

# NFPA 1123

## Code for Fireworks Display

2006 Edition



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## NFPA 1123

### Code for

## Fireworks Display

### 2006 Edition

This edition of NFPA 1123, *Code for Fireworks Display*, was prepared by the Technical Committee on Pyrotechnics and acted on by NFPA at its June Association Technical Meeting held June 6–10, 2005, in Las Vegas, NV. It was issued by the Standards Council on July 29, 2005, with an effective date of August 18, 2005, and supersedes all previous editions.

This edition of NFPA 1123 was approved as an American National Standard on August 18, 2005.

### Origin and Development of NFPA 1123

The development of NFPA 1123 began in 1975 with the submission to the Technical Committee on Pyrotechnics of a proposed standard drafted by the American Pyrotechnics Association. The proposed standard was redrafted and was officially adopted by the National Fire Protection Association at its 1978 Fall Meeting. The 1978 edition was amended in 1980, and the amended version was adopted by the Association at its 1981 Fall Meeting.

In the 1990 edition of NFPA 1123, the Committee initiated a complete revision of the document that incorporated a good deal of additional detail on the operation of outdoor fireworks displays, including enhancements in the safe conduct of outdoor fireworks displays by increasing the audience separation distances. The Committee also addressed the new technology of electrically firing outdoor displays of fireworks. Generally, the Committee provided performance requirements rather than supply specific prescriptions for meeting those requirements.

The 1995 edition of NFPA 1123 represented partial amendments to the document and included editorial revisions to improve its ability to be used, adopted, and enforced and to make it conform with the *Manual of Style for NFPA Technical Committee Documents*. The Committee updated the definitions used for fireworks to be consistent with the terminology used in the U.S. Department of Transportation regulations that incorporated the United Nations' shipping designations for fireworks (explosives), including the marking of aerial shells. The 1995 edition also incorporated a new chapter containing requirements for electrically firing fireworks displays and refined the provisions for manually firing large-diameter aerial shells.

The 2000 edition of NFPA 1123 contained three significant changes. First, a new Chapter 4 on display fireworks launched from floating vessels and floating platforms was added to the document. It provided guidance on the construction, sizing, operations, and egress requirements for those fireworks displays launched from floating vessels and floating platforms. Second, requirements for mortar installation and placement were added. The third significant change revised and expanded the tables in Appendix A that provided guidance on mortar wall thickness for steel, paper, high-density polyethylene (HDPE), and fiberglass mortars. Chapter 2 was also reorganized to provide a more logical sequence.

The 2005 edition contains three major revisions to the code. The Committee added smaller aerial shell sizes to the separation distances table in Chapter 5 and reorganized Chapter 5 to clarify the requirements for the various shell types. The reorganization of the chapter established clear requirements for aerial shells, mines and comets, and ground display pieces.

This new edition also includes new guidance on displays from rooftops and other limited or restricted access sites. The code also has been reorganized according to the *Manual of Style for NFPA Technical Committee Documents*.

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

**Committee Scope:** This Committee shall have primary responsibility for documents on the manufacture, transportation, and storage of consumer and display fireworks, pyrotechnic special effects, and model and high power rocket motors. This Committee shall have primary responsibility for the use of display fireworks and for model and high power rocketry, and the construction, launching, and other operations that involve model and high power rocket motors. The Committee shall have primary responsibility for documents on the wholesale and retail sale and storage of consumer fireworks.

The Committee does not have responsibility for documents on the use of consumer fireworks by the general public; on the use of pyrotechnic special effects before a proximate audience; on the manufacture, transportation, storage for use of military, automotive, agricultural, and industrial pyrotechnics.

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

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex G. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

## Chapter 1 General

### 1.1 Scope.

1.1.1 This code shall apply to the following:

- (1) Construction, handling, and use of fireworks and equipment intended for outdoor fireworks display
- (2) Operation of the display (*See 3.3.15, Fireworks Display.*)

1.1.2 This code shall not apply to the following:

- (1)\*Manufacture, transportation, or storage of fireworks at a manufacturing facility
- (2) Testing of fireworks under the direction of their manufacturer, provided that permission for such testing has been obtained from the authority having jurisdiction (AHJ)
- (3) Use of consumer fireworks by the public
- (4) Transportation, handling, or use of fireworks by the armed forces of the United States
- (5) Transportation, handling, or use of industrial pyrotechnic devices or fireworks, such as railroad torpedoes, fusees, automotive, aeronautical, and marine flares, and smoke signals
- (6) Use of pyrotechnic devices or materials in the performing arts at distances less than those specified in this code and used in conformance with NFPA 1126, *Standard for the Use of Pyrotechnics Before a Proximate Audience*
- (7) Use of flame special effects in the performing arts when used in conformance with NFPA 160, *Standard for the Use of Flame Effects Before an Audience*

- (8) Sale and use of rockets, rocket motors, motor reloading kits, pyrotechnic modules, or components used in conformance with NFPA 1122, *Code for Model Rocketry*, NFPA 1127, *Code for High Power Rocketry*, or other propulsion devices classified by the U.S. Department of Transportation as Rocket Motors (UN0186), or Cartridges, power device (UN0275)
- (9) Use of explosives, firearms, or flammable special effects used in motion pictures, television, or other entertainment industries

**1.2 Purpose.** The purpose of this code shall be to provide the following:

- (1) Minimum requirements for outdoor fireworks displays
- (2) Recommended local permit regulations (*See Annex B.*)
- (3) Recommended regulations for state certification of display operators (*See Annex C.*)

**1.3 Equivalency.** Nothing in this code is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this code.

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

**1.3.2** The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

**1.4 Enforcement.** This code shall be administered and enforced by the authority having jurisdiction designated by the governing authority. (*See Annex F for sample wording for enabling legislation.*)

## Chapter 2 Referenced Publications

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

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

NFPA 160, *Standard for the Use of Flame Effects Before an Audience*, 2006 edition.

NFPA 306, *Standard for the Control of Gas Hazards on Vessels*, 2003 edition.

NFPA 1122, *Code for Model Rocketry*, 2002 edition.

NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles*, 2006 edition.

NFPA 1126, *Standard for the Use of Pyrotechnics Before a Proximate Audience*, 2006 edition.

NFPA 1127, *Code for High Power Rocketry*, 2002 edition.

**2.3 Other Publications.**

**2.3.1 APA Publications.** American Pyrotechnics Association, P. O. Box 213, Chestertown, MD 21620.

APA Standard 87-1, *Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics*, 2001.

**2.3.2 U.S. Government Publications.** 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 27, Code of Federal Regulations, Parts 18 and 181, Bureau of Alcohol, Tobacco and Firearms, U.S. Department of Treasury.

Title 49, Code of Federal Regulations, Parts 171 to end, U.S. Department of Transportation.

### 2.3.3 Other Publication.

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

## 2.4 References for Extracts in Mandatory Sections.

NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles*, 2006 edition.

NFPA 1126, *Standard for the Use of Pyrotechnics Before a Proximate Audience*, 2006 edition.

## Chapter 3 Definitions

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

### 3.2 NFPA Official Definitions.

**3.2.1\* Approved.** Acceptable to the authority having jurisdiction.

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

**3.2.3\* Code.** A standard that is an extensive compilation of provisions covering broad subject matter or that is suitable for adoption into law independently of other codes and standards.

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

**3.2.5 Shall.** Indicates a mandatory requirement.

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

### 3.3 General Definitions.

**3.3.1\* Aerial Shell.** A cartridge containing pyrotechnic composition, a burst charge, and an internal time fuse or module, that is propelled into the air from a mortar and that is intended to burst at or near apogee.

**3.3.2\* Assistant.** A person who works under the supervision of the pyrotechnic operator.

**3.3.3\* Barrage.** A rapidly fired sequence of aerial fireworks.

**3.3.4\* Battery.** A collection of fireworks devices, such as a group of mortars (finale battery) or a bundle of roman candles (candle

battery), fused together in such a manner that they are fired within a short period of time.

**3.3.5\* Break.** An individual burst from an aerial shell, generally producing either a visual effect (stars) or noise (salute).

**3.3.6 Cake.** A chain-fused firework that propels a series of aerial shell, comet, or mine effects into the air from collectively attached tubes.

**3.3.7\* Chain Fusing.** A series of two or more aerial shells fused to fire in sequence from a single ignition.

**3.3.8\* Comet.** A single pellet of pyrotechnic composition that is ignited and simultaneously propelled into the air from a mortar or tube; a comet is self-consuming as it rises into the air and can be designed to split apart.

### 3.3.9 Device.

**3.3.9.1 Aerial Device (Display).** A fireworks device designed to be launched into the air for use in a fireworks display.

**3.3.9.2 Pyrotechnic Device.** Any device containing pyrotechnic materials and capable of producing a special effect as defined in this code. [1126, 2006]

**3.3.10\* Electrical Firing Unit.** A device that provides and controls the electric current used to ignite fireworks during a display.

**3.3.10.1\* Automatic Electrical Firing Unit.** A panel or box that operates automatically to provide the source of electric current used to ignite electric matches.

**3.3.10.2\* Handheld Electrical Firing Unit.** A small, handheld unit with manually operated switches that control the flow of electric current to electric matches attached to fireworks devices.

**3.3.10.3\* Manual Electrical Firing Unit.** A panel or box with manually operated switches that control the flow of electric current to electric matches attached to fireworks devices.

**3.3.11\* Fallout Area.** The designated area in which hazardous debris is intended to fall after a pyrotechnic device is fired.

**3.3.12\* Finale.** A rapidly fired sequence (barrage) of aerial fireworks, typically fired at the end of a display.

**3.3.13 Fire (verb).** To ignite pyrotechnics by using an electric match, electrical current, or some other means. [1126, 2006]

**3.3.14\* Fireworks.** Any composition or device for the purpose of producing a visible or an audible effect for entertainment purposes by combustion, deflagration, or detonation, that meets the definition of *Consumer Fireworks* or *Display Fireworks* as set forth in this code. [1124, 2006]

**3.3.14.1\* Consumer Fireworks.** Small fireworks devices containing restricted amounts of pyrotechnic composition, designed primarily to produce visible or audible effects by combustion that comply with the construction, chemical composition, and labeling regulations of the U.S. Consumer Product Safety Commission (CPSC), as set forth in CPSC 16 CFR 1500 and 1507, 49 CFR 172, and APA Standard 87-1, *Standard for the Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics*. [1124, 2006]

**3.3.14.2\* Display Fireworks.** Large fireworks devices that are explosive materials intended for use in fireworks displays and designed to produce visible or audible effects by combustion, deflagration, or detonation, as set forth in CPSC 16 CFR 1500 and 1507, 49 CFR 172, and APA Standard 87-1, *Standard for the Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics*. [1124, 2006]

**3.3.15 Fireworks Display.** A presentation of fireworks for a public or private gathering.

**3.3.16 Fusee.** A highway distress flare, sometimes used to ignite fireworks at outdoor fireworks displays.

**3.3.17 Ground Display Piece.** A pyrotechnic device that functions on the ground (as opposed to an aerial shell that functions in the air) and that includes fountains, wheels, and “set pieces.”

**3.3.18\* Hazardous Debris.** Any debris produced or expelled by the functioning of a pyrotechnic device that is capable of causing personal injury or unpredicted property damage.

**3.3.19 Ignition.**

**3.3.19.1\* Electrical Ignition.** A technique used to ignite fireworks using a source of electric current.

**3.3.19.2 Manual Ignition.** A technique used to ignite fireworks using a handheld ignition source such as a fusee or portfire.

**3.3.20\* Lance.** A thin cardboard tube packed with color-producing pyrotechnic composition used to construct ground display pieces.

**3.3.21\* Lift Charge.** The composition that propels (lifts) the pyrotechnic device into the air.

**3.3.22 Loader.** An assistant who loads or reloads aerial shells, comets, or mines into mortars.

**3.3.23 Match.**

**3.3.23.1 Black Match.** A fuse made from string that is impregnated with Black Powder.

**3.3.23.2\* Electric Match.** An electric device that contains a small amount of pyrotechnic material that ignites when current flows through the device.

**3.3.23.3\* Quick Match.** A black match that is encased in a loose-fitting sheath.

**3.3.24\* Mine.** A device containing multiple pyrotechnic effects that are simultaneously ignited and dispersed into the air from mortar or tube.

**3.3.25 Mortar.** A tube from which certain aerial devices are fired into the air.

**3.3.26 Mortar Rack.** A frame containing one or more mortars.

**3.3.27 Mortar Trough.** Aboveground structure filled with sand or similar material into which mortars are positioned.

**3.3.28 Operator.** The person with overall responsibility for the operation and safety of a fireworks display.

**3.3.29 Portfire.** A long tube containing slow-burning pyrotechnic composition that is sometimes used to ignite fireworks at outdoor fireworks displays.

**3.3.30 Powder.**

**3.3.30.1 Black Powder.** A low explosive consisting of an intimate mixture of potassium or sodium nitrate, charcoal, and sulfur. [1126, 2006]

**3.3.30.2 Salute Powder.** A pyrotechnic composition that makes an explosive sound when ignited and constitutes the sole pyrotechnic effect of a salute.

**3.3.31 Pyrotechnic Material (Pyrotechnic Special Effects Material).** A chemical mixture used in the entertainment industry to produce visible or audible effects by combustion, deflagration, or detonation. [1124, 2006]

**3.3.32 Pyrotechnic Special Effect.** A special effect created through the use of pyrotechnic materials and devices. [1126, 2006]

**3.3.33 Pyrotechnics.** Controlled exothermic chemical reactions that are timed to create the effects of heat, gas, sound, dispersion of aerosols, emission of visible electromagnetic radiation, or a combination of these effects to provide the maximum effect from the least volume. [1124, 2006]

**3.3.34 Ready Box.** A storage container for aerial devices for use during setup and display.

**3.3.35\* Ready Box Tender.** An assistant who controls and dispenses the contents of ready boxes during a fireworks display.

**3.3.36 Roman Candle.** A chain-fused firework that propels a series of aerial shell, comet, or mine effects into the air from a single tube.

**3.3.37 Safety Cap.** A tube, closed at one end, that is placed over the end of the fuse until the intended ignition to protect it from damage and accidental ignition.

**3.3.38 Salute.** Fireworks designed to produce an explosive sound as their primary effect.

**3.3.38.1 Aerial Salute.** A salute that functions as an aerial shell.

**3.3.38.2 Ground Salute.** A salute that functions from a stationary or secured position.

**3.3.39 Shooter.** A member of the fireworks display crew (either the operator or an assistant) who performs the actual ignition of the fireworks, either by manual or electrical means.

**3.3.40 Site.**

**3.3.40.1 Discharge Site.** The area immediately surrounding the fireworks mortars used for an outdoor fireworks display.

**3.3.40.2 Display Site.** The immediate area where a fireworks display is conducted, including the discharge site, the fallout area, and the required separation distance from mortars to spectator viewing areas, but not spectator viewing areas or vehicle parking areas.

**3.3.41 Sponsor.** The organization (person, group, or government agency) that arranges with a duly authorized fireworks supplier for its services in presenting a fireworks display or in providing fireworks for use in a display.

**3.3.42 Spotter.** A member of the fireworks display crew (either the operator or an assistant) who observes the firing and bursting of aerial shells and other display fireworks for the purpose of detecting proper mortar angling, noting the occurrence of duds, and observing for other potentially hazardous situations.

**3.3.43 Trough.** See 3.3.27, Mortar Trough.

## Chapter 4 Requirements for Display Fireworks Aerial Shells and Equipment

### 4.1 Construction of Display Fireworks Aerial Shells.

**4.1.1 Classification and Description.** Aerial shells, mines, and comets shall be classified and described only in terms of the inside diameter of the mortar from which they are fired [e.g., 3 in. (76 mm) aerial shells, mines, and comets shall be used only in 3 in. (76 mm) mortars].

**4.1.2\* Construction.** Aerial shells shall be constructed so that they fit into the appropriate size mortar and so that the lift charge and internal delay fuse propel the shell to the designed altitude before it functions.

#### 4.1.3\* Labeling of Display Fireworks Aerial Shells.

**4.1.3.1 Label Information.** Each shell shall bear a label containing the following information:

- (1) A description of the size of the shell [e.g., “3 in. (76 mm) shell”]
- (2) A description of the type of shell (e.g., “2-break with report”)
- (3) A warning statement reading as shown in Figure 4.1.3.1.
- (4) The name and location of business of the manufacturer, importer, or distributor

**WARNING: DANGEROUS EXPLOSIVE**

IF FOUND, DO NOT HANDLE —  
CONTACT LOCAL FIRE OR  
POLICE DEPARTMENT.

FIGURE 4.1.3.1 Warning Statement.

#### 4.1.3.2 Conspicuousness.

**4.1.3.2.1** The statement “Warning: Dangerous Explosive” shall be printed in capital letters having a printed image of at least ⅛ in. (3.2 mm) and be underlined.

**4.1.3.2.2** The remaining printed matter shall not be required to be printed in capital letters but shall have a printed image at least ⅛ in. (3.2 mm) high.

**4.1.3.2.3** The required statements shall be printed in a color contrasting sharply with the background and shall be printed within a borderline.

**4.1.3.2.4** The label shall be at least 9 in.<sup>2</sup> (57.8 cm<sup>2</sup>), unless the size of the shell is too small, in which case the label shall be permitted to be reduced to a size no smaller than necessary.

#### 4.1.4 Fuses.

**4.1.4.1** The fuse for manually fired individual aerial shells that use a quick match fuse to ignite the lift charge shall be long enough to allow not less than 6 in. (152 mm) of fuse to protrude after the shell has been inserted into the mortar.

**4.1.4.2** Only the ignition leader of manually fired chain-fused aerial shells shall be required to be long enough to allow not less than 6 in. (152 mm) of fuse to protrude from the mortar.

**4.1.4.3** Shells that are to be fired electrically shall not be required to have a quick match fuse.

#### 4.1.5 Time Delay.

**4.1.5.1** The time delay from ignition of the tip of a manually fired aerial shell’s fuse and the lifting of the aerial shell shall be designed to be not less than 2 seconds and not more than 6 seconds.

**4.1.5.2** For electrically ignited aerial shells, no delay period shall be required.

**4.1.6 Safety Cap.** For manually fired shells, a safety cap shall be installed over the exposed end of the fuse.

**4.1.6.1** The safety cap shall be a different color from that of the fuse and installed so that the fuse is not damaged.

**4.1.6.2** Fuses of electrically fired shells shall not require a safety cap, provided there is no exposed pyrotechnic composition.

#### 4.1.7 Salute Shell Limits.

**4.1.7.1** Single-break aerial salute shells shall be limited to a maximum size of 5 in. (127 mm) in diameter and length.

**4.1.7.2** Minimum standards for use of single-break aerial salute shells shall include the following:

- (1) Nonmetal mortars shall be used.
- (2) Mortars used for salutes more than 3 in. (76 mm) in diameter and length shall be individually supported and separated from other mortars by 10 times the inside diameter of the mortar.
- (3) Remote ignition or use of an added 5-second minimum delay fuse extension shall be used.
- (4) Salute shells shall be preloaded into mortars.

**4.1.7.3** Salutes more than 3 in. (76 mm) in diameter or length shall be permitted to be used only by the following:

- (1) Licensed operators or designated agents of licensed companies
- (2) Displays under the direct control of a licensed professional fireworks display company

**4.1.7.4** Multiple-break shells with salutes and shells consisting of multiple-salute inserts or components shall be permitted, provided that the following requirements are met:

- (1) Final or “bottom” shots (salutes) on multiple-break shells shall not exceed the criteria for single-break salutes.
- (2) Aerial shells containing multiple salutes shall consist of component salutes not exceeding 3 in. (76 mm) and 3 oz (85 g) individually.
- (3) Requirements for use and operator restrictions described for single-break salutes shall apply, except that multiple-break shells shall be permitted to be fired from steel mortars buried in the ground, troughs, or drums.

**4.1.7.5** Ground salutes shall conform to the following specifications:

- (1) Ground salutes shall not exceed 3 in. (76 mm) in diameter and length.
- (2) The maximum quantity of salute powder in ground salutes shall not exceed 2.5 oz (71 g).
- (3) Ground salutes shall be constructed of paper or other equivalent materials and shall not be constructed of metal or brittle plastic.

## 4.2 Storage and Transportation of Fireworks.

**4.2.1\* General.** Any storage, handling, assembly, testing, or transportation of fireworks materials and devices intended for outdoor display prior to their delivery to the display site shall be in accordance with the following:

- (1) NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles*
- (2) 27 CFR 18 and 181, Bureau of Alcohol, Tobacco, and Firearms, *Commerce in Explosives*
- (3) 49 CFR 171-177, U.S. Department of Transportation

### 4.2.2 Preparation of Fireworks.

**4.2.2.1** Shells shall be kept in their shipping cartons until they are prepared, loaded, or set up for display.

**4.2.2.2** Preparation area(s) for display fireworks shall be secured from public access by at least 100 ft (30 m).

**4.2.2.3** Preparation area(s) shall have only authorized personnel in them at any time display fireworks are being prepared.

**4.2.2.4\*** All fireworks shall be handled carefully while being unloaded from the delivery vehicle, prepared, loaded, or set up.

**4.2.2.5\*** The assembly, minor repair, installation of fuses and electric match, and similar activities shall be permitted to be performed in a preparation area, and shall not be considered manufacturing.

### 4.2.3 Inspection.

**4.2.3.1** Shells shall be inspected by the operator or assistants following their delivery to the display site.

**4.2.3.2** Any shells having tears, leaks, broken fuses, or signs of having been wet shall be set aside for review by the operator.

**4.2.3.3** If the operator determines that any aerial shells cannot be repaired as set forth in 4.2.3.6, those aerial shells shall be handled as follows:

- (1) They shall not be fired.
- (2) After the display, such shells shall be either returned to the supplier or disposed of in accordance with the supplier's instructions.

**4.2.3.4** At the display site, assembly or repair of fireworks shall not be performed within 50 ft (15.2 m) of fireworks storage.

**4.2.3.5** Assembly of fireworks at the display site shall be limited to ground display pieces from finished fireworks or pyrotechnic articles and the attachment of black matches and electric matches to fireworks and pyrotechnic articles.

**4.2.3.6** Repair of fireworks and pyrotechnic articles at the display site shall be limited to repairs that do not require disassembly of the device.

**4.2.4 Ready Boxes.** A ready box shall be a portable, weather-resistant container that protects contents from burning debris with a self-closing cover or equivalent means of closure.

**4.2.4.1** Tarpaulins shall not be used as ready boxes.

**4.2.4.2** Manually fired shells used to reload mortars shall be stored in ready boxes and shall be separated according to size and designation as salutes.

**4.2.4.3\*** During the performance of an outdoor fireworks display, ready boxes shall be located at a distance not less than 25 ft (7.7 m) upwind from the mortar placements.

**4.2.4.4** If the wind shifts during a display, the ready boxes shall be located to again be upwind from the discharge site.

## 4.3 Installation of Mortars.

### 4.3.1\* Inspection.

**4.3.1.1** Mortars shall be inspected prior to placement.

**4.3.1.2** Defective mortars shall not be used.

**4.3.2\*** Mortars shall be positioned and spaced so that shells are propelled over the fallout area and to afford maximum protection to the shooter and loader. (See also Section 5.2.)

**4.3.3\*** Where mortars are to be reloaded during a display, the following procedures shall be followed:

- (1) Mortars of various sizes shall not be intermixed.
- (2) Mortars of the same size shall be placed in groups, and the groups shall be separated from one another.

### 4.3.4 Mortar Reloading.

**4.3.4.1** Unless the requirements of 4.3.4.2 are met, any type of mortar 6 in. (152 mm) in diameter or less shall be permitted to be reloaded and fired up to seven times during a performance.

**4.3.4.2** The requirements of 4.3.4.1 shall not apply to steel mortars, which require no limit to the number of times a steel mortar 6 in. (152 mm) or less is permitted to be reloaded.

**4.3.5\*** Mortars shall be positioned to afford protection to the spectators and display personnel.

**4.3.6** Mortars shall be inspected before the first shells are loaded to ensure that no water or debris has accumulated in the bottom of the mortar.

**4.3.7\*** Mortars shall be of sufficient strength and durability to fire the aerial shells and to be used safely.

**4.3.7.1\*** Paper, HDPE, and fiberglass mortars shall be permitted to be used.

**4.3.7.2** Cast iron, stove pipe, corrugated culvert, clay, bamboo, and wood shall not be used to make mortars.

**4.3.7.3** Metal mortars shall be permitted to be either seamed or seamless.

**4.3.7.4** Where seamed mortars are used, mortars shall be placed so that all seams face either right or left when the line of mortars are viewed.

**4.3.8\*** Single-break salute shells shall be fired from nonmetallic mortars.

**4.3.9\*** Mortars shall be of sufficient length to allow aerial shells to be propelled to the height at which the aerial shells were designed to burst.

## 4.4 Installation of Buried Mortars.

**4.4.1\*** Mortars shall be buried to a depth of at least two-thirds of their length, either in the ground or in aboveground troughs or drums.

**4.4.2** Mortars that are to be reloaded during the display shall be buried to a depth between two-thirds and three-quarters of their length, either in the ground or in aboveground troughs or drums.

**4.4.3** Where paper mortars are to be placed in damp ground or damp sand or are to be in the ground or sand for more than 12 hours prior to the display, they shall be placed inside a

water-resistant bag or otherwise protected against moisture prior to placement in the ground or sand.

**4.4.3.1** Wherever there is the likelihood of groundwater leaking into the mortar, the mortar shall be placed inside a water-resistant bag prior to placement in the ground.

**4.4.3.2** Weather-resistant coverings shall be placed over the mouth of mortars wherever there is imminent danger of water collecting in the mortars.

**4.4.4\*** Where buried mortars are to be fired more than once during a display, the mortars shall be placed to prevent them from being driven into the ground or re-angled when fired.

**4.4.5\*** Unless the requirements of 4.4.5.1 are met, mortars that are buried in the ground, in troughs, or in drums shall be separated from adjacent mortars by a distance at least equal to the diameter of the mortar.

**4.4.5.1** The requirements of 4.4.5 shall not apply where electrical ignition of unchained aerial shells 6 in. (152 mm) and less in diameter is used, in which case no separation of mortars is required.

**4.4.5.2** Mortars in troughs or drums shall be positioned to afford the maximum protection to the shooter.

**4.4.5.2.1** In all other cases, a separation distance of at least 2 in. (50 mm) or one-half the diameter of the mortar, whichever is greater, shall be required between the mortar and the wall of the trough or drum.

**4.4.5.2.2** Where electrical ignition is used, all mortars placed in troughs or drums shall be spaced at least 2 in. (50 mm) from the wall of the trough or drum.

#### **4.4.6 Trough and Drum Placement.**

**4.4.6.1** If troughs and drums are used, they shall be filled with sand or soft dirt and, in all cases, shall be free of stones or other potentially dangerous debris.

**4.4.6.2** Troughs shall be reinforced or braced in a minimum of two places on the sides at intervals not greater than every 4 ft (1.2 m).

#### **4.5 Installation of Mortar Racks.**

**4.5.1\*** Single-break shells not exceeding 6 in. (152 mm) in diameter shall be permitted to be fired from securely positioned mortar racks.

**4.5.2** Single-break shells greater than 8 in. (203 mm) in diameter and multiple-break shells shall not be fired from mortar racks.

**4.5.3** Single-break shells that are 7 in. (178 mm) or 8 in. (203 mm) in diameter that are fired from mortar racks shall meet the following conditions:

- (1) The mortar is not metallic.
- (2) Electrical or equivalent means of remote ignition is used to fire the shell.
- (3) The shell is not chain fused to any other shells.

**4.5.4** Mortar racks and bundles shall be constructed and installed to hold multiple mortars in position during normal functioning.

**4.5.5** Mortar racks or bundles that are not inherently stable shall be secured or braced by means of stakes, legs, A-frames, side-boards, or equivalent means.

**4.6 Requirements for Chain Fusing.** Wherever more than three shells are to be chain fused, additional measures shall be required to prevent adjacent mortars from being repositioned in the event that a shell explodes in a mortar, causing it to burst.

#### **4.6.1\* Mortars in Racks.**

**4.6.1.1\*** For mortars in racks, prevention of repositioning shall be accomplished by using mortar racks that are designed to withstand a shell exploding in a mortar, which causes the mortar to burst.

**4.6.1.2** Where there is doubt concerning the strength of racks holding chain-fused mortars, the separation distances from those racks to spectators shall be twice those listed in Table 5.1.3.1 for the largest mortar in the sequence.

#### **4.6.2 Chain-Fused Mortar Rack Requirements.**

**4.6.2.1** Unless the requirements of 4.6.2.2 apply, chain-fused mortar racks shall comply with the following:

- (1) Racks containing mortars 3 in. (76 mm) or less in diameter shall be limited to a maximum of 15 mortars per unit.
- (2) Racks containing mortars 4 in. (100 mm) in diameter shall be limited to a maximum of 12 mortars.
- (3) Racks containing mortars 5 in. to 6 in. (125 mm to 150 mm) in diameter shall be limited to a maximum of 10 mortars.
- (4) Racks shall not be used for mortars greater than 6 in. (150 mm) in diameter.

**4.6.2.2** The requirements of 4.6.2.1 shall not apply to boxed finale items containing tubes 2.5 in. (75 mm) or less in diameter only.

**4.6.3\*** All chain-fused aerial fireworks devices, including those not in mortar racks such as roman candle batteries and multi-tube aerial items, shall be positioned using stakes, racks, sandbags, earth, or equivalent means to prevent tipover or hazardous movement during operation.

**4.6.4** Staple guns shall not be permitted to be used to secure quick match that is connected to aerial shells, mines, or comets.

**4.6.5** Mortars shall not be permitted to be reloaded with chain-fused aerial shells.

## **Chapter 5 Display Site Selection**

**5.1 General.** The intent of this chapter shall be to provide requirements for clearances upon which the AHJ bases its approval of an outdoor fireworks display site.

#### **5.1.1 AHJ Discretion.**

**5.1.1.1** Where added safety precautions have been taken, or particularly favorable conditions exist, the AHJ shall be permitted to decrease the required separation distances as it deems appropriate upon demonstration that the hazard has been reduced or the risk has been protected.

**5.1.1.2** Where unusual or safety-threatening conditions exist, the AHJ shall be permitted to increase the required separation distances as it deems necessary.

### 5.1.2 Site Plan.

**5.1.2.1** A site plan shall be submitted to the AHJ within a time period required by the AHJ prior to the display.

**5.1.2.2** The site plan shall include the dimensions of the discharge site, spectator viewing area, parking areas, and the fall-out area and the associated separation distances.

**5.1.2.3** After review of the site plan, the AHJ shall inspect the area depicted on the site plan. *(See Annex B for additional information.)*

**5.1.2.4** When trenches or holes are dug into the ground in order to place mortars, the operator shall consult with the sponsor and AHJ in order to locate any buried utility lines in the discharge site.

**5.1.3\* Minimum Site Size Requirements.** The site for the outdoor land or water display shall have a radius at least as great as specified for those items in the display with the greatest required radius.

**5.1.3.1** For aerial shells, the minimum required radius of the display site shall be 70 ft per in. (22 m per 25 mm) of the internal mortar diameter of the largest aerial shell to be fired, as shown in Table 5.1.3.1.

**5.1.3.2** For non-splitting or non-bursting comets and mines containing only stars or non-splitting or non-bursting comets, the minimum required radius of the display site shall be 35 ft per in. (11 m per 25 mm) of the internal mortar diameter of the largest comet or mine to be fired, one-half that shown in Table 5.1.3.1.

### 5.1.3.3 Minimum Radius for Chain-Fused Aerial Shells, Comets, and Mines.

**5.1.3.3.1** For chain-fused aerial shells, comets, and mines to be fired from mortars, racks, or other holders that are sufficiently strong to prevent their being repositioned in the event of an explosive malfunction of the aerial shells, comets, or mines, the minimum required radius shall be the same as that required in 5.1.3.1 and 5.1.3.2. *(See also Section 4.6.)*

**5.1.3.3.2** For chain-fused aerial shells and comets and mines to be fired from mortars, racks, or other holders that are not sufficiently strong to prevent their being repositioned in the event of an explosive malfunction of the aerial shells, comets, or mines, the minimum required radius shall be double that required in 5.1.3.1 and 5.1.3.2. *(See also Section 4.6.)*

### 5.1.3.4 Roman Candles and Cakes.

**5.1.3.4.1** For Roman candles and cakes, the minimum required radius shall be that specified for chain-fused aerial shells, comets, or mines, depending on whether they produce aerial shell, comet, or mine effects.

**5.1.3.4.2** For Roman candles and cakes producing both aerial shell and comet or mine effects, the minimum required radius shall be that for aerial shells.

### 5.1.3.5 Ground Display Pieces.

**5.1.3.5.1\*** For ground display pieces of low hazard potential, the minimum radius shall be 75 ft (23 m).

**5.1.3.5.2\*** For ground display pieces with greater hazard potential, the minimum radius shall be 125 ft (38 m).

**Table 5.1.3.1 Distances for Outdoor Aerial Shell Display Sites: Minimum Separation Distances from Mortars to Spectators for Land or Water Displays**

| Mortar Size <sup>a</sup> |     | Minimum Secured Diameter of Site <sup>b</sup> |     | Vertical Mortars <sup>c</sup> |     | Angled Mortars <sup>d</sup><br>1/3 Offset |     | Mortars to Special Hazards <sup>e</sup> |     |
|--------------------------|-----|-----------------------------------------------|-----|-------------------------------|-----|-------------------------------------------|-----|-----------------------------------------|-----|
| in.                      | mm  | ft                                            | m   | ft                            | m   | ft                                        | m   | ft                                      | m   |
| ≤1                       | 25  | 150                                           | 46  | 75                            | 23  | 75                                        | 23  | 150                                     | 46  |
| 1.5                      | 38  | 210                                           | 64  | 105                           | 32  | 75                                        | 23  | 210                                     | 64  |
| 2                        | 50  | 280                                           | 85  | 140                           | 43  | 95                                        | 29  | 280                                     | 85  |
| 2.5                      | 63  | 350                                           | 107 | 175                           | 54  | 115                                       | 35  | 350                                     | 107 |
| 3                        | 76  | 420                                           | 128 | 210                           | 64  | 140                                       | 43  | 420                                     | 128 |
| 4                        | 102 | 560                                           | 171 | 280                           | 85  | 190                                       | 58  | 560                                     | 171 |
| 5                        | 127 | 700                                           | 213 | 350                           | 107 | 230                                       | 70  | 700                                     | 213 |
| 6                        | 152 | 840                                           | 256 | 420                           | 128 | 280                                       | 85  | 840                                     | 256 |
| 7                        | 178 | 980                                           | 299 | 490                           | 149 | 320                                       | 98  | 980                                     | 299 |
| 8                        | 203 | 1120                                          | 341 | 560                           | 171 | 370                                       | 113 | 1120                                    | 341 |
| 10                       | 254 | 1400                                          | 427 | 700                           | 213 | 460                                       | 140 | 1400                                    | 427 |
| 12                       | 305 | 1680                                          | 512 | 840                           | 256 | 560                                       | 171 | 1680                                    | 512 |

Note: >12 in. (>305 mm) requires the approval of the AHJ.

<sup>a</sup> See 4.1.1.

<sup>b</sup> See 5.1.3.

<sup>c</sup> See 5.2.1.3.

<sup>d</sup> See 5.2.1.3. Note that for angled mortars, the minimum secured diameter of the display site does not change. Only the location of the mortars within the secured area changes when the mortars are angled.

<sup>e</sup> See 5.1.4. Note that this is only the distance to the special hazards. The minimum secured diameter of the display site does not change.

**5.1.3.6** Equipment, including mortars, used as holders to support smaller devices such as Roman candles, pre-loaded mines, and pre-loaded comets shall not be used to determine the radius or area of the display site, or separation distances.

#### **5.1.4 Other Site Requirements.**

**5.1.4.1\*** Distances from the point of discharge of any firework to a health care or detention and correctional facility shall be at least twice the distances specified in 5.1.3.

**5.1.4.2** The requirements of 5.1.4.1 shall not apply where approved by the AHJ and the health care or detention and correctional facility.

**5.1.4.3\*** The distance between the discharge site and bulk storage areas of materials that have a flammability, explosive, or toxic hazard shall be twice that required by 5.1.3.

**5.1.4.4** The fuel tanks on vehicles or other motorized equipment located in the display site shall not be considered bulk storage.

**5.1.4.5** No spectators or spectator parking areas shall be located within the display site.

**5.1.4.6** Dwellings, buildings, and structures shall be permitted to be located within the display site with the approval of the AHJ and the owner of the dwelling, building, or structure, provided that the dwelling, building, or structure is unoccupied during the display, or if the structure provides protection for the occupants through noncombustible or fire-resistant construction.

**5.1.4.7** The area selected for the discharge of aerial shells shall be located so that the trajectory of the shells shall not come within 7.7 m (25 ft) of any overhead object.

#### **5.1.5 Fallout Area.**

**5.1.5.1\*** The fallout area shall be an open area.

**5.1.5.2** Spectators, unauthorized vehicles, watercraft, or readily combustible materials shall not be located within the fallout area during the display.

**5.1.6** Fire protection and other emergency response personnel and their vehicles shall remain at or beyond the perimeter of the display site during the actual firing of the display.

#### **5.2 Minimum Spectator Separation Distance Requirements.**

**5.2.1** The minimum separation distance from the point of discharge of each firework shall be at least as great as those specified in this section.

**5.2.1.1\*** For aerial shells, comets, mines, Roman candles, and cakes that are discharged vertically, the minimum required spectator separation distance shall be the same as the minimum required radius specified in 5.1.3.

**5.2.1.2** For ground display pieces, the minimum required separation distance from the point of discharge shall be the same as the minimum specified in 5.1.3.

##### **5.2.1.3\* Angling of Mortars.**

**5.2.1.3.1** Aerial shells, comets and mines, and Roman candles and cakes shall be permitted to be angled for a display to allow for wind and to carry their effects away from the main spectator viewing area.

**5.2.1.3.2** The mortars or tubes shall be angled so that any dud shells or components fall at a point approximately equal

to the offset of the mortars or tubes from the otherwise required discharge point, but in the opposite direction.

#### **5.3 Tents.**

**5.3.1** Tents shall not be located within the discharge site during the display.

**5.3.2** Where tents are permitted in the fallout area by the operator and AHJ, such tents shall not be occupied during the display.

## **Chapter 6 Floating Vessels and Floating Platforms**

### **6.1 General.**

**6.1.1** The intent of this chapter shall be to provide guidance for the display of fireworks from floating vessels and floating platforms.

**6.1.2** Floating vessels and floating platforms shall be permitted to be manned or unmanned, provided that the pyrotechnic crew remains in control of the site and firing of the display.

**6.1.3** Floating vessels and floating platforms shall be held in control at all times, whether self-propelled, controlled by another vessel, or secured by mooring or anchoring.

### **6.2 Construction.**

**6.2.1\*** Floating vessels and floating platforms shall be of sufficient strength and stability to safely allow the firing of the display.

**6.2.2** The types of fireworks and placement of the fireworks launch tubes and accompanying equipment shall be such that, when fired, the stability of the site structures and seaworthiness of the floating vessels or platforms shall not be jeopardized.

**6.2.3** Floating vessels and floating platforms that are manned during electrical firing shall have a safety shelter meeting the following requirements:

- (1) It shall be of sufficient size to accommodate all personnel present during the actual firing of the display.
- (2) It shall have a minimum of three sides and a roof.
- (3) It shall have walls and a roof constructed of at least  $\frac{3}{4}$  in. (19 mm) plywood or equivalent material.

### **6.3 Platform Sizing Requirements.**

**6.3.1\* Criteria for Sizing.** The minimum size for the floating vessel or floating platform for electrically fired programs that are manned shall be based on the area for the setup of the display plus the area for the safety shelter.

**6.3.1.1 Minimum Barge Area.** The minimum barge area specifications shall be defined by the following formula:

$$\text{Minimum barge area (ft}^2\text{)} = M + C + G$$

where:

$M$  = the area needed for mortars

$C$  = the area needed for cakes and multi-tube devices

$G$  = the area needed for ground displays

**6.3.1.1.1** The area needed for mortars and mortars in racks shall be calculated according to the following formula:

$$\text{Minimum display setup area (ft}^2\text{)} = \sum \frac{M_n \times D_n}{2}$$

where:

$M_n$  = number of each mortar size from 1 to  $n$

$D_n$  = inside diameter (in inches) for each size mortar

**6.3.1.1.2** The area needed for cakes and multi-tube devices up to 3 in. (76 mm) shall be calculated using the following formula:

$$C(\text{ft}^2) = \sum 2 \times C_n \times F_n$$

where:

$C_n$  = number of each cake and multi-tube size from 1 to  $n$

$F_n$  = footprint (in  $\text{ft}^2$ ) for each size cake and multi-tube device

**6.3.1.1.3** The area needed for ground display items shall be calculated using the following formula:

$$G(\text{ft}^2) = \sum G_n \times A_n$$

where:

$G_n$  = number of each type of ground item from 1 to  $n$

$A_n$  = footprint (in  $\text{ft}^2$ ) occupied by each type of ground display item

### 6.3.1.2 Safety Shelter Area Requirements.

**6.3.1.2.1** The minimum separation distance between mortars and the safety shelter shall be as follows:

- (1) 2 ft per in. (0.6 m per 25 mm) of the shell diameter of mortars up to 6 in. (152 mm) in diameter
- (2) 4 ft per in. (2 m per 25 mm) of the shell diameter of mortars larger than 6 in. (152 mm) in diameter

**6.3.1.2.2** If the safety shelter is constructed of material stronger than that required by 6.2.3(3), the separation distance between mortars and the shelter shall be permitted to be reduced.

### 6.3.2 Egress Requirements.

**6.3.2.1** A minimum of two separate egress paths shall be provided at all times.

**6.3.2.2** Only one egress path from protective barricades or safety shelters shall be required.

**6.3.2.3** Egress paths shall be unobstructed and free of impediments.

**6.3.3\* Floating Platforms.** Floating platforms constructed of wood or other combustible material shall be permitted to be used as a fireworks launch vessel.

### 6.4 Operations.

**6.4.1** Manual firing of displays shall be permitted on floating vessels and floating platforms under the following conditions:

- (1) All shells shall be preloaded into mortars prior to the display.
- (2) Shells shall be limited to single-break and shall not exceed 6 in. (152 mm) in diameter.
- (3) The minimum size of the floating vessel or floating platform shall be twice that required for an electrically fired display as specified in 6.3.1.
- (4) A protective barrier(s) meeting the strength requirements of 3/4 in. (19 mm) plywood or equivalent shall be provided.

(5) During the display, all personnel other than the shooter(s) and operator shall be behind the barrier(s) specified in 6.4.1(4).

(6) Electrical firing on the same vessel or platform where manual firing is used shall be in accordance with 9.1.3.

**6.4.2** Shells shall be loaded into mortars and in place prior to the start of a display.

**6.4.3** No reloading of any material during the display shall be permitted.

**6.4.4** All personnel, other than spotters or fire watch, shall be in safety shelters.

**6.4.5** During the display, spotters and fire watch on a floating platform or floating vessel shall be behind protective barriers with a minimum wall construction of 3/4 in. (19 mm) plywood or equivalent material.

**6.4.6** A U.S. Coast Guard-approved personal flotation device (PFD) shall be provided and available for each person on a display launched from floating vessels and floating platforms.

**6.4.6.1** PFDs shall be worn as designed any time the vessel is not moored at the dock.

**6.4.6.2** PFDs shall have a visual location device.

**6.4.7** A watercraft ready and capable of providing rapid emergency response shall be present during the display.

**6.4.8\*** The positions of the mortars on floating vessels and floating platforms from which fireworks are launched shall comply with minimum safety distance requirements as outlined in Table 5.1.3.1.

**6.5\* Communications.** An approved means of communication shall be on board manned vessels and platforms from which fireworks are being discharged.

**6.6\* Personnel.** During the display, only necessary personnel shall be aboard any floating vessel or floating platform.

### 6.7 Combustible Material.

**6.7.1\*** Floating vessels and floating platforms shall be free of all nonessential flammable or combustible materials.

**6.7.2** Tank vessels used as floating platforms shall be certified as gas free in accordance with NFPA 306, *Standard for the Control of Gas Hazards on Vessels*.

**6.7.3** Portable power generation equipment, motorized vehicles, and material-handling equipment deemed necessary for the performance of the display shall be permitted.

## Chapter 7 Rooftops, Other Structures, and Other Limited Egress Locations

### 7.1 General Conditions.

**7.1.1** The intent of this chapter is to provide additional guidance for the outdoor display of fireworks from rooftops, bridges, towers, stadiums, parking decks, other structures, and other limited egress locations.

**7.1.2** Due to the unique elements of these types of displays, the operator shall have the knowledge and experience for the specialized nature of these locations.