NFPA®

1123

Code for Fireworks Display

2018

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NFPA® 1123

Code for

Fireworks Display

2018 Edition

This edition of NFPA 1123, *Code for Fireworks Display*, was prepared by the Technical Committee on Pyrotechnics. It was issued by the Standards Council on August 1, 2017, with an effective date of August 21, 2017, and supersedes all previous editions.

This edition of NFPA 1123 was approved as an American National Standard on August 21, 2017.

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, 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 revised and expanded the tables in Annex 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 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 also was reorganized according to the *Manual of Style for NFPA Technical Committee Documents*.

The 2010 edition incorporated minor revisions to definitions, requirements for 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 of 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 added provisions for separation distances for marine preparation areas. This edition also increased spectator distances for elevated display sites, including these requirements in the spectator section of the code. Annex material was added for clarification of these separation distances.

The 2018 edition has incorporated a number of changes to clarify existing requirements and to add 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 the entire system functions as designed and protects 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 on the construction material and the security and stabilization of racks on such trailers.

The code was also modified to require additional information to the site plan for the use of elevated firing locations to assist the authority having jurisdiction (AHJ) in the evaluation and approval of spectator separation distances.

Other changes include the addition of annex material to clarify that the term *fallout area* does not include areas where cardboard and nonhazardous remnants of pyrotechnic devices might fall to the ground and the addition of eight hours of continuing education requirements for fireworks operator license renewal every four years.

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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 documents on 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. This Committee does not have responsibility for documents on the retail sales and associated storage of consumer fireworks nor on the use of consumer fireworks by the general public; on the use of pyrotechnic special effects before a proximate audience; nor on the manufacture, transportation, storage for use of military, automotive, agricultural, and industrial pyrotechnics.

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Code for

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2018 Edition

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

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex G. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. 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 3.3.16, Fireworks Display.)*

Δ **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
(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,* 2016 edition.

NFPA 306, *Standard for the Control of Gas Hazards on Vessels,* 2014 edition.

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

NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks and Pyrotechnic Articles,* 2017 edition.

NFPA 1126, *Standard for the Use of Pyrotechnics Before a Proximate Audience,* 2016 edition.

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

2.3 Other Publications.

Δ **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 U.S. Government Publications. U.S. 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,* 2017 edition.

NFPA 1126, *Standard for the Use of Pyrotechnics Before a Proximate Audience,* 2016 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 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 and capable of producing a special effect as defined in this code. [**1126,** 2016]

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,** 2017]

Δ **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,** 2017]

Δ **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,** 2017]

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,** 2016]

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,** 2017]

3.3.33 Pyrotechnic Special Effect. A special effect created through the use of pyrotechnic materials and devices. [**1126,** 2016]

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,** 2017]

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 [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 $in.^2$ (5810 mm^2), 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.

Δ **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.

Δ **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.

Δ **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.

N **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.

N **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.

4.5.5 The number of racks in a group of racks shall not be limited as long as the racks are securely fastened and stable.

4.5.6 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.

N **4.5.6.1** Plastic strip ties ("zip ties") shall not be used to secure or stabilize mortar racks.

N **4.5.7*** Mortar racks shall be permitted to be constructed of metal, wood, or other materials as long as the system and methods employed in the use of the racks are designed to protect the technicians and the public from injury due to catastrophic malfunction.

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 4.5.7 or 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. (102 mm) in diameter shall be limited to a maximum of 12 mortars.
(3) Racks containing mortars 5 in. to 6 in. (127 mm to 152 mm) in diameter shall be limited to a maximum of 10 mortars.
(4) Racks shall not be used for mortars greater than 6 in. (152 mm) in diameter.

4.6.2.2* The requirements of 4.6.2.1 shall not apply to boxed finale items as supplied by the manufacturer containing only mortars 4 in. (102 mm) or less in diameter.

4.6.2.3 The number of racks in a group of racks shall not be limited as long as each individual rack in the group complies with 4.6.2.1 and the racks are securely fastened and stable.

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 held and positioned using a system to prevent tipover or hazardous movement during operation.

N **4.6.3.1** Additional means of securing or stabilizing shall not be required if the fireworks device is stable by means of an adequate base to height ratio or inherent weight while functioning.

N **4.6.4*** The system and methods employed in the use of chain-fused aerial fireworks devices, including those not in mortar racks, such as roman candle batteries and multi-tube aerial items, shall be designed to protect the technicians and the public from injury resulting from catastrophic malfunction.

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

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

N **4.7 Trailer Firing.**

N **4.7.1 General.** This section shall address the use of trailers as firing platforms for mortars, mortar racks, or other pyrotechnic devices.

N **4.7.2** Mortars mounted on trailers shall not be reloaded during a display.

N **4.7.3** Mortars, mortar racks, and other pyrotechnic devices fired from trailers shall only be ignited electronically in accordance with Chapter 9.

N **4.7.3.1** Hand firing shall only be allowed from the trailer if the setup meets the requirements of Sections 7.3 and 7.6.

N **4.7.3.2** If there are no personnel on the trailer during the actual firing of the display, the requirements of Section 7.3, 7.6.1(3), 7.6.1(4), and 7.6.1(5) shall not apply.

N **4.7.4** Mortars shall be made of materials approved by this Code.

N **4.7.5** Trailers shall be secured and stabilized at the discharge site and disconnected from the tow vehicle prior to firing.

N **4.7.5.1*** Trailers shall be stabilized to minimize movement in any direction during firing.

N **4.7.5.2** The deck of the trailer shall be constructed strong enough to withstand the repeated discharge of display fireworks and other pyrotechnic devices on its surface.

N **4.7.5.3** Trailers that are used shall be maintained in a roadworthy condition in accordance with all local, state, and federal regulations when the trailer is intended to travel on a public road or highway.

N **4.7.6** All mortars, mortar racks, or other pyrotechnic devices shall be secured in a manner that prevents any repositioning during the transportation and firing.

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 display site and location of discharge site(s), spectator viewing area(s), parking area(s), fallout area(s), and the associated separation distances.

N **5.1.2.2.1** For display sites where fireworks are to be discharged from an elevation greater than 25 ft (7.5 m) above ground level *(see 5.2.1.2)*, the elevation of the firing site(s) shall be included in the site plan.

N **5.1.2.2.2** For display sites where fireworks are to be discharged at angles for aesthetic purposes *(see 5.2.1.4.4)*, the location of the point(s) of discharge, the direction(s) of firing, and the firing tilt angle(s) shall be included in the site plan.

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 the 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.

Δ **5.1.3.1** For aerial shells, the minimum required radius of the display site shall be 70 ft/in. (22 m/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/in. (11 m/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 of the display site shall be the same as that required in 5.1.3.1 and 5.1.3.2. *(See also Section 4.6.)*

Δ **5.1.3.3.2** For chain-fused aerial shells, 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 separation distance shall be double that required in 5.1.3.1 and 5.1.3.2.

5.1.3.4 Roman Candles and Cakes.

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

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[a]		Minimum Secured Diameter of Site[b]		Vertical Mortars[c]		Angled Mortars[d] ⅓ Offset		Mortars to Special Hazards[e]	
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

[a] See 4.1.1. Note that the discharge of fireworks using mortars >12 in. (>305 mm) in size requires the approval of the AHJ.
[b] See 5.1.3.
[c] See 5.2.1.4.
[d] See 5.2.1.4. Note that for mortars angled away from the main spectator area, 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 away from the main spectator area.
[e] 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.

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

5.1.3.4.3 During the firing of the display, cakes shall be located a minimum of 100 ft (30 m) from any ready box and mortars to be reloaded.

5.1.3.5 Ground Display Pieces.

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

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

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 the 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 25 ft (7.6 m) 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 spectator 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 from firing positions elevated 25 ft (7.6 m) or less above ground level, the minimum required spectator separation distance shall be the same as the minimum required radius specified in 5.1.3, including Table 5.1.3.1.

5.2.1.2* For aerial shells, comets, mines, roman candles, and cakes that are discharged vertically from firing positions elevated more than 25 ft (7.6 m) above ground level, the minimum required spectator separation distance required by 5.2.1.1 shall be increased by 25 ft (7.6 m) and an additional 25 ft (7.6 m) for each 100 ft (30 m) of elevation.

5.2.1.3 For ground display pieces and mines containing only stars or non-splitting or non-bursting comets fired vertically from any elevation, the minimum required spectator separation distance from the point of discharge shall be the same as the minimum display site radius specified in 5.1.3.

5.2.1.4 Angling of Mortars.

5.2.1.4.1* Aerial shells, comets, mines, roman candles, and cakes shall be permitted to be angled as needed to adjust for the effects of wind on the fallout of dud aerial shells.

N **5.2.1.4.2*** Aerial shells, comets, mines, roman candles, and cakes shall be permitted to be angled if the shells or components are projected away from the main spectator area and the location of the mortars are offset as specified in Table 5.1.3.1.

5.2.1.4.3* If the offset provided in Table 5.1.3.1 is followed, 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.

N **5.2.1.4.4** Aerial shells, comets, mines, roman candles, and cakes shall be permitted to be angled for aesthetic effect if the spectator separation distance specified in 5.2.1 is correspondingly increased in the direction of the mortar tilt angle.

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 ¾ 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:

[6.3.1.1]

$$\text{Minimum barge area} = M + C + G$$

where:
M = area needed for mortars [ft² (m²)]
C = area needed for cakes and multi-tube devices [ft² (m²)]
G = area needed for ground displays [ft² (m²)]

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

[6.3.1.1.1]

$$M = \sum \frac{M_n \times D_n}{2}$$

where:
M = area needed for mortars and mortars in racks [ft² (m²)]
M_n = number of each mortar size from 1 to n
D_n = inside diameter for each size mortar [in. (mm)]

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

[6.3.1.1.2]

$$C = \sum 2 \times C_n \times F_n$$

where:
C = area needed for cakes and multi-tube devices up to 3 in. (76 mm) [ft² (m²)]
C_n = number of each cake and multi-tube size from 1 to n
F_n = footprint for each size cake and multi-tube device [ft² (m²)]

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

[6.3.1.1.3]

$$G = \sum G_n \times A_n$$

where:
G = area needed for ground display items [ft² (m²)]
G_n = number of each type of ground item from 1 to n
A_n = footprint occupied by each type of ground display item [ft² (m²)]

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/in. (0.6 m/25 mm) of the shell diameter of mortars up to 6 in. (152 mm) in diameter
(2) 4 ft/in. (1.2 m/25 mm) of the shell diameter of mortars larger than 6 in. (152 mm) in diameter

Δ **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.

Δ **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 ¾ 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 At an electrically fired display, all personnel, other than spotters and fire watch, shall be in safety shelters.

6.4.5 During the display, spotters and fire watch on a floating platform or a floating vessel shall be behind protective barriers with a minimum wall construction of ¾ 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 aboard 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.

Δ **6.7.2** Tank vessels used as floating platforms shall be certified as gas free in accordance with NFPA 306.

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

6.8 Marine Preparation Area Separation.

6.8.1 Dwellings, buildings, structures, and marine craft shall be permitted to be located within 100 ft (30 m) of the preparation area with the approval of the AHJ and the owner of the dwelling, building, structure, or marine craft, provided that either of the following conditions is met:

(1) The dwelling, building, structure, or marine craft is unoccupied during the loading of the floating platform.
(2) The dwelling, building, structure, or marine craft provides protection for the occupants through noncombustible or fire-resistant construction.

6.8.2 Unauthorized marine craft shall be separated from floating vessels or platforms by a minimum distance of 25 ft (7.6 m) during loading of fireworks.

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.

7.1.3 Spectator separation distances for elevated firing positions, shall be as specified in Section 5.2.

7.2 Construction.

7.2.1* Rooftops, bridges, towers, parking decks, and any other structures used as discharge sites shall be of sufficient strength and stability to safely allow the firing of the display.

7.2.2 Rooftops, bridges, towers, parking decks, and any other structures used as discharge sites shall be approved by the AHJ and the owner (or his or her agent).

7.2.3 Other dwellings, buildings, and structures shall be permitted to be located within the display site, provided all the following requirements are met:

(1) Approval of the AHJ
(2) Approval of the owner of the dwelling, building, or structure
(3) Assurance that the dwelling, building, or structure is unoccupied during the display, or the occupants are protected by the dwelling, building, or structure or other means
(4) Notification to the responding local fire department if other than the AHJ

7.3 Size Requirements.

7.3.1 The minimum size of the area needed for a limited egress location shall be based upon the area for the setup of the display plus the safety area for the personnel.

7.3.2 The minimum specifications shall be defined by the following formula:

[7.3.2]

$$\text{Minimum limited egress location area} = M + C + G$$

where:
M = area needed for mortars [ft² (m²)]
C = area needed for cakes and multi-tube devices [ft² (m²)]
G = area needed for ground displays [ft² (m²)]

7.3.2.1 The area needed for mortars and mortars in racks (M) shall be calculated according to the following formula:

[7.3.2.1]

$$(M) = \sum \frac{M_n \times D_n}{2}$$

where:
M = area needed for mortars and mortars in racks [ft² (m²)]
M_n = number of each mortar size from 1 to n
D_n = inside diameter for each size mortar [in. (mm)]

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

[7.3.2.2]

$$C = \sum 2 \times C_n \times F_n$$

where:
C = area needed for cakes and multi-tube devices up to 3 in. (76 mm) [ft^2 (m^2)]
C_n = number of each cake and multi-tube size from 1 to n
F_n = footprint for each size cake and multi-tube device [ft^2(m^2)]

7.3.2.3 The area needed for ground display items (G) shall be calculated using the following formula:

[7.3.2.3]

$$G = \sum G_n \times A_n$$

where:
G = area needed for ground display items [ft^2 (m^2)]
G_n = number of each ground item from 1 to n
A_n = footprint occupied by each ground display item [ft^2(m^2)]

7.3.3 In the event personnel are present at the firing location during the firing of the display, an additional safety area shall be provided to accommodate those personnel.

7.3.3.1 This area shall be located according to the following:

(1) A minimum of 75 ft (23 m) from the closest aerial shell mortar
(2) A minimum of 15 ft (4.6 m) from the nearest pyrotechnic effect where some alternative means of protection is provided for the personnel *(see A.8.2.9.2.2)*

7.3.3.2 The provisions of 7.3.3 and 7.3.3.1 shall not be required where some alternative means of protection is provided for the personnel *(see A.8.2.9.2.2)*.

7.3.4 Where the requirements of 7.3.3 are not met for aerial shell mortars, a safety shelter shall be provided at the firing location.

7.3.4.1 The safety shelter shall meet the following specifications:

(1) Be of sufficient size to accommodate all personnel present during the actual firing of the display
(2) Have a minimum of three sides and a roof
(3) Have walls and a roof constructed of at least ¾ in. (19 mm) plywood or equivalent material

7.3.4.2 Separation between aerial shell mortars and the safety shelter shall be 2 ft/in. (0.6 m/25 mm) of diameter of any mortars up to 6 in. (152 mm) in diameter.

7.3.4.3 For shells larger than 6 in. (152 mm) in diameter, the minimum separation distance between aerial shell mortars and the safety shelter shall be 4 ft/in. (1.2 m/25 mm) of shell diameter.

7.4 Egress Requirements.

7.4.1 During the firing of the display, an egress path shall be provided from any area where personnel are present in the discharge site.

7.4.2 Egress paths shall be unobstructed and free of impediments.

7.4.3 Egress paths shall be in a direction that does not pass through a discharge site.

7.5 Rooftops and Other Structures.

7.5.1 All openings in a rooftop or on the surface of any other structure shall be identified by the building owner or agent, venue manager, or maintenance personnel as to the function of the opening.

7.5.2 Any glass, openings, or fragile ornamentation in the display area shall be protected from damage caused by the display.

7.5.3 Intake Openings.

7.5.3.1 Intake openings for HVAC or ventilation in the proximate area of the firing site shall be covered to prevent any smoke or material from entering the building.

7.5.3.2 If the intake openings cannot be covered, the circulating system shall be disabled during the firing of the display.

7.5.4* Vent pipes for sewer vents shall be covered to prevent any flammable material from entering these openings during the display.

7.5.5 There shall be no overhead towers, antennas, or electric or communication lines within 25 ft (7.6 m) of the trajectory of an aerial shell.

7.5.6 The operator, the building owner or agent, and the AHJ shall determine if there are any requirements necessary to protect the surface of the roof or structure from any operation of the conduct of the display.

7.5.7 Security.

7.5.7.1 When the delivery of fireworks or other pyrotechnic materials is conducted in an area open to the public, the fireworks or pyrotechnic materials shall be protected from direct access by the public.

7.5.7.2 Any time the fireworks or pyrotechnic materials are on location, they shall not be left unattended or unsecured.

7.5.8 When required by the AHJ, the parking location of the vehicle containing the fireworks or the pyrotechnic materials and the path for their delivery shall be approved prior to the time they are delivered to the location.

7.6 Operations.

7.6.1 Manual firing of displays shall be permitted on rooftops, bridges, towers, stadiums, parking decks, other structures, and other limited egress locations 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 discharge site shall be twice that required for an electrically fired display, as specified in 7.3.1.
(4) A protective barrier(s) meeting the strength requirements of ¾ 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 7.3.4.
(6) Electrical firing on the same discharge site where manual firing is used shall be in accordance with 9.1.3.

7.6.2 Loading.

7.6.2.1 Fireworks and pyrotechnic materials shall be loaded into mortars or in place prior to the start of a display.

7.6.2.2 There shall be no reloading of any fireworks and pyrotechnic materials during firing of the display.

7.6.3 Fireworks and pyrotechnic materials shall be fired only when the display site is in clear view of the pyrotechnic operator or an assistant who is in direct communication with the operator.

7.6.4 Spotters.

7.6.4.1 During the display, approved support personnel shall be positioned to visually observe the roofs of any structures within the fallout area.

7.6.4.2 The approved support personnel shall be in communication with the shooter and the fire service assigned to the display.

7.6.5 During the display, two-way voice communication shall be present on sites from which fireworks and other pyrotechnic materials are being discharged, with communication between each shooter, the operator, and life safety personnel.

7.7 Flammable and Combustible Materials.

7.7.1 Rooftops, other structures, and other limited egress locations shall be free of all nonessential flammable or combustible materials.

7.7.2 All flammable or combustible materials shall be protected or removed from the display site.

Chapter 8 Operation of the Display

8.1 General Requirements. The sponsor of the display shall make provisions for fire protection for the display.

8.1.1* The sponsor shall consult with the AHJ, the local responding fire department (if different from the AHJ), and the operator to determine the level of fire protection required.

8.1.2* The following shall apply to crowd control:

(1) Monitors whose sole duty is the enforcement of crowd control shall be located around the display site and at other locations as determined by the sponsor.
(2) The AHJ and the operator shall approve the provisions for crowd control.

8.1.2.1 Monitors shall be positioned around the display site to prevent spectators or any other unauthorized persons from entering the discharge site.

8.1.2.2 Where required by the AHJ, approved delineators or barriers shall be used to aid in crowd control.

8.1.2.3 Portions of the display site, other than the discharge site(s), shall be permitted to be open to the public prior to the display as long as the provisions of 4.2.2.2 are maintained.

8.1.2.4 Unescorted public access to the discharge site shall not be permitted where pyrotechnic materials are present during the period before the display.

8.1.2.5 The discharge site shall be restricted throughout the display and until the discharge site has been inspected after the display.

8.1.3* The operator shall have primary responsibility for safety.

8.1.3.1* The operator shall be responsible for ensuring that a sufficient number of assistants are available for the safe conduct of the fireworks display.

8.1.3.2 Only the operator, authorized assistants, and inspector(s) representing the AHJ shall be permitted in the display site while the display is in progress.

8.1.3.3 The operator shall be responsible for ensuring that all assistants are trained in the performance of their assigned tasks and that they are educated with regard to safety hazards.

8.1.3.4* During the firing of the display, all personnel in the discharge site shall wear the following:

(1) Head protection
(2) Eye protection
(3) Hearing protection
(4) Foot protection
(5) Cotton, wool, or similarly flame-resistant, long-sleeved, long-legged clothing

8.1.3.5 Personal protective equipment (PPE), as necessary, shall be worn by the operator and assistants during the setup and cleanup of the display.

8.1.4 Wherever, in the opinion of the AHJ or the operator, any hazardous condition exists, the fireworks display shall be stopped until the condition is corrected.

8.1.4.1 If, in the opinion of the AHJ or the operator, the lack of crowd control poses a hazard, the fireworks display shall be postponed or discontinued immediately until such time as the situation is corrected.

8.1.4.2* If high winds, precipitation, or other adverse weather conditions prevail or begin such that a hazard exists in the opinion of the operator or the AHJ, the fireworks display shall be postponed or discontinued until weather conditions improve.

8.1.4.3 One or more spotters shall watch the flight and behavior of aerial shells and other aerial fireworks to verify that they are functioning as intended.

8.1.4.3.1 If any unsafe condition is detected, such as hazardous debris falling into the audience, the spotter shall signal the shooter to cease firing until the unsafe condition is corrected.

8.1.4.3.2 The spotters shall be in direct communication with the shooter during the conduct of the display.

8.1.4.4 In the event of a condition arising that requires the entry of fire protection or other emergency response personnel into the fallout area or security perimeter, the display shall be halted until the situation is resolved and the area is once again clear.

8.1.5 Operators and assistants shall use only flashlights, electric lighting, or other nonincendive illumination such as chemiluminescent devices for illuminating the firing area and the ready box area.

8.1.6 Control of Ignition Sources.

8.1.6.1 Smoking materials, matches, lighters, or open flame devices shall not be permitted within 50 ft (15 m) of any area where fireworks or other pyrotechnic materials are present.

8.1.6.2 Devices such as fusees, portfires, and torches shall be permitted to be used to ignite fireworks.

8.1.7 Pyrotechnic materials used in the display shall be protected from adverse weather conditions.

8.1.8 Moisture-damaged pyrotechnic materials shall not be used.

8.1.9 Impairment.

8.1.9.1* No person shall be present in the discharge site with alcohol in his or her system or while under the influence of drugs that are not over-the-counter or prescription medications used in compliance with the manufacturer's or physician's written instructions.

8.1.9.2 No person shall be present in the discharge area while under the influence of over-the-counter or prescription medications that impair the judgment, mobility, or stability of the user to such a degree that he or she cannot understand and conform to the requirements of applicable laws, regulations, and standards governing the display.

8.2 Firing of Shells.

8.2.1* Shells shall be carried from the storage area to the discharge site only by the body of the shell and shall not be carried by their fuses.

8.2.2* Loading.

8.2.2.1 When being loaded into the mortars, shells shall be held by their fuses or lowering cords if provided and shall be lowered into the mortar.

8.2.2.2 At no time shall any part of the body of the loader be over the mouth of the mortar.

8.2.3 Shells shall be checked for correct fit in their mortars prior to the display.

8.2.4* Shells shall be seated at the bottom of the mortar.

8.2.5 Incorrect Fit.

8.2.5.1 Shells shall not be forced into a mortar too small to accommodate them.

8.2.5.2 Shells that do not fit properly into the mortars shall not be fired and shall be disposed of in accordance with the procedure prescribed in 8.2.10.2.

8.2.6* Manually fired shells shall be ignited by lighting the tip of the fuse with a fusee, torch, portfire, or similar device.

8.2.6.1 The safety cap protecting the fuse shall be removed only by the shooter and only immediately before the shell is to be fired.

8.2.6.2 As soon as the fuse is ignited, the shooter shall turn and step away from the immediate proximity of the mortar area.

8.2.7 Under no circumstances shall a person place any body part over the mortar during the loading and firing of a display until mortars have been checked following the display for the absence of any shells.

8.2.8 The following safety requirements shall apply once an outdoor fireworks display has begun:

(1) The first shell fired shall be observed to determine whether the shell functions over the fallout area and whether any hazardous debris or unexploded shells land in the fallout area.
(2) The display shall be interrupted at any time, and the mortars shall be re-angled or repositioned as necessary, for safety during an outdoor fireworks display.

8.2.9 Large-Diameter Shells.

8.2.9.1 Loading Requirements. Aerial shells greater than 6 in. (152 mm) in diameter shall be preloaded into mortars prior to the beginning of the display.

8.2.9.2 Firing Methods.

8.2.9.2.1 Unless the requirements of 8.2.9.2.2 are met, all aerial shells greater than 6 in. (152 mm) in diameter shall be fired using electrical ignition *(see Chapter 9)* or other means of remote ignition that places the shooter and assistants at least 75 ft (23 m) away from the mortar or behind a sturdy barricade at the time of ignition of the lift charge.

8.2.9.2.2* Shells that are nominal 7 in. (178 mm) or 8 in. (203 mm) in diameter shall not be subject to the requirements of 8.2.9.2.1, but shall be permitted to be ignited manually, provided that the mortars are buried at least three-quarters of their length into the ground and the shooter has been provided with alternative means of protection.

8.2.10* Unfired Shells. In the event that a shell fails to ignite in the mortar, the mortar shall be marked to indicate the presence of an unfired shell, and the mortar shall not be reloaded or reused while the misfired shell remains a hazard.

8.2.10.1 Handling Procedures.

Δ **8.2.10.1.1** Unless the requirements of 8.2.10.1.2 apply, immediately following the display but no sooner than 15 minutes after the attempted firing, if the shell still has not fired, the following procedure shall be required:

(1) Any shells that were fired but are not exploded shall not be handled until at least 15 minutes have elapsed from the time the shells were fired.
(2) The fireworks then shall be treated as specified in either 8.2.10.1.1(2)(a) or 8.2.10.1.1(2)(b):
    (a) The fireworks shall be doused with water and allowed to remain undisturbed for at least 5 additional minutes before being placed in a plastic bucket or fiberboard box.
    (b) The fireworks shall remain undisturbed for at least 30 additional minutes before being placed in a plastic bucket or fiberboard box.

8.2.10.1.2 The requirements of 8.2.10.1.1 shall not apply where electrical ignition is used and the firing failure is electrical in nature or where the aerial shell was not fired intentionally, in which case the shell shall be permitted to be salvaged by the operator.

8.2.10.2 Disposal Instructions. The disposal instructions shall be provided by the supplier and shall be followed.

8.2.10.3* Area Control.

8.2.10.3.1 In manually fired displays, it shall be the responsibility of the shooter to accomplish the following:

(1) Determine when a shell does not fire from a mortar
(2) Warn others in the area
(3) Ensure that the mortar is marked to indicate the presence of an unfired aerial shell

8.2.10.3.2 In electrically fired displays or in the electrically fired portions of displays, the mortars from which aerial shells have not fired at the end of the display shall not be required to be marked.

8.2.10.3.3 Persons in the discharge area after the fireworks display shall conduct themselves as though unfired aerial shells present a hazard until otherwise advised by the operator.

8.2.11* Manual re-ignition of chain-fused aerial shells shall be attempted only at installed ignition points.

8.2.12* Following the display and before any public access to the site is permitted, the firing crew shall conduct an inspection of the fallout area for the purpose of locating any unexploded aerial shells or live components.

Δ **8.2.12.1** When the inspection specified in 8.2.12 has been completed, the following procedure shall be required:

(1) Any shells or live components found during the inspection that were fired but are not exploded shall not be handled until at least 15 minutes have elapsed from the time the shells were fired.
(2) The fireworks then shall be treated as specified in either 8.2.12.1(2)(a) or 8.2.12.1(2)(b):
   (a) The fireworks shall be doused with water and allowed to remain undisturbed for at least 5 additional minutes before being placed in a plastic bucket or fiberboard box.
   (b) The fireworks shall remain undisturbed for at least 30 additional minutes before being placed in a plastic bucket or fiberboard box.

8.2.12.2 The disposal instructions provided with the fireworks by the supplier shall be followed.

8.2.12.3 Where fireworks are displayed at night, a search of the fallout area shall be made immediately after the display and at first light the following morning by the operator or designated personnel acceptable to the AHJ.

Δ **8.3 Ground Display Pieces.** All ground display pieces shall be constructed, assembled, and stored in accordance with NFPA 1124 or at the display site.

8.3.1 Setup and Site Preparation.

8.3.1.1 Unless the requirements of 8.3.1.2 or 8.3.1.3 are met to the extent that it is practical, all ground display pieces shall be positioned outside the discharge area of aerial displays.

8.3.1.2 The requirements of 8.3.1.1 shall not apply where ground display pieces are to be fired electrically, in which case they shall be permitted to be located in the fallout area.

8.3.1.3 The requirements of 8.3.1.1 shall not apply where aerial shells have been preloaded, in which case ground display pieces shall be permitted to be located in the discharge area.

8.3.2 Dry grass or combustible materials located beneath ground display pieces shall be wet down before the display if they present a fire hazard.

8.3.3 Poles for ground display pieces shall be installed so that they do not fall over during functioning of the fireworks device.

Chapter 9 Electrical Ignition of a Display

9.1* General.

9.1.1* The intent of this chapter shall be as follows:

(1) To provide requirements for the correct setup and operation of an outdoor display of fireworks that is to be ignited using electrical means
(2) To provide requirements and minimum standards for the design and use of electrical firing units employed in electrically fired displays, including manually operated, automatically operated, and handheld firing units

9.1.2 Separation Distances.

9.1.2.1 Unless the requirements of 9.1.2.2 are met, where only electrical ignition is used, the operator and all assistants shall be positioned a minimum of 75 ft (23 m) from any mortar or shall be positioned behind a protective barrier approved by the AHJ.

9.1.2.2 The requirements of 9.1.2.1 shall not apply to the electrical ignition of lance work and other set pieces of similar low hazard.

9.1.3 Where both manual firing and electrical ignition are used during a display, the mortars to be used for manual firing shall be separated from the mortars to be used for electrical ignition by a distance of at least 25 ft (7.6 m).

9.2 Design of Electrical Firing Units.

9.2.1 Electrical firing units shall be manufactured specifically for use in the electrical ignition of pyrotechnic devices or explosives.

9.2.1.1 Unless the requirements of 9.2.1.2 are met, the manufacturer of electrical firing units shall supply specifications and instructions for the setup and use of each unit.

9.2.1.2 The requirements of 9.2.1.1 shall not apply where the electrical firing unit has been manufactured by the person operating the unit at the display.

9.2.2* Manual electrical firing units shall include a key-operated switch or similar device to reduce the possibility that unauthorized or unintentional firings can occur.

9.2.3* Manual electrical firing units shall be designed so that at least two positive actions are necessary to apply a firing current to an electric match.

9.2.4* Switches used to apply power to electrical firing units for testing, firing, or both shall indicate the function or functions of each switch.

9.2.5 A light, a beeper, or both shall activate when a manual electrical firing unit is armed.

9.2.6 Handheld Firing Units.

9.2.6.1 Unless the requirements of 9.2.6.2 are met, a handheld electrical firing unit shall have two switches or require two actions, one to arm the unit and one to fire the unit.

9.2.6.1.1 The handheld unit shall be designed so that it cannot be fired without first being armed.

9.2.6.1.2 Switches shall be identified, and the unit shall have a light or indicator that signals when the unit is ready to fire.

9.2.6.1.3 Handheld firing units that incorporate a capacitive discharge design shall dissipate the stored charge within 15 seconds after the arming switch is released.

9.2.6.2 The requirements of 9.2.6.1 shall not apply to blasting machines such as clackers, rotary generators, and plunger-type firing units that derive their energy from mechanical action.

Δ **9.2.7** Automatic electrical firing units shall incorporate some form of a "dead-man switch" so that all firings cease the moment that the switch is released.

9.2.8 If an electrical firing unit has a built-in test circuit, the firing unit shall be designed to limit the test current (into a short circuit) to 0.05 ampere or to 20 percent of the maximum current that can be applied to an electric match for 5 seconds at room temperature, without the match igniting the electric match being used, whichever is less.

9.2.9 Multitesters, such as volt-ohm meters, shall not be used for testing electric matches unless the tester's maximum current delivery potential has been measured and found to meet the requirements of 9.2.8.

9.2.10 Shunts of the type sometimes used in commercial blasting shall not be required on any electrical firing unit used for the ignition of pyrotechnic devices at an outdoor display of fireworks.

9.2.11 Electrical firing units shall be powered by batteries or isolated power supplies used for firing purposes only.

9.2.11.1 If batteries are used, they shall be self-contained in the firing unit or otherwise covered or protected to prevent accidental contact with wires leading to the fireworks.

9.2.11.2 Electrical firing units powered by commercial power shall be permitted, provided that they incorporate an isolation transformer and that the transformer is located within the firing unit or elsewhere in the firing system.

9.3 Setup of Electrical Firing Units.

9.3.1 Inspection.

9.3.1.1 All portions of the electrical firing unit from the power supply to the electric match shall be visually inspected prior to the display by the shooter controlling the electrical firing unit or by an assistant.

9.3.1.2 The electrical firing unit shall not be in test or arm status during the inspection specified in 9.3.1.1.

9.3.2* The electrical firing unit shall be set up and located so that there is a clear line of sight to the mortars and to other parts of the discharge site, unless a spotter is in direct communication with the shooter controlling the electrical firing unit.

9.3.3 Only those persons necessary for the firing of the display shall be permitted in the vicinity of the electrical firing unit during the display.

9.3.4 Where fireworks are being loaded into mortars or otherwise set up for firing at the display site, cables from the electrical firing unit shall be disconnected.

9.3.5 Once the fireworks have been loaded or otherwise set up, testing of the circuits shall be permitted.

9.3.6 No persons shall be permitted in the immediate area of any fireworks that have been attached to the electrical firing unit when any circuit testing is performed.

9.3.7 If the testing of the circuits indicates that a problem exists, the following requirements shall apply:

(1) The operator or assistant shall be permitted to reinspect any cables, connections, or electric matches that are in question.
(2) The reinspection shall be performed only after the electrical firing unit has been switched off or disconnected from the power source.

9.4 Operation of the Electrical Firing Unit.

9.4.1 Prior to arming the electrical firing unit, the shooter controlling the unit shall confirm that no personnel are present in the mortar area that is to be electrically ignited.

9.4.2 The shooter controlling the electrical firing unit shall be provided with a means of communicating with the operator.

9.4.3* Where a significant malfunction exists at a discharge site, the following procedure shall be performed:

(1) The shooter controlling the electrical firing unit shall cease firing until the operator or an assistant visually inspects the discharge site for damage to mortars, equipment, or remaining fireworks and indicates that it is safe for firing to resume.
(2) The electrical firing unit shall be switched off or disconnected while the inspection is being performed.

9.4.4 When a serious electrostatic discharge hazard exists, such as during an electrical storm, all electrostatic discharge–sensitive operations shall be suspended, and personnel shall withdraw to a safe location.

9.5 Post-Display Operations.

9.5.1 After the completion of the display, the electrical firing unit shall be switched off and all cables disconnected prior to any cleanup or other work in the display site.

9.5.2* After the display, personnel shall not enter the discharge site for a period of time that the operator deems necessary for safety, after which the discharge site shall be inspected by the operator or assistants for any unfired devices.

9.5.2.1* Unfired devices shall be permitted to be either of the following:

(1) Fired in accordance with this code
(2) Packaged and returned to the supplier in compliance with all applicable regulations

Chapter 10 Qualifications

10.1 Operator Qualifications.

10.1.1 The operator shall be at least 21 years old and licensed or approved by the AHJ in accordance with any and all applicable federal, state, and local laws.

10.1.2* Applicants for licensing as an operator shall provide evidence of actual experience as an operator or assistant as part of demonstrating competency to the AHJ.

10.1.3 Applicants for licensing as an operator shall successfully complete a written examination of laws, regulations, and safety practices pertaining to the discharge of fireworks that shall be administered by the AHJ or shall otherwise demonstrate knowledge of these areas.

10.2 Assistants. All assistants shall be trained in the duties they are to perform, be under the direct supervision of the operator, and be at least 18 years old.

10.3 Permits Required.

10.3.1* Prior to performing the fireworks display, the operator, supplier, or sponsor shall obtain a display permit from the AHJ.

N **10.3.1.1** If the display permit is denied by the AHJ, the AHJ shall notify the permit applicant and specify in writing the reasons for the denial.

N **10.3.1.1.1** The permit applicant shall be permitted to resubmit the display permit application to address the reasons specified by the AHJ for denial of the display permit.

10.3.2 As part of the permit process, the operator, supplier, or sponsor shall demonstrate financial responsibility for the fireworks display to the AHJ by providing proof of insurance or by other approved means.

10.3.3 The operator or supplier shall maintain any federal or state permit(s) or license(s) required to possess and use fireworks.

10.3.4 The AHJ shall meet all the requirements of Chapter 10 if the AHJ acts as the operator of the display.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

Δ **A.1.1.2(1)** For additional information see NFPA 1124.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.3 Code. The decision to designate a standard as a "code" is based on such factors as the size and scope of the document, its intended use and form of adoption, and whether it contains substantial enforcement and administrative provisions.

A.3.3.1 Aerial Shell. Comets and mines are not aerial shells. The shells are most commonly 3 in. to 6 in. (76 mm to 152 mm) outside diameter and are fired from mortars. Upon firing, the fuse and lift charge are consumed.

A.3.3.2 Assistant. The duties of an assistant include tasks such as setting up the equipment and fireworks, loading mortars (loader), spotting the bursting location of aerial shells (spotter), tending a ready box (ready box tender), igniting the fireworks (shooter), striking the equipment, and cleaning the discharge site.

A.3.3.3 Barrage. Mortars are loaded prior to the display, and the aerial shells are chain fused to fire in rapid sequence.

A.3.3.4 Battery. This term is not to be confused with an electrical battery used to provide a source of current.

A.3.3.5 Break. Aerial shells can be either single-break (having only one burst) or multi-break (having two or more bursts).

A.3.3.7 Chain Fusing. Finales and barrages typically are chain fused.

A.3.3.8 Comet. A comet is not an aerial shell or mine. Comets frequently leave a trail of sparks as they rise in the air, and they sometimes burst into smaller fragments at their zenith.

A.3.3.10 Electrical Firing Unit. A firing unit normally has switches to control the routing of the current to the devices to be used during the display and also might contain test circuits and warning indicators. Units can be manual, automatic, or handheld.

A.3.3.10.1 Automatic Electrical Firing Unit. The unit is attached by wires or cables to junctions that are connected to the electric matches, which, in turn, are attached to fireworks devices. Automatic units often are operated by magnetic tape or by computer.

A.3.3.10.2 Handheld Electrical Firing Unit. The unit is connected directly to the electric matches by means of wires.

A.3.3.10.3 Manual Electrical Firing Unit. The unit contains wires or cables that are attached to junctions that are, in turn, connected to the electric matches.

A.3.3.11 Fallout Area. The shells burst over the area, and unsafe debris and malfunctioning aerial shells fall into this area. The fallout area is the location where a typical aerial shell dud falls to the ground, depending on the wind and the angle of mortar placement. The term does not include areas where cardboard and nonhazardous remnants of pyrotechnic devices might fall to the ground.

A.3.3.12 Finale. The mortars are loaded prior to the display, and the aerial shells are chain fused to fire in rapid sequence.

A.3.3.13 Fire (verb). Fireworks can include, but not be limited to, aerial shells, ground display pieces, proximate pyrotechnics, and other pyrotechnic devices intended for entertainment purposes.

Δ **A.3.3.15 Fireworks.** Toy caps for use in toy pistols, toy canes, toy guns, and novelties and trick noisemakers are not considered to be fireworks *(see Annex D)*. The regulations referred to limit the explosive content of each toy cap to not more than an average of 0.25 gr (16.2 mg). Also, each package containing such caps has to be labeled to indicate the maximum explosive content per cap. For information on the use of model rockets and model rocket motors, see NFPA 1122. For information on the use of high power rockets and high power rocket motors, see NFPA 1127. Model rockets, model rocket motors, high power rockets, and high power rocket motors designed, sold, and used for the purpose of propelling recoverable aero models are not considered to be fireworks. [**1124,** 2017]

A.3.3.15.1 Consumer Fireworks. Consumer fireworks are normally classed as Explosives, 1.4G and described as Fireworks, UN 0336 by the U.S. Department of Transportation (U.S. DOT) *(see Annex D)*. Some small devices designed to produce audible effects are included, such as whistling devices, ground devices containing 0.8 gr (50 mg) or less of explosive composition (salute powder), and aerial devices containing 2 gr (130 mg) or less of explosive composition (salute powder) per explosive unit. Consumer fireworks contain limited quantities of pyrotechnic composition per unit and do not pose a mass explosion hazard where stored. Therefore, they are not required to be stored in a magazine.

Δ **A.3.3.15.2 Display Fireworks.** Display fireworks are described as Fireworks, UN 0335 and are classified as Explosives, 1.3G by the U.S. Department of Transportation (U.S. DOT) *(see Annex D)*.

Display fireworks include, but are not limited to, the following:

(1) Salutes or firecrackers containing more than 2 gr (130 mg) of explosive composition (salute powder)
(2) Aerial shells containing more than 2.1 oz (60 g) of total pyrotechnic and explosive composition
(3) Other display pieces that exceed the limits for classification as consumer fireworks

Such fireworks are also described as fireworks, 49 CFR 172 by the U.S. DOT. [**1124,** 2017]

A.3.3.18 Ground Display Piece. Ground display pieces can include, but not be limited to, the following devices: fountains (gerbs), wheels, and "set pieces."

A.3.3.19 Hazardous Debris. Confetti, lightweight foam pieces, feathers, novelties, and so forth, are not to be construed as hazardous debris.

A.3.3.20.1 Electrical Ignition. Typically, electric matches are attached to or inserted into fireworks devices prior to the display and are connected to wires leading back to an electrical firing unit. During the display, the operator or an assistant controls the ignition of the fireworks using the electrical firing unit.

A.3.3.21 Lance. Lances are mounted on a frame and fused so that ignition of all tubes is nearly simultaneous.

A.3.3.22 Lift Charge. A time delay fuse then ignites the main part of the shell, producing the desired effect.

A.3.3.24.2 Electric Match. When a sufficient electric current is passed through the wire circuit, the heat that is generated ignites the pyrotechnic composition, producing a small burst of flame. This flame can be used to ignite a fuse or a lift charge in a fireworks device. For the purposes of this code, the term *electric match* also refers to other similar technologies in which an electric current is used to produce a high temperature for ignition purposes.

A.3.3.24.3 Quick Match. While an exposed black match burns slowly, quick match propagates flame extremely rapidly, almost instantaneously. Quick match is used in fuses for aerial shells and for simultaneous ignition of a number of pyrotechnic devices, such as lances in a ground display piece.

A.3.3.25 Mine. A mine is a fireworks device designed to project stars and/or other effects or components into the air from a mortar. A black powder lift charge at the base of the mine ignites its contents and projects them into the air usually to an altitude that is lower than that reached by an aerial shell of the same diameter. The visual effect is similar to that of a flowerpot. Mines are not aerial shells or comets.

Δ **A.3.3.36 Ready Box Tender.** Tasks that a ready box tender might perform include making sure sparks do not enter the ready box and dispensing aerial shells to the loader as needed.

A.4.1.2 If there is doubt regarding whether aerial shells were manufactured to operate safely or whether the mortars and shells are correctly sized, it is recommended that test firings be conducted in order to establish whether they perform safely. It generally is believed that shells should be constructed so that the difference between the inside diameter of the mortar and the outside diameter of the shell is no less than ⅛ in. (3.2 mm) for all shell sizes. Furthermore, it generally is believed that aerial shells should be constructed so that the difference between the inside diameter of the mortar and the outside diameter of the shell is no more than ¼ in. (6.4 mm) for 2 in. to 3 in. (51 mm to 76 mm) shells; ⅜ in. (9.4 mm) for 4 in. to 6 in. (102 mm to 152 mm) shells; or ½ in. (12.7 mm) for shells larger than 6 in. (152 mm).

A.4.1.3 Shells that function to deploy a parachute suspending burning pyrotechnic composition can present additional safety concerns if the parachute does not deploy as designed or if the shell is fired in high winds.

A.4.2.1 This requirement applies to, but is not limited to, ground display pieces, wheels, roman candle batteries, and multishot devices.

Δ **A.4.2.2.2** For displays conducted on floating platforms and barges and for trailer-mounted displays, the preparation site can be in a location different from the display site.

A.4.2.2.4 Fireworks, especially those with electric matches installed, should not be dropped. They should be kept in closed shipping cartons until they are sorted, inspected, prepared, and loaded or set up for display.

A.4.2.2.5 The assembly, minor repair, and installation of fuses and electric match, and similar activities when done at a display site have not been considered manufacturing but part of the normal activities needed to prepare for a display.

Δ **A.4.2.4.3** An example of additional protection to ready boxes is the use of a flame-resistant tarpaulin meeting the requirements of NFPA 701.

A.4.3.1 The requirement for careful inspection of mortars is of particular importance for paper mortars that can sustain undetected damage to their interiors that can result in serious malfunctions. Defects can include dents, bent ends, damaged interiors, splits and cracks, and damaged plugs.

A.4.3.2 If there is doubt concerning the proper angling of mortars, it is appropriate to fire one or more test shells for verification.

A.4.3.3 To the extent practical, where mortars are to be reloaded during a display, groups of one size of mortars should not be placed adjacent to mortars of only 1 in. (25 mm) difference in diameter. This reduces the likelihood that shells are loaded into oversized mortars. For example, an arrangement of mortar groups such as 5 in., 3 in., 6 in., and 4 in. (127 mm, 76 mm, 152 mm, and 102 mm) is greatly preferred to an arrangement of 3 in., 4 in., 5 in., and 6 in. (76 mm, 102 mm, 127 mm, and 152 mm).

A.4.3.6 Malfunctions can present a hazard from dangerous flying debris. It is appropriate that measures such as personal protective equipment, barriers, or alternate procedures be utilized to reduce the exposure to the hazard. Where possible, the narrow side of the trough should face the greatest number of spectators, and the firing progression should develop in a direction away from the spectators.

A.4.3.8 The specifications in Table A.4.3.8(a) through Table A.4.3.8(d) are not intended to be construed as absolute minimums. Experience has demonstrated that these recommendations function reliably in use.

If there is reason to doubt that the strength of a mortar is adequate, a test can be devised to determine whether its strength is sufficient. One possible strength test for mortars is to fire the heaviest aerial shell of a given size to be used with a charge of lift powder that is 1.5 times the normal quantity. This approximately doubles the normal stress on the mortar. It is not appropriate to conduct this test at the display site. In addition, mortars meeting the specifications of Table A.4.3.8(a) through Table A.4.3.8(d) generally are believed to have ample strength.

A.4.3.8.1 HDPE mortars (and possibly other types) can lose significant strength if fired repeatedly over a relatively short period of time. Accordingly, when mortars will be reloaded during a display, it is appropriate to consider this potential problem.

A.4.3.10 Where there is concern that a mortar is too short to cause an aerial shell to be propelled to a safe altitude, a test firing should be conducted. However, it generally is believed that mortars of the lengths specified in Table A.4.3.10 are sufficient.

Δ **Table A.4.3.8(a) Steel Mortars: Adequate Mortar Wall Thickness in Inches**

Mortar ID	Spherical	Cylindrical Single-Break	Cylindrical Multi-Break
2	0.03	0.10	0.15
2.5	0.03	0.11	0.19
3	0.04	0.11	0.21
4	0.05	0.12	0.23
5	0.06	0.13	0.25
6	0.07	0.14	0.27
8	0.09	0.16	0.31
10	0.11	0.18	0.36
12	0.13	0.20	0.40
16	0.17	0.24	0.55
>16	NA	NA	NA

For SI units, 1 in. = 25.4 mm.
NA: Data not currently available.
Note: The tensile strength of steel pipe should be at least 40,000 psi (275,800 kPa).

Δ **Table A.4.3.8(b) Paper Mortars (Convolute or Spiral): Adequate Mortar Wall Thickness in Inches**

Mortar ID	Spherical	Cylindrical Single-Break	Cylindrical Two-Break
2	0.18	0.25	0.37
2.5	0.18	0.25	0.37
3	0.25	0.25	0.37
4	0.25	0.33	0.50
5	0.31	0.42	0.62
6	0.37	0.50	0.75
8	0.50	NA	NA
10	0.62	NA	NA
12	0.75	NA	NA
16	NA	NA	NA

For SI units, 1 in. = 25.4 mm.
NA: Data not currently available.
Note: The cross-grain tensile strength of the paper should be at least 2300 psi (16,000 kPa).

The lengths specified in Table A.4.3.10 are not intended to be construed as absolute minimums; however, experience has demonstrated that these recommendations function reliably in use.

A.4.4.1 The use of securely positioned racks located on barges and trailers can be permitted, provided that all other code requirements are met.

A.4.4.3 Examples of materials for use in providing added support include wood and flat stones.

A.4.4.4 Where practical, additional separation distances between buried mortars should be used. Additional separation distances for buried mortars provide more room for loaders and shooters to work and reduce the chances of crew injury.

A.4.5.1 Audience safety should be considered during the orienting and angling of mortar racks and bundles.

Δ Table A.4.3.8(c) High-Density Polyethylene (HDPE) Mortars: Adequate Mortar Wall Thickness in Inches

Mortar ID	Spherical	Cylindrical Single-Break	Cylindrical Two-Break
2	0.12	0.17	0.17
2.5	0.12	0.17	0.17
3	0.15	0.17	0.17
4	0.20	0.25	0.25
5	0.25	0.25	0.25
6	0.30	0.32	0.32
8	0.32	NA	NA
10	0.32	NA	NA
12	0.37	NA	NA
>12	NA	NA	NA

For SI units, 1 in. = 25.4 mm.
NA: Data not currently available.
Note: The tensile strength of plastic should be at least 3300 psi (22,750 kPa).

Δ Table A.4.3.8(d) Fiberglass Reinforced Epoxy Mortars: Adequate Mortar Wall Thickness in Inches

Mortar ID	Spherical	Cylindrical Single-Break	Cylindrical Two-Break
2	0.07	0.11	0.11
2.5	0.07	0.11	0.11
3	0.07	0.11	0.11
4	0.11	0.11	0.11
5	0.11	0.11	0.11
6	0.11	0.11	0.11
8	0.25	NA	NA
10	0.25	NA	NA
12	0.25	NA	NA
>12	NA	NA	NA

For SI units, 1 in. = 25.4 mm.
NA: Data not currently available.
Note: The tensile strength of fiberglass should be at least 11,000 psi (76,000 kPa).

Table A.4.3.10 Minimum Inside Mortar Length in Inches

Mortar ID	Single-Break	Two-Break	Up to Four-Break
3	15	18	21
4	20	23	27
5	24	28	32
6	28	32	37
8	34	40	46
10	40	46	54
12	46	52	62

For SI units, 1 in. = 25.4 mm.

A.4.5.1.1 The code does not permit the loading of multiple, individually lifted aerial shells into a single mortar. This section permits the use of commercially manufactured devices that contain multiple spherical aerial shells assembled with a single lift charge. Common names for these items include "peanut shells," "double-bubble," "stacked shells," and "piled shells."

A.4.5.1.2 See A.4.5.1.1.

N **A.4.5.7** The materials used in rack construction vary widely in the industry. There is no single material or construction method that is uniquely acceptable for fireworks display racks. This performance-based requirement addresses the concern about mortar rack construction and provides direction in order to ensure operator and audience safety during fireworks displays.

Many accidents characterized as rack-related accidents might actually be related to violations of current code such as mortar stabilization, shell type, or chain fusing. Mortar rack construction might be neither a cause of these accidents nor a means by which such accidents might be best prevented in the future.

Examples of the employed systems and methods related to the use of racks include the following:

(1) How racks are secured and stabilized
(2) Use of additional containment and/or framework construction
(3) Types of shells utilized
(4) Placement in the field
(5) Use of natural barriers and/or berms
(6) Use of other barriers (e.g., metal dumpsters)
(7) Audience location
(8) Use of other, smaller caliber shell mortar racks to surround and contain the larger 5 in. and 6 in. (127 mm to 152 mm) shell mortars
(9) Chain fusing
(10) Use of additional separation distances as prescribed by code related to the use of chain fusing and other actions
(11) Consideration for mortar rack construction and the materials used for construction

A.4.6.1 Aboveground racks should be constructed to withstand a catastrophic malfunction in a mortar. Wooden racks should have sides and bottom plates of at least 2 in. (51 mm) nominal thickness. The racks should be boxed on both sides at the top and bottom by 1 in. × 6 in. (25.4 mm × 152 mm) nominal thickness boards or ½ in. (13 mm) thick plywood. Blocks of 2 in. (51 mm) nominal thickness should be attached to the horizontal boards between each mortar of inside diameter greater than 3 in. (76 mm). Boards should be fastened by nails, screws, or other fasteners that penetrate a minimum of 1 in. (25.4 mm) into the member to which a board is attached. Racks should be secured to prevent tipping over by attaching stakes or spikes driven into the ground, banding, using A-frames, or other equivalent means. Aboveground wood frame mortar racks with lightweight mortar materials such as paper, HDPE, or fiberglass generally will not withstand a catastrophic aerial shell malfunction in a mortar.

A.4.6.1.1 Chain-fused mortar racks should be positioned perpendicular to spectator viewing areas, where practical, to maximize audience safety.

A.4.6.2.2 A boxed finale item can be fired at any point during the display.

Δ **A.4.6.3** Stakes, sandbags, trenches, boxes, screens, or barriers are among the common means used to secure chain-fused aerial fireworks devices that require additional stabilization.

N **A.4.6.4** The materials used in rack construction vary widely in the industry. There is no single material or construction method that is uniquely acceptable for fireworks display racks. This performance-based requirement addresses the concern about mortar rack construction and provides direction in order to ensure operator and audience safety during fireworks displays.

Many accidents characterized as rack-related accidents might actually be related to violations of current code such as mortar stabilization, shell type, or chain fusing. Mortar rack construction might be neither a cause of these accidents nor a means by which such accidents might be best prevented in the future.

Examples of the employed systems and methods related to the use of racks include the following:

(1) How racks are secured and stabilized
(2) Use of additional containment and/or framework construction
(3) Types of shells utilized
(4) Placement in the field
(5) Use of natural barriers and/or berms
(6) Use of other barriers (e.g., metal dumpsters)
(7) Audience location
(8) Use of other, smaller caliber shell mortar racks to surround and contain the larger 5 in. and 6 in. (127 mm to 152 mm) shell mortars
(9) Chain fusing
(10) Use of additional separation distances as prescribed by code related to the use of chain fusing
(11) Consideration for mortar rack construction and the materials used for construction

N **A.4.7.5.1** Methods such as jacks, trailer dollies, and tires could be used to ensure the total platform surface area is stabilized during firing operations.

A.5.1.2.2 By definition, the "display site" includes the discharge site, the fallout area, and the required separation distances. Therefore, the dimensions of the display site, at a minimum, include a fallout area that allows for the separation distances required for the fireworks planned in the display. Generally, the display site and the fallout area can be considered the same thing; however, where the fallout area is to be limited within a larger display site, the location and dimensions of the fallout area should be included. Allowing the fallout area to be located anywhere in the display site offers the greatest flexibility for on-site adjustments while maintaining required separation distances.

A.5.1.3 Where more than one shooter is to manually ignite the aerial shells for an outdoor fireworks display, the line of mortars should be separated in some manner, and only one shooter should be igniting shells in each area.

A.5.1.3.5.1 Examples of ground display pieces of low hazard potential are items such as lancework, gerbs or fountains, and illuminations.

A.5.1.3.5.2 Examples of ground display pieces with greater hazard potential are items such as large wheels with powerful drivers and items employing large salutes.

Δ **A.5.1.4.1** See NFPA *101* for definitions of health care and detention and correctional facilities.

A.5.1.4.3 To determine whether materials are considered to possess these hazards, see NFPA's *Fire Protection Guide to Hazardous Materials*.

A.5.1.5.1 The presence of a modest number of trees and shrubs should not be considered a safety problem, provided that they are not so numerous as to make it significantly more difficult to locate unexploded aerial shells or to pose a serious fire safety threat.

A.5.2.1.1 Figure A.5.2.1.1 illustrates some of the requirements for a permitted display site where mortars are placed vertically, such as might be the case for an electrically ignited display.

A.5.2.1.2 The increased spectator separation distance for elevated mortars allows for a wind speed aloft of up to approximately 10 mph (16 km/hr).

N **A.5.2.1.4.1** For typical aerial shells, a mortar tilt angle of approximately 1.5 degrees into the wind for each 5 mph (8 km/hr) of wind speed aloft is sufficient to correct for the fallout of dud shells. However, this mortar angling has little effect on the fallout of other hazardous debris from the firing of aerial shells, comets and mines, and roman candles and cakes.

A.5.2.1.4.2 Figure A.5.2.1.4.2 illustrates some of the requirements for a permitted display site where mortars are to be angled away from the main spectator area and offset (shown as *d* in the figure) up to one-third the separation distance toward the spectators as specified in Table 5.1.3.1.

N **A.5.2.1.4.3** For typical aerial shells, a mortar tilt angle of approximately 8 degrees is required to achieve the full one-third displacements of mortar location and the center of the fallout area from the center of the display site.

A.6.2.1 The types of fireworks and placement of the fireworks mortars and accompanying equipment should be such that, when fired, the stability of site structures and the seaworthiness of the floating vessels and floating platforms are not jeopardized.

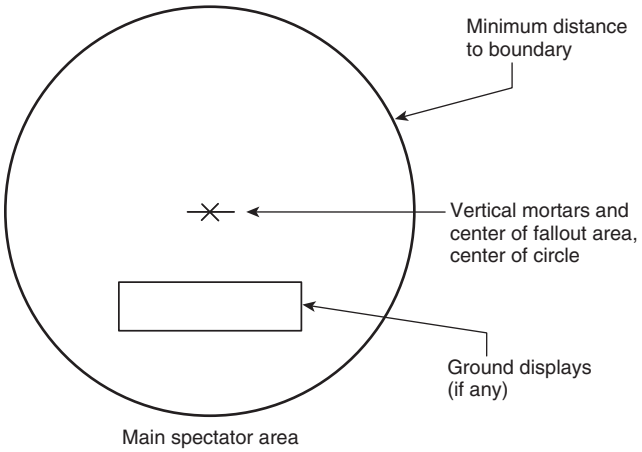

FIGURE A.5.2.1.1 Typical Layout for a Display Site with Vertically Positioned Mortars.

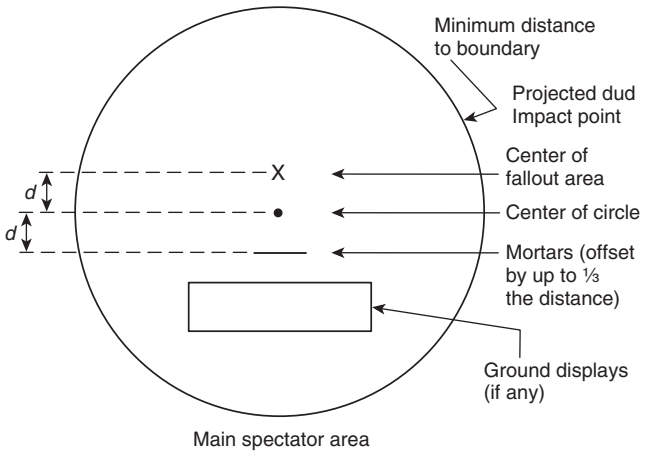

FIGURE A.5.2.1.4.2 Typical Layout for a Display Site Using Mortars Angled Away from the Main Spectator Area. The distance, *d*, should be at least one-sixth but not more than one-third the radius of the circle, indicating the minimum distance to the secured boundary.

A.6.3.1 An example using the following formula for determining the minimum display setup is provided:

[A.6.3.1a]

$$\frac{\left[\left(\begin{matrix}\text{total no. of 3 in.}\\ \text{mortars} \times 3\end{matrix}\right)+\left(\begin{matrix}\text{total no. of 4 in.}\\ \text{mortars} \times 4\end{matrix}\right)+\left(\begin{matrix}\text{total no. of 5 in.}\\ \text{mortars} \times 5\end{matrix}\right)+\ldots\right]}{2}$$

= minimum display setup

EXAMPLE: A display containing one hundred 3 in. (76 mm) shells, fifty 4 in. (102 mm) shells, twenty 5 in. (127 mm) shells, ten 6 in. (152 mm) shells, and five 8 in. (203 mm) shells would require the following minimum display setup area:

[A.6.3.1.b]

$$\frac{\left[M_1 \times D_1\right]+\left[M_2 \times D_2\right]+\left[M_3 \times D_3\right]+\ldots\left[M_n \times D_n\right]}{2}$$

$$\frac{(100\times 3)+(50\times 4)+(20\times 5)+(10\times 6)+(5\times 8)}{2}$$

$$=\frac{300+200+100+60+40}{2}$$

$$=\frac{700}{2}=350\ \text{ft}^2\left(32.5\ \text{m}^2\right)$$

where:
M_n = number of each mortar size, from 1 to n
D_n = inside diameter of each size mortar [in. (mm)]

Therefore, the minimum display setup area is 350 ft^2 (32.5 m^2).

A.6.3.3 Floating platforms constructed of wood or other combustible material can be used, provided that the surfaces of such platforms have been protected from fire by means acceptable to the AHJ. These floating platforms should also be of sufficient construction and configuration to safely allow the firing of the display.

A.6.4.8 Consideration should be given to the conditions that could affect the separation distances. Greater distances could be required to allow for the effect of sea conditions, wind, drift of the vessel at anchor, and so forth.

A.6.5 Communication could be needed between the display operator and the tug operator, spotter, the AHJ, life safety and fire safety personnel, and any other necessary personnel.

A.6.6 Necessary personnel should include, but are not limited to, display crew and spotters, fire department inspectors, and vessel operators.

A.6.7.1 Fuel tanks are deemed essential to perform the display for self-propelled vessels and for vessels controlling, marshaling, or adjoining a non-self-propelled vessel or platform, from which fireworks are being discharged.

A.7.2.1 The types of fireworks and placement of the mortars and accompanying equipment should be such that when fired, the stability of the site structures should not be jeopardized.

A.7.5.4 It is desirable to allow very small openings in the coverings of those sewer vent pipes so that the pipe can still vent gases.

A.8.1.1 The AHJ should be consulted well enough in advance so that the required fire protection can be arranged. Fire protection could include portable fire extinguishers for the discharge area and standby fire apparatus for protection down range.

A.8.1.2 Monitors should wear some distinctive identification (e.g., badges, brightly colored vests).

A.8.1.3 Although the operator is permitted to participate actively in the firing of the fireworks display, safety should be the primary concern of the operator.

A.8.1.3.1 In most situations, it is believed that it is appropriate to have one ready box tender tending each ready box or shell storage area in use at a given time. Similarly, it is believed that there should be two loaders reloading shells into mortars for each person igniting the aerial shells. Unless racks of chain-fused shells are being fired, it generally is believed that a single shooter can safely ignite no more than approximately 10 shells per minute. If a greater rate of firing is desired, more than one shooter should be lighting them.

A.8.1.3.4 The appropriate personal protective equipment (PPE) for each person is determined by conducting a hazard assessment of that person's duties at the fireworks display, as required by the U.S. Occupational Safety and Health Administration (OSHA).

A.8.1.4.2 In considering when wind speed is excessive for the reasonably safe performance of a fireworks display, there are two primary considerations, as follows:

(1) The potential for an increased risk of hazardous debris from the display falling into the spectator areas
(2) The potential for an increased probability of fire that is made excessively difficult to control

An increased fallout hazard occurs when the wind is traveling in a direction toward one or more spectator areas. Under these circumstances mitigation strategies that should be considered are as follows:

(1) To move the spectators out of the path of the fallout
(2) To redirect the fallout by moving the fireworks or reangling the mortars
(3) To increase the separation distance between the fireworks and the spectators
(4) To modify the content of the display to eliminate the fireworks of greatest concern
(5) To delay the display until the weather conditions have improved
(6) To implement a combination of these strategies

Some possible mitigation strategies to be considered regarding fire risks are as follows:

(1) To water down the areas and items of concern immediately before the display
(2) To redirect the fallout by moving the fireworks or reangling the mortars
(3) To increase the separation distance between the fireworks and the areas containing the fire hazards
(4) To modify the content of the display to eliminate the fireworks of greatest concern
(5) To increase the amount of suppression equipment and personnel in the immediate area
(6) To delay the display until weather conditions have improved
(7) To implement a combination of these strategies

A.8.1.9.1 This requirement is not intended to include ambient levels of alcohol commonly present in his or her system.

A.8.2.1 It should be noted that shell fuses can be damaged by rough handling. Therefore, appropriate care should be taken when handling shells and fuses.

A.8.2.2 It generally is believed that it is not safe to be loading mortars within 10 ft (3 m) of mortars that are being fired. When loading a shell into a recently fired mortar, the loader should crouch alongside the mortar, and his or her back should be kept facing the area where shells are being fired.

A.8.2.4 A gentle tug on the fuse usually can determine whether a shell has been properly seated at the bottom of the mortar.

Δ **A.8.2.6** Fusees and portfires can be mounted on a holder of some sort so that the shooter is an additional distance away. Wooden broom handles and other lightweight materials make serviceable holders.

A.8.2.9.2.2 Alternative means of protection should include a sturdy barricade, the placement of sandbags or similar protection on the shooter side of the mortar, or other alternative protection acceptable to the AHJ.

A.8.2.10 The operator and assistants should use extreme caution whenever approaching or handling a malfunctioned live aerial shell. Before approaching or handling the shell, as much time as practical following the malfunction should be allowed to pass. This minimizes the possibility that the shell will contain a live spark that could cause the shell to explode unexpectedly. Operators or assistants never should attempt to dry or repair a damaged shell. In all such cases, the supplier should be contacted for disposal instructions.

A.8.2.10.3 Where aerial shells are fired electrically or as a finale or barrage, it often is difficult to detect when unfired shells remain in the mortars. Therefore, it is advisable to use some method to aid in identifying when shells have not fired properly. One such method is to place a strip of paper tape over the mouth of each mortar; the presence of unbroken tape is then a certain indication that the shell has not fired. However, it should be noted that broken tape is *not* a certain indication that the shell *has* fired. It always should be assumed that the mortar is loaded.

A.8.2.11 Remaining within 25 ft (7.6 m) of chain-fused aerial shells after their ignition, for the purpose of manual re-ignition, is unreasonably dangerous. Similarly, the act of manual re-ignition of chain-fused aerial shells is dangerous unless re-ignition is attempted at properly installed ignition points. The necessity for such actions can be avoided through the use of redundant fusing or multiple ignition points.

A.8.2.12 The operator and assistants should use extreme caution whenever they approach a malfunctioned live aerial shell. Before approaching or handling the shell, personnel should allow as much time to pass as practical following the malfunction. This precaution minimizes the possibility that the shell still contains a live spark that could cause the shell to explode unexpectedly. Operators or assistants never should attempt to dry or reuse a shell that has malfunctioned. In all such cases, the supplier should be contacted for disposal instructions.

A.9.1 In an electrically fired display, all aerial shells to be used in the display normally are loaded prior to the firing of the first shell. A mortar therefore is required for each shell. Other fireworks devices such as set pieces, roman candle batteries, and fountains that are to be fired during the display are also set up for firing prior to the display and ignited electrically. It therefore is normally not necessary for any personnel to be in the immediate area during the firing of the display.

A.9.1.1 Electrical ignition often is used for larger displays, for displays fired on frequent occasions at a fixed location, and for other displays where precise control over the timing of the fireworks is desired for aesthetic reasons.

A.9.2.2 Switches should have labels under or above each switch. The labels should use either letters or numbers.

A.9.2.3 For example, this requirement might be accomplished with two switches in series, both of which need to be operated for current to flow to the electric match.

A.9.2.4 A switch used to power the electrical firing unit for testing should be a different style from that used to ignite electrical matches and also should be provided with lights to indicate the status of the unit.

A.9.3.2 The electrical firing unit should be placed on a flat surface or table, and it should be provided with some form of shield or other means of protection where located near the firing site.

A.9.4.3 A significant malfunction normally means that a fireworks device has violently exploded in a mortar and there is a possibility that mortars have been dislodged from their intended placement in racks or in the ground. A flowerpot or low burst normally does not require stopping the display to check the mortar area.

A.9.5.2 A delay of 15 minutes or more is recommended before approaching areas that might contain hangfires. Chain-fused and multishot devices are prone to this behavior.

A.9.5.2.1 Because much of the ability to control the audience is lost once the display is concluded, it normally is not recommended to fire leftover aerial shells. However, under favorable circumstances, it is possible and can be desirable to ignite any unfired set pieces, fountains, roman candles, or other low-level devices.

N **A.10.1.2** Applications for licenses based on experience as an assistant should demonstrate that the assistant actively participated in the operation and safety of fireworks displays. This experience should represent to the AHJ that the operator mentored the assistant in developing the skills as a future operator.

A.10.3.1 In some jurisdictions only municipalities or civic organizations are issued display permits, while in others only licensed operators or suppliers are issued display permits.

Annex B Recommended Regulations for Applications for Permits for the Outdoor Display of Fireworks

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Permit Application. The following are recommended elements to be included in the permit application for outdoor display of fireworks:

(1) Application for permit to operate a display of outdoor fireworks in conformance with the terms of _____ of the General Laws of _____ should be made in writing on forms provided by the AHJ.

(2) Such application should provide the following information:

(a) The name, address, email address, and phone number of the individual, group, or organization sponsoring the outdoor fireworks display.

(b) The name, address, email address, and phone number of the supplier of the fireworks, if different from that of the operator.

(c) Evidence of financial responsibility by the sponsor of the event or festival and by the operator of the fireworks display. This could take the form of an insurance certificate or other document attesting to coverage or responsibility.

(d) The date and time of day at which the outdoor fireworks display is to be held, with a proposed rain/wind date and time in the event the display is postponed.

(e) The exact location planned for the outdoor fireworks display.

(f) Confirmation of the license of the operator and the number of assistants who are to be present.

(g) The approximate number and kinds of fireworks to be discharged.

(h) The manner and place of storage of such fireworks prior to delivery to the outdoor fireworks display site.

(i) A diagram of the grounds on which the outdoor fireworks display is to be held, showing the point at which the fireworks are to be discharged; the display site; the approximate distances from mortars to spectator viewing areas; the location and approximate distances of all buildings, highways, and other lines of communication; the lines behind which the audience is to be restrained; the controls that will be used to maintain audience separation; and the location of other possible overhead obstructions.

(3) Upon receipt of such application _____ days in advance of the date set for this outdoor fireworks display, the AHJ should make or initiate an investigation of the site of the proposed display for the purpose of determining compliance with these regulations in the case of the particular display.

(4) The AHJ should approve or deny the permit application with comments provided to the permit applicant. If the application is denied, the AHJ should specify the reasons for the denial so that the permit applicant can attempt to address the reasons for a denial with a resubmitted permit application.

Annex C Suggested Requirements for Operator Licensing

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

C.1 Operator Licensing Requirements.

C.1.1 A requirement of licensing is that the applicant has attained the age of 21 years.

C.1.2 A requirement of licensing is that the applicant has passed a comprehensive written examination covering state laws pertaining to the display of fireworks and this code. At the option of the issuing office, an alternate requirement can be substituted, such as acceptance of competency certification by a national organization or of licensing by another state.

C.1.3 A requirement of licensing is that the applicant has provided evidence of actively participating in the performance of at least five outdoor fireworks displays. At the option of the issuing office, an alternate requirement can be substituted.

C.2 Provisions of Operator Licensing.

C.2.1 The license should be valid for a period of 4 years.

C.2.2 Renewal of the license should be automatic upon provision of proof of active participation in at least three outdoor fireworks displays and 8 hours of continuing education during the prior 4 years.

Annex D Extract from American Pyrotechnics Association 87-1, *Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics*

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex is extracted from the 2001 edition of APA 87-1.

D.1 Introduction.

D.1.1 This Standard provides manufacturers, importers, and distributors of fireworks and novelties with information to assist them in manufacturing, testing, shipping, and labeling the products of the fireworks industry in accordance with applicable federal laws and current good manufacturing practices. (GMPs). Paragraphs in this Standard which apply to the approval by the U.S. Department of Transportation (DOT) for transportation of fireworks are indicated by a dagger [†] at the end of the appropriate paragraphs. [†]

D.1.2 The information in this Standard should enable manufacturers, importers, and distributors of fireworks and novelties to provide their customers with products that can be transported and used safely and without unreasonable risk. [†]

D.1.3 Fireworks, pyrotechnic articles for theatrical purposes, and novelties are not acceptable for transportation within the jurisdiction of the United States unless they are classed, packaged, labeled, and marked and are in proper condition for shipment in accordance with DOT regulations in Title 49, CFR. *(See Section D.5 of this annex for further discussion.)* [†]

D.1.4 Consumer fireworks (fireworks classed as 1.4G and 1.4S) (formerly Fireworks, Common) and novelties are not acceptable for sale to the public unless they are manufactured, labeled, and sold in conformance with the regulations of the U.S. Consumer Product Safety Commission (CPSC) published in Title 16, CFR. *(See Section D.3 of this annex for further discussion.)* [†]

Note: Consumer Fireworks are normally classed as 1.4G but may be classed by DOT as 1.4S on the basis of examination and testing in accordance with Title 49, CFR, 173.56.

D.1.5 United States laws and regulations prescribe mandatory requirements that a person must follow in order to market certain products. In these instances, failure to comply may be regarded by courts as negligence *per se* in product liability litigation. [†]

D.1.6 This Standard applies to fireworks devices, pyrotechnic articles, and novelties for entertainment purposes. [†]

D.2 Definitions.

D.2.1 Approval. For purposes of this Standard, approval means the assignment of proper hazard class, EX (explosives approval) number, proper shipping name, and UN (United Nations) identification number by DOT so that fireworks and novelties may be transported under conditions specified in Title 49, CFR. *(See Section D.5 of this annex for details.)* [†]

D.2.2 Black Match (Instantaneous Fuse). An uncovered fuse made from thread impregnated with Black Powder and used for igniting pyrotechnic devices. Black match may be classed as 1.3G and described as Fuse, non-detonating, UN0101, under the provisions of this Standard. For any other classification, examination and testing as specified in Title 49, CFR, 173.56, CFR is required. *(See also Quick Match.)* [†]

D.2.3 Blowout. The unintended release of a pressure effect from other than the intended orifice of a fireworks device. Examples include expulsion of the bottom plug of a roman candle, expulsion of the clay choke of a fountain, or the rupturing of the wall of a mine or shell. [†]

D.2.4 Burnout. The unintended escape of flame through the wall of a pyrotechnic chamber during functioning of a fireworks device. [†]

D.2.5 Burst Charge. Chemical composition used to break open a fireworks device after it has been propelled into the air, producing a secondary effect such as a shower of stars. Burst charge is also sometimes referred to as expelling charge or break charge. Any burst charge containing metallic powder (such as magnalium or aluminum) less than 100 mesh in particle size, is considered to be intended to produce an audible effect, and is limited to 130 mg in 1.4G fireworks devices. Burst charge consisting of black powder or equivalent non-metallic composition is not considered to be intended to produce an audible effect when it is used to expel and ignite a secondary effect in a fireworks device. Burst charge for use in 1.3G fireworks is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel for approval under the provisions of this Standard. [†]

D.2.6 Chemical Composition. All pyrotechnic and explosive composition contained in a fireworks device. Inert materials such as clay used for plugs, or organic matter such as rice hulls used for density control are not considered to be chemical composition. [†]

D.2.6.1 Explosive Composition. Any chemical compound or mixture, the primary purpose of which is to function by explosion, producing an audible effect (report) in a fireworks device. [†]

D.2.6.2 Pyrotechnic Composition. A chemical mixture which on burning, and without explosion, produces visible or brilliant displays or bright lights, or whistles or motion. [†]

D.2.7 Fireworks. Any device, other than a novelty or theatrical pyrotechnic article, intended to produce visible and/or audible effects, by combustion, deflagration, or detonation. Fireworks are further described as Fireworks UN0336 (formerly Common Fireworks and now referred to in this Standard as Consumer Fireworks) or Fireworks UN0335 (formerly Special Fireworks and now referred to in this Standard as Display Fireworks). Fireworks may also be described as Fireworks UN0337 if examination and testing in accordance with Title 49, CFR, 173.56 is performed that warrants that classification. [†]

Note: Propelling and expelling charges consisting of a mixture of sulfur, charcoal, and potassium nitrate (saltpeter or similar pyrotechnic compositions not containing metal powders) are not considered as designed to produce audible effects.

D.2.7.1 Consumer Fireworks (Formerly Common Fireworks). Any fireworks device in a finished state, exclusive of mere ornamentation, suitable for use by the public that complies with the construction, performance, composition, and labeling requirements promulgated by CPSC in Title 16, CFR, in addition to any limits and other requirements of this Standard. *(See Section D.3 of this annex for details.)* [†]

D.2.7.2 Display Fireworks (Formerly Special Fireworks). Fireworks devices in a finished state, exclusive of mere ornamentation, primarily intended for commercial displays which are designed to produce visible and/or audible effects, by combustion, deflagration or detonation, including, but not limited to: salutes containing more than 130 mg (2 grains) of explosive composition; aerial shells containing more than 40 g of chemical composition exclusive of lift charge; and other exhibition display items that exceed the limits contained in this Standard for consumer fireworks. Certain devices intended for signaling, illuminating, and incendiary purposes and formerly classed as Special Fireworks no longer fall into this fireworks category. *(See Section D.4 of this annex for details.)* [†]

D.2.8 Electric Match (Igniter). A device used for the electrical ignition of fireworks and pyrotechnic articles that contains a small amount of pyrotechnic material that ignites when a specified electric current flows through the leads. [†]

D.2.9 Labeling. A display of written, printed, or graphic matter upon a fireworks device and/or upon the immediate package of any such device(s). Included are diamond-shaped labels required by DOT to be displayed on outside packaging for transportation purposes. The term also includes any identification, cautions, and other information required by this Standard or by any federal government agency. [†]

D.2.10 Lift Charge. Pyrotechnic composition used to propel a component of a mine or shell device into the air. Lift charge is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel. [†]

D.2.11 Marking. The application of the proper shipping name, identification number (UN number), instructions, cautions, weight, or specification mark or combination thereof to a package of hazardous material. Marking also includes any required specification mark on a shipping package. [†]

D.2.12 Novelty. A device containing small amounts of pyrotechnic and/or explosive composition. Such devices produce limited visible or audible effects. These items must be approved by DOT and are normally classed as 1.4G. A different classification may be assigned based on testing and examination as specified in Title 49, CFR, 173.56. Certain novelties which meet the criteria specified in D.3.2 are not regulated as explosives, and approval by DOT is not required for those specific items. [†]

D.2.13 Placard. A warning symbol of a square-on-point configuration mounted on each side and each end of a truck, rail car or freight container which informs the public and emergency personnel of the hazardous nature of the cargo, as specified in Title 49, CFR, 172. [†]

D.2.14 Quick Match (Instantaneous Fuse). Black match that is encased in a loose-fitting paper or plastic sheath to make it burn extremely rapidly. Quick match is used for aerial shells and for simultaneous ignition of a number of pyrotechnic devices, such as lances in a ground display piece. Quick match may be approved under the provisions of this Standard and classed as 1.3G, described as Fuse, non-detonating, and assigned identification number UN0101. A different classification may be recommended based on testing and examination as specified in Title 49, CFR, 173.56. [†]

D.2.15 Safety Fuse. A fuse consisting of a thread-wrapped Black Powder train that has been coated with a water resistant material. Such fuse is typically $^{3}/_{32}$ in. (2.4 mm) in outside diameter and frequently green in color. Safety Fuse is described as Fuse, Safety UN0105 and classed as 1.4S. [†]

D.2.16 Star. A pressed or consolidated pellet of pyrotechnic composition that is usually cylindrical, spherical, or rectangular in shape. Stars are fired from a launch tube by means of a propelling charge of Black Powder in roman candles and mines, or they are a component of an insert that is fired into the air in an aerial shell. Stars produce a visible display of color and light as they burn in the air, and sometimes a crackling or similar audible effect is also produced. Stars are typically 0.375-1.0 in. in diameter. Larger cylindrical stars are known as comets. A star is not considered a finished firework, and stars cannot be approved for transportation under the provisions of this Standard. [†]

D.2.17 Theatrical Pyrotechnics. Pyrotechnic devices for professional use in the entertainment industry similar to consumer fireworks in chemical composition and construction but not intended for consumer use. Such articles, meeting the lift and effect powder weight limits for similar consumer fireworks but not labeled as such, and containing only chemicals listed in Table D.3.7.1 may be approved under the provisions of this Standard and classified as Articles, Pyrotechnic, 1.4G, UN0431. [†]

Note: Theatrical pyrotechnics devices may be classed by DOT as Articles, Pyrotechnic, 1.4S, UN0432 or as Articles, Pyrotechnic, 1.3G, UN0430 on the basis of examination and testing as specified in Title 49, CFR, 173.56.

D.3 Requirements for Consumer Fireworks, Novelties, and Theatrical Pyrotechnics. Note 1: Devices in this category, formerly classed as Class C Explosive, Common Fireworks, are now classed as Fireworks 1.4G under the UN System, and referred to in this Standard as Consumer Fireworks.

Note 2: Devices intended for non-consumer use in the entertainment industry, termed Theatrical Pyrotechnics in this Standard, that meet the chemical composition weight requirements of Section D.3 may be classed as 1.4G and described as Articles, Pyrotechnic UN0431 under the provisions of this Standard, but are not required to comply with the fuse, construction, and labeling requirements of CPSC for consumer fireworks. Theatrical Pyrotechnics may or may not have an ignition device attached.

D.3.1 Types of Consumer Fireworks. The following fireworks devices are subject to the requirements of Section D.3 of this annex. *(See Appendix A of APA Standard 87-1 for diagrams.)* [†]

D.3.1.1 Ground and Hand-Held Sparkling Devices ("Sparklers"). These devices are ground-based or hand-held devices that produce a shower of white, gold, or colored sparks as their primary pyrotechnic effect. Additional effects may include a colored flame, an audible crackling effect, an audible whistle effect, and smoke. These devices do not rise into the air, do not fire inserts or projectiles into the air, and do not explode or produce a report (a mild audible crackling-type effect is not considered to be a report). Ground-based or hand-held devices that produce a cloud of smoke as their sole pyrotechnic effect are also included in this category. Types of devices in this category include those in D.3.1.1.1 through D.3.1.1.8. [†]

D.3.1.1.1 Cylindrical Fountain. Cylindrical tube containing not more than 75 g of pyrotechnic composition. Upon ignition, a shower of colored sparks, and sometimes a whistling effect or

smoke, is produced. This device may be provided with a spike for insertion into the ground (Spike Fountain), a wood or plastic base for placing on the ground (Base Fountain), or a wood or cardboard handle to be hand held (Handle Fountain). When more than 1 tube is mounted on a common base, total pyrotechnic composition may not exceed 200 g. *(See D.3.5 for exceptions.)* [†]

D.3.1.1.2 Cone Fountain. Cardboard or heavy paper cone containing not more than 50 g of pyrotechnic composition. The effect is the same as that of a cylindrical fountain. When more than 1 cone is mounted on a common base, total pyrotechnic composition may not exceed 200 g. *(See D.3.5 for exceptions.)* [†]

D.3.1.1.3 Illuminating Torch. Cylindrical tube containing not more than 100 g of pyrotechnic composition that produces a colored flame upon ignition. May be spike, base, or hand held. When more than 1 tube is mounted on a common base, total pyrotechnic composition may not exceed 200 g. *(See D.3.5 for exceptions.)* [†]

D.3.1.1.4 Wheel. Pyrotechnic device intended to be attached to a post or tree by means of a nail or string. May have one or more drivers, each of which may contain not more than 60 g of pyrotechnic composition. No wheel may contain more than 200 g total pyrotechnic composition. Upon ignition, the wheel revolves, producing a shower of color and sparks and, sometimes, a whistling effect. [†]

D.3.1.1.5 Ground Spinner. Small device containing not more than 20 g of pyrotechnic composition, venting out an orifice usually on the side of the tube. Similar in operation to a wheel but intended to be placed flat on the ground and ignited. A shower of sparks and color is produced by the rapidly spinning device. [†]

D.3.1.1.6 Flitter Sparkler. Narrow paper tube attached to a stick or wire and filled with not more than 5 g of pyrotechnic composition that produces color and sparks upon ignition. The paper at one end of the tube is ignited to make the device function. [†]

D.3.1.1.7 Toy Smoke Device. Small plastic or paper item containing not more than 100 g of pyrotechnic composition that, upon ignition, produces white or colored smoke as the primary effect. *(For devices containing less than 5 g of pyrotechnic composition, see D.3.2, Novelties.)* Toy smoke devices, when complying with the provisions of this section, are classed as Fireworks, 1.4G unless classed as 1.4S or not regulated as an explosive on the basis of examination and testing as specified in Title 49, CFR, 173.56. [†]

D.3.1.1.8 Wire Sparkler/Dipped Stick. These devices consist of a metal wire or wood dowel that has been coated with pyrotechnic composition. Upon ignition of the tip of the device, a shower of sparks is produced. Sparklers may contain up to 100 g of pyrotechnic composition per item. Certain wire sparklers and dipped sticks are considered as novelties under this Standard. *(See D.3.2.)* [†]

D.3.1.2 Aerial Devices.

D.3.1.2.1 Sky Rockets and Bottle Rockets. Cylindrical tube containing not more than 20 g of chemical composition with a wooden stick attached for guidance and stability. Rockets rise into the air upon ignition. A burst of color and/or sound may be produced at or near the height of flight. [†]

D.3.1.2.2 Missile-Type Rocket. A device similar to a sky rocket in size, composition, and effect that uses fins rather than a stick for guidance and stability. Missiles shall contain not more than 20 g of total chemical composition. [†]

D.3.1.2.3 Helicopter, Aerial Spinner. A tube containing not more than 20 g of chemical composition, with a propeller or blade attached. Upon ignition the rapidly spinning device rises into the air. A visible or audible effect may be produced at or near the height of flight. [†]

D.3.1.2.4 Roman Candle. Heavy paper or cardboard tube containing not more than 20 g of chemical composition. Upon ignition, stars *(see D.2.14)* are individually expelled. [†]

D.3.1.2.5 Mine and Shell Devices. Heavy cardboard or paper tube usually attached to a wooden or plastic base and containing not more than 60 g of total chemical composition (lift charge, burst charge, and visible/audible effect composition.) Upon ignition stars, components producing reports containing up to 130 mg of explosive composition per report, or other devices are propelled into the air. The term *mine* refers to a device with no internal components containing a bursting charge, and the term *shell* refers to a device that propels a component that subsequently bursts open in the air. A mine or shell device may contain more than 1 tube provided the tubes fire in sequence upon ignition of 1 external fuse. The term *cake* refers to a dense-packed collection of mine/shell tubes. Total chemical composition including lift charges of any multiple-tube devices may not exceed 200 g. The maximum quantity of lift charge in any one tube of a mine or shell device shall not exceed 20 g, and the maximum quantity of break or bursting charge in any component shall not exceed 25 percent of the total weight of chemical composition in the component. [†]

Note: Shells that are offered for transportation without a launching tube may not be approved as Fireworks, 1.4G, UN0336 under the provisions of this Standard, except as provided in D.3.1.2.6 for kits. Aerial shells without launching tubes may be approved for transportation as Fireworks, 1.3G, UN0335. *(See D.4.1.1.)*

D.3.1.2.6 Aerial Shell Kit, Reloadable Tube. A package (kit) containing a cardboard, high-density polyethylene (HDPE), or equivalent launching tube and not more than 12 small aerial shells. *(See D.4.1.1.)* Each aerial shell is limited to a maximum of 60 g of total chemical composition (lift charge, burst charge, and visible/audible effect composition), and the maximum diameter of each shell shall not exceed 1.75 inches. In addition, the maximum quantity of lift charge in any shell shall not exceed 20 g, and the maximum quantity of break or bursting charge in any shell shall not exceed 25 percent of the total weight of chemical composition in the shell. The total chemical composition of all the shells in a kit, including lift charge, shall not exceed 400 g for approval under the provisions of this standard. The user lowers a shell into the launching tube, at the time of firing, with the fuse extending out of the top of the tube. After firing, the tube is then reloaded with another shell for the next firing. All launching tubes must be capable of firing twice the number of shells in the kit without failure of the tube. Each package of 12 shells must comply with all warning label requirements of CPSC. [†]

D.3.1.3 Audible Ground Devices.

D.3.1.3.1 Firecracker. Small, paper-wrapped or cardboard tube containing not more than 50 mg of explosive composition, those used in aerial devices may contain not more than 130 mg of explosive composition per report. Upon ignition, noise and a flash of light are produced. [†]

Note: Firecrackers are not subject to the requirements of fuse in D.3.5.1 and chemicals in D.3.6.1 of this annex.

D.3.1.3.2 Chaser. Paper or cardboard tube venting out the fuse end of the tube containing not more than 20 g of chemical composition. The device travels along the ground upon ignition. A whistling effect, or other noise, is often produced. Explosive composition may be included to produce a report but may not exceed 50 mg. [†]

D.3.2 Novelties. The following devices do not require approval from DOT and are not regulated as explosives under the provisions of this Standard, provided that they are manufactured and packaged as described below. Any devices not complying with the requirements set forth in this section require approval from DOT, and are classed as Fireworks 1.4G and described as Fireworks, UN0336, unless they are classed as 1.4S or not regulated as hazardous materials based on examination and testing as specified in Title 49, CFR, 173.56. Devices described in this section which are not regulated as explosives are not considered to be consumer fireworks; however, these devices must still comply with all labeling requirements of CPSC applicable to consumer fireworks devices. Novelties must be packaged in strong outer packagings that are sealed to prevent leakage of the contents. Each package, and overpack if used, offered for surface transportation must be plainly marked NOVELTIES, NOT REGULATED, EXCEPT WHEN TRANSPORTED BY AIR, IN CONFORMANCE WITH APA STANDARD 87-1. If novelties are transported by aircraft, they must be classed, labeled, and described as Flammable Solid, Inorganic, n.o.s (Novelties), UN3178. [†]

D.3.2.1 Party Popper. Small devices with paper or plastic exteriors that are actuated by means of friction (a string or trigger is typically pulled to actuate the device.) They frequently resemble champagne bottles or toy pistols in shape. Upon activation, the device expels flame-resistant paper streamers, confetti, or other novelties and produces a small report. Devices may contain not more than 16 mg (0.25 grains) of explosive composition, which is limited to potassium chlorate and red phosphorus. These devices must be packaged in an inner packaging which contains a maximum of 72 devices. [†]

D.3.2.2 Snapper. Small, paper-wrapped devices containing not more than 1.0 mg of silver fulminate coated on small bits of sand or gravel. When dropped, the device explodes, producing a small report. Snappers must be in inner packages not to exceed 50 devices each, and the inner packages must contain sawdust or a similar, impact-absorbing material. [†]

D.3.2.3 Toy Smoke Devices. Small devices consisting of cork-like spheres, or cardboard or plastic tubes, containing not more than 5 g of pyrotechnic composition that produces a small cloud of smoke after activation. The devices are typically ignited by means of safety fuse. The outer configuration is usually a sphere (smoke ball), cylindrical tube, or paper cone. The chemical composition for white smoke consists of potassium nitrate and sulfur, while colored smokes are produced by mixtures consisting of potassium chlorate, sulfur or sugar, and a sublimable organic dye. Mixtures containing potassium chlorate must also contain a neutralizer/coolant such as sodium bicarbonate. To be eligible for not regulated status, these devices must produce smoke as their sole pyrotechnic effect following ignition, and must be packaged in inner units containing a maximum of 72 devices. [†]

D.3.2.4 Snakes, Glow Worms. Pressed pellets of pyrotechnic composition that contain 2 g or less of composition per article. Upon burning, they produce a snake-like ash that expands in length as the pellet burns. Chemical compositions vary, but typically contain ammonium perchlorate, nitrated pitch, asphaltum, and similar carbonaceous materials. These devices are limited to a maximum of 25 pellets per inner package in order to be transported as not regulated devices. [†]

D.3.2.5 Wire Sparklers, Dipped Sticks. These devices consist of a metal wire or wood dowel that has been coated with pyrotechnic composition. Upon ignition of the tip of the device, a shower of sparks is produced. Sparklers may contain up to 100 g of composition per item. Sparklers typically use barium nitrate as the oxidizer, with aluminum and dextrine as fuels. Iron filings produce the spark effect. Color-producing sparklers use potassium perchlorate as an oxidizer. Any sparkler containing a chlorate or perchlorate oxidizer is limited to a maximum of 5 g of composition per article. Sparklers must be packaged in inner packagings that contain 8 devices or less to be transported as not regulated devices. [†]

D.3.3 Toy Caps. Toy plastic or paper caps for toy pistols in sheets, strips, rolls, or individual caps, containing not more than an average of 0.25 grains (16 mg) of explosive composition per cap. Toy caps are described as Toy Caps NA0337 and classed as 1.4S. Toy caps shall only be approved for transportation using the procedure specified in Title 49, CFR, § 173.56(b). [†]

D.3.4 Other Devices. The Approvals Branch at DOT should be contacted regarding the requirements and procedures for approval of any device that is a unique shape or design, or any device that produces unique pyrotechnic or explosive effects, or combinations of effects not enumerated in Section D.3 of this Standard. [†]

D.3.5 Multiple-Tube Fireworks Devices and Pyrotechnic Articles.

D.3.5.1 Multiple-tube devices contain more than one cardboard tube. The ignition of one external fuse causes all of the tubes to function in sequence. The tubes are either individually attached to a wood or plastic base, or are dense-packed and are held together by glue, wire, string, or other means that securely holds the tubes together during operation. [†]

D.3.5.2 Multiple-tube devices are normally limited to a maximum of 200 g of total pyrotechnic composition for approval as Fireworks, UN0336, 1.4G or Article, Pyrotechnic, UN0431, 1.4G under this Standard. *(See D.3.5.4 for exceptions.)* The weight of chemical composition per tube is limited to the weight limit for the specific type of device in the tube. *(See D.3.1 for the weight limits per tube, based on type of effect.)* [†]

D.3.5.3 The connecting fuses on multiple-tube devices must be fused in sequence so that the tubes fire sequentially rather than all at once. [†]

D.3.5.4 When the tubes are securely attached to a wood or plastic base, and the tubes are separated from each other on

the base by a distance of at least 0.50 in. (12.7 mm), a maximum total weight of 500 g of pyrotechnic composition shall be permitted for approval as 1.4G. [†]

D.3.6 Specific Requirements for Consumer Fireworks.

D.3.6.1 Fuse.

D.3.6.1.1 Only safety fuse or other fuse that has been protected to resist side ignition may be used in consumer fireworks devices subject to the requirements of this Standard. [†]

Note: See APA 87-1, Appendix B, for method of measuring resistance to side ignition. Devices, such as ground spinners, that require a restricted orifice for proper functioning and that contain less than 6 g of pyrotechnic composition, are not subject to the requirements of D.3.6.1.1.

D.3.6.1.2 The fuse must be of sufficient length to burn at least 3 seconds but not more than 9 seconds before ignition of the device. The fuse for roman candles or similar devices requiring a longer fuse for safe functioning may burn up to 12 seconds before ignition of the device. [†]

D.3.6.1.3 The fuse must be securely attached so that it will support either the weight of the device plus 8 ounces (227 g) of dead weight or double the weight of the device, whichever is less, without separation from the fireworks device. [†]

D.3.6.1.4 The fuse on multiple tube devices must be fused in sequence between individual tubes. [†]

D.3.6.2 Construction.

D.3.6.2.1 Bases. Each fireworks device that requires a base shall utilize a base of wood or plastic (preferably non-brittle, medium impact polystyrene). The minimum horizontal dimension or the diameter of the base must be equal to at least the height of the device (excluding any protruding fuse), unless the device remains upright when subjected to a tilt of 12 degrees from the horizontal. Bases shall remain firmly attached to the item during transportation, handling, and normal operation. *(See APA 87-1, Appendix B, for method of measuring.)* [†]

Note: Multiple tube mine and shell devices which contain at least one launching tube with an inner diameter of 1.5 inches or greater must be stable when placed on a test fixture that holds the device at a 60°angle. This is a static test, the fireworks device is not ignited while at a 60°angle.

D.3.6.2.2 Sticks. The stick on a rocket (sky rockets and bottle rockets), and on other fireworks devices that utilize a stick, shall be firmly attached to the body of the device by means of glue, staples, or wire. Sticks must be secure enough to remain firmly attached during transportation, handling, and normal operation. Sticks shall be rigid and of such length so as to assure stable flight. The maximum curvature of such stick(s) may not exceed 1 in. (25 mm). *(See APA 87-1, Appendix B, for method of testing rigidity.)* [†]

D.3.6.2.3 Handles. Each fireworks device which is intended to be hand-held, and is so labeled, must incorporate a handle at least 4 in. (101 mm) in length. Handles must remain firmly attached during transportation, handling, and normal operation of the device. Or must consist of an integral section of the device which extends at least 4 in. (101 mm) below the pyrotechnic chamber. Sparklers 10 in. (253 mm) or less in length shall have handles at least 3 in. (76 mm) in length. [†]

D.3.6.2.4 Spikes. Spikes which constitute an integral part of a fireworks device shall protrude at least 2 in. (51 mm) from the base of the device and shall have a blunt tip not less than ⅛ in. (3.2 mm) in diameter or ⅛ in. (3.2 mm) square. [†]

D.3.6.2.5 Pyrotechnic Chamber. The pyrotechnic chamber in a fireworks device that functions other than by exploding must be of sufficient thickness and rigidity to allow normal functioning of the device without burnout or blowout. The chamber must also be constructed and sealed to prevent leakage of the pyrotechnic composition during transportation, handling, and normal operation. [†]

D.3.6.2.6 Wings. Wings on helicopter-type rockets and similar devices must be securely attached to the body by means of gluing, wiring, or other appropriate means so that they will remain firmly attached during transportation, handling, and normal operation. [†]

D.3.6.2.7 Wheel Devices. Each wheel device must be constructed so that the driver(s), motor(s), and axle(s), when needed (i.e., on wheel devices intended to operate in a fixed location) remain securely attached to the device during transportation, handling, and normal operation. [†]

D.3.6.2.8 Aerial Devices. Each device intended to produce a visible or audible effect high in the air must be designed to produce the effect at or near the apex of its flight. [†]

D.3.6.2.9 Smoke Devices. Each smoke device must be constructed so that it will neither burst nor produce excessive flame (excluding fuse and small but brief bursts of flame accompanying normal smoke production). Smoke devices may not contain plastic in direct contact with the pyrotechnic composition, nor may smoke devices resemble, in color and configuration, banned fireworks devices, such as M-80 salutes, cherry bombs, or silver salutes. [†]

D.3.7 Prohibited Chemicals and Components.

D.3.7.1 Prohibited Chemicals. Consumer fireworks devices offered or intended for sale to the public may not contain a chemical enumerated in Table D.3.7.1, except for small amounts (less than 0.25% by weight) as impurities, and except as specified therein. [†]

Note: Display fireworks and theatrical pyrotechnics *(see D.2.15)* are not subject to the provisions of this section.

D.3.7.2 Prohibited Components. No component of any consumer fireworks device or novelty may, upon functioning, project or disperse any metal, glass, or brittle plastic fragments. [†]

D.3.7.3 Forbidden Devices. Any device intended for sale to the public that produces an audible effect (other than a whistle) by a charge of more than 130 mg (2 grains) of explosive composition per report. Devices obtained for bonafide pest control purposes in accordance with regulations promulgated by CPSC in Title 16, CFR are not forbidden if approved in accordance with Title 49, CFR, 173.56. [†]

Note: For transportation purposes, the term, *forbidden devices,* may also include mixtures or devices that contain a chlorate and an ammonium salt, or an acidic metal, salt. Or, devices that contain yellow or white phosphorus, devices that combine an explosive and a detonator or blasting cap. And, any device that has not been approved by the DOT.

Table D.3.7.1 Prohibited Chemicals for Consumer Fireworks

1. Arsenic sulfide, arsenates, or arsenites
2. Boron
3. Chlorates, except:
   a. In colored smoke mixtures in which an equal or greater weight of sodium bicarbonate is included
   b. In party poppers
   c. In those small items (such as ground spinners) wherein the total powder content does not exceed 4 g of which not greater than 15% (or 600 mg) is potassium, sodium, or barium chlorate
   d. In firecrackers
   e. In toy caps
4. Gallates or gallic acid
5. Magnesium (magnesium/aluminum alloys, called magnalium, are permitted)
6. Mercury salts
7. Phosphorus (red or white) (red phosphorus is permissible in caps and party poppers)
8. Picrates or picric acid
9. Thiocyanates
10. Titanium, except in particle size that does not pass through a 100-mesh sieve
11. Zirconium
12. Lead tetroxide (red lead oxide) and other lead compounds

D.3.8 Specific Requirements for Theatrical Pyrotechnics.

D.3.8.1 Theatrical pyrotechnics that are approved as UN0431, Articles, Pyrotechnic, 1.4G shall not bear a warning label that resembles the required wording on a consumer fireworks device. A warning label providing instructions to a trained operator is permitted, but alternative wording must be used. [†]

D.3.8.2 Theatrical pyrotechnics may or may not have an ignition device attached. [†]

D.3.8.3 All requests for approval of a device as Articles, Pyrotechnic shall be accompanied by a signed certification stating that the article is intended for professional use in the entertainment industry and will not be offered for sale to the general public. [†]

D.3.8.4 Approvals for classification as Articles, Pyrotechnic shall be evaluated based on the weight of pyrotechnic composition in the individual article, and compared to the allowable weights for the corresponding category of 1.4G consumer fireworks. If a 1.4G classification is desired for an article containing more pyrotechnic composition than is permitted for a comparable consumer firework, the DOT approval procedure in Title 49, CFR, 173.56(b)(1) shall be followed. [†]

D.3.9 Approval. All consumer fireworks (Fireworks, UN0336), novelties, and theatrical pyrotechnics offered for transportation in the United States shall be classified and approved for transportation purposes by the DOT, in accordance with the following procedure. [†]

D.3.9.1 Fireworks and novelties containing mixtures of chemicals specified in Table D.4.3.1, but none of the chemicals prohibited by D.3.7. For each item for which approval is sought, manufacturers shall submit a copy of an approval application *(see APA 87-1, Appendix D)* to DOT. DOT may issue an approval for the device as 1.4G based on the information contained in the form or, at its option, may require laboratory examination by a person approved by DOT to examine explosives. [†]

D.3.9.2 Fireworks and novelties containing any chemical not specified in Table D.4.3.1, but none of the chemicals prohibited by D.3.7. For each item in which approval is sought, the manufacturer shall obtain a report from a person approved by DOT to examine explosives or, obtain a test report from a recognized competent authority (for fireworks manufactured abroad). The manufacturer shall then submit an approval application *(see APA 87-1, Appendix D)* together with the appropriate examination reports to DOT. DOT may then issue approval based on the information contained in the application and accompanying laboratory reports, or may require additional information. [†]

D.3.9.3 Theatrical pyrotechnics containing only mixtures of chemicals specified in Table D.4.3.1. For each item in which approval is sought, manufacturers shall submit a copy of an approval application *(see APA 87-1, Appendix D)* to DOT. DOT may issue an approval for the device as 1.4G based on the information contained in the form. Or, at DOT's discretion, may require a report from a person approved by DOT to examine explosives or may require a test report from a recognized competent authority (for articles manufactured abroad). [†]

D.3.9.4 Theatrical pyrotechnics containing any chemical not specified in Table D.4.3.1. For each item in which approval is sought, the manufacturer shall obtain a report from a person approved by DOT to examine explosives or obtain a test report from a recognized competent authority (for articles manufactured abroad). The manufacturer shall then submit an approval application *(see Appendix D of this Standard)* together with the appropriate laboratory reports to DOT. DOT may then issue an approval based on the information contained in the application and accompanying laboratory reports. [†]

D.3.9.5 If classification other than 1.4G is sought, the DOT approval procedure in Title 49, CFR, 173.56(b)(1) must be followed. This includes obtaining a laboratory report from a person approved by DOT to examine explosives. [†]

D.3.10 Marking and Labeling. Fireworks intended for consumer sale and use shall be labeled in conformance with the requirements of the Federal Hazardous Substances Act and regulations promulgated thereunder in Title 16, CFR, 1500. All outside packaging containing fireworks must be marked and labeled in conformance with Title 49, CFR, 172. *(See APA 87-1, Appendix C, and Section D.5 of this annex for details and examples.)* [†]

D.4 Requirements for Display Fireworks Devices. Note: Devices in this category, formerly classed as Class B Explosives, Special Fireworks, are now classed as 1.3G, under the UN system and referred to as display fireworks. [†]

D.4.1 Types of Display Fireworks Devices. The following fireworks devices are subject to the requirements of Section D.4 of this annex. [†]

D.4.1.1 Aerial Shell. A cylindrical or spherical cartridge containing lift charge, burst charge and effect composition. Shells are most commonly 2 inches (50 mm) to 6 inches (152 mm) in diameter, and are fired from metal, high-density polyethylene (HDPE), fiberglass, or heavy cardboard tubes. Upon firing, the lift charge is consumed and the cartridge is expelled into the air. A pyrotechnic effect is produced near the apex of flight. Aerial shells are typically ignited by means of a quick match fuse or electric match. Burst charge used in aerial shells is limited to Black Powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition may not be approved under the provisions of this Standard as 1.3G articles. Aerial shells exceeding 10 inches (250 mm) in diameter or containing a burst charge that has metallic fuel may be approved under this Standard as Fireworks, UN0333, 1.1G. [†]

Note: All aerial shells that are not contained in a launch tube (D.3.1.2.5) or sold as part of a reloadable shell kit (D.3.1.2.6) may only be approved under the provisions of this Standard as Fireworks, UN0335, 1.3G.

D.4.1.2 Salute. Paper-wrapped, cardboard tube, or sphere containing explosive composition in excess of 130 mg (2 grains.) Upon ignition, noise and a flash of light are produced. The maximum quantity of explosive composition in a salute shell, or in a salute component of a multi-effect shell, shall not exceed 2.5 oz (71 g) for approval under this Standard as a 1.3G article. Salutes or articles with salute components containing more than 2.5 oz (71 g) of explosive composition per salute or per component may be approved under this Standard as Fireworks, UN0333 1.1G. [†]

D.4.1.3 Other Fireworks Devices.

D.4.1.3.1 When the quantity of explosive and/or pyrotechnic composition exceeds the limit for inclusion in the Fireworks, UN0336 category, devices enumerated in D.3.1 are classed as 1.3G and described as Fireworks, UN0335 (formerly described as Fireworks, Special and classed as Class B Explosives). This includes multiple tube devices containing more than 200 g of total chemical composition, except as otherwise specified in D.3.5. [†]

D.4.1.3.2 Certain devices intended for signaling, illuminating, and incendiary purposes such as: railway torpedoes; airplane flares; illuminating projectiles; incendiary and smoke projectiles, as well as flash cartridges (formerly classed as special fireworks), no longer fall into the fireworks category under DOT regulations effective on 10/1/91, and are not part of this Standard. [†]

D.4.2 Construction of Aerial Shells.

D.4.2.1 Each shell shall be identified only in terms of the inside diameter (not the circumference) of the mortar in which it can be safely used [e.g., 3 in. (76 mm) shells are only for use in 3 in. (76 mm) mortars]. [†]

D.4.2.2 Each shell shall be constructed so that the difference between the inside diameter of the mortar in which it can be safely used and the outside diameter of the shell is no less than ⅛ in. (3.2 mm) and not more than ¼ in. (6.4 mm) for shells not exceeding 3 in. (76 mm) or ½ in. (12.7 mm) for shells larger than 3 in. (76 mm). [†]

D.4.2.3 Each shell needs to be marked with the type of shell, the diameter measurement, and the name of the manufacturer or distributor. [†]

D.4.2.4 The length of the internal delay fuse and the amount of lift charge must be sized to insure proper functioning of the shell in its mortar. Quick match fuse, if required, must be long enough to allow not less than 6 in. (152 mm) of fuse to protrude from the mortar after the shell is properly inserted. [†]

D.4.2.5 The length of exposed black match on a shell, if required, may not be less than 3 in. (76 mm) and the fuse shall not be folded or doubled back under the safety cap. Also, the time delay between ignition of the tip of the exposed black match and ignition of the lift charge may not be less than 3 seconds to allow the operator to retreat safely. [†]

D.4.2.6 A safety cap shall be installed over the exposed end of the fuse, if ignition fuse is present. The safety cap must be of a different color than that used for the paper of the fuse. [†]

D.4.2.7 If an electric match is attached to an aerial shell or other display firework prior to transportation, the requirements in D.5.8 must be complied with. [†]

D.4.3 Approval. Prior to being offered for transportation in the United States all display fireworks (Fireworks, 1.3G) must be classified and approved by DOT in accordance with the following procedures. [†]

D.4.3.1 Devices Containing Only Mixtures of Chemicals Specified in Table D.4.3.1. The manufacturer shall submit a copy of an approval application *(see APA 87-1, Appendix D)* to DOT for any item that has not previously been approved by DOT. DOT may issue an approval for the device based on the information contained in the form. Or, at its discretion, may require examination by a person approved by DOT to examine explosives, or may accept a test report from a recognized competent authority (for fireworks manufactured abroad). [†]

D.4.3.2 Devices Containing any Chemical Not Specified in Table D.4.3.1. For each item in which approval is sought, the manufacturer shall submit a sample of each pyrotechnic mixture that contains any chemical not specified in Table D.4.3.1 to a person approved by DOT to examine explosives. Or, the applicant may obtain a test report from a recognized competent authority (for fireworks manufactured abroad). The manufacturer shall then submit an approval application *(see APA 87-1, Appendix D)*, together with the appropriate laboratory reports to DOT. DOT may then issue approval based on the information contained in the application and accompanying laboratory report(s). [†]

Miscellaneous Compounds: Organic compounds may be compounds such as: lactose; shellac; red gum; chlorinated paraffin; and polyvinyl chloride that consist of some combination of carbon with hydrogen, oxygen and/or chlorine. Nitrogen may be present if it accounts for less than 10% (by weight) of the compound. [†]

Nitrocellulose with not more than 12.6% nitrogen by mass, that meets the criteria for classification as a 4.1 flammable solid, is permitted as a propelling or expelling charge provided there is less than 15 g of nitrocellulose per article. [†]

Note: Exact chemical identity of each organic compound must be included when submitting an approval application *(See APA 87-1, Appendix D)* to DOT. [†]

Δ Table D.4.3.1 Standard Fireworks Chemicals

Chemical	Typical Use
Aluminum	Fuel
Ammonium Perchlorate	Oxygen Donor
Antimony	Fuel
Antimony Sulfide	Fuel
Barium Carbonate	Neutralizer
Barium Nitrate	Oxygen Donor
Barium Sulfate	Oxygen Donor
Bismuth Oxide	Oxygen Donor
Boric Acid	Neutralizer
Calcium Carbonate	Neutralizer
Calcium Sulfate	Oxygen Donor
Carbon or Charcoal	Fuel
Copper Metal	Color Agent
Copper Oxide	Oxygen Donor/Color Agent
Copper Salts (except Copper Chlorate)	Color Agent
Dextrine	Fuel/Binder
Hexamethylenenetetramine (Hexamine)	Fuel
Iron and Iron Alloys (e.g., ferro/titanium)	Fuel
Iron Oxide	Oxygen Donor
Magnalium (Magnesium/Aluminum)	Fuel
Magnesium (in display fireworks and theatrical pyrotechnics only)	Fuel
Magnesium Carbonate	Neutralizer
Magnesium Sulfate	Oxygen Donor
Nitrocellulose (see Miscellaneous Compounds)	
Nitrocellulose Based Lacquers	Binder
Phosphorus, Red (only as provided in Table D.4.3.1)	Fuel
Potassium or Sodium Benzoate	Whistle
Potassium Bichromate (Potassium Dichromate) (not to exceed 5% of formulation)	Oxygen Donor
Potassium Chlorate (only as provided in Table D.4.3.1)	Oxygen Donor
Potassium Hydrogen Phthalate	Whistle
Potassium Nitrate	Oxygen Donor
Potassium Perchlorate	Oxygen Donor
Potassium Sulfate	Oxygen Donor
Silicon	Fuel
Sodium Bicarbonate (Sodium Hydrogen Carbonate)	Neutralizer
Sodium Nitrate	Oxygen Donor
Sodium Salicylate	Whistle
Sodium Salts (except Sodium Chlorate)	Color Agent
Sodium Sulphate	Oxygen Donor
Strontium Carbonate	Color Agent
Strontium Nitrate	Oxygen Donor
Strontium Salts (except Strontium Chlorate)	Color Agent
Strontium Sulfate	Oxygen Donor
Sulfur	Fuel
Titanium (particle size must not pass through 100 mesh sieve if 1.4G or 1.4S Fireworks)	Fuel

D.4.4 Approval for Combination Devices for Display Purposes. When two or more articles of consumer or display fireworks, or theatrical pyrotechnics (already approved by DOT) are combined to form one unit, a separate approval for the combination device is not required if all of the following conditions are met. [†]

D.4.4.1 The combination device is to be used for display or entertainment purposes, but is not intended for consumer use. [†]

D.4.4.2 The combination device is constructed from approved fireworks, novelties, and theatrical pyrotechnics. [†]

D.4.4.3 The combination device is transported by private carrier. [†]

D.4.4.4 The assembled unit is transported using the EX numbers for the individual components. [†]

D.4.4.5 If all components of the combination device have been approved as 1.4G articles, the combination item is classed as a 1.4G article provided that the total weight of pyrotechnic composition (including lift and effect charges) in the article does not exceed 200 g. *(See D.3.5 for exception.)* The combination device shall be described as UN0431, Articles, Pyrotechnic, 1.4G if all of the components are approved as UN0431. Otherwise, the device shall be described as UN0336, Fireworks, 1.4G. [†]

D.4.4.6 If one or more of the components has been classed as a 1.3G Article, or if the total weight of pyrotechnic composition (including lift and effect charges) is more than 200 g *(see D.3.5 for exception)*, then the assembled unit is classed as a 1.3G Article. The combination device shall be described as UN0430, Articles, Pyrotechnic, 1.3G if all of the components are classed as either UN0430 or UN0431. Otherwise, the device shall be described as UN0335, Fireworks, 1.3G. [†]

D.5 Shipping Requirements.

D.5.1 Transportation Regulating Authorities. Transportation of fireworks is regulated by DOT. Some states and municipalities also regulate transportation of fireworks through their jurisdiction, often by incorporation of federal regulations. [†]

D.5.2 Approval. Except for samples prepared in accordance with DOT regulations, or unless specifically permitted by this Standard, no fireworks device or novelty may be offered for transportation or transported until it is classed and approved by DOT, and an approval number (EX number) is issued (Title 49, CFR, 173.86). *(See Sections D.3 and D.4 of this annex and APA 87-1, Appendix D.)* [†]

D.5.2.1 EX numbers for fireworks contained in a shipping carton must be marked on the shipping carton or on the shipping paper. [†]

D.5.2.2 Cartons containing 5 or more different fireworks devices must be marked with at least 5 of the EX numbers covering items in the carton, or the EX numbers must appear on the shipping paper [Title 49, CFR, 172.320(c) and (d)]. [†]