal, gums, metals, sulfur, or antimony sulfide.

2-12 Fire Protection and Emergency Procedures.

2-12.1 Portable fire extinguishers shall be provided in all buildings according to the requirements of NFPA 10, *Standard for Portable Fire Extinguishers*.

Exception: Extinguishers shall not be located in buildings in which explosive or pyrotechnic mixtures are exposed.

2-12.2 Each plant shall have formal emergency procedures. Such procedures shall include employee instruction and training and shall be applicable to all anticipated emergencies. An emergency warning signal shall be established.

2-12.3 Emergency procedures shall include instruction in the use of portable fire extinguishers and instructions on which fires they may be safely used.

2-12.3.1 Employees shall be instructed to abandon fire fighting efforts if the fire involves or may spread to explosive or pyrotechnic compositions or devices. In such cases, employees shall be instructed to evacuate the building immediately and to alert other plant personnel.

2-12.4 A master electrical disconnect shall be provided at the point where the electrical service enters the plant. This master disconnect shall be arranged to disconnect all electrical power to the plant.

Exception: Emergency circuits, such as the electrical supply to fire pumps or emergency lighting, shall have their own master disconnects.

2-13 Testing of Fireworks. Testing of fireworks and fireworks components shall be performed only in an area set aside specifically for that purpose. The test site shall be located at a safe distance from all plant buildings or structures.

Chapter 3 Storage of Special Fireworks, Salute Powder, and Black Powder

3-1 Basic Requirements.

3-1.1 Special fireworks, salute powder, and black powder shall be stored in magazines meeting the requirements of this chapter. They shall be so stored at all times unless in the process of manufacture, packaging, or being transported.

3-1.1.1 Salutes and bulk salute powder shall be stored only in Type 1 or Type 2 magazines.

3-1.1.2 Special fireworks, other than bulk salutes, that are not bullet-sensitive and black powder shall be stored only in a Type 1, 2, 3, or 4 magazine.

3-1.2 Magazines containing special fireworks shall be separated from inhabited buildings, passenger railways and public highways by the distances specified in Table 2-6.3 or 2-6.4.

3-1.3 Magazines containing special fireworks shall be separated from other magazines and from plant buildings by barricades or screen barricades and by the distances specified in Table 2-6.2.

3-1.4 Magazines containing black powder shall be separated from inhabited buildings, passenger railways, public highways, and other magazines by the distances specified in Table 2-6.3.

3-2 Magazine Construction — General.

3-2.1 Magazines shall be constructed so as to comply with this chapter or in a manner substantially equivalent to the requirements of this chapter.

3-2.2 The ground around magazines shall be graded so that water drains away from the magazine.

3-2.3 Magazines requiring heat shall be heated by either hot water radiant heating within the magazine building or by indirect warm air heating.

3-2.3.1 Indirect warm air shall be heated by either hot water or low-pressure (15 psig or less) steam coils located outside the magazine building.

3-2.3.2 Magazine heating systems shall meet the following requirements:

(a) Radiant heating coils within the building shall be installed so that explosive materials or their containers cannot contact the coils and so that air is free to circulate between the coils and the explosives. The surface temperature of the coils shall not exceed 165°F (76°C).

(b) Heating ducts shall be installed so that the hot air discharge from the ducts is not directed against explosive materials or their containers.

(c) The heating system shall be controlled so that the ambient temperature of the magazine does not exceed 130°F (54°C).

(d) Any electric fan or pump used in the heating system shall be located outside the magazine, separate from the magazine walls, and shall be grounded.

(e) Any electric motor and any controls for electric heating devices used to heat water or produce steam shall have overload devices and disconnects which comply with NFPA 70, *National Electrical Code*. All electrical switchgear shall be located at least 25 ft (7.6 m) from the magazine.

(f) Any fuel-fired heating source for the hot water or steam shall be separated from the magazine by a distance of not less than 25 ft (7.6 m). The area between the heating unit and the magazine shall be cleared of all combustible materials.

(g) Explosive materials stored in magazines shall be arranged so that uniform circulation of air is assured.

3-2.4 When lighting is necessary within the magazine, electric safety flashlights or electric safety lanterns shall be used.

Exception: As provided for in 3-2.4.1.

3-2.4.1 Electric lighting may be used within a magazine only if the installation meets the following requirements:

(a) Junction boxes containing fuses or circuit breakers and electrical disconnects shall be located at least 25 ft (7.6 m) from the magazine.

(b) Disconnects, fuses, and circuit breakers shall be protected by a voltage surge arrester capable of handling 2500 amperes for 0.1 seconds.

(c) All wiring from switches, both inside and outside the magazine, shall be installed in rigid conduit. Wiring leading into the magazine shall be installed underground.

(d) Conduit and light fixtures inside the magazine shall be protected from physical damage by suitable guards or by location.

(e) Light fixtures shall be suitably enclosed to prevent sparks or hot metal from falling on the floor or onto material stored in the magazine.

(f) Junction boxes located within the magazine shall have no openings and shall be equipped with close-fitting covers.

(g) Magazines containing materials that may release flammable vapors shall have wiring and fixtures which meet the requirements of Article 501 of NFPA 70, *National Electrical Code*.

(h) Lights inside magazines shall not be left on when the magazine is unattended.

3-2.5 There shall be no exposed ferrous metal on the interior of the magazine where it may contact material stored within.

3-2.6 When ventilation is required in the magazine, sufficient ventilation shall be provided to protect the stored materials for the specific area in which the plant is located.

3-2.6.1 Stored materials shall be placed so that they do not interfere with ventilation and so as to prevent contact with masonry walls, any steel, or any other ferrous metal by means of a nonsparking lattice or equivalent lining.

3-3 Magazine Construction — Requirements for Specific Types.

3-3.1 Type 1 Magazine. A Type 1 magazine shall be a permanent structure, such as a building or igloo, that is bullet-resistant, fire-resistant, theft-resistant, weather-resistant, and ventilated.

(a) Walls and doors shall be bullet-resistant and may be constructed according to any of the specifications listed in Appendix B.

(b) The roof may be constructed of any type of structurally sound material which is or has been made fire-resistant on the exterior.

(c)* Where the natural terrain around a Type 1 magazine makes it possible for a bullet to be shot through the roof and ceiling at such an angle that the bullet can strike the explosive materials within, then either the roof or the ceiling shall be of bullet-resistant construction.

(d) The foundation may be of masonry, wood, or metal and shall be completely enclosed except for openings to provide cross ventilation. A wood foundation enclosure shall be covered on the exterior with not less than 26-gage metal.

(e) The floor shall be constructed of wood or other suitable material. Floors constructed of materials that may cause sparks shall be covered with a nonsparking surface or the packages of explosive material shall be packed on pallets of nonsparking material.

(f) Type 1 magazines shall be ventilated to prevent dampness or heating of explosives. Ventilation openings shall be screened to prevent entrance of sparks. Ventilators in side walls shall be offset or shielded. Magazines having foundation and roof ventilators, with the air circulating between side walls and floor and between side walls and ceil-

ing, shall have a wood lattice lining or equivalent means to prevent packages from being stacked against side walls and blocking air circulation. A 2-in. (51-mm) air space shall be provided between side walls and the floor.

(g) Each door of the magazine shall be equipped with one of the following locking systems:

1. two mortise locks;
2. two padlocks in separate hasps and staples;
3. a mortise lock and a padlock;
4. a mortise lock that requires two keys to open;
5. a three-point lock or an equivalent lock that secures the door to the frame at more than one point.

Padlocks shall be steel, shall have at least five tumblers, and shall have at least a ⅜-in. (9.5-mm) case-hardened shackle. All padlocks shall be protected by steel hoods installed so as to discourage insertion of bolt cutters. Doors secured by a substantial internal bolt do not require additional locking devices. Hinges and hasps shall be securely fastened to the magazine and all locking hardware shall be secured rigidly and directly to the door frame.

3-3.2 Type 2 Magazine. A Type 2 magazine shall be a portable or mobile structure, such as a box, skid-magazine, trailer, or semi-trailer that is fire-resistant, theft-resistant, weather-resistant, and ventilated. If used for outdoor storage, Type 2 magazines shall be bullet-resistant.

3-3.2.1 Type 2 Outdoor Magazine.

(a) Walls and roof or ceiling shall be constructed according to the provisions of 3-3.1(a), (b) and (c).

(b) Doors shall be of metal, constructed according to the provisions of 3-3.1 (a) or shall have a metal exterior with an inner door meeting the provisions of 3-3.1(a).

(c) Floors constructed of ferrous metal shall be covered with a nonsparking surface.

(d) A magazine that is top opening shall have a lid that overlaps the sides by at least 1 in. (25.4 mm) when in the closed position.

(e) The magazine shall be supported so that its floor does not directly contact the ground.

(f) Magazines less than 1 cu yd (0.77 m^3) in size shall be securely fastened to a fixed object to prevent theft of the entire magazine.

(g) Hinges, hasps, locks, and locking hardware shall comply with 3-3.1(g).

Exception: Padlocks on vehicular magazines need not be protected by steel hoods.

(h) Whenever a vehicular magazine is left unattended, its wheels shall be removed or its kingpins shall be locked or it shall otherwise be effectively immobilized.

3-3.2.2 Type 2 Indoor Magazines.

(a) The magazine shall have substantial wheels or casters to facilitate removal from the building in case of emergency.

(b) The cover of the magazine shall have substantial strap hinges and a means for locking. The magazine shall be kept locked, except during placement or removal of explosive materials, with a five-tumbler padlock or its equivalent.

(c) The magazine shall be painted red and the top shall bear the words "Explosives — Keep Fire Away" in white letters at least 3 in. (76 mm) high.

(d) Magazines constructed of wood shall have sides, bottoms, and covers or doors of 2-in. (51-mm) hardwood, well-braced at corners. The magazines shall be covered with sheet metal of not less than 26 gage. Nails exposed to the interior of the magazines shall be countersunk.

(e) Magazines constructed of metal shall be of 12-gage sheet metal and shall be lined with a nonsparking material. Edges of metal covers shall overlap the sides by at least 1 in (25.4 mm).

3-3.3 Type 3 Magazine. A Type 3 magazine shall be a portable structure that is fire-resistant, theft-resistant, and weather-resistant.

(a) The magazine shall be equipped with a five-tumbler padlock.

(b) Magazines constructed of wood shall have sides, bottoms, and covers or doors of 4-in. (102-mm) hardwood, well-braced at corners. They shall be covered with sheet metal of not less than 26 gage. Nails exposed to the interior of the magazine shall be countersunk.

(c) Magazines constructed of metal shall meet the requirements of 3-3.2.2(e).

3-3.4 Type 4 Magazine. A Type 4 magazine shall be a permanent, portable, or mobile structure such as a building, igloo, box, semi-trailer or other mobile container that is fire-resistant, theft-resistant, and weather-resistant.

3-3.4.1 Type 4 Outdoor Magazine.

(a) The magazine shall be constructed of masonry, wood covered with sheet metal, fabricated metal, or a combination of these materials. Doors shall be metal or wood covered with metal.

(b) Permanent magazines shall comply with 3-3.1(d), (f), and (g).

(c) Vehicular magazines shall comply with 3-3.2.1(g) and shall be immobilized when unattended, as described in 3-3.2.1(h).

3-3.4.2 Type 4 Indoor Magazine. A Type 4 indoor magazine shall comply with all provisions of 3-3.2.2.

3-4 Storage Within Magazines.

3-4.1 Magazines shall be under the responsibility of a competent person at all times. This person shall be at least 21 years of age and shall be responsible for the enforcement of all safety precautions.

3-4.2 All magazines containing explosives shall be inspected at intervals not exceeding seven days to determine whether there has been unauthorized or attempted entry or whether there has been unauthorized removal of the magazines or their contents.

3-4.3 Magazine doors shall be kept locked except during placement or removal of explosive materials or during inspection.

3-4.4 When explosive materials are removed from the magazine for use, the oldest stock shall be used first.

3-4.5 Corresponding grades and brands of explosive materials shall be stored together so that brand and grade markings are readily visible. All stock shall be stored so as to be easily counted and checked.

3-4.6 Containers of explosive materials shall be piled in a stable manner, laid flat and with top side up.

3-4.7 Open containers of explosive materials shall be securely closed before being returned to a magazine. No container without a closed lid may be stored in a magazine.

3-4.8 Containers of explosive materials shall not be opened, unpacked, or repacked inside or within 50 ft (15.25 m) of a magazine or in close proximity to other explosives.

Exception: Fiberboard containers may be opened inside or within 50 ft (15.25 m) of a magazine. They shall not, however, be unpacked.

3-4.9 Tools used for opening containers of explosive materials shall be nonsparking.

Exception: Metal slitters may be used for opening fiberboard containers.

3-4.10 Magazines shall be used exclusively for the storage of explosive and pyrotechnic materials. Metal tools other than nonferrous conveyors shall not be stored in magazines. Ferrous metal conveyor stands protected by a coat of paint may be stored within magazines.

3-4.11 Magazine floors shall be regularly swept and kept clean, dry, free of grit, paper, empty packing materials, and rubbish. Brooms and other cleaning utensils shall not have spark-producing metal parts. Sweepings from magazine floors shall be disposed of according to manufacturer's instructions.

3-4.12 When any explosive or pyrotechnic material has deteriorated to the extent that it has become unstable or dangerous, the person responsible shall immediately contact the manufacturer for assistance.

3-4.13 Before making repairs to the interior of a magazine, all explosive or pyrotechnic material shall be removed and the interior shall be cleaned.

3-4.14 Before making repairs to the exterior of a magazine where there is a possibility of causing sparks or fire, all explosive and pyrotechnic material shall be removed.

3-4.15 Explosive or pyrotechnic material removed from a magazine undergoing repair shall either be placed in another magazine or be placed a safe distance from the magazine, where they shall be properly guarded and protected. Upon completion of the repairs, the materials shall be promptly returned to the magazine.

3-5 Miscellaneous Safety Precautions.

3-5.1 Smoking, matches, open flames, spark-producing devices and firearms shall not be permitted inside of or within 50 ft (15.25 m) of a magazine.

Exception: Firearms carried by authorized guards.

3-5.2 The area around a magazine shall be kept clear of brush, dried vegetation, leaves, and similar combustibles for a distance of at least 25 ft (7.6 m).

3-5.3 Combustible materials shall not be stored within 50 ft (15.25 m) of a magazine.

3-6 Requirements for Shipping Buildings for Special Fireworks.

3-6.1 Shipping buildings must be separated from process buildings in accordance with the distances specified in Table 2-6.2.

3-6.2 Shipping buildings must be separated from inhabited buildings, passenger railroads, public highways, and magazines in accordance with the distances specified in Table 2-6.3.

3-6.3 A maximum of 10,000 pounds (gross weight) of special fireworks is permitted at one time in a shipping building.

3-6.4 No more than 30 pounds of salute powder (net weight), as finished salutes, is permitted at any time in a shipping building.

3-6.5 All electrical equipment and fixtures in a shipping building shall be approved for use in a Class II, Group E, Division 1 location.

3-6.6 Special fireworks awaiting packing and shipping may remain in a shipping building overnight provided that the building is fire and theft resistant. The building shall be securely locked when not in operation, and windows shall be guarded with bars or similar protection.

Chapter 4 Storage of Common Fireworks at Manufacturing Plants

4-1 Basic Requirements.

4-1.1 Common fireworks at fireworks manufacturing plants shall be stored in buildings meeting the requirements of this chapter. They shall be so stored at all times unless in the process of manufacture, packaging, or being transported.

4-1.2 Storage buildings shall be constructed so as to comply with this chapter or in a manner substantially equivalent to the requirements of this chapter.

4-1.3 Storage buildings containing common fireworks shall be separated from inhabited buildings, passenger railways, and public highways by the distances specified in Table 2-6.5. They shall be separated from other storage

buildings, magazines, and fireworks manufacturing buildings by the distances specified in Table 2-6.2.

4-2 Construction of Storage Buildings.

4-2.1 Storage buildings for Class C fireworks may be a building, igloo, box, trailer, semi-trailer, or other mobile facility. They shall be constructed to resist fire from an external source and to be weather-resistant and theft-resistant.

4-2.2 All openings shall be equipped with a means for locking.

4-2.3 All doors shall open outward and all exits must be clearly marked. Aisles and exit doors shall be kept free of obstructions.

4-2.4 All electrical fixtures shall be dust-ignitionproof. All electrical wiring shall comply with Articles 500 and 502 of NFPA 70, *National Electrical Code*.

4-2.4.1 Electrical receptacles or unguarded light fixtures shall not be permitted within 25 ft (7.6 m) of any fireworks or pyrotechnic composition. Light fixtures within 25 ft (7.6 m) of any fireworks shall have guards.

4-2.4.2 An electrical disconnect shall be located outside each storage building and shall be arranged to de-energize all electrical power to the building.

4-3 Operations in Storage Buildings.

4-3.1 Storage buildings shall be under the direct supervision of a competent person while in operation. This person shall be at least 21 years of age, and shall be responsible for enforcing all safety precautions.

4-3.2 Doors shall be kept locked when the building is not in operation.

4-3.3 Common fireworks shall be stored in their original packages, in unopened cases and cartons. All containers shall be stacked neatly and in a stable manner.

Exception: Unpackaged fireworks returned to the storage building by retailers may be stored temporarily in bins until repackaged.

4-3.4 Tools used for opening containers shall be nonsparking.

Exception: Metal slitters may be used for opening fiberboard containers.

4-3.5 Storage buildings shall be kept clean, dry, free of grit, paper, empty used packages and rubbish. Brooms and other cleaning utensils shall not have spark-producing metal parts. Sweepings from magazine floors shall be disposed of properly.

4-3.6 Before making repairs to the interior of a storage building, all fireworks shall be removed and the interior shall be cleaned.

4-3.7 Before making repairs to the exterior of a storage building where there is a possibility of causing sparks or fire, all fireworks shall be removed.

4-3.8 Fireworks removed from a storage building undergoing repair shall be handled according to 3-4.16.

4-3.9 Smoking, matches, open flames, spark-producing devices and firearms shall not be permitted inside of a storage building or within 25 ft (7.6 m) of stored fireworks.

Exception: Firearms carried by authorized guards.

4-3.10 The area around storage buildings shall be kept clear of brush, dried vegetation, leaves, and similar combustibles for a distance of at least 25 ft (7.6 m).

Chapter 5 Transportation of Fireworks

5-1 Basic Requirements.

5-1.1 Transportation of fireworks shall meet all applicable requirements of the U.S. Department of Transportation.

5-1.2 Transportation of fireworks shall meet the requirements of this chapter, to the extent that they do not conflict with the requirements of the U.S. Department of Transportation.

5-2 Vehicle Inspection. A motor vehicle used to transport fireworks shall be inspected to determine that it is in proper condition by checking the following:

5-2.1 Fire extinguishers shall be fully charged and in working order.

5-2.2 All electrical wiring shall be protected and securely fastened to prevent short circuits and intermittent open circuits.

5-2.3 The chassis, motor, oil pan, and body underside shall be reasonably clean and free of excess oil and grease.

5-2.4 The fuel tank and fuel lines shall be secure and shall have no leaks.

5-2.5 Brakes, lights, horn, windshield wipers, and steering apparatus shall all function properly.

5-2.6 Tires shall be checked for proper inflation and defects.

5-2.7 The vehicle shall be in proper condition in all other respects and shall be acceptable for handling explosives and fireworks.

5-3 Driver Qualifications.

5-3.1 Vehicles shall be driven by and in the charge of a properly licensed driver or a qualified representative of the carrier operating the vehicle who is physically fit, careful, capable, reliable, able to read and write the English language, and not addicted to or under the influence of intoxicants, narcotics, or other dangerous drugs.

5-3.2 The driver or representative shall be at least 21 years of age.

5-4 Vehicle Attendance, Routing, and Parking.

5-4.1 A motor vehicle transporting any quantity of black powder or Class B fireworks shall be attended at all times by the driver or the representative of the operator of the vehicle. This attendant shall be informed of the class of material carried and its inherent dangerous properties. He shall be instructed in the procedures to be followed in order to protect the public from danger.

5-4.1.1 The driver or representative shall be thoroughly familiar with the vehicle and shall be trained, given the necessary means, and authorized to move the vehicle when required.

5-4.1.2 The driver or representative shall be familiar with the provisions of this chapter, local and state traffic regulations, and state and federal regulations governing the transportation of fireworks.

5-4.1.3 For the purpose of this section, a motor vehicle shall be considered "attended" when the driver or other attendant is physically on or in the vehicle, or has the vehicle within his field of vision and can reach it quickly and without interference. "Attended" also means that the driver or other attendant is awake, alert, and not engaged in activities which may divert his attention from the vehicle.

Exception No. 1: Necessary communication with public officers or representatives of the carrier, shipper, or consignee or necessary absence from the vehicle to obtain food or to provide for physical comfort.

Exception No. 2: A vehicle may be left unattended in an area where such parking is permitted, such as an area meeting the requirements of NFPA 498, Standard for Explosive Motor Vehicle Terminals.

5-4.2 Vehicles transporting Class B fireworks shall avoid congested areas and heavy traffic. Where routes through congested areas have been designated by local authorities, such routes shall be followed.

5-4.3 A vehicle transporting Class B fireworks shall not be parked before reaching its destination, even though attended, on any public street adjacent to or near any bridge, tunnel, dwelling, building, or place where people work, congregate, or assemble.

Exception: This requirement shall not apply in cases of emergency or when the driver or attendant leaves the vehicle to obtain food or to provide for physical comfort.

5-5 Ignition Sources. Spark-producing metal or metal tools, oil, matches, firearms, electric storage batteries, flammable materials, acids, oxidizing materials, or corrosive materials shall not be carried in the body of a vehicle transporting Class B fireworks.

5-6 Delivery of Fireworks. Delivery of fireworks shall be made only to authorized persons.

Chapter 6 Referenced Publications

6-1 The following documents or portions thereof are referenced within this Code 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 10-1988, *Standard for Portable Fire Extinguishers*

NFPA 70-1987, *National Electrical Code*

NFPA 101-1988, *Life Safety Code*

NFPA 498-1986, *Standard for Explosives Motor Vehicle Terminals*

NFPA 1121L-1982, *Model State Fireworks Law*

NFPA 1122-1987, *Code for Unmanned Rockets*

NFPA 1123-1982, *Standard for Public Display of Fireworks.*

6-1.2 Government Publications.

U.S. Government Publications. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Title 16, *Code of Federal Regulations,* Parts 1500 and 1507, U.S. Consumer Product Safety Commission

Title 29, *Code of Federal Regulations,* Part 1910.1200, "Hazard Communication," U.S. Department of Transportation

Title 49, *Code of Federal Regulations,* Parts 173.88 and 173.100, U.S. Department of Transportation

Title XI, *Regulation of Explosives, of the Crime Control Act of 1970* (Title 18, *United States Code,* Chapter 40, Importation, Manufacture, Distribution, and Storage of Explosive Materials), 1970

Title 18, *United States Code,* Chapter 40, Importation, Manufacture, Distribution, and Storage of Explosive Materials, 1970.

6-1.3 Other Publications.

American Table of Distances for Storage of Explosives; May, 1983; Institute of Makers of Explosives, 1575 Eye St., NW, Washington, DC 20005.

American Civil Engineering Practice (Abbott, Vol. 1, Table 46, Sec. 3-7.4, 1956 Edition, John Wiley and Sons).

Appendix A

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

A-1-4 Explosive. A list of explosives determined to be within the scope of 18 United States Code, Chapter 40, is published at least annually by the Bureau of Alcohol, Tobacco, and Firearms, U.S. Department of the Treasury.

Classification of explosives described in the Hazardous Materials Regulations of the U.S. Department of Transportation is as follows:

Class A Explosives:	Possessing detonating or otherwise maximum hazard, such as dynamite, desensitized nitrogylcerine, lead azide, fulminate of mercury, black powder, blasting caps, and detonating primers.
Class B Explosives:	Possessing flammability hazards, such as propellants, including some smokeless propellants and photographic flash powders.
Blasting Agents:	Possessing minimum accidental explosion hazard.
Class C Explosives:	Includes certain manufactured articles which contain Class A or Class B explosives, or both, as components, but in restricted quantities.
Forbidden Explosives:	Explosives which are forbidden from or not acceptable for transportation by common carriers.

Certain chemicals and fuel materials may have explosive characteristics, but are not within the scope of 18 USC, Chapter 40, and are not specifically classified as explosives by the U.S. Department of Transportation. Authoritative information should be obtained for such materials and action commensurate with their hazards, location, isolation, and safeguards should be taken.

A-1-4 Fireworks, Exception No. 1: The regulations referred to limit the explosive content of each cap to not more than an average of 0.25 grains (16.25 mg). Also, each package containing such caps must be labeled to indicate the maximum explosive content per cap.

A-2-7.1 In general, the wall having the largest area should be chosen to provide explosion relief. The entire area of the wall should be utilized. The term "weakwall" is used to describe the relative strength of the explosion relieving wall as compared to the rest of the building.

A-2-7.5 For information on the use of conductive surfaces to minimize the hazard of static electricity, see NFPA 99, *Standard for Health Care Facilities*, Chapter 3, Use of Inhalation Anesthetics.

A-2-10.1 This requirement is for purposes of minimizing personnel exposure and is distinct from any requirement on maximum building occupancy that may exist in local ordinances.

A-2-11.2.1 Smoking materials include matches, lighters, cigarettes, cigars, and pipes.

A-2-11.6 Oxidizers include nitrates, chlorates, and perchlorates.

A-3.3.1(c) A bullet-resistant roof may be constructed according to any of the specifications listed in Appendix B. A bullet-resistant ceiling may be constructed at the eave line, covering the entire area of the magazine, except for the necessary ventilation space. Examples of bullet-resistant ceiling construction include:

1. Any construction meeting the specifications listed in Appendix B.
2. A sand tray having a sand depth of at least 4 in. (102 mm)

Appendix B Magazine Construction

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

Magazines constructed according to the following minimum specifications are approved as bullet-resistant (as defined in Chapter 1 of this Code). All steel and wood dimensions are actual thickness; concrete block and brick dimensions are nominal.

B-1 Steel Exterior.

B-1.1 Five-eighths in. steel with an interior lining of nonsparking material.

B-1.2 One-half in. steel with an interior lining of plywood at least ⅜ in. thick.

B-1.3 Three-eighths in. steel lined with one of the following:

(a) 2 in. of hardwood;
(b) 3 in. of softwood;
(c) 2¼ in. of plywood.

B-1.4 One-fourth in. steel lined with one of the following:

(a) 3 in. of hardwood;
(b) 5 in. of softwood;
(c) 5¼ in. of plywood;
(d) 1½ in. of plywood with an intermediate layer of 2 in. of hardwood.

B-1.5 Three-sixteenths in. steel lined with one of the following:

(a) 4 in. of hardwood;
(b) 7 in. of softwood;
(c) 6¾ in. of plywood;
(d) Three-fourths in. of plywood with an intermediate layer of 3 in. of hardwood.

For SI Units: 1 in. = 25.4 mm.

B-1.6 One-eighth in. steel lined with one of the following:

(a) 5 in. of hardwood;

(b) 9 in. of softwood;

(c) Three-fourths in. of plywood with an intermediate layer of 4 in. of hardwood.

(d) Two layers of ¾-in. plywood with an intermediate layer of 3⅝ in. of well-tamped dry sand or sand/cement mixture.

B-2 Fire-Resistant Exterior. Exterior of any type of fire-resistant material which is structurally sound with:

B-2.1 An interior lining of ½-in. plywood placed securely against an intermediate 4-in. thick layer of solid concrete block, solid brick, or solid concrete.

B-2.2 An interior lining of ¾-in. plywood, a first intermediate layer of ¾-in. plywood, a second intermediate layer of 3⅝ in. of well-tamped dry sand or sand/cement mixture, a third intermediate layer of ¾-in. plywood, and a fourth intermediate layer of 2-in. hardwood or 14 gage steel.

B-2.3 An intermediate 6-in. space filled with well-tamped dry sand or sand/cement mixture.

B-3 Masonry Exterior.

B-3.1 Standard 8-in. concrete block with voids filled with well-tamped dry sand or sand/cement mixture.

B-3.2 Standard 8-in. solid brick.

B-3.3 Eight-in. solid concrete.

B-3.4 Two layers of 4-in. concrete block.

For SI Units: 1 in. = 25.4 mm.

Appendix C Referenced Publications

C-1 The following documents or portions thereof are referenced within this Code for informational purposes only and thus are not 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.

C-1.1 NFPA Publications.

NFPA 43A-1980, *Code for the Storage of Liquid and Solid Oxidizing Materials*

NFPA 99-1987, *Standard for Health Care Facilities.*

C-1.2 U.S. Government References.

Title 18, *United States Code,* Chapter 40, Importation, Manufacture, Distribution and Storage of Explosive Materials.

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