

NFPA 1123

Code for

Fireworks Display

1995 Edition



National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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NFPA 1123

Code for Fireworks Display

1995 Edition

This edition of NFPA 1123, *Code for Fireworks Display*, was prepared by the Technical Committee on Pyrotechnics and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held May 22-25, 1995, in Denver, CO. It was issued by the Standards Council on July 21, 1995, with an effective date of August 11, 1995, and supersedes all previous editions.

This edition of NFPA 1123 was approved as an American National Standard on August 11, 1995.

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

Origin and Development of NFPA 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 incorporates 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 represents partial amendments to the document and includes editorial revisions to improve its ability to be used, adopted, and enforced and to make it conform with the NFPA Manual of Style. The Committee has 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.

For this edition, a new chapter containing requirements for electrically firing fireworks displays has been incorporated and the provisions for manually firing large diameter aerial shells has been refined. In addition, a new glossary of fireworks terms was added to the appendix of the document.

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

Committee Scope: This Committee shall have primary responsibility for documents on protection against the fire and life hazards associated with the manufacture, transportation, and storage of fireworks; fireworks used in outdoor displays; pyrotechnics used before a proximate audience; and the construction, launching, and other operations that involve unmanned rockets, including the manufacture of model rocket motors. This Committee shall not have responsibility for documents on the use of fireworks by the general public.

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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 Appendix A.

Information on referenced publications can be found in Chapter 7 and Appendix G.

Chapter 1 General

1-1 Scope.

1-1.1 This code shall apply to the construction, handling, and use of fireworks intended solely for outdoor fireworks display. It also shall apply to the general conduct and operation of the display. (See definition of *Fireworks Display*.)

1-1.2 This code shall not apply to the manufacture, transportation, or storage of fireworks at a manufacturing facility. Similarly, this code shall not apply to the testing of fireworks under the direction of its manufacturer, provided permission for such testing has been obtained from the authority having jurisdiction, which shall be in accordance with NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks*.

1-1.3 This code shall not apply to the use of consumer fireworks by the general public.

1-1.4 This code shall not apply to the transportation, handling, or use of fireworks by the armed forces of the United States.

1-1.5 This code shall not apply to the transportation, handling, or use of industrial pyrotechnic devices or fireworks, such as railroad torpedoes, fuses, automotive, aeronautical, and marine flares and smoke signals.

1-1.6 This code shall not apply to the use of pyrotechnic devices or materials in the performing arts at distances less than those specified in this code and used in conformance with NFPA 1126, *Standard for the Use of Pyrotechnics before a Proximate Audience*.

1-1.7 This code shall not apply to the sale and use of model rockets, model rocket motors, motor reloading kits, pyrotechnic modules, or components used in conformance with NFPA 1122, *Code for Model Rocketry*, or other propulsion devices as classified by the U.S. Department of Transportation as Rocket motors (UN0186), or Cartridges, power device (UN0275).

1-1.8 This code shall not apply to the use of explosives, firearms, or flammable special effects used in motion pictures, television, or other entertainment industries.

1-2 Purpose.

1-2.1 The purpose of this code is to provide requirements for the reasonably safe conduct of outdoor fireworks displays.

1-2.2 The purpose of this code also is to provide recommended local permit regulations. (See Appendix C.)

1-2.3 The purpose of this code also is to provide recommended regulations for state certification of display operators. (See Appendix D.)

1-3 Equivalency. This code is not intended to prevent the use of systems, methods, or devices that provide protection equivalent to the provisions of this code, provided equivalency can be demonstrated to the authority having jurisdiction.

1-4 Definitions. For the purpose of this code, the terms below shall be defined as follows:

Aerial Shell. Usually a cylindrical or spherical cartridge containing pyrotechnic composition, a long fuse or electric match wires, and a black powder lift charge. 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.

Approved.* Acceptable to the authority having jurisdiction.

Assistant. A person who works under the direction of the operator to put on an outdoor fireworks display. The duties of an assistant include tasks such as loading mortars, spotting the bursting location of aerial shells, tending a ready box, setting up and cleaning the discharge site, and igniting fireworks.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

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

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

Black Match. A fuse made from string that is impregnated with black powder and used for igniting pyrotechnic devices.

Break. An individual burst from an aerial shell, generally either producing a visual effect (stars) or noise (salute). Aerial shells can be either single-break (having only one burst) or multi-break (having two or more bursts).

Chain Fusing. A series of two or more aerial shells fused to fire in sequence from a single ignition. Finales and barrages typically are chain fused.

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

Comet. A fireworks device consisting of a large pellet of pyrotechnic composition that is ignited and propelled from a mortar tube by a charge of black powder. Comets frequently leave a trail of sparks as they rise in the air, and they sometimes burst into smaller fragments at their zenith.

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

Display Site. The immediate area where a fireworks display is conducted. This includes the discharge site, the fallout area, and the required separation distance from mortars to spectator viewing areas. The display site does not include spectator viewing areas or vehicle parking areas.

Electrical Firing Junction. A box or slat, connected by wire or cable to the firing unit, that contains electrical connectors that are intended to be attached to electric matches.

Electrical Firing Unit. A device that provides and controls the electric current used to ignite fireworks during an outdoor display. 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 hand-held.

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

Hand-Held Electrical Firing Unit. A small, hand-held unit with manually operated switches that control the flow of electric current to electric matches attached to fireworks devices. The unit is connected directly to the electric matches by means of wires.

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. The unit contains wires or cables that are attached to junctions that are, in turn, connected to the electric matches.

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

Electric Match. A device consisting of wires terminating at a relatively high-resistance element surrounded by a small quantity of heat-sensitive pyrotechnic composition. 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.

Fallout Area. The area over which aerial shells are fired. 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.

Finale. A rapidly fired sequence (barrage) of aerial fireworks, typically fired at the end of a display. The mortars are loaded prior to the display, and the aerial shells are chain fused to fire in rapid sequence.

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.

*Exception No. 1: *Toy caps for use in toy pistols, toy canes or toy guns, and novelties and trick noisemakers as enumerated in Appendix E of this code are not considered to be fireworks.*

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

Consumer Fireworks. Any small fireworks device designed primarily to produce visible effects by combustion or deflagration that complies with the construction, chemical composition, and labeling regulations of the U.S. Consumer Product Safety Commission, as set forth in Title 16, *Code of Federal Regulations*, Parts 1500 and 1507. Some small devices designed to produce audible effects are included, such as whistling devices, ground devices containing 50 mg (0.002 g) or less of explosive composition (salute powder), and aerial devices containing 130 mg (0.005 g) or less of explosive composition (salute powder) per explosive unit. Consumer fireworks are normally classed as Explosives, 1.4G and described as Fireworks, UN0336 by the U.S. Department of Transportation. Various categories of consumer fireworks devices are enumerated in Appendix E.

Display Fireworks. Fireworks devices intended for use in fireworks displays that are presented in conformance with the provisions of this code. These devices are designed to produce visible or audible effects for entertainment purposes by combustion, deflagration, or detonation. The term "display fireworks," as used in this code, includes consumer fireworks to be used in fireworks displays; larger devices of similar construction and chemical composition that are classed as Explosives, 1.3G and described as Fireworks, UN0335 by the U.S. Department of Transportation; and other devices that produce visible or audible effects for entertainment purposes that are classed as Explosives, 1.3G, 1.4G, or 1.4S and described as Article, Pyrotechnic by the U.S. Department of Transportation.

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

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

Ground Display Piece. A pyrotechnic device that functions on the ground (as opposed to an aerial shell that functions in the air). Typical ground display pieces include fountains, roman candles, wheels, and "set pieces."

Hazardous Debris. Any debris produced or expelled by the functioning of a pyrotechnic device that is capable of causing personal injury or unpredicted property damage. This includes, but is not limited to, hot sparks, heavy casing fragments, and unignited components. Confetti, light-weight foam pieces, feathers, novelties, etc., are not to be construed as hazardous debris.

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.

Lance. A thin cardboard tube packed with color-producing pyrotechnic composition used to construct ground display pieces. Lances are mounted on a frame and fused so that ignition of all tubes is nearly simultaneous.

Lift Charge. That composition in an aerial shell that propels (lifts) the shell into the air when ignited. It usually consists of a black powder charge ignited by a quick match fuse. (A time delay fuse then ignites the main part of the shell, producing the desired effect.)

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

Manual Ignition. A technique used to ignite fireworks using a hand-held ignition source such as a fusee or portfire.

Mine. A device designed to project numerous stars and other effects, such as whistles and firecrackers, into the air from a mortar. A black powder charge ignites the contents of the mine, propelling its contents into the air to altitudes that usually are lower than those reached by aerial shells.

Monitor. A person designated by the sponsors of the display to keep the audience in the intended viewing area and out of the discharge site and fallout area.

Mortar. A tube from which aerial shells are fired into the air.

Mortar Rack. A strong frame containing mortars. Such racks most often are used for barrages and finales and in electrically ignited displays.

Mortar Trough. Aboveground structures filled with sand or similar material into which mortars are positioned ready for use in a fireworks display.

No-fire Current. The maximum current that can be applied to an electric match for 5 seconds at room temperature without the match igniting.

Operator. The person with overall responsibility for the safety set up, and discharge of an outdoor fireworks display.

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

Potential Landing Area. See Fallout Area.

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

Ready Box. A storage container for aerial fireworks such as mines, comets, and shells at the site of a fireworks display.

Safety Cap. A paper tube, closed at one end, that is placed over the end of the fuse of a fireworks device to protect it from damage and accidental ignition.

Salute. A display fireworks item that is designed to produce a loud report.

Salute Powder. A pyrotechnic composition that makes a loud report when ignited and constitutes the sole pyrotechnic effect of a salute.

Shall. Indicates a mandatory requirement.

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.

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

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.

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.

Trough. See Mortar Trough.

Chapter 2 Requirements for Display Fireworks Aerial Shells and Equipment

2-1 Construction of Display Fireworks Aerial Shells.

2-1.1 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 are only for use in 3-in. (76-mm) mortars].

2-1.2* Aerial shells shall be constructed so that they fit easily into the appropriate size mortar and so that the lift charge and internal delay fuse are appropriate to propel the shell to a safe altitude before functioning.

2-1.3* Shells shall be marked with the type of shell, the shell size, and the name of the manufacturer or distributor. Shells also shall carry a warning label, as described in Appendix B.

2-1.3.1 The label or wrapper of any type of aerial shell shall be marked conspicuously with a number to indicate the shell size (the diameter of the mortar to be used).

2-1.3.2 The label or wrapper of any type of aerial salute shall be conspicuously marked with the word "Salute."

2-1.4 For aerial shells using a quick match fuse to ignite the lift charge, that fuse shall be long enough to allow not less than 6 in. (152 mm) of fuse to protrude from the mortar after the shell has been inserted properly.

Exception: This requirement shall not apply where shells are to be fired electrically.

2-1.5 In order to allow the person igniting the aerial shells to retreat safely, the time delay between igniting the tip of the shell's fuse and the firing of the shell shall not be less than 3 seconds or more than 6 seconds.

Exception: For electrically ignited displays, no delay period shall be required.

2-1.6 A safety cap shall be installed over the exposed end of the fuse. The safety cap shall be of a different color than that of the fuse. The safety cap shall be installed in such a manner that the fuse is not damaged.

Exception: For electrically fired displays, no safety cap shall be required, but there shall be no exposed pyrotechnic composition.

2-1.7 Salute Shell Limits.

2-1.7.1 Single break salute shells shall not exceed 3 in. (76 mm) in diameter or 3 in. (76 mm) in length (exclusive of the propellant charge). The maximum quantity of salute powder in such salutes shall not exceed 2.5 oz (71 g).

2-1.7.2 For single break shells greater than 3 in. (76 mm) in diameter containing multiple internal salutes and for multi-break shells greater than 3 in. (76 mm) in diameter, the maximum quantity of salute powder per shell shall not exceed 5 oz (142 g).

2-1.7.3 Ground Salutes.

2-1.7.3.1 Ground salutes shall not exceed 3 in. (76 mm) in diameter by 3 in. (76 mm) in length.

2-1.7.3.2 The maximum quantity of salute powder in ground salutes shall not exceed 2.5 oz (71 g).

2-1.7.3.3 Ground salutes shall not be constructed using brittle plastic.

2-2 Transportation to and Storage of Fireworks at the Discharge Site.

2-2.1 All fireworks materials and devices in transit to the fireworks discharge site shall be transported in accordance with Title 49, *Code of Federal Regulations*, "Federal Regulation for Transport," NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks*, and Title 27, *Code of Federal Regulations*, Part 18, Bureau of Alcohol, Tobacco and Firearms, Part 181, Commerce in Explosives.

2-2.2 As soon as the fireworks have been delivered to the display site, they shall not be left unattended, and they shall be kept dry.

2-2.3 All shells shall be inspected by the operator or assistants following delivery to the display site. Any shells having tears, leaks, broken fuses, or signs of having been wet shall be set aside and shall not be fired. After the display, such shells shall be either returned to the supplier or destroyed in accordance with the supplier's instructions.

Exception: Minor repairs to fuses shall be permitted. For electrically ignited displays, attachment of electric matches and other similar tasks shall be permitted.

2-2.4 Ready Boxes.

2-2.4.1 A ready box shall be a weather-resistant container that protects contents from burning debris with a self-closing cover or equivalent means of closure required.

2-2.4.2 After delivery and prior to the display, all shells shall be separated according to size and their designation as salutes. Any display fireworks that will be temporarily stored at the display site during the fireworks display shall be stored in ready boxes separated according to size and their designation as salutes. Tarpaulins shall not be considered as ready boxes.

Exception: For electrically ignited displays, or displays where all shells are loaded into mortars prior to the show, there is no requirement for separation of shells according to size, their designation as salutes, or for the use of ready boxes.

2-2.4.3* During the performance of an outdoor fireworks display, ready boxes shall be located at a distance not less than 25 ft (7.7 m) upwind from the mortar placements. If the wind shifts during a display, the ready boxes shall be located to again be upwind from the discharge site.

Exception No. 1: Where permitted by the authority having jurisdiction, alternate measures shall be taken.

Exception No. 2: Where there are no shells requiring storage during a display, such as for an electrically ignited display, no ready boxes shall be required.

2-3 Installation of Mortars.

2-3.1* Prior to placement, mortars shall be inspected carefully for defects, such as dents, bent ends, damaged interiors, and damaged plugs. Defective mortars shall not be used.

2-3.2* Mortars shall be positioned so that shells are propelled away from spectators and over the fallout area. Under no circumstances shall mortars be angled toward the spectator viewing area. (Also see Section 3-2.)

2-3.3* Mortars shall be buried to a depth of at least $\frac{2}{3}$ to $\frac{3}{4}$ of their length, either in the ground or in aboveground troughs or drums.

Exception No. 1: Securely positioned mortar racks shall be permitted for the firing of single break shells not exceeding 6 in. (152 mm) in diameter.

Exception No. 2: Securely positioned mortar racks shall be permitted for firing single break shells that are 7 in. (178 mm) or 8 in. (203 mm) in diameter, provided that the mortar is not metallic, electrical or equivalent means of remote ignition is used to fire the shell, and the shell is not chain fused to any other shells.

2-3.3.1 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.

2-3.3.1.1 Wherever there is the likelihood of ground water leaking into the mortar, the mortar shall be placed inside a water-resistant bag prior to placement in the ground.

2-3.3.1.2 Weather-resistant coverings shall be placed over the mouth of mortars wherever there is imminent danger of water collecting in the mortars.

2-3.3.2* In soft ground, where there is significant danger of the mortars being driven further into the ground when they are fired, sufficient added support shall be placed beneath the mortars.

Exception: Where a mortar is to be used only once, such as for an electrically fired display, added support shall be optional and shall not be required.

2-3.3.3* 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.

Exception: Where electrical ignition is used, all mortars buried in earth or placed in drums or troughs shall be spaced at least 2 in. (50 mm) nominally apart.

2-3.3.3.1 Mortars in troughs or drums shall be positioned to afford the maximum protection to the shooter.

Exception: This requirement shall not apply where electrical firing is used.

2-3.3.3.2 There shall be a separation distance of at least 2 in. (50 mm) or $\frac{1}{2}$ the diameter of the mortar, whichever is greater, between the mortar and the trough or drum.

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

2-3.3.4 If troughs and drums are used, they shall be filled with sand or soft dirt; in no case shall stones or other potentially dangerous debris be present.

2-3.3.5 Provisions for Chain Fusing. Wherever more than three shells are to be chain fused, such as for sequential firing, additional measures shall be required to prevent adjacent mortars from being repositioned in the event that a shell detonates in a mortar, causing it to burst.

2-3.3.5.1 For buried mortars, prevention of repositioning shall be accomplished by spacing the mortars with a minimum separation distance of four times their diameter.

Exception: Where the separation distance is twice that required in Table 3-1.3, buried mortars shall be separated by a minimum distance of the internal diameter of the largest mortar in the sequence.

2-3.3.5.2* For mortars in racks, prevention of repositioning shall be accomplished by using mortar racks that have sufficient strength to withstand such a failure successfully.

Exception: 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 3-1.3 for the largest mortar in the sequence.

2-3.3.5.3 Chain fused mortar racks shall be positioned to maximize the placement of racks perpendicular to spectator viewing areas.

2-3.3.5.4 Chain fused mortar racks containing mortars 3 in. (76 mm) or less in diameter only shall be limited to a maximum of 15 mortars per unit. Racks containing mortars 4 in. (100 mm) in diameter shall be limited to a maximum of 12 mortars. Racks containing mortars 5 in. to 6 in. (125 mm to 150 mm) in diameter shall be limited to a maximum of 10 mortars. Chain fused racks shall not be used for mortars greater than 6 in. (150 mm) in diameter.

Exception: Boxed finale items containing tubes 2.5 in. (75 mm) or less in diameter only shall not be required to comply with the limitations in 2-3.3.5.4.

2-3.3.5.5 All chain fused aerial fireworks devices, including those not in mortar racks such as roman candle batteries and multiple-tube aerial items on boards, shall be positioned securely to prevent tipover or movement during operation. This shall be accomplished by the use of stakes, racks, sand bags, earth, or equivalent means.

2-3.3.6* Where mortars are to be reloaded during a display, mortars of various sizes shall not be intermixed. Mortars of the same size shall be placed in groups, and the groups shall be separated from one another.

2-3.4 Where personnel are to be in the immediate area of the mortars during an outdoor fireworks display, sand bags or other suitable protection shall be placed around the mortars up to the approximate level of the mouth of the mortar in each direction where personnel could be present.

2-3.5 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.

2-3.6.1 Mortars shall be of sufficient strength and durability to fire the aerial shells to be used safely.

2-3.6.2 Cast iron, stove pipe, corrugated culvert, clay, bamboo, and wood shall not be used to make mortars.

2-3.6.3* Metal mortars shall be either seamed or seamless; however, seamed mortars shall be placed so that all seams face either right or left when viewing the line of mortars.

2-3.6.4 Mortars shall be of sufficient length to cause aerial shells to be propelled to safe heights.

2-3.7 The dimension of the inside diameter of the mortar shall be conspicuously painted or otherwise marked on the top of all mortars.

Exception: Designation of the inside diameter dimension shall not be required for outdoor fireworks displays fired under the direct control of a professional fireworks display company.

Chapter 3 Display Site Selection

3-1 General.

3-1.1 The intent of this chapter is to provide requirements for clearances upon which the authority having jurisdiction shall base its approval of an outdoor fireworks display site. Where added safety precautions have been taken, or particularly favorable conditions exist, the authority having jurisdiction 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 properly protected. Where unusual or safety threatening conditions exist, the authority having jurisdiction shall be permitted to increase the required separation distances as it deems necessary.

3-1.2 The areas selected for the discharge site, spectator viewing area, parking areas, and the fallout area shall be inspected and approved by the authority having jurisdiction.

3-1.3* The site for the outdoor land or water display shall have at least a 70-ft/in. (22-m/2.5 mm) radius of internal mortar diameter of the largest aerial shell to be fired as shown in Table 3-1.3.

Exception: For mortars less than 3 in. (76 mm) in diameter or greater than 12 in. (305 mm) in diameter, see Table 3-1.3.

3-1.3.1 No spectators or spectator parking areas shall be located within the display site.

3-1.3.2 Dwellings, buildings, and structures shall be permitted to be located within the display site with the approval of the authority having jurisdiction and the owner of the dwelling, building, or structure, if the dwelling, building, or structure is unoccupied during the display, or if the structure provides protection through substantial noncombustible or fire-resistant construction to the occupants.

Table 3-1.3 Distances for Outdoor Fireworks Display Sites

Minimum Separation Distances Mortars to Spectators for Land or Water Displays									
Mortar Size ¹ (in.)	Mortar Size ¹ (mm)	Minimum Secured Diameter of Site ² (ft)	Minimum Secured Diameter of Site (m)	Vertical Mortars ³ (ft)	Vertical Mortars ³ (m)	Angled Mortars ⁴ 1/3 offset (ft)	Angled Mortars ⁴ 1/3 offset (m)	Mortars to Special Hazards ⁵ (ft)	Mortars to Special Hazards ⁵ (m)
<3	(<76)	280	(85)	140	(43)	95	(29)	280	(85)
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)

>12 Approval of the Authority Having Jurisdiction.

¹See 2-1.1.

²See 3-1.3.

³See 3-2.3.

⁴See 3-2.3.1. Note that for angled mortars, the minimum secured diameter of the display site does not change. Only the location of the mortars within the secured area changes when the mortars are angled.

⁵See 3-1.3.2. Note that this is only the distance to the special hazards. The minimum secured diameter of the display site does not change.

3-1.3.3* Distances from health care and detention and correctional facilities shall be at least twice the distances specified in Table 3-1.3.

Exception: Where approved by the health care or detention and correctional facility.

3-1.3.4* The distance between the mortar line and bulk storage areas of materials that have a flammability, explosive, or toxic hazard shall be twice that required by Table 3-1.3.

3-2 Discharge Site.

3-2.1 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 (7.7 m) of any overhead object.

3-2.2 Ground display pieces shall be located a minimum distance of 75 ft (23 m) from spectator viewing areas and parking areas.

Exception: For ground pieces with greater hazard potential (such as large wheels with powerful drivers, roman candle batteries, and items employing large salutes) the minimum separation distance shall be increased to 125 ft (38 m).

3-2.3* Where the mortars are positioned vertically, the mortars shall be placed at the approximate center of the display site.

3-2.3.1* Mortars shall be permitted to be angled during a display to allow for wind and to carry shells away from the main spectator viewing areas.

3-2.3.1.1 The angled mortars shall be permitted to be placed up to 1/3 of the distance from the center of the display site (see Table 3-1.3) toward the main spectator viewing area.

3-2.3.1.2 The mortars shall be angled so that any dud shells fall at a point approximately equal to the offset of the mortars from the center of the display site, but in the opposite direction.

3-2.4 Fireworks shall not be discharged within 100 ft (30 m) of any tent or canvas shelter.

3-3 Fallout Area.

3-3.1* The fallout area shall be a large open area.

3-3.2 Spectators, vehicles, or readily combustible materials shall not be located within the fallout area during the display.

3-3.3 Fire protection personnel and their vehicles and other emergency response personnel and vehicles shall remain at or beyond the perimeter of the display site during the actual firing of the display.

Chapter 4 Operation of the Display

4-1 General Requirements. The sponsor of the display shall make provisions for adequate fire protection for the display.

4-1.1* The sponsor shall consult with the authority having jurisdiction and the operator to determine the level of fire protection required.

4-1.2* Monitors whose sole duty shall be the enforcement of crowd control shall be located around the display area and as determined by the sponsor. The authority having jurisdiction and the operator shall approve the provisions for crowd control.

4-1.2.1 Monitors shall be positioned around the discharge site to prevent spectators or any other unauthorized persons from entering the discharge site. The discharge site shall be so restricted throughout the display and until the discharge site has been inspected after the display. Where practical, fences and rope barriers shall be used to aid in crowd control.

4-1.2.2 During the period before the display, where pyrotechnic materials are present, unescorted public access to the site shall not be permitted.

4-1.3 The operator shall have primary responsibility for safety. While the operator shall be permitted to participate actively in the firing of the fireworks display, safety shall be the primary concern of the operator.

4-1.3.1* The operator shall be responsible for ensuring that a sufficient number of assistants are available for the safe conduct of the fireworks display. Only the operator and necessary assistants shall be permitted in the discharge area while the display is in progress.

4-1.3.2 The operator shall be responsible for ensuring that all assistants are fully trained in the proper performance of their assigned tasks and that they are educated with regard to safety hazards.

4-1.3.3* During the firing of the display, all personnel in the discharge site shall wear head protection, eye protection, hearing protection, and foot protection, and shall wear cotton, wool, or similarly flame-resistant, long-sleeved, long-legged clothing. Personal protective equipment, as necessary, shall be worn by the operator and assistants during the setup and cleanup of the display.

4-1.4 Wherever, in the opinion of the authority having jurisdiction or the operator, any hazardous condition exists, the fireworks display shall be postponed until the condition is corrected.

4-1.4.1 If, in the opinion of the authority having jurisdiction or the operator, the lack of crowd control poses a hazard, the fireworks display shall be discontinued immediately until such time as the situation is corrected.

4-1.4.2 If high winds, precipitation, or other adverse weather conditions prevail such that a significant hazard exists in the opinion of the operator or authority having jurisdiction, the fireworks display shall be postponed until weather conditions improve to a reasonable level.

4-1.4.3 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. 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. The spotters shall be in direct communication with the shooter during the conduct of the display with an effective means of informing the shooter of any hazardous condition.

4-1.4.4 In the event of a condition arising requiring 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.

4-1.5 Operators and assistants shall use only flashlights, electric lighting, or other nonincendive illumination such as chemiluminescent devices for illuminating the firing and ready box area.

4-1.6 No smoking shall be allowed within 50 ft (15 m) of any area where fireworks or other pyrotechnic materials are present.

4-1.7 Measures shall be taken to protect all pyrotechnic materials to be used in the display from adverse weather conditions. Moisture-damaged materials shall not be used.

4-1.8 No person shall be allowed in the discharge area while under the influence of alcohol, narcotics, or medication that could adversely affect judgment, mobility, or stability.

4-2 Firing of Shells.

4-2.1* Shells shall be carried from the storage area to the discharge site only by their bodies and shall never be carried by their fuses.

Exception: As specified in 4-2.3.

4-2.2 Shells shall be checked for proper fit in their mortars prior to the display.

4-2.3* When being loaded into the mortars, shells shall be held by their fuses or lowering cords if provided, and shall be lowered carefully into the mortar. At no time shall any part of the body of the person loading the shells be placed over the mouth of the mortar.

4-2.4* The person loading shells shall be certain to the degree practicable that the shell is properly seated in the bottom of the mortar.

4-2.5 Shells shall not, under any circumstances, be forced into a mortar too small to accommodate them. Shells that do not fit properly into the mortars shall not be fired and shall be disposed of in accordance with the procedure described in 4-2.10.2.

4-2.6 Manually fired shells shall be ignited by lighting the tip of the fuse with a fusee, torch, portfire, or similar device. As soon as the fuse is ignited, the shooter shall vacate the mortar area.

4-2.6.1 The safety cap protecting the fuse shall not be removed by the person responsible for igniting the fuse until immediately before the shell is to be fired.

4-2.7 No person ever shall place any body part over the mortar during the loading and firing of a display until mortars have been checked for the absence of any shells following the display.

4-2.8 The first shell fired shall be observed carefully to determine that its trajectory is such that the shell functions over the fallout area and that any hazardous debris or unexploded shells land in the fallout area.

4-2.8.1 The display shall be interrupted and the mortars shall be reangled or repositioned as necessary for safety at any time during an outdoor fireworks display.

4-2.9 Large Diameter Shells.

4-2.9.1 All aerial shells greater than 6 in. (152 mm) in diameter shall be preloaded into mortars prior to the beginning of the display.

Exception: Shells that are nominal 7 in. (178 mm) or 8 in. (203 mm) in diameter shall be permitted to be reloaded during the firing of the display provided that the mortars to be reloaded are buried at least $\frac{3}{4}$ of their length in the ground. The reloading of 7-in. (178-mm) and 8-in. (203-mm) mortars in troughs, drums, or racks shall not be permitted.

4-2.9.2 All aerial shells greater than 6 in. (152 mm) in diameter shall be fired using electrical ignition (see Chapter 5), or other means of remote ignition that place 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.

*Exception: *Shells that are nominally 7 in. (178 mm) or 8 in. (203 mm) in diameter shall be permitted to be ignited manually provided that the mortars are buried at least $\frac{3}{4}$ of their length in the ground and the shooter has been provided with alternative means of protection.*

4-2.10* 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.

4-2.10.1 Immediately following the display but no sooner than 15 minutes after the attempted firing, if the shell still has not fired, the mortar shall be flooded with water cautiously and allowed to stand for a minimum of 5 minutes before it is emptied cautiously of the shell.

Exception: Where electrical ignition is used and the firing failure is electrical in nature or the aerial shell was not fired intentionally, the shell shall be permitted to be salvaged by the operator.

4-2.10.2 The proper disposal instructions shall be provided by the supplier and shall be followed.

4-2.10.3* It shall be the responsibility of the person igniting the aerial shells to detect when a shell does not fire from a mortar. That person shall warn others in the area and shall ensure that the mortar is marked to indicate the presence of an unfired aerial shell.

Exception: Where electrically firing, the mortar shall not be required to be marked. However, persons entering the area after the fireworks display shall conduct themselves as though unfired shells present a hazard until otherwise advised by the operator.

4-2.11* Manual reignition of chain fused aerial shells shall be attempted only at properly installed ignition points.

4-2.12* Following the display, the firing crew shall conduct an inspection of the fallout area for the purpose of locating any unexploded aerial shells or live components. This inspection shall be conducted before any public access to the site shall be permitted.

4-2.12.1 Any shells found during the search shall not be handled until at least 15 minutes have elapsed from the time the shells were fired. The fireworks then shall be doused with water and allowed to remain for at least 5 additional minutes before being placed cautiously in a plastic bucket or fiberboard box.

4-2.12.2 The proper disposal instructions provided with the fireworks by the supplier shall be followed.

4-2.12.3 Where fireworks are displayed at night and it is not possible to inspect the site thoroughly, the operator, or designated assistant(s), shall search the entire site at first light the following morning.

4-3 Ground Display Pieces.

4-3.1 To the extent that it is practical, all ground display pieces shall be positioned outside the discharge area of aerial displays.

Exception No. 1: Where ground display pieces are to be fired electrically, they shall be permitted to be located in the fallout area.

Exception No. 2: Where aerial shells have been preloaded, ground display pieces shall be permitted to be located in that discharge area.

4-3.2 Dry grass or combustible materials located beneath ground display pieces shall be wet down before the display if they are in sufficient quantity to be a fire hazard.

4-3.3 Poles for ground display pieces shall be securely placed and firmly braced so that they do not fall over during functioning of the fireworks device.

Chapter 5 Electrical Ignition of a Display

5-1 General.

5-1.1* The intent of this chapter is to provide requirements for the proper setup and operation of an outdoor display of fireworks that are to be ignited using electrical means.

5-1.2 The intent of this chapter also is to provide requirements and minimum standards for the design and use of electrical firing units used in electrically fired displays, including manually operated, automatically operated, and hand-held firing units.

5-1.3* 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 authority having jurisdiction.

Exception: This shall not be required for the electrical ignition of lance work and other set-pieces of similar low hazard.

5-1.4 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 (7.7 m).

5-2 Design of Electrical Firing Units.

5-2.1 Electrical firing units and accompanying junctions shall be manufactured specifically for use in the electrical ignition of pyrotechnic devices or explosives. The manufacturer shall supply specifications and instructions for the proper setup and use of each unit.

Exception: Specifications and instructions shall not be required where the electrical firing unit has been manufactured by the person operating the unit at the display.

5-2.2* Manual electrical firing units shall include a key-operated switch or similar device that greatly reduces the possibility that unauthorized or unintentional firings can occur.

5-2.3* Manual electrical firing units shall be designed so that at least two positive actions shall be necessary to apply an electric current to an electric match.

5-2.4* Switches used to apply power to electrical firing units for testing, firing, or both, shall clearly indicate the function or functions of each switch.

5-2.5 A light, a beeper, or both, shall activate when a manual electrical firing unit is armed.

5-2.6 A hand-held electrical firing unit shall have two switches, or require two actions, one to arm the unit and one to fire the unit. The unit shall be designed so that it cannot be fired without first being armed. Switches shall be clearly identified, and the unit shall have a light or indicator that signals when the unit is ready to fire. Hand-held firing units that incorporate a capacitive discharge design shall dissipate the stored charge within 15 seconds after the arming switch is released.

Exception: This requirement shall not apply to blasting machines such as clackers, rotary generators, and plunger-type firing units that derive their energy from mechanical action.

5-2.7 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.

5-2.8 If an electrical firing unit or junction has a built-in test circuit, the unit shall be designed to limit the test current (into a short circuit) to 0.05 ampere or to 20 percent of the no-fire current of the electric match being used, whichever is less.

5-2.9 Multi-testers, 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 5-2.8.

5-2.10 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.

5-2.11 Electrical firing units shall be powered by batteries or isolated power supplies used for firing purposes only. 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.

Exception: Electrical firing units powered by commercial power shall be permitted, provided they incorporate an isolation transformer. The transformer shall be located within the firing unit or elsewhere in the firing system.

5-3 Setup of Electrical Firing Units.

5-3.1 All electrical firing units, cables, and junctions and the attached electric matches shall be visually inspected by the operator or an assistant prior to the display.

5-3.1.1 The electrical firing unit shall not be in test or arm status during this inspection.

5-3.1.2 Repairs shall be permitted, provided that the system can be returned to full, safe operating condition prior to the display.

5-3.2* The electric firing unit shall be set up and located so that there is a clear line of sight to the mortars and other parts of the discharge site.

Exception: A direct line of sight shall not be required where an assistant acting as a spotter is in direct communication with the operator of the firing unit.

5-3.3 Only those persons necessary for the proper and safe firing of the display shall be permitted in the vicinity of the electrical firing unit during the display.

5-3.4 Where fireworks are being loaded into mortars or otherwise set up for firing at the display site, cables from the junctions to the electrical firing unit shall be disconnected.

5-3.5 Once the fireworks have been loaded or otherwise set up, testing of the circuits shall be permitted. 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.

5-3.6 If the testing of the circuits indicates that a problem might exist, the operator or assistant shall be permitted to reinspect any cables, connections, or electric matches that are in question. This inspection shall be performed only after the electrical firing unit has been switched off or disconnected from the power source.

5-4 Operation of the Electrical Firing Unit.

5-4.1 Prior to arming the electrical firing unit for firing, the operator of the unit shall confirm that no personnel are present in the electrically ignited mortar area.

5-4.2 The person controlling the electrical firing unit shall be provided with a means of communicating with the operator.

5-4.3* The person controlling the electrical firing unit shall cease firing from any discharge site that has a significant malfunction 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. The electrical firing unit shall be switched off or disconnected while this inspection is being performed.

5-5 Post-Display Operations.

5-5.1 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.

5-5.2 All fireworks display mortars and other equipment shall be inspected carefully for any unfired devices.

5-5.2.1* Where conditions allow, the firing of any unfired devices after the display shall be permitted, in accordance with all other sections of this code.

5-5.2.2 Otherwise, the remaining fireworks shall be properly packaged and returned to the supplier or disposed of in compliance with all applicable regulations.

Chapter 6 Qualifications

6-1 Operator Qualifications.

6-1.1 The operator shall be at least 21 years old and licensed or approved by the authority having jurisdiction in accordance with any and all applicable laws.

6-1.2 Applicants for licensing as an operator shall provide evidence of actual experience as an operator or assistant as part of demonstrating competency to the authority having jurisdiction.

6-1.3 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 authority having jurisdiction, or otherwise shall demonstrate knowledge of these areas.

6-2 Assistants. All assistants shall be at least 18 years old.

6-3 Permits Required.

6-3.1 The fireworks display company or the pertinent organization or group of individuals shall obtain a permit from the authority having jurisdiction prior to performing the fireworks display.

6-3.2 As part of the permit process, the fireworks display company or the pertinent organization, or group of individuals shall demonstrate financial responsibility by providing proof of insurance or by other appropriate means.

Chapter 7 Referenced Publications

7-1 The following documents or portions thereof are referenced within this code and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

7-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1122, *Code for Model Rocketry*, 1994 edition.

NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks*, 1995 edition.

NFPA 1126, *Standard for the Use of Pyrotechnics before a Proximate Audience*, 1992 edition.

7-1.2 Other Publications.

7-1.2.1 U.S. Government Publications. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Title 16, *Code of Federal Regulations*, Parts 1500 and 1507, U.S. Consumer Products Safety Commission Labeling Regulations, Federal Hazardous Substances Act.

Title 27, *Code of Federal Regulations*, Part 18, Bureau of Alcohol, Tobacco and Firearms, Part 181, Commerce in Explosives.

Title 49, *Code of Federal Regulations*, U.S. Department of Transportation, Parts 171-177, "Hazardous Materials Regulations."

Appendix A Explanatory Material

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

A-1-4 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 concerned with product evaluations that is in a position to determine compliance with appropriate standards for the current production of listed items.

A-1-4 Authority Having Jurisdiction. The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, 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-1-4 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-1-4 Fireworks, Exception No. 1. For information on recoverable aero models, see NFPA 1122, *Code for Model Rocketry*.

A-1-4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A-2-1.2 If there is doubt regarding whether aerial shells were manufactured to operate safely, or if there is doubt regarding whether the mortars and shells are properly sized, it is recommended that test firings be conducted in order to establish whether or not 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 $\frac{1}{8}$ 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 $\frac{1}{4}$ in. (6.4 mm) for 2 in. to 3 in. (51 mm to 76 mm) shells; $\frac{3}{8}$ in. (9.4 mm) for 4 in. to 6 in. (102 mm to 152 mm) shells; or $\frac{1}{2}$ in. (12.7 mm) for shells larger than 6 in. (152 mm).

A-2-1.3 Shells that function to deploy a parachute suspending burning pyrotechnic composition can present additional safety concerns if the parachute does not properly deploy or if the shell is fired in high winds.

A-2-2.4.3 An example of additional protection to ready boxes is the use of a flame-resistant tarpaulin meeting the requirements of NFPA 701, *Standard Methods of Fire Tests for Flame-Resistant Textiles and Films*.

A-2-3.1 The requirements 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.

A-2-3.2 If there is doubt concerning the proper angling of mortars, it is appropriate to fire one or more test shells for verification.

A-2-3.3 The use of securely positioned racks located on barges and trailers can be permitted, providing that all other code requirements are met.

A-2-3.3.2 Examples of materials for use in providing added support include wood and flat stones.

A-2-3.3.3 Where practical, additional separation distances between buried mortars should be used.

A-2-3.3.5.2 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. (5-cm) nominal thickness. The racks should be boxed on both sides at the top and bottom by 1-in. \times 6-in. (2.5-cm \times 15-cm) nominal thickness boards or $\frac{1}{2}$ -in. (1.3-cm) thick plywood. 2-in. (5-cm) nominal thick blocks should be

attached to the horizontal boards between each mortar greater than 3-in. (76-mm) inside diameter. Boards should be fastened by nails, screws, or other fasteners that penetrate a minimum of 1-in. (2.5-cm) into the member that a board is attached to. Racks should be secured to prevent tipping over by attaching stakes or spikes driven into the ground, banding, the use of A-frames, or other equivalent means.

A-2-3.3.6 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. 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-2-3.6 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 Tables A-2-3.6(a), (b), and (c) generally are believed to have ample strength.

A-2-3.6.3 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-2-3.6.3 are sufficient.

A-3-1.3 Where more than one person is to ignite the aerial shells for an outdoor fireworks display, the line of mortars should be separated in some manner and only one person should be lighting shells in each area.

A-3-1.3.3 See NFPA 101®, *Life Safety Code*®, for definitions of health care and detention and correctional facilities.

A-3-1.3.4 To determine whether materials are considered to possess these hazards, see NFPA 325, *Guide to Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids*, and NFPA 49, *Hazardous Chemicals Data*.

A-3-2.3 Figure A-3-2.3 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-3-2.3.1 Figure A-3-2.3.1 illustrates some of the requirements for a permitted display site where aerial shells are to be stored at the discharge site for subsequent loading into mortars during the display, such as might be the case for a manually ignited display.

A-3-3.1 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.

Table A-2-3.6(a) Minimum Mortar Wall Thickness (in.) for Steel Mortars¹

Mortar ID (in.)	Spherical	Cylindrical Single Break	Cylindrical Multi-Break ²
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	0.35
12	0.13	0.20	0.39

For SI units: 1 in. = 25.4 mm.

¹The tensile strength of steel pipe should be at least 40,000 psi (275,800 kPa).

²Wall thicknesses are those of American National Standard ANSI/ASME B 36.10M, *Welded and Seamless Wrought Steel Pipe*, 1985. (Schedule 40 wrought pipe).

Table A-2-3.6(b) Minimum Mortar Wall Thickness (in.) for Paper Mortars (Convolute or Spiral)¹

Mortar ID (in.)	Spherical	Cylindrical Single Break	Cylindrical Two Break
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	0.62	2
10	0.62	2	2
12	0.75	2	2

For SI units: 1 in. = 25.4 mm.

¹The cross-grain tensile strength of the paper should be at least 2300 psi (16,000 kPa).

²Data not currently available.

Table A-2-3.6(c) Minimum Mortar Wall Thickness (in.) for High Density Polyethylene Mortars¹

Mortar ID (in.)	Spherical	Cylindrical Single Break	Cylindrical Two Break
3	0.15	0.20	2
4	0.20	0.26	2
5	0.25	2	2
6	0.30	2	2

For SI units: 1 in. = 25.4 mm.

¹The tensile strength of plastic should be at least 3500 psi (24,000 kPa).

²Data not currently available.

A-4-1.1 The authority having jurisdiction 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-4-1.2 Monitors should wear some distinctive identification (e.g., badges, brightly colored vests).

Table A-2-3.6.3 Minimum Inside Mortar Length (in.)

Mortar ID (in.)	Single Break	Double Break	Up to 4-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.

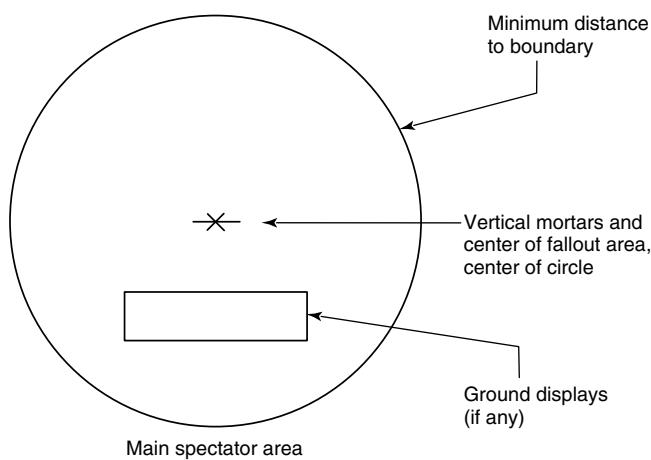


Figure A-3-2.3 Typical layout for a display site with vertically positioned mortars.

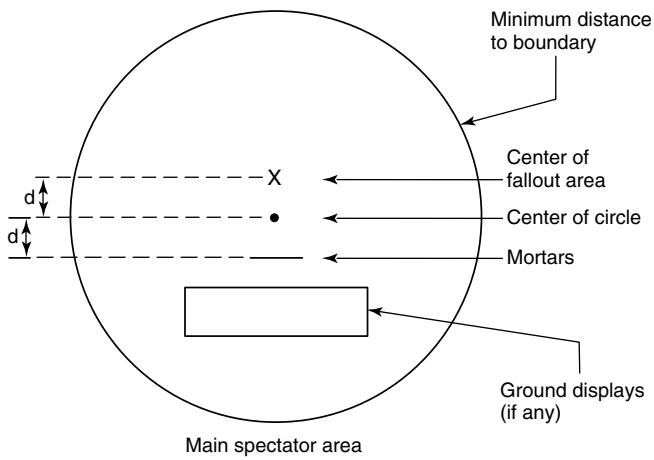


Figure A-3-2.3.1 Typical layout for a display site using angled mortars. The distance "d" shall be at least $\frac{1}{6}$ but not more than $\frac{1}{3}$ the radius of the circle indicating the minimum distance to the secured boundary.

A-4-1.3.1 In most situations, it is believed that it is appropriate to have one person tending each ready box or shell storage area in use at a given time. Similarly, it is believed that there should be two persons 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 per-

son can safely ignite no more than approximately 10 shells per minute. If a greater rate of firing is desired, more than one person should be lighting them.

A-4-1.3.3 The appropriate personal protective equipment 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.

A-4-2.1 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-4-2.3 It generally is believed that it is not safe to be loading mortars within 10 ft (3 m) of mortars that are being fired. Where loading a shell into a recently fired mortar, the person loading should crouch alongside the mortar and their back should be kept facing the area where shells are being fired.

A-4-2.4 A gentle tug on the fuse usually can determine whether a shell has been properly seated in the bottom of the mortar.

A-4-2.9.2 Exception: 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 authority having jurisdiction.

A-4-2.10 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 still contains 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-4-2.10.3 Where firing aerial shells 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-4-2.11 Remaining within 25 ft (7.7 m) of chain fused aerial shells after their ignition, for the purpose of manual reignition, is unreasonably dangerous. Similarly, the act of manual reignition of chain fused aerial shells is dangerous unless reignition 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-4-2.12 The operator and assistants should use extreme caution whenever approaching 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 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-5-1.1 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-5-1.3 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 also are 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-5-2.2 Switches should have labels under or above each switch. The labels should use either letters or numbers.

A-5-2.3 For example, this might be accomplished with two switches in series, both of which need to be operated for current to flow to the electric match.

A-5-2.4 A switch used to power the electrical firing unit for testing should be a different style than that used to ignite electrical matches and also should be provided with lights to indicate the status of the unit.

A-5-3.2 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-5-4.3 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-5-5.2.1 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 desireable to ignite any unfired set pieces, fountains, roman candles, or other low-level devices.

Appendix B Labeling of Display Fireworks Aerial Shells

This Appendix is not a part of the requirements of this NFPA document but is included for informational purposes only. Appendix B provides additional explanatory information on the requirements in 2-1.3.

B-2-1.3 Labeling of Display Fireworks Aerial Shells.

B-2-1.3.1 As a minimum, each shell should bear a label containing the following information:

(a) A description of the size of the shell [e.g., "3-in. (76-mm) shell"];

(b) A description of the type of shell (e.g, "2-break with report");

(c) A warning statement reading:

WARNING: DANGEROUS EXPLOSIVE

If found, do not handle —
Contact local fire or
police department

(d) The name and location of business of the manufacturer, importer, or distributor.

B-2-1.3.2 Conspicuousness.

(a) The statement "WARNING: DANGEROUS EXPLOSIVE" should be printed in capital letters having a printed image of at least $1/8$ in. (3.2 mm) and should be underlined.

(b) The remaining printed matter does not need to be printed in capital letters but should have a printed image at least $1/8$ in. (3.2 mm) high.

(c) The required statements should be printed in a color contrasting sharply with the background and should be printed within a borderline.

(d) The label should be at least 9 in.² (57.8 cm²), unless the size of the shell is too small to accommodate this size, in which case the size can be reduced to a size no smaller than necessary.

Appendix C Recommended Regulations for Applications for Permits for the Outdoor Display of Fireworks

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

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

(b) Such application should provide:

1. The name, address, and phone number of the individual, group, or organization sponsoring the outdoor fireworks display.

2. The name, address, and phone number of the supplier of the fireworks to the operator, if different than that of the operator.

3. 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.

4. 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.

5. The exact location planned for the outdoor fireworks display.

6. Confirmation of the license of the operator and the number of assistants that are to be present.

7. The approximate number and kinds of fireworks to be discharged.

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

9. 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 location of all buildings, highways and other lines of communication, the lines behind which the audience is to be restrained, and the location of other possible overhead obstructions.

(c) Upon receipt of such application _____ days in advance of the date set for this outdoor fireworks display, the authority having jurisdiction 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.

Appendix D Suggested Requirements for Operator Licensing

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

D-1 Operator Licensing Requirements.

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

D-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.

D-1.3 A requirement of licensing is that the applicant has provided evidence of actively participating in the performance of at least 5 outdoor fireworks displays. At the option of the issuing office, an alternate requirement can be substituted.

D-2 Provisions of Operator Licensing.

D-2.1 The license shall be valid for a period of 4 years.

D-2.2 Renewal of the license shall be automatic upon provision of proof of actively participating in at least 3 outdoor fireworks displays during the prior 4 years.

Appendix E Extract from American Pyrotechnics Association Standard 87-1, Standard for Construction and Approval for Transportation of Fireworks

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

E-1 Introduction.

†E-1.1 This appendix provides manufacturers, importers, and distributors of fireworks and novelties 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.

NOTE: Paragraphs of this appendix that apply to the approval by the U.S. Department of Transportation (DOT) for transportation of fireworks are indicated by a dagger (†) preceding the paragraph number.

E-1.2 The information in this appendix 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.

†E-1.3 Fireworks 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 the DOT regulations in Title 49, *Code of Federal Regulations*. See Section E-5 of this appendix for further discussion.

E-1.4 Consumer fireworks (fireworks classed as 1.4G and 1.4S) (formerly “Common Fireworks”) 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, *Code of Federal Regulations*. See Section E-3 of this appendix for further discussion.

NOTE: Consumer fireworks are normally classed as 1.4G but can be classed by the DOT as 1.4S on the basis of specific test results.

E-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 can be regarded by courts as negligence *per se* in product liability litigation.

†E-1.6 This appendix applies to fireworks devices and novelties for entertainment purposes.

E-2 Definitions.

†E-2.1 Approval. For purposes of this appendix, approval means the assignment of proper hazard class, EX number, and proper shipping name by the DOT so that fireworks and novelties can be transported under conditions specified in Title 49, *Code of Federal Regulations*. See Section E-5 of this appendix for details.

†E-2.2 Black Match. A fuse made from thread impregnated with black powder and used for igniting pyrotechnic devices. Black Match is classed as “1.3G” and described as “Fuse, Instantaneous, non-detonating UN0101,” or “Quickmatch UN0101.”

†E-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.

†E-2.4 Burnout. The unintended escape of flame through the wall of a pyrotechnic chamber during functioning of a fireworks device.

†E-2.5 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.

†E-2.5.1 Explosive Composition. Any chemical compound or mixture, the primary purpose of which is to function by explosion, producing an audible effect in a fireworks device.

†E-2.5.2 Pyrotechnic Composition. A chemical mixture that on burning and without explosion produces visible or brilliant displays or bright lights, or whistles or motion.

†E-2.6 Fireworks. Any device, other than a novelty, intended to produce visible or audible effects, or both, by combustion, deflagration, or detonation. Fireworks are further described as “Fireworks UN0336” or “Fireworks UN0337” (formerly “Common Fireworks” and now referred to in this document as “Consumer Fireworks”), “Forbidden Fireworks,” or “Fireworks UN0335” (formerly “Special Fireworks” and now referred to in this document as “Display Fireworks”).

NOTE: Propelling and expelling charges consisting of a mixture of sulfur, charcoal, and saltpeter are not considered as designed to produce audible effects.

†E-2.6.1 Consumer Fireworks (formerly “Common Fireworks”). Any fireworks device for use by the public that complies with the construction, performance, composition, and labeling requirements promulgated by the U.S. Consumer Product Safety Commission (CPSC) in Title 16, *Code of Federal Regulations*, in addition to any limits and other requirements of this document. See Section E-3 of this appendix for details.

†E-2.6.2 Display Fireworks (formerly “Special Fireworks”). Fireworks devices primarily intended for commercial displays that are designed to produce visible or audible effects, or both, 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 (1.4 oz) of chemical composition exclusive of lift charge; and other exhibition display items that exceed the limits contained in this document 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 E-4 of this appendix for details.

†E-2.6.3 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 weight limits for consumer fireworks but not labeled as such and containing only chemicals shown in Table E-4.3.1 can be approved under the provisions of this document and classified as “Article, Pyrotechnic, 1.4G, UN0431.”

NOTE: Theatrical pyrotechnics devices can be classed as “Article, Pyrotechnic, 1.4S, UN0432” by the DOT on the basis of specific test results.

†E-2.7 Labeling. A display of written, printed, or graphic matter upon a fireworks device(s) or upon the immediate container of any such device(s), or both. Included are diamond shaped labels required by the DOT to be displayed on outside packaging for transportation purposes. The term also includes any identification, cautions, and other information required by this document or by any Federal Government agency.

†E-2.8 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 the inside or outside of a shipping container.

†E-2.9 Novelty. A device containing small amounts of pyrotechnic or explosive composition, or both, but not described as consumer fireworks. Such devices produce limited visible or audible effects. These items shall be classed as “1.4G,” unless classed as “1.4S” or deregulated as a hazardous material by the DOT on the basis of specific test results.

†E-2.10 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 that informs the public and emergency personnel of the hazardous nature of the cargo, as specified in Title 49, *Code of Federal Regulations*, Part 172.

†E-2.11 Quick Match (Instantaneous Fuse). Black match that is encased in a loose-fitting paper 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 is

classed as “1.3G” and described as “Fuse, instantaneous, non-detonating” or “Quickmatch,” and assigned identification number “UN0101.”

†E-2.12 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 $\frac{3}{32}$ 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.”

E-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 U.N. System, and referred to in this document as “Consumer Fireworks.”

NOTE 2: Devices intended for non-consumer use in the entertainment industry that meet the chemical composition requirements of this appendix can be classed as “1.4G” and described as “Article, Pyrotechnic UN0431” under the provisions of this document but are not required to comply with the fuse, construction, and labeling requirements of this appendix.

†E-3.1 Types of Consumer Fireworks. The following fireworks devices are subject to the requirements of Section E-3 of this appendix.

E-3.1.1 Ground and Hand-held Sparkling and Smoke Devices.

E-3.1.1.1 Cylindrical Fountain. Cylindrical tube containing not more than 75 g (2.6 oz) of pyrotechnic composition. Upon ignition, a shower of colored sparks, and sometimes a whistling effect or smoke, is produced. This device can 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). Where more than one tube is mounted on a common base, total pyrotechnic composition cannot exceed 200 g (7.1 oz).

†E-3.1.1.2 Cone Fountain. Cardboard or heavy paper cone containing not more than 50 g (1.8 oz) of pyrotechnic composition. The effect is the same as that of a cylindrical fountain. Where more than one cone is mounted on a common base, total pyrotechnic composition cannot exceed 200 g (7.1 oz).

†E-3.1.1.3 Illuminating Torch. Cylindrical tube containing not more than 100 g (3.5 oz) of pyrotechnic composition that produces a colored flame upon ignition. Can be spike, base, or hand-held. Where more than one tube is mounted on a common base, total pyrotechnic composition cannot exceed 200 g (7.1 oz).

†E-3.1.1.4 Wheel. Pyrotechnic device intended to be attached to a post or tree by means of a nail or string. Can have one or more drivers, each of which can contain not more than 60 g (2.1 oz) of pyrotechnic composition. No wheel can contain more than 200 g (7.1 oz) total pyrotechnic composition. Upon ignition, the wheel revolves, producing a shower of color and sparks and, sometimes, a whistling effect.

†E-3.1.1.5 Ground Spinner. Small device containing not more than 20 g (0.7 oz) 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.

†E-3.1.1.6 Flitter Sparkler. Narrow paper tube attached to a stick or wire and filled with not more than 5 g (0.2 oz) of pyro-

technic composition that produces color and sparks upon ignition. The paper at one end of the tube is ignited to make the device function.

†E-3.1.1.7 Toy Smoke Device. Small plastic or paper item containing not more than 100 g (3.5 oz) pyrotechnic composition that, upon ignition, produces white or colored smoke as the primary effect. (These devices, where complying with the provisions of this appendix, are classed as "1.4G" unless classed as "1.4S" or not regulated as an explosive by the DOT on the basis of specific test results.)

E-3.1.2 Aerial Devices.

†E-3.1.2.1 Sky Rockets and Bottle Rockets. Cylindrical tube containing not more than 20 g (0.7 oz) of chemical composition with a wooden stick attached for guidance and stability. Rockets rise into the air upon ignition. A burst of color or sound, or both, can be produced at or near the height of flight.

†E-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 not contain more than 20 g (0.7 oz) of total chemical composition.

†E-3.1.2.3 Helicopter, Aerial Spinner. A tube containing not more than 20 g (0.7 oz) of chemical composition, with a propeller or blade attached. Upon ignition, the rapidly spinning device rises into the air. A visible or audible effect can be produced at or near the height of flight.

†E-3.1.2.4 Roman Candle. Heavy paper or cardboard tube containing not more than 20 g (0.7 oz) of chemical composition. Upon ignition, "stars" (pellets of pressed pyrotechnic composition that burn with bright color) are individually expelled.

†E-3.1.2.5 Mine, Shell. Heavy cardboard or paper tube usually attached to a wooden or plastic base and containing not more than 40 g (1.4 oz) of chemical composition plus not more than 20 g (0.7 oz) of "lift" charge [the part that actually lifts the aerial effect(s) into the air] per tube. Upon ignition, "stars" (see E-3.1.2.4), components producing reports containing up to 130 mg (2 grains) of explosive composition per report (see E-3.1.3.1), or other devices are propelled into the air. A mine can contain more than one tube, provided the tubes fire in sequence upon ignition of one external fuse. Total chemical composition including lift charges of any multiple tube device cannot exceed 200 g (7.1 oz).

E-3.1.3 Audible Ground Devices.

†E-3.1.3.1 Firecracker. Small, paper-wrapped or cardboard tube containing not more than 50 mg (0.8 grains) of explosive composition, except that those used in aerial devices can contain up to 130 mg (2 grains) 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 E-3.5.1 and chemicals in E-3.6.1 of this appendix.

E-3.1.3.2 Chaser. Paper or cardboard tube venting out the fuse end of the tube containing not more than 20 g (0.7 oz) of chemical composition. The device travels along the ground upon ignition. A whistling effect or other noise is often produced. Explosive composition can be included to produce a report but cannot exceed 50 mg (0.8 grains).

†E-3.2 Types of Novelties. The following devices 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 specific test results. These devices that are not regulated are not considered to be consumer fireworks.

†E-3.2.1 Party Popper. Small plastic or paper item containing not more than 16 mg (0.25 grains) of explosive composition that is friction sensitive. A string protruding from the device is usually pulled to ignite it. This item expels nonflammable paper streamers or other nonflammable novelties, or both, and produces a small report.

†E-3.2.2 Snapper. Small, paper-wrapped item containing not more than 1 mg (0.02 grains) of explosive composition coated on small bits of sand, and packaged with sawdust in individual containers of not more than 50 units. When dropped, the device explodes, producing a small report.

†E-3.2.3 Snake, Glow Worm. Pressed pellet of not more than 2 g (0.07 oz) of pyrotechnic composition and packaged in retail packages of not more than 25 units that produces as the primary effect a snake-like ash upon burning. The ash expands in length as the pellet burns. (These devices are not regulated for transportation purposes.)

†E-3.2.4 Sparkler. Wire or stick coated with pyrotechnic composition, that cannot exceed 100 g (3.5 oz) per item, that produces a shower of sparks upon ignition. These items cannot contain magnesium, except that magnalium (magnesium-aluminum alloy) is permitted. Items containing any chlorate or perchlorate salts cannot exceed 5 g (0.2 oz) of composition per item. (These items are not regulated as explosives for transportation purposes. However, some meet the criteria for flammable solids.)

†E-3.2.5 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 "Fireworks UN0336" and classed as "1.4G." Toy caps are to be packed in inside packages constructed of cardboard not less than 0.013 in. (0.33 mm) in thickness, metal not less than 0.008 in. (0.2 mm) in thickness, noncombustible plastic not less than 0.015 in. (0.38 mm) in thickness, or a composite blister package consisting of cardboard not less than 0.013 in. (0.33 mm) in thickness, and noncombustible plastic not less than 0.005 in. (0.13 mm) in thickness, which are to provide a complete enclosure. The minimum dimensions of each side or end of such package are to be not less than $1/8$ in. (3.2 mm) in height. The number of caps in these inside packages are to be limited so that no more than 10 grains (650 mg) of explosive composition are to be packed into 1 in.³ (16.4 cm³) of space. In addition, no more than 17.5 grains (1138 mg) of the explosive composition of toy caps are to be packed in any inside container. These inner containers are to be packed in outside containers meeting the requirements specified in E-5.3.1 of this appendix.

†E-3.2.6 Other Novelties. Devices intended to produce unique visual or audible effects and containing 50 mg (0.8 grains) or less of explosive composition and limited amounts of other pyrotechnic composition. Examples include cigarette loads, trick matches, explosive auto alarms, and other trick noise makers.

†E-3.3 Other Devices. Any device producing unique pyrotechnic or explosive effects or combinations of effects not enumerated in Section E-3 of this appendix.

†E-3.4 Combination Items. Fireworks devices intended to produce more than one of the effects described in Section E-3 of this appendix, and that contain not more than 200 g (7.1 oz) of total chemical composition.

E-3.5 Specific Requirements.

E-3.5.1 Fuse.

E-3.5.1.1 Only safety fuse or other fuse that has been protected to resist side ignition can be used in devices subject to the requirements of this appendix.

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 (0.2 oz) of pyrotechnic composition are not subject to the requirements of E-3.5.1.1.

E-3.5.1.2 The fuse needs to be of sufficient length to burn at least 3 seconds but not more than 6 seconds before ignition of the device, except that fuse for roman candles or similar devices requiring a longer fuse for safe functioning can burn up to 12 seconds before ignition of the device.

E-3.5.1.3 The fuse needs to be securely attached, so that it will support either the weight of the device plus 8 oz (227 g) of dead weight or double the weight of the device, whichever is less, without separation from the fireworks device.

E-3.5.2 Construction.

E-3.5.2.1 Bases. Each fireworks device that requires a base needs to utilize a base of wood or plastic (preferably nonbrittle, medium-impact polystyrene). The minimum horizontal dimension or the diameter of the base needs to be equal to at least one-third 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 are to remain firmly attached to the item during transportation, handling, and normal operation.

NOTE: See APA 87-1, Appendix B, for method of measuring.

E-3.5.2.2 Sticks. The stick on a rocket (including skyrockets and bottle rockets), and on other fireworks devices that utilize a stick, are to be firmly attached to the body of the device by means of glue, staples, or wire, and are to be secure enough to remain firmly attached during transportation, handling, and normal operation. Sticks are to be rigid and of such length so as to ensure stable flight. The maximum curvature of such stick(s) cannot exceed 1 in. (25 mm).

NOTE: See APA 87-1, Appendix B, for method of testing rigidity.

E-3.5.2.3 Handles. Each fireworks device that is intended to be hand-held and is so marked is to incorporate a handle at least 4 in. (101 mm) in length. Handles are to remain firmly attached during transportation, handling, and normal operation of the device, or are to consist of an integral section of the device extending at least 4 in. (101 mm) below the pyrotechnic chamber, except that sparklers 10 in. (253 mm) or less in length shall have handles at least 3 in. (76 mm) in length.

E-3.5.2.4 Spikes. Spikes that constitute an integral part of a fireworks device are to protrude at least 2 in. (51 mm) from the base of the device and are to have a blunt tip not less than $1/8$ in. (3.2 mm) in diameter or $1/8$ in. (3.2 mm) square.

†E-3.5.2.5 Pyrotechnic Chamber. The pyrotechnic chamber in a fireworks device that functions other than by exploding needs to be of sufficient thickness and rigidity to allow normal functioning of the device without burnout or blowout. The chamber also needs to be constructed and sealed to prevent leakage of the pyrotechnic composition during transportation, handling, and normal operation.

E-3.5.2.6 Wings. Wings on helicopter-type rockets and similar devices need to 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.

E-3.5.2.7 Wheel Devices. Each wheel device needs to be constructed so that the driver(s), motor(s), and axle(s), where 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.

E-3.5.2.8 Aerial Devices. Each device intended to produce a visible or audible effect high in the air needs to be designed to produce the effect at or near the apogee of its flight.

E-3.5.2.9 Smoke Devices. Each smoke device needs to 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 cannot contain plastic in direct contact with the pyrotechnic composition, nor can smoke devices resemble, in color and configuration, banned fireworks devices, such as M80 salutes, cherry bombs, or silver salutes.

E-3.6 Prohibited Chemicals and Components.

†E-3.6.1 Prohibited Chemicals. Consumer fireworks devices offered or intended for sale to the public cannot contain a chemical enumerated in Table E-3.6.1, except for trace amounts as impurities, and except as specified therein.

NOTE: Display fireworks and theatrical pyrotechnics (E-2.6.3) are not subject to the provisions of this appendix.

†E-3.6.2 Prohibited Components. No component of any consumer fireworks device or novelty can, upon functioning, project or disperse any metal, glass, or brittle plastic fragments.

†E-3.6.3 Forbidden Explosive Devices. Any explosive 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 bona fide pest control purposes in accordance with regulations promulgated by CPSC in Title 16, *Code of Federal Regulations*, are not forbidden.

For transportation purposes, the term forbidden explosive devices also includes mixtures or devices containing a chlorate and an ammonium salt or an acidic metal salt, 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 E-3.6.1 Prohibited Chemicals for Consumer Fireworks

(a)	Arsenic sulfide, arsenates, or arsenites.
(b)	Boron.
(c)	Chlorates, except:
1.	In colored smoke mixtures in which an equal or greater weight of sodium bicarbonate is included.
2.	In party poppers.
3.	In those small items (such as ground spinners) wherein the total powder content does not exceed 4 g (0.14 oz) of which not greater than 15 percent or 600 mg (9.3 grains) is potassium, sodium, or barium chlorate.
4.	In firecrackers.
5.	In toy caps.
(d)	Gallates or gallic acid.
(e)	Magnesium (magnesium/aluminum alloys, called magnalium, are permitted).
(f)	Mercury salts.
(g)	Phosphorus (red or white), except that red phosphorus is permissible in caps and party poppers.
(h)	Picrates or picric acid.
(i)	Thiocyanates.
(j)	Titanium, except in particle size greater than 100-mesh.
(k)	Zirconium.

†E-3.7 Approval. All consumer fireworks (“Fireworks UN0336”), novelties, and theatrical pyrotechnics offered for transportation in the United States need to be classified and approved for transportation purposes by the DOT, in accordance with the following procedure.

†E-3.7.1 Fireworks and Novelties containing only mixtures of chemicals specified in Table E-4.3.1 but none of the chemicals prohibited by E-3.6. For each item for which approval is sought, manufacturers need to submit a copy of the Approval Application (*see APA 87, Appendix D*) to the DOT. The DOT can issue an approval for the device as “1.4G” based on the information contained in the form or, at its option, can require fireworks laboratory examination by the Bureau of Explosives, Bureau of Mines, or other fireworks laboratory acceptable to the DOT.

†E-3.7.2 Consumer fireworks devices and theatrical pyrotechnics containing any chemical not specified in Table E-4.3.1, but none of the chemicals prohibited by E-3.6. For each item for which approval is sought, the manufacturer needs to submit a sample of each device to the Bureau of Explosives, Bureau of Mines, or other fireworks laboratory acceptable to the DOT (such as a recognized competent authority for fireworks manufactured abroad) for examination and thermal stability testing. The manufacturer needs to then submit a fireworks Approval Application (*see APA 87-1, Appendix D*) together with the appropriate fireworks laboratory reports to the DOT. The DOT can then issue approval based on the information contained in the application and accompanying fireworks laboratory reports.

†E-3.7.3 Theatrical pyrotechnics containing only mixtures of chemicals specified in Table E-4.3.1. For each item for which approval is sought, manufacturers need to submit a copy of the Approval Application (*see APA 87-1, Appendix D*) to the DOT. The DOT can issue an approval for the device as “1.4G” based on the information contained in the form or, at its option, can require fireworks laboratory examination by

the Bureau of Explosives, Bureau of Mines, or other fireworks laboratory acceptable to the DOT.

†E-3.7.4 If classification other than as “1.4G” is sought, the DOT approval procedure in Title 49, *Code of Federal Regulations*, 173.56(b)(1) needs to be followed. This includes obtaining a fireworks laboratory report from the Bureau of Explosives, or other fireworks laboratory acceptable to the DOT.

†E-3.8 Marking and Labeling. Fireworks intended for consumer sale and use need to be labeled in conformance with the requirements of the Federal Hazardous Substances Act and regulations promulgated thereunder in Title 16, *Code of Federal Regulations*, Part 1500. All outside packaging containing fireworks must be marked and labeled in conformance with Title 49, *Code of Federal Regulations*, Part 172. See APA 87-1, Appendix C, and Section E-5 of this appendix for details and examples.

E-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 in this appendix as “Display Fireworks.”

†E-4.1 Types of Display Fireworks Devices. The following fireworks devices are subject to the requirements of Section E-4 of this appendix.

E-4.1.1 Aerial Shell. A cylindrical or spherical cartridge containing chemical composition exceeding 40 g (1.4 oz) in weight or explosive composition exceeding 130 mg (2 grains) per report, and a black powder propelling charge (lift charge). Shells are most commonly 3 in. to 6 in. (76 mm to 152 mm) in diameter, and are fired from metal 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 apogee of flight.

†E-4.1.2 Salute. Paper-wrapped or cardboard tube containing explosive composition in excess of 130 mg (2 grains). Upon ignition, noise and a flash of light are produced.

E-4.1.3 Other Fireworks Devices.

†E-4.1.3.1 Where the quantity of explosive or pyrotechnic composition, or both, exceeds the limit for inclusion in the “Fireworks UN0336” category, devices enumerated in E-3.1 are classed as “1.3G” and described as “Fireworks UN0335” (formerly described as “Special Fireworks” and classed as “Class B Explosives”). This includes multiple tube devices containing more than 200 g (7.1 oz) of total chemical composition.

†E-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, and flash cartridges, formerly classed as “Special Fireworks,” no longer fall into the “Fireworks” category under the DOT regulations effective on October 1, 1991 and are not part of this appendix.

E-4.2 Construction of Aerial Shells.

E-4.2.1 Each shell is to be identified only in terms of the inside diameter (and 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].

E-4.2.2 Each shell needs to 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 $\frac{1}{8}$ in. (3.2 mm) and no more than $\frac{1}{4}$ in. (6.4 mm) for shells not exceeding 3 in. (76 mm) or $\frac{1}{2}$ in. (12.7 mm) for shells larger than 3 in. (76 mm).

E-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.

E-4.2.4 The length of the internal delay fuse and the amount of lift charge needs to be sized to ensure proper functioning of the shell in its mortar. Quick match fuse, if required, needs to 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.

E-4.2.5 The length of exposed black match on a shell cannot be less than 3 in. (76 mm) and the fuse is not to 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 cannot be less than 3 seconds to allow the operator to retreat safely.

E-4.2.6 A safety cap needs to be installed over the exposed end of the fuse. The safety cap needs to be of a different color than that used for the paper of the fuse.

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

†E-4.3.1 Devices containing only mixtures of chemicals specified in Table E-4.3.1. The manufacturer needs to submit a copy of the Approval Application (*see APA 87-1, Appendix D*) to the DOT for any item that has not previously been approved by the DOT. The DOT can issue an approval for the device based on the information contained in the form or, at its option, can require fireworks laboratory examination by the Bureau of Explosives, Bureau of Mines, or other fireworks laboratory acceptable to the DOT.

†Table E-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
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
Hexamethylenetetramine (hexamine)	Fuel
Iron and iron alloys (e.g., ferro/titanium)	Fuel

†Table E-4.3.1 Standard Fireworks Chemicals

Chemical	Typical Use
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-based lacquers	Binder
Phosphorus, red (only as provided in Table E-3.6.1)	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 E-3.6.1)	Oxygen donor
Potassium hydrogen phthalate	Whistle
Potassium nitrate	Oxygen donor
Potassium perchlorate	Oxygen donor
Potassium sulfate	Oxygen donor
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 > 100 mesh if 1.4G or 1.4S Fireworks)	Fuel

†E-4.3.2 Devices containing any chemical not specified in Table E-4.3.1. For each item for which approval is sought, the manufacturer needs to submit a sample of each pyrotechnic mixture containing any chemical not specified in Table E-4.3.1 to the Bureau of Explosives or other fireworks laboratory acceptable to the DOT for examination. The manufacturer shall then submit a Fireworks Approval Application (*see APA 87-1, Appendix D*), together with the appropriate fireworks laboratory reports to the DOT. The DOT can then issue approval based on the information contained in the application and accompanying fireworks laboratory report(s).

Miscellaneous Compounds:

Organic compounds [compounds such as lactose, shellac, red gum, chlorinated paraffin, and polyvinyl chloride, consisting of some combination of carbon with hydrogen, oxygen, or chlorine, or all three; nitrogen can be present if it accounts for less than 10 percent (by weight) of the compound.]

NOTE: Exact chemical identity of each "organic compound" is to be included when submitting an Approval Application (*see APA 87-1, Appendix D*) to the DOT.

E-5 Shipping Requirements.

†E-5.1 Transportation Regulating Authorities. Transportation of fireworks is regulated by the United States Department of Transportation (DOT). Some states and municipalities also