NFPA 1122
Code for Model Rocketry

1997 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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This edition of NFPA 1122, *Code for Model Rocketry,* was prepared by the Technical Committee on Pyrotechnics and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held May 19–22, 1997, in Los Angeles, CA. It was issued by the Standards Council on July 24, 1997, with an effective date of August 15, 1997, and supersedes all previous editions.

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.

This edition of NFPA 1122 was approved as an American National Standard on August 15, 1997.

Origin and Development of NFPA 1122

NFPA 1122 was created originally as a tentative code by the Technical Committee on Pyrotechnics as NFPA 41L, *Code for Model Rocketry.* It was adopted tentatively in 1967 and adopted officially by the Association in May 1968. In November 1976, a major revision of NFPA 41L, including its redesignation as NFPA 1122L, *Code for Unmanned Rockets,* was adopted. The 1976 edition was revised by the Technical Committee on Pyrotechnics in 1980 to eliminate the "L" designation and to delete the requirements for cold propellant model rocket motors, which no longer are allowed because of their use of chlorofluorocarbons (Freon 12™). Other technical changes were made at that time. Those revisions were adopted at the 1981 NFPA Fall Meeting, and the new document became the 1982 edition. Amendments to the 1982 edition were processed at the 1986 NFPA Fall Meeting, resulting in the 1987 edition. Because of the rapid progress in consumer rocket technology and the emergence of the commercial space transportation industry, the 1987 edition was amended, and its title was changed back to NFPA 1122, *Code for Model Rocketry,* for the 1994 edition.

For the 1997 edition, the terminology and provisions relating to reloadable solid propellant model rockets and reloadable solid propellant model rocket motors were incorporated into the document for consistency with changes made to federal regulations that affected the model rocketry industry. These changes in federal regulations occurred after the previous edition of this code was adopted. These changes are reflected throughout the document.

In addition, the citations for federal regulations were updated throughout the document to reflect changes made to those regulations since the last edition of the code was prepared.

Other changes were editorial in nature to bring the document into conformance with the NFPA *Manual of Style.*

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

The Committee does not have responsibility for documents on the use of consumer fireworks by the general public and the use of pyrotechnic special effects before a proximate audience.

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in membership may have occurred. A key to classifications is found at the back of this document.

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.

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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 6 and Appendix D.

FOREWORD

This code is intended to prohibit the making and launching of dangerous homemade "rocket bombs" and to eliminate the tragic injuries and deaths that have occurred due to experiments with explosive "rocket fuels," homemade rocket motors, and unsafe launching mechanisms.

This code contains instructional guidelines and specific standards for the design, construction, limitation of charge and power, and reliability of all rocket motors manufactured for sale to the general public; for the design and construction of rockets propelled by these motors; and for the performance of tests, launchings, and other operations involving such rockets in order to minimize hazards.

The NFPA Technical Committee on Pyrotechnics believes that this code contains appropriate measures to safeguard this popular and growing activity. Safe model rocket activities should not be confused with the hazardous, uncontrolled operations of so-called basement bombers and amateur rocketeers, who attempt to make their own propellants, rocket motors, and large, metallic rocket vehicles. Model rocket activities should be allowed within the specifications of this code to guide our science-minded youth and citizens safely.

Chapter 1 General Requirements

1-1 Scope.

1-1.1 This code shall apply to the design, construction, limitation of propellant mass and power, and reliability of model rocket motors and model rocket motor reloading kits and their components, produced commercially for sale to or for use by the public for purposes of education, recreation, and sporting competition.

1-1.2 This code also shall apply to the design and construction of model rockets propelled by model rocket motors specified in 1-1.1.

1-1.3 This code also shall apply to the conduct of launch operations of model rockets specified in 1-1.2.

1-1.4 This code shall not apply to the design, construction, production, manufacture, fabrication, maintenance, launching, flight, test, operation, use of, or any other activity in connection with a rocket or rocket motor when carried out or engaged in by any of the following:

(a) The government of the United States of America

(b) Any state or local government

(c) Any individual, firm, partnership, joint venture, corporation, or other business entity engaged as a licensed business in the research, development, production, testing, maintenance, or supply of rockets, rocket motors, rocket propellant chemicals, or rocket components or parts

(d) Any college or university

1-1.5 This code shall not apply to the design, construction, fabrication, maintenance, production, manufacture, launching, flight, test, operation, or use of rocket-propelled model aircraft that sustain their mass against the force of gravity by aerodynamic lifting surfaces that support the aircraft during the entire duration of its flight in the air. However, this code shall apply to the model rocket motors and their components that provide the propulsion for such model aircraft.

1-1.6 This code shall not apply to model or toy rockets propelled by pressurized-liquid rocket motors containing less than 250 ml (8.45 fl oz) of water.

1-1.7 This code shall not apply to fireworks rockets or pyrotechnic rockets as defined in NFPA 1123, *Code for Fireworks Display.*

1-1.8 This code shall not apply to NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks.*

1-1.9 This code shall not apply to NFPA 1126, *Standard for the Use of Pyrotechnics before a Proximate Audience.*

1-1.10 This code shall not apply to high power rocketry as defined in NFPA 1127, *Code for High Power Rocketry.*

1-2 Purpose.

1-2.1 The purpose of this code shall be to ensure the wide and easy availability of commercial model rocket motors and components that meet standards of safety and reliability, thereby ensuring that the creative and experimental urges of the public regarding model rocket devices have reasonably safe outlets.

1-2.2 The purpose of this code also shall be to discourage the making and launching of homemade rockets and other rocket-like vehicles, propelled or intended to be propelled, by homemade rocket-propulsion devices.

1-2.3 The purpose of this code also shall be to discourage experiments with explosive or highly energetic rocket propellants, construction of homemade rocket-propulsion motors, and attempted launchings or operations of these homemade rocket devices, thereby minimizing tragic deaths and injuries.

1-3 Definitions. For the purposes of this code, the following terms shall be defined as specified in this section.

Approved.* Acceptable to the authority having jurisdiction.

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

Cold-Propellant Model Rocket Motor. A model rocket motor that produces force or thrust by a change of state of its propellant, i.e., not by a process involving combustion.

Commercial Manufacturer. Any individual, firm, partnership, joint venture, corporation, or other business entity engaged as a licensed business in research, development, production, preparation, testing, maintenance, or supply of model rockets, model rocket motors, model rocket propellant chemicals, model rocket propellant, delay or ejection modules, or model rocket components or parts.

Hybrid Model Rocket Motor. A model rocket motor in which the fuel exists in a different physical state (solid, liquid, or gaseous) than the oxidizer and that derives its force or thrust from the combination thereof.

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.

Liquid-Propellant Model Rocket Motor. A model rocket motor that contains a fuel and an oxidizer in liquid form, or in a combined monopropellant liquid form as a single chemical, and that derives its force or thrust from the combustion thereof.

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

Model Rocket. A model rocket is a rocket that is propelled by a model rocket motor. It has structural parts made of paper, wood, and breakable plastic; it has a means for its return to the ground so it can be flown again; and its primary use is for purposes of education, recreation, and sporting competition.

Model Rocket Engine. See Model Rocket Motor.

Model Rocket Motor. A solid propellant or pressurized-liquid rocket motor that conforms to the standards for model rocket motors as set forth in this code. Where the term "model rocket motor" is used in this code, it includes both assembled reloadable model rocket motors and manufactured expendable model rocket motors.

Model Rocket Vehicle. See Model Rocket.

Module. A pyrotechnic component of a reloadable model rocket motor in which the component's chemical composition is cast into a finished assembly to avoid the measuring or mixing of ingredients or the handling of raw pyrotechnic materials by the user.

Motor Reloading Kit. A package designed and produced by a commercial manufacturer that contains all the components and parts necessary to reload and re-use a nonexpendable model rocket motor casing specifically designed and manufactured for use with such components and parts. These components and parts normally include a propellant module(s), a new model rocket motor nozzle, new insulation components, prepackaged delay and ejection modules, an electrical igniter, and the parts necessary to seal the casing during operation.

Pressurized-Liquid Model Rocket Motor. A model rocket motor that derives its force or thrust from a liquid expelled from the model rocket motor by pressurized gas and that involves no combustion or change of state.

Production Lot. A quantity of solid propellant model rocket motors, motor casings, or motor reloading kits produced during a single work shift on the same manufacturing device, using the same batch of pyrotechnic material.

Propellant. The material(s) utilized in a model rocket motor that produces thrust by the discharge of a working fluid generated by combustion, decomposition, change of state, or other operation of such material contained, carried, or stored within the model rocket motor.

Reloadable Rocket Motor. A model rocket motor that has been designed and manufactured so that the user can load, reload, and re-use the pressure-containing body or casing using the parts and components of a motor reloading kit specifically designed, manufactured, and intended for use with that model rocket motor casing by the manufacturer.

Rocket. A device that ascends into the air without the use of aerodynamic lifting forces acting against gravity and that is propelled by a rocket motor.

Rocket Engine. See Rocket Motor.

Rocket Motor. A device, or combination of devices, that provides the necessary force or thrust to cause a rocket to move. The force or thrust shall be created by the discharge of gas generated by combustion, decomposition, change of state, or other operation of materials contained, carried, or stored solely within the rocket motor or rocket and not dependent upon the outside environment for reaction mass.

Rocket Vehicle. See Rocket.

Shall. Indicates a mandatory requirement.

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

Solid Propellant Model Rocket Motor. A model rocket motor containing a fuel and an oxidizer in solid form and deriving its force or thrust from the combustion thereof.

Steam Model Rocket Motor. A model rocket motor that produces its force or thrust by means of steam carried or stored within the model rocket motor or model rocket vehicle or produced in the model rocket motor or model rocket vehicle by the heating of water therein.

Structural Parts. The load-bearing parts of a model rocket, specifically, the nose cone, body tube, and fins.

Chapter 2 Requirements for Model Rocket Construction and Operation

2-1* Model Rocket Operations. A model rocket shall comply at all times with the requirements of construction and operation as set forth in *Federal Aviation Administration Regulations*, Title 14, *Code of Federal Regulations*, Parts 101.1 through 101.25.

2-2 Model Rocket Materials. A model rocket's structural parts, including the body, nose cone, and fins, shall be made of paper, wood, or plastic and shall contain no substantial metal parts. A model rocket motor shall be assembled with all pyrotechnic ingredients preloaded into a cylindrical paper or similarly constructed nonmetallic tube that will not fragment into sharp, hard pieces.

Exception: A model rocket motor casing which is metallic and reloadable, and which meets the specifications in this code shall be permitted.

2-3* Model Rocket Recovery. A model rocket shall have a means for returning it to the ground so it can be flown again (e.g., a parachute). All recovery wadding used in a model rocket shall be flame resistant.

2-4* Model Rocket Weight Limits.

2-4.1 A model rocket shall weigh no more than 453 g (16 oz) at lift-off, including propellant.

2-4.2* A model rocket shall use no more than 113 g (4 oz) of propellant.

*Exception: *A model rocket weighing in excess of 453 g (16 oz) but no more than 1500 g (53 oz) including propellant, or using more than 113 g (4 oz) but less than or equal to 125 g (4.4 oz) of propellant, shall be permitted if the Federal Aviation Administration notice requirements are met.*

2-5 Model Rocket Power Limits. A model rocket's installed motor(s) shall produce a total impulse of no more than 320 Newton-seconds (72 pound-seconds).

2-6 Model Rocket Payloads. A model rocket shall not carry a payload that is intended to be flammable, explosive, or harmful to persons or property. A model rocket shall not be launched on a flight path aimed at a target.

2-7 Model Rocket Launch Site. A model rocket shall be launched outdoors in a cleared area, free of tall trees, power lines, buildings, and dry brush and grass.

2-8 Model Rocket Launch Site Size. The launch site shall be at least as large as specified in Table 2-8.

Table 2-8 Minimum Launch Site Dimensions[1]

Installed Total Impulse[2] (Newton-seconds)	Equivalent Motor Type	Minimum Site Dimensions (ft)	(m)
0 – 1.25	1/4 A and 1/2 A	50	15
1.26 – 2.50	A	100	30
2.51 – 5.00	B	200	61
5.01 – 10.00	C	400	122
10.01 – 20.00	D	500	152
20.01 – 40.00	E	1000	305
40.01 – 80.00	F	1000	305
80.01 – 160.00[2, 3]	2F (or 1G)[3]	1000	305
160.01 – 320.00	4F (or 2G)[3]	1500	457

[1] *For a circular area, the minimum launch site dimension is the diameter; for a rectangular area, it is the shortest side.*
[2] *See 2-8.1.*
[3] *See 2-8.2.*

2-8.1 A model rocket with an installed total propellant weight exceeding 113 g (4 oz) but less than or equal to 125 g (4.4 oz) shall comply with the additional operating notice requirements as set forth in *Federal Aviation Administration Regulations*, Title 14 *Code of Federal Regulations*, Parts 101.3 through 101.25.

2-8.2 "G" motors with an installed total impulse of more than 80 Newton-seconds (18 pound-seconds), but not more than 160 Newton-seconds (36 pound-seconds), shall be permitted to be used by individuals 18 years of age and older.

2-8.3 As an alternative to the minimum launch site dimensions of Table 2-8, the size of the launch site shall be established as no less than 1/2 the maximum altitude as stated by the manufacturer for the model rocket and motor(s) combination being flown, or as approved by the authority having jurisdiction based on flight demonstration or data required to substantiate the anticipated altitude.

2-9 Model Rocket Launchers. A model rocket shall be launched from a stable launch device that provides rigid guidance until it has reached a speed adequate to ensure a safe flight path.

2-10 Model Rocket Launcher Eye Safety. To prevent accidental eye injury, the launcher shall be placed so the end of the rod is above eye level, or the end shall be capped when approaching it. The launch rod shall be capped or disassembled when not in use and shall not be stored in an upright position.

2-11 Model Rocket Launch Safety. The launcher shall have a blast deflector device to prevent the motor exhaust from hitting the ground directly. The area around a launch device shall be cleared of brown grass, dry weeds, or other easy-to-burn materials.

2-12 Model Rocket Ignition System. The system used to launch a model rocket shall be remotely controlled and electrically operated. It shall have a launching switch that will return to the "off" position when released. The system shall be equipped with a removable safety interlock in series with the launch switch.

2-13 Spectator Distances. All persons shall remain at least 15 ft (4.6 m) from the model rocket when igniting model rocket motors with an installed total impulse of 30 Newton-seconds (6.7 pound-seconds) or less, and at least 30 ft (9 m) from the model rocket when igniting model rocket motors with an installed total impulse of more than 30 Newton-seconds (6.7 pound-seconds).

2-14 Spectator Notification. All people in the launch area shall be made aware of the pending model rocket launch. An audible 5-second countdown shall take place.

2-15 Model Rocket Misfires. If a model rocket misfires, no person shall approach the launcher until one minute has elapsed and the safety interlock has been removed or the battery has been disconnected from the ignition system.

2-16 Model Rocket Launch Weather. A model rocket shall not be launched in a wind of more than 20 mph (32 km/h) or into a cloud or near an aircraft in flight.

2-17 Model Rocket Launch Angle. The launch device shall be pointed within 30 degrees of vertical.

2-18 Model Rocket Retrieval Safety. A model rocket shall not be retrieved if it becomes entangled in a power line or other dangerous place.

Chapter 3 Requirements for Model Rocket Motors and Components

3-1 Solid Propellant Model Rocket Motors and Components.

3-1.1* A solid propellant model rocket motor, motor reloading kit, or component shall be a device produced by a commercial manufacturer.

3-1.1.1 Expendable Model Rocket Motor.

3-1.1.1.1 An expendable (nonreloadable) model rocket motor shall have all of the propellant preloaded into the motor casing in such a manner that the propellant cannot be removed without destroying the motor.

3-1.1.1.2 Delay trains and ejection charges shall be permitted to be included as an integral part of the motor. Motors that are available only to adults (age 18 and above) shall be permitted to use separately packaged delays and ejection charges.

3-1.1.2 Reloadable Model Rocket Motor.

3-1.1.2.1 Propellant modules packaged in motor reloading kits for reloadable model rocket motors having a total impulse equal to or greater than 30 Newton-seconds (6.7 pound-seconds) shall be shipped and stored in an insulating sleeve of equal or greater length than the propellant module. The insu-

lating sleeve shall have a low thermal conductivity and a thickness of not less than 0.030 in. (0.08 cm).

3-1.1.2.2 Propellant modules packaged in motor reloading kits for reloadable model rocket motors having a total impulse of less than 30 Newton-seconds shall be limited to a maximum of three modules per package.

3-1.1.2.3 Ejection charges shall be packaged in such a manner that any flame from ignition of a charge will have a low probability of cross-propagation to other ejection charges.

3-1.2 Motor Casing Temperature. A solid propellant model rocket motor casing shall be made so that the temperature of the external surface of the model rocket motor casing cannot exceed 392°F (200°C) during or after operation.

3-1.3 Motor Casing Requirements.

3-1.3.1 A solid propellant model rocket motor casing shall be designed so that, if it ruptures, it will not project any casing fragments beyond a radial distance of 10 ft (3 m) for motors of less than 30 Newton-seconds (6.7 pound-seconds) total impulse, or 20 ft (6 m) for motors equal to or greater than 30 Newton-seconds (6.7 pound-seconds).

3-1.3.2 Metal casings, if used, shall be designed and constructed so that their primary failure mode shall be along the longitudinal axis of the motor.

3-1.3.3 Reloadable metal motor casings shall be made of 6061-T6 aluminum alloy.

3-1.3.4 Reloadable metal motor casings shall be designed to contain at least twice the design maximum operating pressure of the motor before allowing failure to occur.

3-1.4 Model Rocket Motor Environmental Stability. A solid propellant model rocket motor, motor reloading kit, or component shall be so designed and constructed as to be incapable of ignition when subjected to a temperature of 257°F (125°C) for duration of no less than 30 minutes.

3-1.5* Model Rocket Motor Limitations.

3-1.5.1 A model rocket motor shall contain no more than 62.5 g (2.2 oz) of propellant materials.

3-1.5.2 A model rocket motor shall produce a total impulse less than 80 Newton-seconds (17.98 pound-seconds).

Exception: A model rocket motor sold to and used by individuals 18 years of age or older shall be permitted to have a total impulse not in excess of 160 Newton-seconds (36 pound-seconds).

3-1.5.3 A model rocket motor shall produce an average thrust of 80 Newtons or less.

3-1.5.4 A model rocket motor sold to or used by individuals 17 years of age and younger shall be designed to comply with *Consumer Product Safety Commission (CPSC) Regulations* Title 16, *Code of Federal Regulations,* Parts 1500.85(8) and (9).

3-1.6 Manufacturer Production Lot Testing.

3-1.6.1 A manufacturer of solid propellant model rocket motors or motor reloading kits shall subject a random sample of 1 percent of each motor or motor reloading kit production lot to a static test that shall measure and record the assembled model rocket motor's total impulse, delay time, and action of ejection charge for each item, as included. Static tests shall be conducted with the test items at ambient temperature.

3-1.6.2 Propellant burn time shall be the period, measured in the motor's thrust-time profile, between when the motor's thrust first rises above 5 percent of its eventual peak value, and the point where thrust falls below 5 percent of peak.

3-1.6.3 Delay time measurement shall start at the point where thrust falls below 5 percent of peak thrust and continues to the point of ejection activation.

3-1.6.4 Total impulse shall be measured between the point where the thrust rises to 5 percent of the motor's peak thrust to the point of last measurable thrust prior to ejection or blow through, or, if it is a plugged motor, to the point where all action has ceased.

3-1.6.5 Production lots shall be corrected, destroyed, or retested by the manufacturer under any of the following conditions:

(a) Total impulse of any test item varies more than 20 percent from the established mean total impulse value of the model rocket motor or reloading kit type

(b) Time delay of any test item varies more than 20 percent from the established mean time delay value of the model rocket motor or motor reloading kit type; but in no case shall this variation exceed 3 seconds

(c) Ejection charge, if any, of any test item does not function properly

(d) Any test item malfunctions in any other manner that affects the safety of its shipment, storage, handling, or use

3-1.6.6 For a retest, a manufacturer shall test a minimum additional 2 percent of the production lot in question. If any additional test item exhibits any of the conditions of 3-1.6.5(a) through (d), the entire production lot shall be corrected or destroyed by the manufacturer.

3-1.7 Model Rocket Motor Shelf Life. When the performance of a solid propellant model rocket motor or motor reloading kit deviates from the sample test criteria and limits detailed in 3-1.6.5 within 5 years from the date of manufacture, it shall be withdrawn from commercial sale and redesigned to provide reliable operation when ignited within 5 years from the date of manufacture.

3-1.8 Shipping and Storage Prohibitions. A solid propellant model rocket motor shall not be shipped or stored with an ignition element installed.

3-1.9 Model Rocket Fuse Prohibition. No manufacturer, distributor, or other person shall sell, offer to sell, expose for sale, or otherwise make available to the public any type of model rocket motor ignition device that is intended to be initiated by a handheld flame.

3-1.10 Motor Instruction Requirements.

3-1.10.1 A solid propellant model rocket motor, motor reloading kit, or component shall be shipped and sold with complete instructions for its storage, handling, and use.

3-1.10.2 These instructions shall include a warning to read and follow the instructions and to use the model rocket motor only in accordance with the instructions.

3-1.10.3 The instructions shall also contain the following information:

(a) Instructions that specify how to ignite the model rocket motor by electrical means only

(b) Performance data on the model rocket motor or motor reloading kit type that include propellant weight, total impulse, average thrust, time delay, and representative thrust-time curve

(c) Any special first-aid data or action to be taken in the event of burns or ingestion of the propellant

(d) Proper and safe disposal of the model rocket motor or pyrotechnic components of a motor reloading kit when it has become too old, has been subjected to conditions that might impair its performance, or, in the opinion of the user, has become unsafe

(e) Any special action that shall be taken in the event of a fire involving model rocket motors, or motor reloading kits

(f) For motor reloading kits, safety precautions for handling the propellant, pyrotechnic materials, and for cleaning or any post-firing maintenance on the motor casing

3-1.11 Model Rocket Motor Marking. A model rocket motor or motor reloading kit shall have imprinted on its external surface, casing, or wrapper, a recognized code indicating the nominal performance parameters — e.g., "C6-5" [for a model rocket motor having a total impulse of 5.01 to 10.0 Newton-seconds (1.1 to 2.2 pound-seconds), an average thrust of 6 Newtons, and a time delay of 5 seconds] or "5-second time delay module" (for a time delay module having a time delay of 5 seconds) — and the date of manufacture or equivalent coding.

Exception: If the size, shape, or surface of the model rocket motor does not permit the required designation to be printed on it, then the equivalent coding shall be permitted to be printed on the packaging.

3-1.12 The package containing the motor reloading kits for use in a nonexpendable reloadable model rocket motor shall have visible identification that will identify the motor casing type in which it shall be installed.

3-1.13 The package containing the motor reloading kit shall display instructions that the package shall be kept closed until just prior to use.

3-1.14 Model rocket motors, motor reloading kits, and pyrotechnic components shall be marked with information complying with the *Federal Hazardous Substances Act,* Title 16, *Code of Federal Regulations,* Part 1500.

3-2 Pressurized-Liquid Model Rocket Motors.

3-2.1 A pressurized-liquid model rocket motor shall be sold as a completely prefabricated, assembled device ready for the user to fill, pressurize, and use.

3-2.2 A pressurized-liquid model rocket motor shall use water in the liquid state or other nontoxic liquid as a propellant or reaction mass.

3-2.3 Casing and Pressure Requirements.

3-2.3.1 A pressurized-liquid model rocket motor shall be designed for an internal working pressure not greater than 7 atmospheres gauge (103 psig or a gauge pressure of 710 kPa).

3-2.3.2 A pressurized-liquid model rocket motor shall be equipped with a nonadjustable, nonremovable safety valve or pressure release means that will operate when the internal pressure exceeds 10 atmospheres gauge (147 psig or a gauge pressure of 1014 kPa).

3-2.3.3 The pressurized-liquid model rocket motor casing shall be designed and constructed to possess a minimum burst pressure of 20 atmospheres gauge (294 psig or a gauge pressure of 2027 kPa).

3-2.3.4 Materials used in the construction or fabrication of a pressurized-liquid model rocket motor shall be nonmetallic.

3-2.4 Shipping and Storage Prohibitions for Pressurized-Liquid Model Rocket Motors. A pressurized-liquid model rocket motor shall be shipped and stored with no propellant material inside it and vented to atmospheric pressure.

3-2.5 Pressure Source for Pressurized-Liquid Model Rocket Motors. The pressure used by a pressurized-liquid model rocket motor shall be either generated or produced by a pressure source such as a pump outside the model rocket motor or generated by the noncombustible chemical reaction of chemicals within the model rocket motor or model rocket vehicle.

Chapter 4 Testing and Certification

4-1 Certification of Model Rocket Motors, Motor Reloading Kits, and Components.

4-1.1* A prerequisite for certification of a model rocket motor or motor reloading kit shall be its prior classification by the U.S. Department of Transportation (DOT), or competent authority as Division 1.3 or 1.4 Explosive, or a written acknowledgment from the U.S. Department of Transportation (DOT), or one of its approved testing agencies that the model rocket motor or motor reloading kit is a flammable solid.

Exception: A model rocket motor or motor reloading kit not containing pyrotechnic material shall not be required to have a certificate of classification.

4-1.2 Model rocket motor, motor reloading kit, and component(s) types offered for sale, exposed for sale, sold, used, or made available to the public shall be examined and tested by the authority having jurisdiction to determine whether they comply with the standards and requirements detailed in Chapter 3.

4-1.3 The authority having jurisdiction shall certify as acceptable for sale and use those products that do comply.

4-1.4 At the discretion of the authority having jurisdiction, such examination, testing, and certification shall be permitted to be carried out by a recognized testing organization acceptable to the authority having jurisdiction.

4-1.5 Any changes made to the physical or chemical design of a model rocket motor, motor reloading kit, or components by a manufacturer after certification testing shall be reported to the authority having jurisdiction, recognized testing organization, or both, prior to sale or shipment.

4-1.6 Before granting such certification, the authority having jurisdiction or recognized testing organization shall examine samples of a motor or reloadable motor system as follows:

(a) Static testing, conducted at or corrected to sea level and 20 (± 5)°C [68 (± 9)°F], of a minimum of 10 samples to determine that total impulse, average thrust, and delay time comply with the following requirements:

(1) Standard deviation of the total impulse data shall be no greater than 6.7 percent of the mean measured value.

(2) No time delay shall be measured to have a variation greater than 1 second or 20 percent (whichever is greater, but not to exceed 3 seconds) from the labeled value.

(3) Average thrust shall be within 20 percent (or 1 Newton, whichever is greater) of the average thrust that is computed by dividing the mean total impulse measured during propellant burn time by the mean propellant burn time.

(b) For metal-casing reloadable motors, rupture testing of 1 sample to ensure that the casing complies with the burst pressure and longitudinal failure mode requirements of 3-1.3

(c) Thermal testing to ensure that the casing temperature during and after static firing complies with 3-1.2

(d) Heat sensitivity testing to ensure that the motor or motor reloading kit complies with 3-1.4

(e) Examination of the packaging and instructions to verify compliance with all provisions of this code

4-2 Listing of Certified Model Rocket Motors and Motor Reloading Kits. The authority having jurisdiction shall maintain a current and complete list of all those model rocket motor and motor reloading kit types that are certified as complying with the standards and requirements detailed in Chapter 3 and shall make copies of this list available to citizens and public safety officials who request it.

4-3 Withdrawal of Certification. The certification of a model rocket motor or motor reloading kit shall be permitted to be withdrawn, by the original certifying entity, if it is determined that the certified model rocket motor or motor reloading kit no longer complies with the original certification criteria or current certification criteria, with respect to safety.

Chapter 5 Prohibited Activities and Permit Requirements

5-1 Prohibited Activities. The following activities shall be prohibited by this code:

(a) Use of model rocket motors, motor reloading kits, or components for the primary purpose of producing a spectacular display of color, light, sound, or any combination thereof

Exception: This shall not be construed as prohibiting the public demonstration of model rockets as defined herein and as certified according to these requirements.

(b) Use of a model rocket or model rocket motor, motor reloading kit, or component as a weapon against a target

(c) Use of a model rocket, model rocket motor, motor reloading kit, or component contrary to the instructions for its use and contrary to the provisions of *Federal Aviation Administration Regulations*, Title 14, *Code of Federal Regulations*, Parts 101.1 through 101.25

(d) Tampering with any model rocket motor or motor reloading kit or component in any manner or to any degree that is contrary to the purpose for which the model rocket motor, motor reloading kit, or component is designed and intended to be used

(e) Sale or transfer to the general public, not otherwise exempted in 1-1.4, of any model rocket motor, motor reloading kit, or component that has not been certified in accordance with Chapter 4

(f) Manufacture, production, fabrication, making, operation, maintenance, launch, flight, test, activation, discharge, or other experimentation with model rockets, model rocket motors, motor reloading kits, or components that have not been certified in accordance with the provisions of Chapter 4 including, but not limited to, cold-propellant model rocket motors, hybrid model rocket motors, liquid-propellant model rocket motors, steam model rocket motors, and model rocket propellant chemicals for solid, liquid, and hybrid model rocket motors, including monopropellants

(g) Sale, offer for sale, exposure for sale, making, or use of fuse, wick, or other ignition devices intended to be activated by a handheld flame for the purpose of starting or igniting a model rocket motor

(h) Affixing to a model rocket motor, motor reloading kit, or component a statement of compliance with the regulations or statement of certification required by Chapter 4, or exhibiting statements in writing, in advertising or on packaging that certification in accordance with Chapter 4 has been obtained, when such certification has not been obtained, has been withdrawn, or has been denied

(i) Reloading any expendable solid propellant model rocket motor with any material after that motor has been operated

(j) Reloading, refilling, or pressurizing any model rocket motor with any material or by any means not specifically provided or recommended by the manufacturer

5-2 Residential Storage of Model Rocket Motors and Components.

5-2.1 No more than 50 lb (23 kg) net weight of solid propellant model rocket motors, motor reloading kits, or components shall be stored at a residence, of which no more than 25 lb (11 kg) net weight of solid propellant model rocket motors, motor reloading kits, or components shall be permitted to be stored in the living quarters.

5-2.2 Provisions for the storage of more than 50 lb (23 kg) net weight of solid propellant model rocket motors, motor reloading kits, or components at a residence shall be subject to the approval of the authority having jurisdiction.

Chapter 6 Referenced Publications

6-1 The following documents or portions thereof are referenced within this code as mandatory requirements and shall be considered part of the requirements of this code. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this code. Some of these mandatory documents might also be referenced in this code for specific informational purposes and, therefore, are also listed in Appendix D.

6-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1123, *Code for Fireworks Display,* 1995 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,* 1996 edition.

NFPA 1127, *Code for High Power Rocketry,* 1995 edition.

6-1.2 Other Publications.

6-1.2.1 NAR Publication. National Association of Rocketry, P.O. Box 177, 1311 Edgewood Drive, Altoona, WI 54720.

Model Rocket Safety Code of the National Association of Rocketry, Hobby Industry Association of America, 1991.

6-1.2.2 U.S. Government Publications. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Consumer Product Safety Commission Regulations, Title 16, *Code of Federal Regulations,* Parts 1500.85(a) (8-9).

Alcohol, Tobacco and Firearms Regulations, Title 27, *Code of Federal Regulations,* Parts 55.141(a) (7) (Edition 6/90).

Department of Transportation Regulations, Title 49, *Code of Federal Regulations,* Parts 100 through end.

Federal Aviation Administration Regulations, Title 14, *Code of Federal Regulations,* Parts 101.1 through 101.25.

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-1-3 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A-1-3 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-1-3 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations 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 Excerpt from *Federal Aviation Administration Regulations,* Title 14, *Code of Federal Regulations,* Part 101.1:

(a) This part prescribes rules governing the operation in the United States of the following:

(3)Any unmanned rocket except...

(ii) Model rockets

(a) Using not more than four ounces of propellant;

(b) Using a slow-burning propellant;

(c) Made of paper, wood, or breakable plastic, containing no substantial metal parts, and weighing not more than 16 ounces, including the propellant; and

(d) Operated in a manner that does not create a hazard to persons, property, or other aircraft.

A-2-3 Models should be launched only during daylight hours.

A-2-4 A model rocket should weigh no more than the motor manufacturer's recommended maximum lift-off weight for the motors used or should use motors recommended by the kit manufacturer.

A-2-4.2 Exception. See *Federal Aviation Administration Regulations,* Title 14, *Code of Federal Regulations,* Parts 101.1 through 101.25.

A-3-1.1 See *Consumer Product Safety Commission Regulations,* Title 16, *Code of Federal Regulations,* Part 1500.83(a)(36), for additional labeling requirements for model rocket motors.

A-3-1.5 A nationally recognized testing organization which tests in accordance with NFPA 1122 and certifies model rocket motors to the performance specifications outlined therein can include, but is not limited to, the National Association of Rocketry and Tripoli Rocketry Association or their successor organization(s).

A-4-1.1 Model rocket motors other than preloaded, expendable types should be sold only to persons age 18 or older. A nationally recognized testing organization which tests in accordance with NFPA 1122 and certifies model rocket motors to the performance specifications outlined therein can include, but is not limited to, the National Association of Rocketry and Tripoli Rocketry Association or their successor organization(s).

Appendix B Model Rocket Safety Code of the National Association of Rocketry

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

NOTE: Appendix B is an extract from the Model Rocket Safety Code of the National Association of Rocketry.

1. *Materials.* My model rocket will be made of lightweight materials such as paper, wood, rubber, and plastic suitable for the power used and the performance of my model rocket. I will not use any metal for the nose cone, body, or fins of a model rocket.

2. *Motors.* I will use only commercially-made NAR certified model rocket motors in the manner recommended by the manufacturer. I will not alter the model rocket motor (engine), its parts, or its ingredients in any way.

3. *Recovery.* I will always use a recovery system in my model rocket that will return it safely to the ground so it may be flown again. I will use only flame resistant recovery wadding if wadding is required by the design of my model rocket.

4. *Weight and Power Limits.* My model rocket will weigh no more than 1,500 grams (53 ounces) at liftoff and its rocket motor(s) will produce no more than 320 Newton-seconds (4.45 Newtons equals 1.0 pound) of total impulse. My model rocket will weigh no more than the motor manufacturer's recommended maximum liftoff weight for the motors used, or I

will use motors recommended by the manufacturer for my model rocket.

5. *Stability.* I will check the stability of my model rocket before its first flight, except when launching a model rocket of already proven stability.

6. *Payloads.* Except insects, my model rocket will never carry live animals or a payload that is intended to be flammable, explosive, or harmful.

7. *Launch Site.* I will launch my model rocket outdoors in a cleared area, free of tall trees, power lines, buildings, and dry brush and grass. My launch site will be at least as large as that recommended in the Launch Site Dimensions table, Table B-1.

Table B-1 Launch Site Dimensions

Installed Total Impulse (Newton-seconds)	Equivalent Motor Type	Minimum Site Dimensions (ft)
0 – 1.25	1/4 A & 1/2 A	50
1.26 – 2.50	A	100
2.51 – 5.00	B	200
5.01 – 10.00	C	400
10.01 – 20.00	D	500
20.01 – 40.00	E	1000
40.01 – 80.00	F	1000
80.01 – 160.00	G	1000
160.01 – 321.00	2Gs	1500

8. *Launcher.* I will launch my model rocket from a stable launch device that provides rigid guidance until the model rocket has reached a speed adequate to ensure a safe flight path. To prevent accidental eye injury, I will always place the launcher so the end of the rod is above eye level or I will cap the end of the rod when approaching it. I will cap or disassemble my launch rod when not in use and I will never store it in an upright position. My launcher will have a jet deflector device to prevent the motor exhaust from hitting the ground directly. I will always clear the area around my launch device of brown grass, dry weeds, or other easy-to-burn materials.

9. *Ignition Systems.* The system I use to launch my model rocket will be remotely controlled and electrically operated. It will contain a launching switch that will return to "off" when released. The system will contain a removable safety interlock in series with the launch switch. All persons will remain at least 15 feet from the model rocket when I am igniting model rocket motors totaling 30 Newton-seconds or less of total impulse and at least 30 feet from the model rocket when I am igniting model rocket motors totaling more than 30 Newton-seconds of total impulse. I will use only electrical igniters recommended by the motor manufacturer that will ignite model rocket motor(s) within one second of actuation of the launching switch.

10. *Launch Safety.* I will ensure that people in the launch area are aware of the pending model rocket launch and can see the model rocket's liftoff before I begin my audible five-second countdown. I will not launch a model rocket so its flight path will carry it against a target. If my model rocket suffers a misfire, I will not allow anyone to approach it or the launcher until I have made certain that the safety interlock has been removed or that the battery has been disconnected from the ignition system. I will wait one minute after a misfire before allowing anyone to approach the launcher.

11. *Flying Conditions.* I will launch my model rocket only when the wind is no more than 20 miles per hour. I will not launch my model rocket so it flies into clouds, near aircraft in flight, or in a manner that is hazardous to people or property.

12. *Pre-launch Test.* When conducting research activities with unproven model rocket designs or methods I will, when possible, determine the reliability of my model rocket by pre-launch tests. I will conduct the launching of an unproven design in complete isolation from persons not participating in the actual launching.

13. *Launch Angle.* My launch device will be pointed within 30 degrees of vertical. I will never use model rocket motors to propel any device horizontally.

14. *Recovery Hazards.* If a model rocket becomes entangled in a power line or other dangerous place, I will not attempt to retrieve it.

Appendix C Glossary

Aero Model. A miniature, unmanned flying device that includes the category of model rocket as defined in Section 1-3.

Skyrocket or Rockets with Sticks. Fireworks rockets not intended for re-use that meet the definition of "skyrocket" or "missile-type rocket" in the Hazardous Materials Regulations of the U.S. Department of Transportation (DOT). Fireworks rockets approved for transportation by DOT normally are classed as Fireworks UN 0335, Explosive 1.3G (formerly Class B Explosive, Special Fireworks) or Fireworks UN 0336, Explosive 1.4G (formerly Class C Explosive, Common Fireworks), depending on the quantity of pyrotechnic composition contained in the rocket. Skyrockets use a wooden stick for flight guidance and stability, while missile-type rockets use fins.

NOTE: See *Department of Transportation Regulations,* Title 49, *Code of Federal Regulations,* Parts 172 and 173.

Thrust Augmenter. A device that increases the force or motive power of a model rocket motor by imparting a portion of the momentum of the model rocket motor's exhaust jet to the surrounding environmental medium, and that is considered to be part of a model rocket motor when and where used.

Appendix D Referenced Publications

D-1 The following documents or portions thereof are referenced within this code for informational purposes only and are thus not considered part of the requirements of this code unless also listed in Chapter 6. The edition indicated here for each reference is the current edition as of the date of the NFPA issuance of this code.

D-1.1 NAR Publication. National Association of Rocketry, P.O. Box 177, 1311 Edgewood Drive, Altoona, WI 54720.

Model Rocket Safety Code of the National Association of Rocketry, Hobby Industry Association of America, 1991.

D-1.2 U.S. Government Publications. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Consumer Product Safety Regulations, Title 16, *Code of Federal Regulations,* Parts 1500.83(a)(36) and 1500.85(a)(8-9).

Department of Transportation Regulations, Title 49, *Code of Federal Regulations,* Parts 172–173.

Federal Aviation Administration Regulations, Title 14, *Code of Federal Regulations,* Parts 101.1 through 101.25.