

NFPA®

1123

Code for
Fireworks Display

2022



NFPA® 1123

Code for Fireworks Display

2022 Edition



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NFPA® 1123

Code for

Fireworks Display

2022 Edition

This edition of NFPA 1123, *Code for Fireworks Display*, was prepared by the Technical Committee on Pyrotechnics and acted on by the NFPA membership during the 2021 NFPA Technical Meeting held June 14–July 2. It was issued by the Standards Council on August 26, 2021, with an effective date of September 15, 2021, and supersedes all previous editions.

This edition of NFPA 1123 was approved as an American National Standard on September 15, 2021.

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 to safely conducting outdoor fireworks displays by increasing the audience separation distances. The Committee also addressed the new technology of electrically firing outdoor firework displays. Generally, the Committee provided performance requirements rather than specific, prescriptive requirements.

The 1995 edition of NFPA 1123 included partial amendments to the document, as well as 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 US Department of Transportation regulations that incorporated the United Nations' shipping designations for fireworks (explosives), including the marking of aerial shells. The 1995 edition also included a new chapter with 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. It provided guidance on the construction, sizing, operation, 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 was a revision and expansion of the tables in Annex A covering mortar wall thickness for steel, paper, high-density polyethylene (HDPE), and fiberglass mortars. Chapter 2 was also reorganized into a more logical sequence.

The 2005 edition contained 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. The 2005 edition also included new guidance on displays from rooftops and other limited or restricted access sites. The code was also reorganized according to the *Manual of Style for NFPA Technical Committee Documents*.

The 2010 edition incorporated minor revisions to definitions, requirements for the protection of ready boxes, and requirements for determining the fallout area and display site. The Committee also amended requirements pertaining to single-break aerial salute shells; requirements pertaining to handling live components or unexploded shells; and requirements for angling aerial shells, comets and mines, and Roman candles and cakes.

The 2014 edition incorporated several revisions to definitions and included provisions for separation distances for marine preparation areas. It also increased spectator distances for elevated display sites in the spectator section of the code. Annex material was also added for clarification of these separation distances.

The 2018 edition incorporated a number of changes to clarify existing requirements and added new requirements to the code based on changes in the industry. Changes were made in a number of sections to address the stability of pyrotechnic devices and mortars, including prohibiting the use of plastic or zip ties to secure devices. Performance requirements were added for rack construction and materials to ensure that systems can function as designed and to protect the technicians and the public from injury should a catastrophic malfunction occur.

A new subsection 4.7.1 was added to address the increasing use of densely packed trailers, which are increasingly used for firing pyrotechnics. This new subsection includes requirements for the construction material and the security and stabilization of racks on such trailers.

The 2022 edition includes new information about multi-sized device spacing to address the separation distances required when such devices are used in one location. As long as the minimum separation distance is met for each device, it can be placed anywhere in the display site.

In addition, requirements for flammable liquid fireball effects have been added to provide the appropriate separation distances for pyrotechnic special effects at display sites.

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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 does not have responsibility for documents on the storage and retail sales of consumer fireworks or 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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Code for

Fireworks Display

2022 Edition

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

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Information on referenced and extracted 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 3.3.16, *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; fuses; 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
- (7) Use of flame special effects in the performing arts when used in conformance with NFPA 160
- (8) Sale and use of rockets, rocket motors, motor reloading kits, pyrotechnic modules, or components used in conformance with NFPA 1122 or NFPA 1127, 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.

1.4.1 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.)

1.4.2 The annex sections of this document are not part of the requirements of this NFPA document but are included for informational purposes only.

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*, 2021 edition.

NFPA 306, *Standard for the Control of Gas Hazards on Vessels*, 2019 edition.

NFPA 1122, *Code for Model Rocketry*, 2018 edition.

NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks and Pyrotechnic Articles*, 2022 edition.

NFPA 1126, *Standard for the Use of Pyrotechnics Before a Proximate Audience*, 2021 edition.

NFPA 1127, *Code for High Power Rocketry*, 2018 edition.

2.3 Other Publications.

2.3.1 APA Publications. American Pyrotechnics Association, 7910 Woodmont Avenue, Suite 1220, Bethesda, MD 20814.

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

2.3.2 US Government Publications. US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 16, Code of Federal Regulations, Parts 1000–1799, “Consumer Product Safety Commission.”

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

Title 27, Code of Federal Regulations, Part 555, “Commerce in Explosives.”

Title 49, Code of Federal Regulations, Parts 171–177, “Hazardous Materials Regulations.”

2.3.3 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks and Pyrotechnic Articles*, 2022 edition.

NFPA 1126, *Standard for the Use of Pyrotechnics Before a Proximate Audience*, 2021 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 or other firework items fused to fire in sequence or simultaneously 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 Fireworks Device (Display). Any fireworks device designed for use in a fireworks display.

3.3.9.2 Pyrotechnic Device. Any device containing pyrotechnic materials or pyrotechnic effect simulation equipment, as described in the following definitions, and capable of producing a special effect as defined in this code. [1126, 2021]

3.3.9.2.1* Pyrotechnic Effect Simulation Equipment. Equipment that uses a chemical mixture, heat source, and the introduction of oxygen to initiate or maintain combustion and that is used to produce visible or audible effects by combustion, deflagration, or detonation. [1126, 2021]

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

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 fireworks by using a portfire, fusee, electric match, electrical current, or some other means.

3.3.14 Fire Resistive. Refers to properties or designs to resist the effects of any fire to which a material or structure can be expected to be subjected.

3.3.15* 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, 2022]

3.3.15.1* 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 87-1, *Standard for the Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics*. [1124, 2022]

3.3.15.2* 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 27 CFR 555, 49 CFR 172, and APA 87-1, *Standard for the Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics*. [1124, 2022]

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

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

3.3.18* Ground Display Piece. A fireworks device that functions on the ground or functions while mounted securely above the ground (as opposed to an aerial shell that functions in the air).

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

3.3.20 Ignition.

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

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

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

3.3.22* Lift Charge. The composition that propels (lifts) the fireworks device into the air.

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

3.3.24 Match.

3.3.24.1 Black Match. A fuse made from string that is impregnated with **black powder**.

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

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

3.3.25* Mine. A device containing multiple pyrotechnic effects that are simultaneously ignited and dispersed by a lift charge into the air from a mortar or tube.

3.3.26 Mortar. A tube, closed at one end, from which certain aerial devices are fired into the air.

3.3.27 Mortar Rack. A frame containing one or more mortars.

3.3.28 Mortar Trough. Aboveground enclosure filled with sand or similar material into which mortars are positioned and securely held in place.

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

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

3.3.31 Powder.

3.3.31.1 Black Powder. A low explosive consisting of an intimate mixture of potassium or sodium nitrate, charcoal, and sulfur. [1126, 2021]

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

3.3.32 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, 2022]

3.3.33 Pyrotechnic Special Effect. A special effect created through the use of pyrotechnic materials and devices. [1126, 2021]

3.3.34 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, 2022]

3.3.35 Ready Box. A sturdy container for storage of fireworks devices to be reloaded at the discharge site of a display.

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

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

3.3.38 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.

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

3.3.39.1 Aerial Salute. A salute that functions as an aerial shell.

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

3.3.40 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.

3.3.41 Site.

3.3.41.1 Discharge Site. The area immediately surrounding the location where fireworks and other devices are ignited for a display.

3.3.41.2 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.

3.3.42 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.

3.3.43 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.

3.3.44 Trough. See 3.3.28, 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.

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
- (2) A description of the type of shell
- (3) A warning statement as shown in Figure 4.1.3.1
- (4) The name and location of business of the manufacturer, importer, or distributor

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 $\frac{1}{8}$ in. (3.2 mm) and be underlined.

WARNING: DANGEROUS EXPLOSIVE

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

FIGURE 4.1.3.1 Warning Statement.

4.1.3.2.2 The remaining printed matter shall not be required to be printed in capital letters but shall have a printed image at least $\frac{1}{8}$ 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.² (5810 mm²), 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) Individual mortars used for salutes more than 3 in. (76 mm) in diameter and length shall be individually supported and separated from other loaded mortars and other firework devices by at least 10 times the inside diameter of the largest mortar.
- (3) Individual salutes more than 3 in. (76 mm) in diameter and length shall be permitted to be fired from racks,

provided that only one mortar in the rack is used or unless the distance between loaded mortars in the rack meets the requirements of 4.1.7.2(2).

- (4) Remote ignition or use of an added 5-second minimum delay fuse extension shall be used.
- (5) 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
- (2) 18 USC 40, "Importation, Manufacture, Distribution and Storage of Explosive Materials," and 27 CFR 555, "Commerce in Explosives," Bureau of Alcohol, Tobacco, Firearms and 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, and 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.

4.2.2.6 All electric matches that are attached to display fireworks shall have a shroud protecting the match head.

4.2.2.7 Cutting of fuse, including quick match, shall be prohibited when an electric match is known to be present in the fuse or quick match being cut.

4.2.3 Inspection.

4.2.3.1 Shells shall be inspected by the operator or assistants following their delivery to the display site at any time prior to the shells being loaded into their mortars or into ready boxes.

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 any location where bulk fireworks, assemblages of fireworks, or boxes of display fireworks have been temporarily placed during or pending the set up of the display.

4.2.3.5 Assembly of fireworks at the display site shall be limited to ground display pieces from finished fireworks or pyrotechnic devices and the attachment of black matches, electric matches, or other ignition sources to fireworks and pyrotechnic devices.

4.2.3.6 Repair of fireworks and pyrotechnic devices 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, and fire-resistive 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 30 ft (9 m) upwind from the mortar placements.

4.2.4.4 If the wind shifts during a display, the ready boxes shall be relocated to be not less than 30 ft (9 m) upwind from the mortar placements, while maintaining the separation distance required in 5.1.3.4.3.

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 Plastic strip ties ("zip ties") shall not be used to secure or stabilize individual mortars or roman candles 2.5 in. (64 mm) in diameter or greater.

4.3.5 Mortar Reloading.

4.3.5.1 Unless the requirements of 4.3.5.2 are met, any type of mortar 6 in. (152 mm) in diameter or less shall be permitted to be reloaded and used up to seven times during a performance.

4.3.5.2 The requirements of 4.3.5.1 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.

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

4.3.7 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.

4.3.8* Mortars shall be of sufficient strength and durability to launch safely the aerial shells loaded into them.

4.3.8.1* Paper, high-density polyethylene (HDPE), and fiberglass mortars shall be permitted to be used.

4.3.8.2 Metal mortars shall be permitted to be either seamed or seamless.

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

4.3.8.4 Cast iron, stovepipe, corrugated culvert, clay, bamboo, and wood shall not be used to make mortars.

4.3.9 Single-break salute shells shall be fired from nonmetallic mortars.

4.3.10* 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 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.

4.4.2.1 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.

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

4.4.3* 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.

4.4.4* Unless the requirements of 4.4.4.1 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.

4.4.4.1 The requirements of 4.4.4 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.

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

4.4.4.2.1 In all other cases, a separation distance of at least 2 in. (51 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.

4.4.4.2.2 Where electrical ignition is used, all mortars placed in troughs or drums shall be spaced at least 2 in. (51 mm) from the wall of the trough or drum.

4.4.5 Trough and Drum Placement.

4.4.5.1 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.

4.4.5.2 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.

4.5.1.1* A device constructed of two or three single-break, 3 in. (76 mm) spherical shells shall be permitted to be fired from aboveground mortar racks provided the mortar is strong enough to maintain form during the firing of the shell.

4.5.1.2* A device constructed of two single-break, 4 in. (102 mm) spherical shells shall be permitted to be fired from aboveground 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 other than as permitted in 4.5.1.1 and 4.5.1.2.

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.