NFPA 1125
Code for the Manufacture of Model Rocket and High Power Rocket Motors

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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Code for the

Manufacture of Model Rocket and High Power Rocket Motors

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This edition of NFPA 1125, *Code for the Manufacture of Model Rocket and High Power Rocket Motors*, 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 1125 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 1125

With the increased interest in high power rocketry, the Technical Committee on Pyrotechnics believed that public safety would be best served by the development of a code relating to the manufacture of model and high power rocket motors rather than relying on the provisions of NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks*. NFPA 1124 pertains to the manufacture of fireworks, much of which is not applicable to the manufacture of model rocket and high power rocket motors.

The development of a specific code for the manufacture of model rocket and high power rocket motors would not only tend to ensure the production of model rocket and high power rocket motors capable of meeting the standards set forth in the various codes relating to these activities but would also serve as a guideline to those companies that wish to enter the field of model and high power rocketry by providing them with information on the requirements believed by the committee to be necessary to promote safety in the manufacture of model rocket and high power rocket motors.

The committee revisions for the 1995 edition include editorial changes to the document to improve the usability, adoptability, and enforceability of the document, with respect to the NFPA Manual of Style, and the addition of requirements for the manufacture of high power rocket motors. The committee revisions to the document make it compatible with industry practices and other industry standards and incorporate regulatory provisions that have changed since the previous edition of the code.

Technical Committee on Pyrotechnics

Randall W. A. Davidson, *Chair*
Risk Int'l Inc./USITT, CA

Kenneth L. Kosanke, *Secretary*
Pyrolabs, CO

Dane Boles, Quest Aerospace Education, Inc., AZ
Jose R. Colon, Connecticut Dept. of Public Safety, CT
Rep. Fire Marshals Assn. of North America
John A. Conkling, Chestertown, MD
Hugh Council, State of CA Office of the Fire Marshal, CA
Thomas DeWille, Luna Tech Inc., AL
Vernon Estes, Canon City, CO
Gary A. Fadorsen, Pyrotech Int'l Inc., OH
Felix J. Grucci, Jr., Fireworks by Grucci, Inc., NY
Lansden E. Hill, Jr., E. E. Hill & Son, Inc./Pyro Shows, TN
Alfred J. Hogan, Reedy Creek Improvement District, FL
Bonnie J. Kosanke, Whitewater, CO
Rep. Pyrotechnics Guild Int'l
Donald F. McCaulley, Falls Church, VA
Larry J. McCune, U.S. Bureau of Alcohol, Tobacco & Firearms, DC
Frederick L. McIntyre, FLMc, Inc., MS
Robert E. Melton, Dallas Fire Dept., TX
Rep. NFPA Fire Service Section
Dale C. Miller, Falls Church, VA
J. Patrick Miller, Nat'l Assn. of Rocketry, TX
Rep. Nat'l Assn. of Rocketry
David J. Pier, MP Assoc., Inc., CA
Michael W. Platt, High Power Rocket Mfrs. & Dealers Assn., Inc., NY
Mary Roberts, Estes Industries, CO
Charles E. Rogers, Lancaster, CA
Rep. Tripoli Rocketry Assn., Inc.
Gary C. Rosenfield, Industrial Solid Propulsion Inc., NV
Pamela K. Stout Hunt, Fireworks Productions Int'l Inc., AZ
Charles Weeth, Skyrockers of La Crosse, Inc., WI

Alternates

Arthur H. Barber, III, U.S. Dept. of the Navy, VA
(Alt. to V. Estes)
Bruce E. Blom, Pyrotechnics Guild Int'l, WI
(Alt. to B. J. Kosanke)
Mark B. Bundick, First Chicago Capital Markets, IL
(Alt. to J. P. Miller)
Ernest F. DeBlasio, Keystone Fireworks Mfg. Co. Inc., PA
(Vot. Alt. to APA Rep.)
Tom Foster, Luna Tech Inc., AL
(Alt. to T. DeWille)
Felix J. (Phil) Grucci, Fireworks by Grucci, Inc., NY
(Alt. to F. J. Grucci, Jr.)
Paul C. Hans, P. Hans & Co., AZ
(Alt. to G. C. Rosenfield)
Julie L. Heckman, Keller and Heckman, DC
(Alt. to J. A. Conkling)
Bruce E. Kelly, Orem, UT
(Alt. to C. E. Rogers)
Larry Mars, MP Assoc., Inc., CA
(Alt. to D. J. Pier)
Jane B. McCaulley, D & J Assoc., VA
(Alt. to D. F. McCaulley)
David S. Shatzer, U.S. Bureau of Alcohol, Tobacco & Firearms, DC
(Alt. to L. M. McCune)
Bill Stine, Quest Aerospace Education, Inc., AZ
(Alt. to D. Boles)
Gerald D. Ward, Bethany Fire & Protection District, IL
(Alt. to R. E. Melton)

Nonvoting

Richard Bowes, Canadian Explosives Research Laboratory, ON
(Alt. to E. Contestabile)
Ettore Contestabile, Canadian Explosives Research Laboratory, ON
Glen E. Gardner, U.S. Occupational Safety & Health Admin, DC
(Alt. to J. Zucchero)
Samuel B. Hall, U.S. Consumer Product Safety Commission, DC
G. Harry Stine, Phoenix, AZ
(Member Emeritus)
Gary Zeller, Zeller Int'l, NY
James J. Zucchero, U.S. Dept. of Labor, OH

Martha H. Curtis, NFPA Staff Liaison

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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 does 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 5 and Appendix C.

Chapter 1 General

1-1 Scope.

1-1.1 This code shall apply to the manufacture of model rocket motors designed, sold, and used for the purpose of propelling recoverable aero models.

NOTE: For further information on propelling recoverable aero models, see NFPA 1122, *Code for Model Rocketry.*

1-1.2 This code also shall apply to high power rocket motors.

1-1.3 This code shall not apply to the sale and use of the following:

(a) Model rocket motors (covered by NFPA 1122, *Code for Model Rocketry*),

(b) High power rocket motors (covered by NFPA 1127, *Code for High Power Rocketry*).

1-1.4 This code shall not apply to the manufacture, transportation, and storage of fireworks.

NOTE: For further information on fireworks, see NFPA 1124, *Code for the Manufacture, Transportation, and Storage of Fireworks.*

1-1.5 This code shall not apply to the manufacture, transportation, and storage of rocket motors by federal and state military agencies.

1-1.6 This code shall not apply to the assembly of reloadable model rocket motors or reloadable high power rocket motors by the user.

1-2 Purpose.

1-2.1 The purpose of this code is to provide reasonable safety in the manufacture of model rocket and high power rocket motors.

1-2.2 The purpose of this code is also to supplement existing federal, state, or local regulations.

1-3 Equivalency. Nothing in this code is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety in place of those prescribed by this code, provided technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency and the system, method, or device is approved for the intended purpose.

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

Approved.* Acceptable to the authority having jurisdiction.

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

Barricade. A natural or artificial barrier that effectively screens a magazine, building, railway, or highway from the effects of an explosion in a magazine or building containing explosives. To be effective, a barricade shall be of such height that a straight line from the top of any sidewall of a magazine or building containing explosives to the eave line of any magazine or building, or to a point 12 ft (3.7 m) above the center of a railway or highway, passes through the barricade.

Artificial Barricade. An artificial mound or revetted wall of earth of a minimum thickness of 3 ft (0.9 m).

Natural Barricade. Natural features of the ground, such as hills or timber of sufficient density that the surrounding exposures that require protection cannot be seen from the magazine or building containing explosives when the trees are bare of leaves.

Screen Barricade. Any barrier that contains the embers and debris from a fire or deflagration in a process building, thus preventing propagation of fire to other buildings or areas. Such barriers shall be permitted to be constructed of metal roofing, $^1/_4$ in. to $^1/_2$ in. (6.4 mm to 13 mm) mesh screen, or equivalent material. The bar- rier extends from floor level to a height such that a straight line from the top of any sidewall of the donor building to the eave line of any exposed building intercepts the screen at a point not less than 5 ft (1.5 m) from the top of the screen. The top 5 ft (1.5 m) of the screen are inclined toward the donor building at an angle of 30 degrees to 45 degrees.

Bullet-Sensitive Explosive Material. Explosive material that can be detonated by 150-grain M2 ball ammunition having a nominal muzzle velocity of 2700 ft/s (823 m/s) where fired from a 0.30 caliber rifle at a distance of 100 ft (30.5 m), measured perpendicularly. The test material is at a temperature of 70°F to 75°F (21°C to 24°C) and is placed against a $^1/_4$-in. (6.4-mm) steel plate.

Composite Propellant Rocket Motor. Any device as defined under "Rocket Motor" that utilizes a propellant charge consisting primarily of an inorganic oxidizer dispersed in a carbonaceous polymeric binder.

Delay Composition. A chemical mixture that, upon burning and without explosion, is used to provide a delay between the thrust and ejection phases.

Ejection Composition. A chemical mixture that, upon burning, produces a burst of gas for deploying recovery devices.

Explosive.* Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion. This term includes, but is not limited to, dynamite, black powder, pellet powder, initiating explosives, detonators, safety fuses, squibs, detonating cord, igniter cord, and igniters. The term "explosive" includes any materials determined to be within the scope of Title 18, *United States Code*, Chapter 40, "Importation, Manufacture, Distribution and Storage of Explosive Materials," and also includes any material classified as an explosive by the Hazardous Materials Regulations of the U.S. Department of Transportation.

Low Explosive. Explosive materials that can be caused to deflagrate when confined (for example, black powder, safety fuses, igniters, igniter cords, fuse lighters, and display fireworks defined as low explosives by U.S. Department of Transportation regulations in Title 49, *Code of Federal Regulations,* Part 173, except for bulk salutes).

Facility. All land and buildings (including the rocket motor plant) constituting a model rocketry manufacturing operation.

High Power Rocket Motor. A rocket motor of more than 160 newton-seconds but less than 40,160 newton-seconds total impulse or producing more than 80 newtons average thrust.

Highway. Any public street, public alley, or public road.

Igniter. A device containing a small quantity of igniting compound in contact with a bridge wire or resistance element used to ignite a rocket motor.

Inhabited Building. A building regularly occupied in whole or in part as a habitation for human beings, or any church, schoolhouse, railroad station, store, or other structure where people are accustomed to assembling. This does not include any building or structure occupied in connection with a rocket motor plant.

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.

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.

Magazine. Any building or structure used exclusively for the storage of explosive materials that meets the requirements of Chapter 4.

Manufacture. The preparation of propellant, delay, and ejection mixes and the loading and assembly of model rocket or high power rocket motors and igniters.

Mixing Building. Any building used primarily for mixing and blending of propellant, delay, or ejection compositions.

Model Rocket Motor. A solid propellant or pressurized liquid rocket motor that conforms to the standards for rocket motors provided in NFPA 1122, *Code for Model Rocketry*.

Motor Vehicle. Any self-propelled vehicle, truck, tractor, semitrailer, or truck-trailer combination used for the transportation of freight over public highways.

Nonprocess Building. Any office building, warehouse, or other building located in a rocket motor plant where no explosives are processed or stored.

Person. Any individual, firm, copartnership, corporation, company, association, or joint-stock association, including any trustee, receiver, assignee, or personal representative thereof.

Pressing System. A building or group of buildings constituting one rocket motor manufacturing unit. Considered as one process building for the application of Table 4-1.2. *(See Table 4-1.2.)*

Process Building. Any mixing building; any building in which propellant, delay composition, or ejection composition is pressed or otherwise prepared for finish and assembly. If while in process, a propellant or delay composition is stored in a process building, the building shall still be considered a process building.

Propellant Composition. A chemical mixture that, upon burning and without explosion, produces thrust to propel a recoverable aero model.

Public Conveyance. Any railroad car, street car, ferry, cab, bus, airplane, or other vehicle that carries passengers for hire.

Railway. Any steam, electric, diesel-electric, or other railroad or railway that carries passengers for hire on the particular line or branch in the vicinity of a rocket motor plant or storage facility.

Reloadable Rocket Motor. A rocket motor that has been designed and manufactured so that the user can load, reload and reuse 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 rocket motor casing by the manufacturer.

Rocket Motor. As used in this code, the term rocket motor means model rocket motor or high power rocket motor.

Rocket Motor Plant. All land and buildings thereon used for the manufacture or processing of propellants and model rocket or high power motors, including storage buildings with or in connection with plant operation.

Shall. Indicates a mandatory requirement.

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

Storage Building. Any building or structure in the rocket motor plant in which model rocket motors or high power rocket motors in any state of processing or finished model rocket motors or high power rocket motors are stored, but in which no processing or manufacturing is actually performed.

Warehouse. Any building or structure used exclusively for the storage of materials that are not used to manufacture model rocket motors or high power rocket motors.

Chapter 2 Manufacturing Operations for Rocket Motors

2-1 Basic Requirements.

2-1.1 The manufacture of any rocket motor, as defined in Section 1-4, shall be prohibited unless it is authorized by federal license, where required, and is conducted in accordance with this code.

2-1.2 The manufacture of any rocket motor shall be prohibited in any residence or dwelling, or in any inhabited building in an area zoned as residential by the local building authority and building codes in effect.

2-2 Permit Requirements.

2-2.1 Any person engaged in the business of importing, manufacturing, or dealing in rocket motors shall possess a valid federal license or permit, where required by Title XI, Regulation of Explosives, of the Crime Control Act of 1970 (Title 18, *United States Code*, Chapter 40) and shall comply with all applicable state and local laws and regulations.

2-2.1.1 Copies of all required licenses and permits shall be posted at each rocket motor plant.

2-2.1.2 License and permit holders shall take reasonable precaution to protect licenses and permits from loss, theft, defacement, destruction, or unauthorized duplication. Any such occurrence shall be reported immediately to the issuing authority.

2-2.1.3 Licenses or permits shall not be reassigned or transferred.

2-2.2 The issuing authority shall be notified immediately of any change of business address.

2-3 Recordkeeping and Reporting.

2-3.1 License or permit holders shall maintain records of all transactions or operations involving explosive materials. Such records shall be kept for five years and shall be made available upon request to the authorities having jurisdiction.

2-3.1.1 An accumulation of invoices, sales slips, delivery tickets or receipts, bills of lading, or similar papers representing individual transactions shall satisfy the requirements for recordkeeping, provided such documents include the signature of the receiver of the explosive materials.

2-3.2 The loss, theft, or unlawful removal of explosive materials shall be reported immediately to the appropriate officer of the Bureau of Alcohol, Tobacco, and Firearms, U.S. Department of the Treasury, and to local law enforcement authorities.

2-4 Applicability. All rocket motor plants that manufacture black powder-based motors shall meet the requirements of this chapter.

2-5 Site Security.

2-5.1 The plant shall be completely surrounded by a substantial fence having a minimum height of 6 ft (1.8 m).

2-5.2 All openings in the fence shall have gates that shall be kept closed and securely locked at all times when the plant is not in operation.

2-5.3 Conspicuous signs that read "WARNING — NO SMOKING — NO TRESPASSING" shall be posted along the fence.

2-5.4 Only authorized employees or representatives of federal, state, or local agencies having jurisdiction over the plant shall be permitted inside the plant without special permission of the person in charge.

2-6 Separation Distances.

2-6.1 Process buildings shall be separated from other inhabited buildings, public highways, and passenger railways in accordance with the distances specified in Table 2-6.1.

Table 2-6.1 Minimum Separation Distances of Process Buildings from Inhabited Buildings, Passenger Railways, and Public Highways[1]

Net Weight of Rocket Motor Composition[2]	Distance from Passenger Railways and Public Highways[3,4]	Distance from Inhabited Buildings[3,4]
(lb)	(ft)	(ft)
100	200	200
200	200	200
400	200	200
600	200	208
800	200	252
1000	200	292

For SI units: 1 lb = 0.454 kg; 1 ft = 0.305 m.
[1]This table does not apply to separation distances for magazines containing 1.4 or 1.3 explosives.
[2]Net weight of all propellant, delay, and ejection composition only.
[3]See Chapter 1 for definitions of passenger railways, public highways, and inhabited buildings.
[4]All distances in this table are to be applied with or without barricades or screen-type barricades.

2-6.2 Process buildings shall be separated from nonprocess buildings by the distances specified in Table 2-6.2. Magazines shall be separated from both process and nonprocess buildings by the distances specified in Table 2-6.2.

Table 2-6.2 Minimum Separation Distances at Rocket Motor Manufacturing Plants[1]

Net Weight of Low Explosives	Distance of Magazine from Process Buildings and Nonprocess Buildings[2,3]	Distance Between Process Buildings and Nonprocess Buildings[2,3]
(lb)	(ft)	(ft)
100	30	30
200	35	35
400	44	44
600	51	51
800	56	56
1000	60	60
2000	76	76
3000	87	87

For SI units: 1 lb = 0.454 kg; 1 ft = 0.305 m.
[1]For the purposes of applying separation distances in Table 2-6.2, process buildings include mixing buildings or any buildings in which propellant, pyrotechnic, or explosive compositions are pressed or otherwise prepared for finishing and assembling. Nonprocess buildings are office buildings, warehouses, and other facility buildings where no propellant, delay, or explosive compositions are processed.
[2]Distances apply with or without barricades or screen-type barricades.
[3]Distances include those between magazines, between a magazine and a process building, and between a magazine and a nonprocess building.

2-7 Process Building Construction.

2-7.1* The interior surfaces of walls and ceilings shall be smooth. Interior finish shall be of noncombustible or limited combustible materials.

Exception: Materials used for deflagration vent closures.

NOTE: For further information on building construction, see NFPA 220, *Standard on Types of Building Construction*.

2-7.2 Horizontal ledges and surfaces upon which dust can settle and accumulate shall be minimized.

2-7.3* Floors and work surfaces shall not have cracks or crevices in which propellant composition can lodge. Floors and work surfaces in mixing and pressing buildings shall be electrically conductive.

2-8 Means of Egress.

2-8.1 Means of egress in process buildings shall comply with the applicable requirements of NFPA *101®*, *Life Safety Code®*, and the following requirements:

(a) In every undivided floor area of more than 100 ft^2 (9 m^2), there shall be at least two remotely located exits.

Exception: Rooms that do not contain exposed propellant composition shall not be required to have more than one exit, provided that exit is located away from or suitably shielded from rooms that do contain such composition.

(b) Exits shall be located so that every point within the room or undivided floor area is within 25 ft (7.6 m) of an exit. The routes to the exits shall not be obstructed.

(c) Exit doors shall open outward and shall be capable of pressure actuation from the inside.

2-9 Heat, Light, and Electrical Equipment.

2-9.1 Stoves, exposed flames, and portable electric heaters shall be prohibited in any manufacturing room where propellant composition, delay composition, ejection composition, or components thereof, or flammable liquids are or can be present.

2-9.2 Heating shall be provided by steam, hot water, or indirect hot air radiators, or any other means acceptable to the authority having jurisdiction.

2-9.2.1 Unit heaters located in rooms that contain or can contain exposed propellant composition shall be equipped with motors and electrical devices suitable for use in Class II, Group E, Division 1 locations.

Exception: Buildings or rooms that are used only for static motor tests.

NOTE: For information on hazardous locations where combustible dust is present, see Article 502 of NFPA 70, *National Electrical Code®*.

2-9.3 All wiring, switches, and electrical fixtures in process buildings shall comply with NFPA 70, *National Electrical Code*, and be suitable for Class II, Group E, Division 1 hazardous locations.

NOTE: For further information on hazardous locations where combustible dust is present, see Article 502 of NFPA 70, *National Electrical Code*.

2-9.3.1 Temporary or loose electrical wiring shall not be used.

2-9.3.2 Where temporary lighting is necessary within a magazine, electric safety flashlights, electric safety lanterns, or chemical illuminescent lighting shall be used.

Exception: Listed portable lighting equipment shall be permitted to be used during repair operations, provided the area has been cleared of all propellant materials and all dust or residue has been removed by washing.

2-9.3.3 All presses and other mechanical devices shall be electrically bonded and grounded.

2-9.4 All artificial lighting shall be electrically powered.

2-10 Maximum Number of Occupants and Maximum Quantity Limitations.

2-10.1* The number of occupants in each process building and in each magazine shall not exceed the number necessary for proper conduct of production operations.

2-10.1.1 The maximum number of occupants permitted in each process building and in each magazine shall be posted in a conspicuous location in each process building or magazine.

2-10.2 No more than 500 lb (227 kg) of propellant composition shall be permitted at any one time in any mixing building.

2-10.3 No more than 75 lb (34 kg) of propellant composition shall be permitted at any one time in a pressing system, with no more than 5 lb (2.3 kg) of propellant composition in the pressing room itself.

2-11 Fire and Explosion Prevention.

2-11.1 All buildings shall be kept clean, orderly, and free of accumulations of dust or rubbish.

2-11.2 Spills of propellant composition shall be cleaned up and removed immediately from the building. The spilled material shall be destroyed by immersion in water (if applicable) or by burning in a manner acceptable to the authority having jurisdiction.

2-11.3 Rags, combustible scrap, and paper shall be kept separate from waste or propellant composition. They shall be kept in containers until removed from the building. Disposal containers shall be removed from buildings on a regular basis and removed from the plant at regular intervals. Waste propellant composition shall be destroyed as described in 2-11.2.

2-11.4* Smoking materials shall not be carried into or in the vicinity of process buildings. Personnel shall deposit all smoking materials at a designated location in a nonprocess building immediately upon entering the plant.

2-11.5 Smoking shall be permitted only in office buildings or in buildings used exclusively as lunchrooms or rest rooms and in which the presence of propellant composition is prohibited.

2-11.6 Authorized smoking locations shall be so marked, shall contain designated receptacles for disposal of smoking materials, and shall be provided with at least one approved portable fire extinguisher for use on Class A fires.

2-11.7 Personnel whose clothing is contaminated with propellant composition to a degree that can endanger personnel safety shall not be permitted in smoking areas.

2-12 Personnel Safety.

2-12.1 No employee or other person shall be permitted to enter the plant while in possession of or under the influence of alcohol, drugs, or narcotics.

2-12.2 Personnel working at or supervising mixing, pressing, and loading operations shall be provided with and shall wear cotton or flame-retardant clothing. Other protective clothing, eye protection, and respiratory protection shall be worn as needed. Short-sleeved shirts and short pants shall not be permitted.

2-12.3 Washing, shower, and changing facilities shall be provided.

2-12.4 Work clothing shall be washed frequently to prevent accumulation of propellant composition.

2-12.5 Each plant shall designate an employee as safety officer who shall be responsible for general safety, fire prevention and protection, and employee safety training. This person normally shall be the area supervisor.

2-12.5.1 The safety officer shall provide formal instruction regarding proper methods and procedures, safety requirements, and procedures for handling propellant composition and devices to all employees upon commencing employment and at least annually thereafter.

2-12.6 In areas where sparks can ignite materials, only nonsparking hand tools shall be used.

Exception: Normal maintenance in rooms containing less than 1 lb (0.45 kg) of dry propellant composition shall not be required to use nonsparking hand tools.

2-12.7* Oxidizers shall not be stored in the same building with combustible powdered materials such as charcoal, gums, metals, or sulfur.

2-13 Fire Protection and Emergency Procedures.

2-13.1 Portable fire extinguishers shall be provided in all buildings in accordance with NFPA 10, *Standard for Portable Fire Extinguishers.*

Exception: Extinguishers shall not be located in buildings in which more than 5 lb (2.3 kg) of propellant composition is exposed.

2-13.2 Each plant shall have formal emergency procedures. Such procedures shall include employee instruction and training and shall be applicable to all anticipated emergencies.

2-13.3 Emergency procedures shall include instruction in the use of portable fire extinguishers and the identification of those fires on which they can be used safely.

2-13.3.1 Employees shall be instructed to abandon fire-fighting efforts if the fire involves or can spread to propellant composition or devices. In such cases, employees shall be instructed to evacuate the building immediately and to alert other plant personnel.

2-14 Testing of Rocket Motors. Testing of motors and motor components shall be performed only in an area spe- cifically designated for that purpose. The test site shall be located at a safe distance from all plant buildings or structures.

Chapter 3 Limited Quantity Manufacturing Operations for Composite Propellant Rocket Motors

3-1 Basic Requirements.

3-1.1 The requirements of this chapter shall apply to the manufacture of composite propellant rocket motors as defined in Section 1-4 and that also meet the following criteria:

(a) Both the raw materials and the finished propellant shall be classified by the U.S. Department of the Treasury, Bureau of Alcohol, Tobacco, and Firearms, as a low explosive.

(b) The propellant ingredients shall be mixed either by hand or in a mixer that does not use moving parts in contact with the propellant composition to effect mixing.

(c) The propellant batch being mixed at any one time shall not exceed a weight of 35 lb (16 kg).

(d) The propellant formulation shall not include solid ferrocene.

3-1.2 Composite propellant manufacturing processes that do not meet these criteria shall adhere to the requirements of Chapter 2, where applicable.

3-1.3 The manufacture of any composite propellant rocket motor, as defined in Section 1-4, shall be prohibited unless it is authorized by federal license, where required, and is conducted in accordance with this code.

3-2 License and Permit Requirements.

3-2.1 Any person engaged in the manufacture of composite propellant rocket motors shall comply with all applicable federal, state, and local laws and regulations.

3-2.1.1 Copies of all required licenses and permits shall be posted at each rocket motor plant.

3-2.1.2 License and permit holders shall take precautions to protect licenses and permits from loss, theft, defacement, destruction, or unauthorized duplication. Any such occurrence shall be reported immediately to the issuing authority.

3-2.1.3 Licenses or permits shall not be reassigned or transferred.

3-2.2 The issuing authority shall be notified immediately of any change of business address.

3-3 Site Security.

3-3.1 All doors to the plant shall be kept closed and securely locked at all times when the plant is not in operation.

3-3.2 Only authorized employees or representatives of federal, state, or local agencies having jurisdiction over the plant shall be allowed in the plant without special permission of the person in charge.

3-4 Storage of Materials.

3-4.1 The storage of ammonium perchlocate oxidizer shipped in 250-lb (113-kg) drums shall comply with NFPA 430, *Code for the Storage of Liquid and Solid Oxidizers.*

3-4.2 In-process storage of less than 100 lb (45 kg) of uncast propellant mix shall be permitted in covered containers in the mix room.

3-4.3 Uncast propellant mix in excess of 100 lb (45 kg) shall be stored in magazines meeting the requirements of Chapter 4.

3-4.4 Storage of binder and metal fuel ingredients shall be separate from storage of oxidizer.

3-5 Process Building Construction.

3-5.1 Interior wall and ceiling surfaces shall be smooth.

3-5.2 Horizontal ledges and surfaces upon which dust can settle and accumulate shall be minimized.

3-5.3 Floor surfaces in mixing and casting areas shall be smooth and nonsparking.

3-5.4 Propellant mixing by mechanical means shall be conducted either outdoors or in a separate building or in a room separated from other areas of the building by walls having a 2-hr fire resistance rating.

3-5.5 A remotely activated or automatic water deluge or sprinkler system shall be provided to the mix room or building. The deluge system or sprinkler system shall be acceptable to the authority having jurisdiction.

3-6 Means of Egress.

3-6.1 Means of egress in process buildings shall meet the following requirements:

(a) There shall be at least two remotely located exits accessible from every point in every undivided floor area of more than 100 ft^2 (9 m^2).

Exception: Toilet rooms shall not be required to have more than one exit, provided the exit is located away from or suitably shielded from process areas.

(b) Exits shall be so located that every point within the room or undivided floor area is within 25 ft (7.6 m) of an exit. The routes to the exits shall not be obstructed.

(c) Exit doors shall open outward and shall be capable of pressure actuation from the inside.

3-7 Heat, Light, and Electrical Equipment.

3-7.1 Stoves, exposed flames, and portable electric heaters shall be prohibited in any manufacturing room where propellant composition, delay composition, ejection composition, or components thereof, are weighed, mixed, cast, machined, or in-process stored.

3-7.2 Heating shall be provided by steam, hot water, or indirect hot air radiators, or any other means acceptable to the authority having jurisdiction.

3-7.2.1 Unit heaters located in rooms where propellant composition, delay composition, ejection composition, or components thereof, are weighed, mixed, cast, machined, or in-process stored shall be equipped with motors and electrical devices suitable for use in Class II, Group E, Division 1 locations.

Exception: Buildings or rooms that are used only for static motor tests.

NOTE: For information on hazardous locations where combustible dust is present, see Article 502 of NFPA 70, *National Electrical Code.*

3-7.3 All wiring, switches, and electrical fixtures in process buildings shall comply with NFPA 70, *National Electrical Code,* and shall be suitable for Class II, Group E, Division 1 hazardous locations.

NOTE: For information on hazardous locations where combustible dust is present, see Article 502 of NFPA 70, *National Electrical Code.*

3-7.3.1 Temporary or loose electrical wiring shall not be used.

3-7.3.2 Where temporary lighting is necessary within a magazine, electric safety flashlights, electric safety lanterns, or chemical illuminescent lighting shall be used.

Exception: Listed portable lighting equipment shall be permitted to be used during repair operations, provided the area has been cleared of all propellant materials and all dust or residue has been removed by washing.

3-7.3.3 All presses and other mechanical devices shall be electrically bonded and grounded.

3-7.4 All artificial lighting shall be electrically powered.

3-8 Maximum Number of Occupants and Maximum Quantity Limitations.

3-8.1 The number of occupants in each process building and in each magazine shall not exceed the number necessary for proper conduct of production operations.

3-8.1.1 The maximum number of occupants permitted in each process building and in each magazine shall be posted in a conspicuous location in each process building or magazine.

3-8.2 No more than 70 lb (32 kg) of propellant composition shall be permitted at any one time in any mixing room or building.

3-8.3 No more than 70 lb (32 kg) of uncased propellant composition shall be permitted at any one time in a finishing or assembly room or building.

3-8.4 Where the quantities of propellant composition exceed the quantity limits stated in 3-8.2 and 3-8.3, the minimum separation distances shall be as specified in Table 3-8.4.

Table 3-8.4 Minimum Separation Distances of Process Buildings from Inhabited Buildings, Passenger Railways, and Public Highways[1]

Net Weight of Propellant Composition[2] Not to Exceed	Distance from Passenger Railways and Public Highways[3,4]	Distance from Inhabited Buildings[3,4]
(lb)	(ft)	(ft)
100	200	200
200	200	200
400	200	200
600	200	208
800	200	252
1000	200	292

For SI units: 1 lb = 0.454 kg; 1 ft = 0.305 m.
[1]This table does not apply to separation distances for magazines containing 1.4 or 1.3 explosives.
[2]Net weight of all propellant, delay, and ejection composition only.
[3]See Chapter 1 for definitions of passenger railways, public highways, and inhabited buildings.
[4]All distances in this table are to be applied with or without barricades or screen-type barricades.

3-9 Fire and Explosion Prevention.

3-9.1 All buildings shall be kept clean, orderly, and free of accumulations of dust or rubbish.

3-9.1.1 Spills of propellant composition shall be cleaned up immediately. The spilled material shall be destroyed by burning in a manner acceptable to the authority having jurisdiction.

3-9.1.2 Rags, combustible scrap, and paper shall be kept separate from waste propellant composition. They shall be kept in containers until removed from the building. Disposal containers shall be removed from buildings on a regular basis and removed from the plant at regular intervals. Waste propellant composition shall be destroyed as described in 3-9.1.1.

3-9.2 Smoking materials shall not be carried into or in the vicinity of process rooms or buildings. Personnel shall deposit all smoking materials at a suitable location in a nonprocess room or building immediately upon entering the plant.

3-9.2.1 Smoking shall be permitted only in office buildings or in buildings used exclusively as lunchrooms or rest rooms and in which the presence of unfinished propellant composition is prohibited.

3-9.2.2 Authorized smoking locations shall be so marked, shall contain suitable receptacles for disposal of smoking materials, and shall be provided with at least one approved portable fire extinguisher suitable for use on Class A fires.

3-9.2.3 Personnel whose clothing is contaminated with propellant composition to a degree that can endanger personnel safety shall not be allowed in smoking locations.

3-10 Personnel Safety.

3-10.1 No employee or other person shall be permitted to enter the plant while in possession of or under the influence of alcohol, drugs, or narcotics.

3-10.2 Personnel working at mixing and casting operations shall be provided with and shall wear cotton or flame-retardant clothing. Other protective clothing, eye protection, and respiratory protection shall be worn as needed. Short-sleeved shirts and short pants shall not be permitted.

3-10.2.1 Washing, shower, and changing facilities shall be provided.

3-10.2.2 Work clothing shall be washed frequently to prevent accumulation of oxidizer or propellant composition.

3-10.3 Each plant shall designate an employee as safety officer who shall be responsible for general safety, fire prevention and protection, and employee safety training. This person normally shall be the area supervisor.

3-10.4 The safety officer shall provide formal instruction regarding proper methods and procedures, safety requirements, and procedures for handling propellant composition, ingredients, and devices to all employees upon commencing employment and at least annually thereafter.

3-10.5 In areas where sparks can ignite materials, only nonsparking hand tools shall be used.

Exception: Normal maintenance in rooms containing less than 1 lb (0.45 kg) of dry propellant composition shall not be required to use nonsparking hand tools.

3-11 Fire Protection and Emergency Procedures.

3-11.1 Portable fire extinguishers shall be provided in all rooms or buildings but shall be used only for Class A or Class B fires.

Exception: Extinguishers shall not be located in rooms in which more than 5 lb (2.3 kg) of propellant composition is exposed.

3-11.2 Each plant shall have formal emergency procedures. Such procedures shall include employee instruction and training and shall be applicable to all anticipated emergencies.

3-11.3 Emergency procedures shall include instruction in the use of portable fire extinguishers and the identification of those fires on which they can be used safely.

3-11.4 Employees shall be instructed to abandon fire-fighting efforts if the fire involves or can spread to propellant compositions or devices. In such cases, employees shall be instructed to evacuate the building immediately and to alert other plant personnel.

3-12 Testing of Rocket Motors. Testing of motors and motor components shall be performed only in an area specifically designated for that purpose. The test site shall be located at a safe distance from all plant buildings or structures.

Chapter 4 Storage of Low Explosives at Rocket Motor Manufacturing Plants

4-1 Basic Requirements.

4-1.1 Low explosives shall be stored in magazines meeting the requirements of this chapter. They shall be so stored at all times unless in the process of manufacture, packaging, or transport.

4-1.1.1 Materials that are bullet-sensitive shall be stored only in a Type 1, 2, or 3 magazine.

4-1.1.2 Black powder and materials that are not bullet-sensitive shall be stored only in a Type 1, 2, 3, or 4 magazine.

4-1.2 Magazines containing low explosives shall be separated from each other and from inhabited buildings, public highways, and passenger railways, according to the distances specified by Table 4-1.2.

Table 4-1.2 Table of Storage Distances for Low Explosives at Model and High Power Rocket Motor Manufacturing Facilities*

Pounds (kg)				Distances in Feet (m)					
Over		Not Over		From Inhabited Building		From Public Railroad and Highway		From Above-Ground Magazine	
0	(0)	1,000	(454)	75	(23)	75	(23)	50	(15)
1,000	(454)	5,000	(2268)	115	(35)	115	(35)	75	(23)
5,000	(2268)	10,000	(4536)	150	(46)	150	(46)	100	(30)
10,000	(4536)	20,000	(9072)	190	(58)	190	(58)	125	(38)
20,000	(9072)	30,000	(13,608)	215	(66)	215	(66)	145	(44)
30,000	(13,608)	40,000	(18,144)	235	(72)	235	(72)	155	(47)
40,000	(18,144)	50,000	(22,680)	250	(76)	250	(76)	165	(50)
50,000	(22,680)	60,000	(27,216)	260	(79)	260	(79)	175	(53)
60,000	(27,216)	70,000	(31,751)	270	(82)	270	(82)	185	(56)
70,000	(31,751)	80,000	(36,287)	280	(85)	280	(85)	190	(58)
80,000	(36,287)	90,000	(40,823)	295	(90)	295	(90)	195	(59)
90,000	(40,823)	100,000	(45,360)	300	(91)	300	(91)	200	(61)
100,000	(45,360)	200,000	(90,718)	375	(114)	375	(114)	250	(76)
200,000	(90,718)	300,000	(136,078)	450	(137)	450	(137)	300	(91)

*Table is extracted from 27 CFR, Part 55 (BATF regulations for the storage of explosive materials).

4-2 Magazine Construction — General.

4-2.1 Magazines shall be constructed to comply with this chapter or in a manner substantially equivalent to the requirements of this chapter.

4-2.2 The ground around magazines shall be graded so that water drains away from the magazine.

4-2.3 Magazines requiring heat shall be heated by either hot water radiant heating within the magazine building or by indirect warm air heating.

4-2.3.1 Indirect warm air shall be heated by either hot water or low-pressure [15 psig (103 kPa gauge) or less] steam coils located outside the magazine building.

4-2.3.2 Magazine heating systems shall meet the following requirements:

(a) Radiant heating coils within the building shall be installed so that explosive materials or their containers cannot contact the coils and so that air is free to circulate between the coils and the explosives. The surface temperature of the coils shall not exceed 165°F (74°C).

(b) Heating ducts shall be installed so that the hot air discharge from the ducts is not directed against explosive materials or their containers.

(c) The heating system shall be controlled so that the ambient temperature of the magazine does not exceed 130°F (54°C).

(d) Any electric fan or pump used in the heating system shall be located outside the magazine, separate from the magazine walls, and shall be grounded.

(e) Any electric motor or any controls for electric heating devices used to heat water or produce steam shall have overload devices and disconnects that comply with NFPA 70, *National Electrical Code*. All electrical switchgear shall be located at least 25 ft (7.6 m) from the magazine.

(f) Any fuel-fired heating source for the hot water or steam shall be separated from the magazine by a distance of not less than 25 ft (7.6 m). The area between the heating unit and the magazine shall be cleared of all combustible materials.

(g) Explosive materials stored in magazines shall be arranged so that uniform circulation of air is ensured.

4-2.4 Where temporary lighting is necessary within a magazine, electric safety flashlights, electric safety lanterns, or chemical illuminescent lighting shall be used.

Exception: Listed portable lighting equipment shall be permitted to be used during repair operations, provided the area has been cleared of all propellant materials and all dust or residue has been removed by washing.

4-2.4.1 Electric lighting shall be permitted to be used within the magazine only if the installation meets the following requirements:

(a) Junction boxes containing fuses or circuit breakers and electrical disconnects shall be located at least 25 ft (7.6 m) from the magazine.

(b) Disconnects, fuses, and circuit breakers shall be protected by a voltage surge arrestor capable of handling 2500 amperes for 0.1 seconds.

(c) All wiring from switches, both inside and outside the magazine, shall be installed in rigid conduit. Wiring leading into the magazine shall be installed underground.

(d) Conduit and light fixtures inside the magazine shall be protected from physical damage by suitable guards or by location.

(e) Light fixtures shall be suitably enclosed to prevent sparks or hot metal from falling on the floor or onto material stored in the magazine.

(f) Junction boxes located within the magazine shall have no openings and shall be equipped with close-fitting covers.

(g) Magazines containing materials that release flammable vapors shall have wiring and fixtures that meet the requirements of Article 501 of NFPA 70, *National Electrical Code*.

(h) Lights inside magazines shall not be left on when the magazine is unattended.

4-2.5 There shall be no exposed ferrous metal on the interior of the magazine where it contacts materials stored within.

4-2.6 Where ventilation is required in the magazine, sufficient ventilation shall be provided to protect the stored materials for the specific area in which the plant is located.

4-2.7 Stored materials shall be placed so they do not interfere with ventilation and to prevent contact with masonry walls, any steel, or any other ferrous metal by means of a nonsparking lattice or equivalent lining.

4-3 Magazine Construction — Requirements for Specific Types.

4-3.1 Type 1 Magazine. A Type 1 magazine shall be a permanent structure, such as a building or igloo, that is bullet resistant, fire resistant, theft resistant, weather resistant, and ventilated and shall include the following specifications:

(a) Walls and doors shall be bullet resistant and shall be permitted to be constructed according to any of the specifications of Appendix B.

(b) The roof shall be permitted to be constructed of any type of structurally sound materials that are or have been made fire resistant on the exterior.

(c) *Where the natural terrain around a Type 1 magazine makes it possible for a bullet to be shot through the roof and ceiling at such an angle that the bullet can strike the explosive materials within, either the roof or the ceiling shall be of bullet-resistant construction.

(d) The foundation shall be permitted to be of masonry, wood, or metal and shall be completely enclosed except for openings to provide cross ventilation. A wood foundation enclosure shall be covered on the exterior with not less than 26-gauge metal.

(e) The floor shall be constructed of wood or other suitable material. Floors constructed of materials that can cause sparks shall be covered with a nonsparking surface, or the packages of explosive material shall be packed on pallets of nonsparking material.

(f) Type 1 magazines shall be ventilated to prevent dampness or heating of explosives. Ventilation openings shall be screened to prevent entrance of sparks. Ventilators in sidewalls shall be offset or shielded. Magazines having foundation and roof ventilators, with the air circulating between sidewalls and floor and between sidewalls and ceiling, shall have a wood lattice lining or equivalent means to prevent packages from being stacked against sidewalls and blocking air circulation.

(g) Each door of the magazine shall be equipped with one of the following locking systems:

1. Two mortise locks;
2. Two padlocks in separate hasps and staples;
3. A mortise lock and a padlock;
4. A mortise lock that requires two keys to open;
5. A three-point lock or an equivalent lock that secures the door to the frame at more than one point.

Padlocks shall be steel, shall have at least five tumblers, and shall have at least a $^{7}/_{16}$-in. (11-mm) case-hardened shackle. All padlocks shall be protected by steel hoods installed to discourage insertion of bolt cutters. Doors secured by a substantial internal bolt shall not require additional locking devices. Hinges and hasps shall be fastened securely to the magazine and all locking hardware shall be secured rigidly and directly to the door frame.

4-3.2 Type 2 Magazine. A Type 2 magazine shall be a portable or mobile structure, such as a box, skid-magazine, trailer, or semitrailer, that is fire resistant, theft resistant, weather resistant, and ventilated. If used for outdoor storage, Type 2 magazines shall be bullet resistant.

4-3.2.1 Type 2 Outdoor Magazine. A Type 2 outdoor magazine shall include the following:

(a) Walls and roof or ceiling shall be constructed according to the provisions of 4-3.1(a), (b), and (c).

(b) Doors shall be of metal, constructed according to the provisions of 4-3.1(a), or shall have a metal exterior with an inner door meeting the provisions of 4-3.1(a).

(c) Floors constructed of ferrous metal shall be covered with a nonsparking surface.

(d) A top-opening magazine shall have a lid that overlaps the sides by at least 1 in. (25 mm) when in the closed position.

(e) The magazine shall be supported so that its floor does not directly contact the ground.

(f) Magazines less than 1 yd^3 (0.77 m^3) shall be fastened securely to a fixed object to prevent theft of the entire magazine.

(g) Hinges, hasps, locks, and locking hardware shall comply with 4-3.1(g).

Exception: Padlocks on vehicular magazines shall not be required to be protected by steel hoods.

(h) Wherever a vehicular magazine is left unattended, its wheels shall be removed or its kingpins shall be locked or it otherwise shall be effectively immobilized.

4-3.2.2 Type 2 Indoor Magazines. A Type 2 indoor magazine shall include the following:

(a) The magazine shall have substantial wheels or casters to facilitate removal from the building in case of emergency.

(b) The cover of the magazine shall have substantial strap hinges and a means for locking. The magazine shall be kept locked, except during placement or removal of explosive materials, with a five-tumbler padlock or its equivalent.

(c) The magazine shall be painted red, and the top shall bear the words "Explosives — Keep Fire Away" in white letters at least 3 in. (76 mm) high.

(d) Magazines constructed of wood shall have sides, bottoms, and covers or doors of 2-in. (51-mm) hardwood, well braced at the corners. The magazines shall be covered with sheet metal of not less than 26 gauge. Nails exposed to the interior of the magazines shall be countersunk.

(e) Magazines constructed of metal shall be of 12-gauge sheet metal and shall be lined with a nonsparking material. Edges of metal covers shall overlap the sides by at least 1 in. (25 mm).

4-3.3 Type 3 Magazine. A Type 3 magazine shall be a portable structure that is fire resistant, theft resistant, and weather resistant and shall include the following:

(a) The magazine shall be equipped with a five-tumbler padlock.

(b) Magazines constructed of wood shall have sides, bottoms, and covers or doors of 4-in. (102-mm) hardwood, well braced at the corners. They shall be covered with sheet metal of not less than 26 gauge. Nails exposed to the interior of the magazine shall be countersunk.

(c) Magazines constructed of metal shall meet the requirements of 4-3.2.2(e).

4-3.4 Type 4 Magazine. A Type 4 magazine shall be a permanent, portable, or mobile structure such as a building, igloo, box, semitrailer, or other mobile container that is fire resistant, theft resistant, and weather resistant.

4-3.4.1 Type 4 Outdoor Magazine. A Type 4 outdoor magazine shall include the following:

(a) The magazine shall be constructed of masonry, wood covered with sheet metal, fabricated metal, or a combination of these materials. Doors shall be metal or wood covered with metal.

(b) Permanent magazines shall comply with 4-3.1(d), (f), and (g).

(c) Vehicular magazines shall comply with 4-3.2.1(g) and shall be immobilized where unattended, as described in 4-3.2.1(h).

4-3.4.2 Type 4 Indoor Magazine. A Type 4 indoor magazine shall comply with all provisions of 4-3.2.2.

4-4 Storage Within Magazines.

4-4.1 Magazines shall be under the responsibility of a competent person at all times. This person shall be at least 21 years old and shall be responsible for the enforcement of all safety precautions.

4-4.2 All magazines containing explosives shall be opened and inspected at intervals not exceeding three days to determine whether there has been unauthorized or attempted entry or whether there has been unauthorized removal of the magazines or their contents.

4-4.3 Magazine doors shall be kept locked except during placement or removal of explosive materials or during inspection.

4-4.4 Safety rules covering the operations of magazines shall be posted on the interior side of the magazine door.

4-4.5 When explosive materials are removed from the magazine for use, the oldest stock shall be used first.

4-4.6 Corresponding grades and brands of explosive materials shall be stored together so that brand and grade markings are readily visible. All stock shall be stored to be easily counted and checked.

4-4.7 Containers of explosive materials shall be piled in a stable manner, laid flat, and with the top side up.

4-4.8 Open containers of explosive materials shall be closed securely before being returned to a magazine. No container without a closed lid shall be stored in a magazine.

4-4.9 Containers of explosive materials shall not be opened, unpacked, or repacked inside or within 50 ft (15 m) of a magazine or in close proximity to other explosives.

Exception: Fiberboard containers shall be permitted to be opened inside or within 50 ft (15 m) of a magazine. They shall not, however, be unpacked.

4-4.10 Tools used for opening containers of explosive materials shall be nonsparking.

Exception: Metal slitters shall be permitted to be used for opening fiberboard containers.

4-4.11 Magazines shall be used exclusively for the storage of propellant composition. Metal tools other than nonferrous conveyors shall not be stored in magazines. Ferrous metal conveyor stands protected by a coat of paint shall be permitted to be stored within magazines.

4-4.12 Magazine floors shall be swept regularly and kept clean, dry, and free of grit, paper, empty packing materials, and rubbish. Brooms and other cleaning utensils shall not have spark-producing metal parts. Sweepings from magazine floors shall be disposed of according to manufacturer's instructions.

4-4.13 Where any propellant composition has deteriorated to the extent that it has become unstable or dangerous, the person responsible shall contact the manufacturer for assistance immediately.

4-4.14 Before making repairs to the interior of a magazine, all propellant composition shall be removed and the interior shall be cleaned.

4-4.15 Before making repairs to the exterior of a magazine where there is a possibility of causing sparks or fire, all propellant composition shall be removed from the magazine.

4-4.16 Propellant composition removed from a magazine undergoing repair shall be placed in another magazine or be placed a safe distance from the magazine, where it shall be properly guarded and protected. Upon completion of the repairs, the propellant composition shall be returned promptly to the magazine.

4-5 Miscellaneous Safety Precautions.

4-5.1 Smoking, matches, open flames, spark-producing devices, and firearms shall not be permitted inside of or within 50 ft (15 m) of a magazine.

Exception: Firearms carried by authorized guards.

4-5.2 The area around a magazine shall be kept clear of brush, dried vegetation, leaves, and similar combustibles for a distance of at least 25 ft (7.6 m).

4-5.3 Combustible materials shall not be stored within 50 ft (15 m) of a magazine.

4-5.4 Property on which Type 1 magazines and outdoor magazines of Types 2 and 4 are located shall be posted with signs reading "Explosives — Keep Off." Such signs shall be located to minimize the possibility that a bullet shot at the sign will hit the magazine.

Chapter 5 Referenced Publications

5-1 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.

5-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 10, *Standard for Portable Fire Extinguishers*, 1994 edition.
NFPA 70, *National Electrical Code*, 1996 edition.
NFPA *101*, *Life Safety Code*, 1994 edition.
NFPA 430, *Code for the Storage of Liquid and Solid Oxidizers*, 1995 edition.
NFPA 1122, *Code for Model Rocketry*, 1994 edition.

5-1.2 Other Publications.

5-1.2.1 U.S. Government Publications. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Title XI, Regulation of Explosives, of the Crime Control Act of 1970 (Title 18, *United States Code*, Chapter 40).
Title 18, *United States Code*, Chapter 40, Importation, Manufacture, Distribution, and Storage of Explosive Materials, 1970.
Title 27, *Code of Federal Regulations*, Part 55, Bureau of Alcohol, Tobacco, and Firearms, U.S. Dept. of Treasury.
Title 49, *Code of Federal Regulations*, Parts 100 to end. (Hazardous Materials Regulations, U.S. Dept. of Transportation.)

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 Explosive. A list of explosives determined to be within the scope of Title 18, *United States Code*, Chapter 40, is published at least annually by the Bureau of Alcohol, Tobacco, and Firearms, U.S. Department of the Treasury.

Certain chemicals and fuel materials might have explosive characteristics but are not within the scope of Title 18, USC, Chapter 40, and are not specifically classified as explosives by the U.S. Department of Transportation. Authoritative information should be obtained for such materials, and action commensurate with their hazards, location, isolation, and safeguards should be taken.

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-2-7.1 In general, the wall having the largest area should be chosen to provide explosion relief. The entire area of the wall should be utilized. The term "weakwall" is used to describe the relative strength of the explosion-relieving wall as compared to the rest of the building.

A-2-7.3 For information on the use of conductive surfaces to minimize the hazard of static electricity, see NFPA 99, *Standard for Health Care Facilities.*

A-2-10.1 This requirement is for purposes of minimizing personnel exposure and is distinct from any requirement on maximum building occupancy that might exist in local ordinances.

A-2-11.4 Smoking materials include matches, lighters, cigarettes, cigars, and pipes.

A-2-12.7 Oxidizers include nitrates, chlorates, and perchlorates.

A-4-3.1(c) A bullet-resistant roof should be constructed in accordance with any of the specifications in Appendix B. A bullet-resistant ceiling should be constructed at the eave line, covering the entire area of the magazine, except for the necessary ventilation space. Examples of bullet-resistant ceiling construction include:

(a) Any construction meeting the specifications in Appendix B.

(b) A sand tray having a sand depth of at least 4 in. (10.2 cm).

Appendix B Magazine Construction

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

Magazines constructed in accordance with the following minimum specifications are approved as bullet resistant (as defined in Section 1-4 of this code). All steel and wood dimensions are actual thickness; concrete block and brick dimensions are nominal.

B-1 Steel Exterior.

(a) Five-eighths-in. (16-mm) steel with an interior lining of nonsparking material.

(b) One-half-in. (13-mm) steel with an interior lining of plywood at least $^3/_8$ in. (9.5 mm) thick.

(c) Three-eighths-in. (9.5-mm) steel lined with one of the following:

1. 2 in. (5 cm) of hardwood;
2. 3 in. (7.6 cm) of softwood;
3. $2^1/_4$ in. (5.7 cm) of plywood.

(d) One-fourth-in. (6.4-mm) steel lined with one of the following:

1. 3 in. (7.6 cm) of hardwood;
2. 5 in. (12.7 cm) of softwood;
3. $5^1/_4$ in. (13.3 cm) of plywood;
4. $1^1/_4$ in. (3.2 cm) of plywood with an intermediate layer of 2 in. (5 cm) of hardwood.

(e) Three-sixteenths-in. (4.8-mm) steel lined with one of the following:

1. 4 in. (10.2 cm) of hardwood;
2. 7 in. (17.8 cm) of softwood;
3. $6^3/_4$ in. (17.1 cm) of plywood;
4. $^3/_4$ -in. (19-mm) of plywood with an intermediate layer of 3 in. (7.6 cm) of hardwood.

(f) One-eighth-in. (3.2-mm) steel lined with one of the following:

1. 5 in. (12.7 cm) of hardwood;
2. 9 in. (23 cm) of softwood;
3. $^3/_4$ in. (19 mm) of plywood with an intermediate layer of 4 in. (10.2 cm) of hardwood;
4. Two layers of $^3/_4$-in. (19-mm) plywood with an intermediate layer of $3^5/_8$ in. (9.2 cm) of well-tamped dry sand or sand/cement mixture.

B-2 Fire-Resistant Exterior. Exterior of any type of fire-resistant material that is structurally sound with:

(a) An interior lining of $^1/_2$-in. (13-mm) plywood placed securely against an intermediate 4-in. (10.2-cm) thick layer of solid concrete block, solid brick, or solid concrete.

(b) An interior lining of $^3/_4$-in. (19-mm) plywood; a first intermediate layer of $^3/_4$ -in. (19-mm) plywood; a second intermediate layer of $3^5/_8$ in. (9.2 cm) of well-tamped dry sand or sand/cement mixture; a third intermediate layer of $^3/_4$-in. (19-mm) plywood; and a fourth intermediate layer of 2-in. (5-cm) hardwood or 14-gauge steel.

(c) An intermediate 6-in. (15-cm) space filled with well-tamped dry sand or sand/cement mixture.

B-3 Masonry Exterior.

(a) Stand3ard 8-in. (20-cm) concrete block with voids filled with well-tamped dry sand or sand/cement mixture.

(b) Standard 8-in. (20-cm) solid brick.

(c) Eight-in. (20-cm) solid concrete.

(d) Two layers of 4-in. (10.2-cm) concrete block.

Appendix C Referenced Publications

C-1 The following documents or portions thereof are referenced within this code for informational purposes only and thus are not considered part of the requirements of this docu-