NFPA 1125

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

2007 Edition

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NFPA 1125

Code for the

Manufacture of Model Rocket and High Power Rocket Motors

2007 Edition

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. It was issued by the Standards Council on July 28, 2006, with an effective date of August 17, 2006, and supersedes all previous editions.

This edition of NFPA 1125 was approved as an American National Standard on August 17, 2006.

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.

In 1988, the Committee developed the first edition of NFPA 1125 for model rocket motors only. However, by 1995, the use of high power rocket motors became important as a distinction from the model rocketry sector of the public. The scope of NFPA 1125 was expanded to address both model and high power rocket motor manufacture. NFPA 1125 included requirements developed by the Committee to promote safety in the manufacture of model rocket motors and also the manufacture of high power rocket motors.

In the 2001 revision, the Committee incorporated changes updating regulatory provisions, which made it compatible with industry practices and consistent with NFPA 1122, *Code for Model Rocketry*, and NFPA 1127, *Code for High Power Rocketry*. The revision also included changes to conform with the *Manual of Style for NFPA Technical Committee Documents*.

The 2007 revision of the code includes updates to definitions for coordination with the rocketry documents and to be consistent with the *NFPA Glossary of Terms*.

The Committee has modified the definition and design requirements for hybrid propellant high power rocket motors to allow the use of liquid fuels. The Committee has also added a requirement of labeling the casing of reloadable rocket motors with the maximum number of times the casing can be reused.

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James K. Lathrop, *Chair*
Koffel Associates, Inc., CT [SE]

Kenneth L. Kosanke, *Secretary*
PyroLabs, Incorporated, CO [SE]

Thomas G. Arnold, Lancaster Bureau of Fire, PA [E]
Dane Boles, Quest Aerospace, Inc., AZ [M]
Richard Bowes, Natural Resources Canada, Canada [RT]
W. G. Bulifant, III, Dominion Fireworks, Inc., VA [U]
Jose R. Colon, Connecticut Department of Public Safety, CT [E]
Rep. International Fire Marshals Association
John A. Conkling, Chestertown, MD [SE]
Randall W. A. Davidson, Risk International & Associates, Inc., CA [SE]
Vernon Estes, Canon City, CO [SE]
Gary A. Fadorsen, Pyrotech International Inc., OH [IM]
Phil Grucci, Fireworks by Grucci, Inc., NY [M]
Garry Hanson, Precocious Pyrotechnics, Inc., MN [M]
Rep. National Fireworks Association
Julie L. Heckman, American Pyrotechnics Association, MD [M]
John Hendrick, Natural Resources Canada, Canada [E]
Lansden E. Hill, Jr., E. E. Hill & Son, Inc./Pyro Shows, TN [U]
Robert J. James, City of Bloomington, MN [E]
Rep. Fire Prevention Code Committee
Bruce E. Kelly, Tripoli Rocketry Association, Inc., UT [U]
John Kitchens, City of Los Angeles Fire Department, CA [E]
Gerald R. Laib, U.S. Department of the Navy, MD [SE]
Peter M. Lamb, Town of Newport Fire-EMS, NH [E]
Joshua Lazarus, State of New Jersey, NJ [E]
J. Patrick Miller, Hardin-Simmons University, TX [U]
Rep. National Association of Rocketry
David J. Pier, MP Associates, Inc., CA [M]
Mary Roberts, Estes Industries, CO [M]
Gary C. Rosenfield, Industrial Solid Propulsion (ISP), UT [M]
David S. Shatzer, U.S. Bureau of Alcohol, Tobacco, Firearms & Explosives, DC [E]
James R. Souza, Pyro Spectaculars, Incorporated, CA [U]
John R. Steinberg, Pyrotechnics Guild International, Inc., MD [U]
Lawrence Weinman, Luna Tech/Schneier-Weinman Consultants, TX [M]
Dan Westcott, Gadsden Fire Department, AL [E]
Rep. NFPA Fire Service Section

Alternates

Arthur H. Barber, III, Springfield, VA [SE]
(Alt. to V. Estes)
Scott Bartel, Black Sky Research, CA [U]
(Alt. to B. E. Kelly)
Gary E. Brown, Pyro Spectaculars, Inc., CA [U]
(Alt. to J. R. Souza)
Kevin T. Brueckner, Fireworks and Stage FX America, Inc., CA [M]
(Alt. to G. Hanson)
Mark B. Bundick, First Chicago Capital Markets, IL [U]
(Alt. to J. P. Miller)
Steve A. Coman, RES Specialty Pyrotechnics Inc., MN [U]
(Alt. to J. R. Steinberg)
Ettore Contestabile, Natural Resources Canada, Canada [RT]
(Alt. to R. Bowes)
H. Stephen Frantz, Western Enterprises, Inc., OK [U]
(Alt. to L. E. Hill)
Felix J. Grucci, Jr., Fireworks by Grucci, Inc., NY [M]
(Alt. to P. Grucci)
Alfred J. Hogan, Reedy Creek Improvement District, FL [E]
(Alt. to P. M. Lamb)
Bonnie J. Kosanke, Journal of Pyrotechnics, Inc., CO [SE]
(Alt. to K. L. Kosanke)
Larry Mars, MP Associates, Inc., CA [M]
(Alt. to D. J. Pier)
Mark C. Orellana, Penn Township, Indiana Fire Department, IN [E]
(Alt. to J. R. Colon)
Brennan S. Phillips, U.S. Department of Justice, WA [E]
(Alt. to D. S. Shatzer)
Gregg S. Smith, American Pyrotechnics Association, PA [M]
(Alt. to J. L. Heckman)
Bill Stine, Quest Aerospace, Incorporated, AZ [M]
(Alt. to D. Boles)
Tad A. Trout, American Promotional Events, Inc., CA [U]
(Alt. to W. G. Bulifant, III)
Gerald D. Ward, Bethany Fire Protection District, IL [E]
(Alt. to D. Westcott)
Charles P. Weeth, Weeth & Associates, LLC, WI [SE]
(Alt. to G. R. Laib)
William A. Weimer, B. J. Alan Company, OH [M]
(Alt. to L. Weinman)

Nonvoting

Matthew I. Chibbaro, U.S. Department of Labor, DC [E]
Rep. Occupational Safety & Health Administration
Joseph A. Domanico, U.S. Department of the Army, MD [RT]
Mark W. Hagemann, U.S. Department of Labor, DC [E]
Rep. Occupational Safety & Health Administration
(Alt. to M. I. Chibbaro)
Gary Zeller, Zeller International, NY [SE]

Guy R. Colonna, NFPA Staff Liaison

--`,,```,,,,````-`-`,,`,,`,`,,`---
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The Committee does not have responsibility for documents on the use of consumer fireworks by the general public; on the use of pyrotechnic special effects before a proximate audience; on the manufacture, transportation, storage for use of military, automotive, agricultural, and industrial pyrotechnics.

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Contents

Chapter 1 Administration **1125–** 5
1.1 Scope **1125–** 5
1.2 Purpose **1125–** 5
1.3 Equivalency **1125–** 5
1.4 Enforcement **1125–** 5

Chapter 2 Referenced Publications **1125–** 5
2.1 General **1125–** 5
2.2 NFPA Publications **1125–** 5
2.3 Other Publications **1125–** 5
2.4 References for Extracts in Mandatory Sections **1125–** 6

Chapter 3 Definitions **1125–** 6
3.1 General **1125–** 6
3.2 NFPA Official Definitions **1125–** 6
3.3 General Definitions **1125–** 6

Chapter 4 Manufacturing Operations for Rocket Motors **1125–** 8
4.1 Basic Requirements **1125–** 8
4.2 Permit Requirements **1125–** 8
4.3 Recordkeeping and Reporting **1125–** 8
4.4 Applicability **1125–** 8
4.5 Site Security **1125–** 8
4.6 Separation Distances **1125–** 8
4.7 Process Building Construction **1125–** 8
4.8 Means of Egress **1125–** 9
4.9 Heat, Light, and Electrical Equipment ... **1125–** 9
4.10 Maximum Number of Occupants and Maximum Quantity Limitations **1125–** 9
4.11 Fire and Explosion Prevention **1125–** 9
4.12 Personnel Safety **1125–**10
4.13 Fire Protection, Training, and Emergency Procedures **1125–**10
4.14 Testing of Rocket Motors **1125–**10

Chapter 5 Limited Quantity Manufacturing Operations for Composite Propellant Rocket Motors **1125–**10
5.1 Basic Requirements **1125–**10
5.2 License and Permit Requirements **1125–**11
5.3 Site Security **1125–**11
5.4 Recordkeeping and Reporting **1125–**11
5.5 Storage of Materials **1125–**11
5.6 Process Building Construction **1125–**11
5.7 Means of Egress **1125–**11
5.8 Heat, Light, and Electrical Equipment ... **1125–**11
5.9 Maximum Number of Occupants and Maximum Quantity Limitations **1125–**12
5.10 Fire and Explosion Prevention **1125–**12
5.11 Personnel Safety **1125–**12
5.12 Fire Protection, Training, and Emergency Procedures **1125–**12
5.13 Testing of Rocket Motors **1125–**13

Chapter 6 Storage of Low Explosives at Rocket Motor Manufacturing Plants **1125–**13
6.1 Basic Requirements **1125–**13
6.2 Magazine Construction — General **1125–**13
6.3 Magazine Construction — Requirements for Specific Types **1125–**14
6.4 Storage Within Magazines **1125–**15
6.5 Miscellaneous Safety Precautions **1125–**15

Chapter 7 Requirements for Rocket Motors and Components **1125–**16
7.1 Solid Propellant Rocket Motors and Components **1125–**16
7.2 Expendable Rocket Motor **1125–**16
7.3 Reloadable Rocket Motor **1125–**16
7.4 Motor Casing Requirements **1125–**16
7.5 Hybrid Propellant High Power Rocket Motors **1125–**16
7.6 Model Rocket Motor Limitations **1125–**17
7.7 High Power Rocket Motor Limitations ... **1125–**17
7.8 Manufacturer Production Lot Testing **1125–**18
7.9 Motor Shelf Life **1125–**18
7.10 Shipping and Storage Prohibitions **1125–**18
7.11 Rocket Motor Fuse Prohibition **1125–**18
7.12 Rocket Motor Instruction Requirements ... **1125–**18
7.13 Rocket Motor Marking **1125–**18
7.14 Motor-Reloading Kit Package Requirements **1125–**19

Chapter 8 Testing and Certification **1125–**19
8.1 Certification of Model Rocket Motors, Motor-Reloading Kits, and Components **1125–**19
8.2 Certification of High Power Rocket Motors, Motor-Reloading Kits, and Components **1125–**19
8.3 Listing of Certified High Power Rocket Motors and Motor-Reloading Kits **1125–**20
8.4 Decertification **1125–**20
8.5 Maintenance of Sales Records of High Power Rocket Motors and Motor-Reloading Kits **1125–**20

Annex A Explanatory Material **1125–**20

Annex B Magazine Construction **1125–**22

Annex C Sample Ordinance Adopting NFPA 1125 ..... **1125–**22

Annex D Informational References **1125–**23

Index **1125–**24

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Information on referenced publications can be found in Chapter 2 and Annex D.

Chapter 1 Administration

1.1 Scope.

1.1.1* This code shall apply to the manufacture of model and high power rocket motors designed, sold, and used for the purpose of propelling recoverable aero models.

1.1.2 This code shall apply to the design, construction, and reliability of model and high power rocket motors and model rocket and high power motor-reloading kits and their components, and to the limitation of propellant mass and power.

1.1.3 This code shall not apply to the sale and use of the following:

(1) Model rocket motors (covered by NFPA 1122, *Code for Model Rocketry*)
(2) 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.

1.1.5 This code shall not apply to the manufacture, transportation, and storage of rocket motors by the United States military or other agencies or political subdivisions of the United States.

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

1.1.7 This code shall not apply to the fabrication of model rocket motors or high power rocket motors by individuals for their personal use.

1.2 Purpose.

1.2.1 The purpose of this code shall be to provide reasonable safety in the manufacture of model rocket and high power rocket motors.

1.2.2 The purpose of this code shall be to ensure the availability of commercial model and high power rocket motors and components that meet the standards as stated herein.

1.2.3 The purpose of this code shall also be 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 over those prescribed by this code.

1.3.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.3.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.4 Enforcement. This code shall be administered and enforced by the authority having jurisdiction designated by the governing authority. *(See Annex C for sample wording for enabling legislation.)*

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this code and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 10, *Standard for Portable Fire Extinguishers,* 2007 edition.
NFPA 70, *National Electrical Code®,* 2005 edition.
NFPA *101®*, *Life Safety Code®,* 2006 edition.
NFPA 430, *Code for the Storage of Liquid and Solid Oxidizers,* 2004 edition.
NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response,* 2007 edition.
NFPA 1122, *Code for Model Rocketry,* 2002 edition.
NFPA 1127, *Code for High Power Rocketry,* 2002 edition.

2.3 Other Publications.

2.3.1 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 16, Code of Federal Regulations, Part 1500, Federal Hazardous Substances Act.

Title 16, Code of Federal Regulations, Parts 1500.85(8) and (9), Consumer Product Safety Commission (CPSC) Regulations.

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Title 18, United States Code, Chapter 40, "Importation, Manufacture, Distribution, and Storage of Explosive Materials," Regulation of Explosives, of the Crime Control Act of 1970, Title XI.

Title 27, Code of Federal Regulations, Part 55, Bureau of Alcohol, Tobacco, Firearms, and Explosives, U.S. Department of the Treasury.

Title 29, Code of Federal Regulations, Part 1910.119.

Title 40, Code of Federal Regulations, U.S. EPA, Superfund Appropriation and Reauthorization Act (SARA), Title III.

Title 49, Code of Federal Regulations, Parts 100 to end (Hazardous Materials Regulations, U.S. Dept. of Transportation).

DOT-E-7887, Exemption to Title 49, Code of Federal Regulations, Parts 171–180.

2.3.2 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 495, *Explosive Materials Code,* 2006 edition.
NFPA 1122, *Code for Model Rocketry,* 2002 edition.
NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles,* 2006 edition.
NFPA 1127, *Code for High Power Rocketry,* 2002 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this code. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ) An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

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

3.2.4 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.5* 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 appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.6 Shall. Indicates a mandatory requirement.

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

3.3 General Definitions.

3.3.1 Aero Model. An unmanned flying device including the category of model or high power rocket as defined in this section.

3.3.2* 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.

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

3.3.2.2 ***Natural Barricade.*** A natural outdoor feature(s), such as hills or trees, with a density sufficient to prevent surrounding exposures that require protection from being seen from a magazine or building containing explosives when the trees are bare of leaves. [**1124,** 2006]

3.3.2.3* ***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.

3.3.3 Building.

3.3.3.1* ***Inhabited Building.*** Any building or structure regularly used in whole or part as a place of human habitation. [**495,** 2006]

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

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

3.3.3.4 ***Process Building.*** Any building in which propellant, delay composition, or ejection composition is mixed, pressed, or modified in any manner, or in which any modification is made to the model or high power rocket motor prior to its completed form, excluding interim storage, labeling, or packaging of the completed motor in consumer packaging or in a container acceptable to the Department of Transportation.

3.3.3.5 ***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.

3.3.4 Certified. Approved or endorsed authoritatively.

3.3.5* Certified Motor. A commercially made rocket motor that has been tested by a recognized testing organization that is acceptable to the authority having jurisdiction and found to meet the requirements set forth in this code.

3.3.6* Certified User. An individual, a distributor, or a seller who has been tested or otherwise examined by a recognized organization that is acceptable to the authority having jurisdiction

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and found to be qualified to purchase, possess, or use high power rocket motors.

3.3.7 Commercial Manufacturer. Any individual, firm, partnership, joint venture, corporation, or other business entity engaged in research, development, production, preparation, testing, maintenance, or supply of rockets, rocket motors, rocket propellant chemicals, rocket propellant, delay or ejection modules, or rocket components or parts. [**1122,** 2002]

3.3.8 Composition.

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

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

3.3.8.3 ***Propellant Composition.*** A chemical mixture that, upon burning, produces thrust to propel a recoverable aero model.

3.3.9* Explosive. Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion. [**495,** 2006]

3.3.9.1 ***Low Explosive.*** Explosive materials that can be caused to deflagrate when confined (e.g., Black Powder, safety fuses, igniters, igniter cords, fuse lighters, and display fireworks defined as low explosives by U.S. Department of Transportation regulations in 49 CFR 173 except for bulk salutes).

3.3.10 Facility. All land and buildings, including the rocket motor plant, constituting a model or high power rocket motor manufacturing operation.

3.3.11 Flight Cylinder. A high-pressure container used in a hybrid rocket motor system to contain pressurized liquid or gas. [**1127,** 2002]

3.3.11.1 ***Sealed Flight Cylinder.*** A flight cylinder used in a hybrid rocket motor system into which a pressurized liquid or gas can be loaded prior to launch and stored for an indefinite period.

3.3.11.2 ***Vented Flight Cylinder.*** A flight cylinder used in a hybrid rocket motor system that continuously vents a pressurized liquid or gas to the atmosphere during the motor fill and ignition procedures.

3.3.12 Highway. Any public street, public alley, or public road including a privately financed, constructed, or maintained road that is regularly and openly traveled by the general public.

3.3.13 Magazine. A building or structure, other than an explosives manufacturing building, approved for the storage of explosive materials. [**1124,** 2006]

3.3.14* Manufacture. The preparation of propellant, delay, and ejection compositions and the loading and assembly of model or high power rocket motors and igniters and any other alteration of their pyrotechnic components.

3.3.15 Model Rocket Engine. See 3.3.25, Rocket Motor.

3.3.16 Module. A pyrotechnic component of a hybrid or reloadable rocket motor in which its chemical composition is preloaded into a finished assembly that does not necessitate mixing of ingredients by the user.

3.3.17 Motor-Reloading Kit. A package designed and produced by a commercial manufacturer that contains all the components and parts necessary to reload and reuse a reloadable model or high power rocket motor casing.

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

3.3.19 Pressing System. A building or group of buildings constituting one rocket motor manufacturing unit; considered as one process building for the application of Table 6.1.2 *(see Table 6.1.2).*

3.3.20 Production Lot. A uniquely identifiable group of solid propellant model or high power rocket motors, motor-reloading kits, or pyrotechnic module(s) possessing the same characteristics resulting from production under common manufacturing conditions using the same batch of materials.

3.3.21 Propellant. The material(s) utilized in a model or high power 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 or high power rocket motor.

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

3.3.23 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.

3.3.24 Rocket Engine. See 3.3.25, Rocket Motor.

3.3.25 Rocket Motor. A device containing propellant that provides the force or thrust to cause a rocket to move. [**1122,** 2002]

3.3.25.1 ***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.

3.3.25.2 ***High Power Rocket Motor.*** A rocket motor that has more than 160 N-sec but no more than 40,960 N-sec of total impulse, or that produces an average thrust of greater than 80 N, or that contains greater than 62.5 g (2.2 oz) of propellant.

3.3.25.3 ***Hybrid Rocket Motor.*** A rocket motor in which one or more of the fuels exist in a physical state (solid, liquid, or gaseous) different than the oxidizer and that derives its force or thrust from the combination thereof.

3.3.25.4 ***Model Rocket Motor.*** A rocket motor that has a total impulse of no greater than 160 N-sec (36 lb-sec), an average thrust of no greater than 80 N (18 lbf), and a propellant weight of no greater than 62.5 g (2.2 oz), and that otherwise meets the other requirements set forth in NFPA 1125, *Code for the Manufacture of Model Rocket and High Power Rocket Motors.* [**1122,** 2002]

3.3.25.5 ***Reloadable Motor System.*** A combination of a reloadable rocket motor casing and a motor-reloading kit that are designed to be used together as a system.

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3.3.25.6 ***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.

3.3.25.7 ***Solid Propellant Rocket Motor.*** A rocket motor that contains a fuel and an oxidizer in a solid form and whose force or thrust is produced by the combustion of the fuel and oxidizer. [**1122,** 2002]

3.3.26 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.

3.3.27 Rocket Propellant. See 3.3.21, Propellant.

3.3.28 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 4 Manufacturing Operations for Rocket Motors

4.1 Basic Requirements.

4.1.1 This chapter shall only apply to the manufacture of any solid propellant rocket motor or motor-reloading kit.

4.1.2 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.

4.1.3 The manufacturer of any rocket motor shall be in compliance with 29 CFR 1910.119.

4.2 Permit Requirements.

4.2.1 Any person engaged in the manufacture of rocket motors, motor-reloading kits, or pyrotechnic modules shall possess a federal license or permit, as required by 18 USC Chapter 40 Title XI, Regulation of Explosives, of the Crime Control Act of 1970 and shall comply with all applicable state and local laws and regulations.

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

4.2.1.2 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.

4.2.1.3 Licenses or permits shall not be reassigned or transferred.

4.2.2 The issuing authority shall be notified when required of any change of business name, controlling ownership, or address.

4.3 Recordkeeping and Reporting.

4.3.1 Records shall be maintained in accordance with 27 CFR 55.

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

4.4 Applicability. All rocket motor plants that manufacture Black Powder–based motors shall meet the requirements of Chapter 4.

4.5 Site Security.

4.5.1* The rocket motor plant shall be completely surrounded by a fence or equivalent barrier capable of deterring entry by unauthorized persons.

4.5.2 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.

4.5.3 Conspicuous signs that read WARNING — NO SMOKING — NO TRESPASSING or other signage as required by the authority having jurisdiction shall be posted at the entrance(s) and along the fence or barrier.

4.5.4 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.

4.6 Separation Distances.

4.6.1 Process buildings shall be separated from other inhabited buildings, passenger railways, and public highways in accordance with the distances specified in Table 4.6.1.

Table 4.6.1 Minimum Separation Distances of Process Buildings from Inhabited Buildings, Passenger Railways, and Public Highways[a]

Net Weight of Rocket Motor Composition[b]		Distance from Inhabited Buildings[c,d]		Distance from Passenger Railways and Public Highways[c,d]	
kg	lb	m	ft	m	ft
45.36	100	60.96	200	60.96	200
90.70	200	60.96	200	60.96	200
181.40	400	60.96	200	60.96	200
272.20	600	63.40	208	60.96	200
362.90	800	76.80	252	60.96	200
453.60	1000	89.00	292	60.96	200

[a] This table does not apply to separation distances for magazines containing 1.4 or 1.3 explosives.
[b] Net combined weight of all propellant, delay, and ejection composition only.
[c] See Chapter 3 for definitions of passenger railways, public highways, and inhabited buildings.
[d] All distances in this table are to be applied with or without barricades or screen-type barricades.

4.6.2 Process buildings shall be separated from nonprocess buildings by the distances specified in Table 4.6.2.

4.6.3 Magazines shall be separated from both process and nonprocess buildings by the distances specified in Table 4.6.2.

4.7 Process Building Construction.

4.7.1* The interior surfaces of walls and ceilings shall be smooth.

4.7.1.1 Interior finish shall be of noncombustible or limited-combustible materials.

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Table 4.6.2 Minimum Separation Distances at Rocket Motor Manufacturing Plants[a]

Net Weight of Low Explosives		Distance of Magazine from Process Buildings and Nonprocess Buildings[b,c]		Distance Between Process Buildings and Nonprocess Buildings[b,c]	
kg	lb	m	ft	m	ft
45.36	100	9.14	30	9.14	30
90.70	200	10.67	35	10.67	35
181.40	400	13.41	44	13.41	44
272.20	600	15.54	51	15.54	51
362.90	800	17.07	56	17.07	56
453.60	1000	18.30	60	18.30	60
907.20	2000	23.20	76	23.20	76
1360.80	3000	26.50	87	26.50	87

[a] For the purposes of applying separation distances in Table 4.6.2, 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.

[b] Distances apply with or without barricades or screen-type barricades.

[c] Distances include those between magazines, between a magazine and a process building, and between a magazine and a nonprocess building.

4.7.1.2 Materials used for deflagration vent closures shall not be required to be of noncombustible or limited-combustible materials.

4.7.2 Horizontal ledges and surfaces on which dust can settle and accumulate shall be minimized.

4.7.3 Floors and work surfaces shall not have cracks or crevices in which propellant, delay, or ejection composition can lodge.

4.7.4* Floor and work surfaces in mixing areas, processing areas, and pressing buildings shall be nonsparking and shall utilize methods and materials to control the buildup and discharge of electrostatic energy.

4.8 Means of Egress. Means of egress in all buildings shall comply with applicable requirements of NFPA *101*, *Life Safety Code*. Means of egress in process buildings also shall comply with the following requirements:

(1) From every point in every undivided floor area of more than 9 m^2 (100 ft^2), there shall be at least two remotely located means of egress.
(2) Where process buildings are divided into rooms, there shall be at least two means of escape from each room of more than 9 m^2 (100 ft^2).
(3) Toilet rooms shall be permitted to have only one means of egress, provided the means of egress is located away from or shielded from process areas.
(4) An unobstructed means of egress shall be located so that every point within the room or undivided floor area is within 7.6 m (25 ft) of a means of egress.
(5) The routes to the exits shall be direct and avoid circuitous paths.
(6) Exit doors shall open outward and shall be capable of being pressure actuated from the inside.
(7) Workstations shall be placed to facilitate egress.

4.9 Heat, Light, and Electrical Equipment.

4.9.1 Stoves, open flames, and portable electric heaters shall be prohibited in any manufacturing room or area where propellant, delay, or ejection composition or flammable materials are present.

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

4.9.2.1 Unit heaters located in rooms where propellant, delay, or ejection composition or flammable materials are being processed or stored shall be equipped with motors and electrical devices in accordance with Article 500, NFPA 70, *National Electrical Code*.

4.9.2.2 Buildings or rooms that are used only for static motor tests shall not have to be equipped with motors and electrical devices in accordance with NFPA 70, *National Electrical Code*.

4.9.3 All wiring, switches, and electrical fixtures in rooms where propellant, delay, or ejection composition or flammable materials are being processed or stored shall comply with NFPA 70, *National Electrical Code*.

4.9.3.1 Temporary or loose electrical wiring shall not be used.

4.9.3.2 Where temporary lighting is necessary within a magazine, electric safety flashlights, electric safety lanterns, or chemiluminescent 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.

4.9.3.3 All presses and other mechanical devices shall be electrically bonded and grounded.

4.9.4 All artificial lighting shall be electrically powered.

4.10 Maximum Number of Occupants and Maximum Quantity Limitations.

4.10.1 With the exception of temporarily authorized persons, the number of occupants in each magazine or process building shall not exceed the number required for the specific operations taking place. Labeling or packaging of complete model and high power rocket motors shall not be considered a process.

4.10.1.1 The maximum number of occupants permitted in each magazine or process building shall be posted in a conspicuous location at all entrances. Labeling or packaging of completed model and high power rocket motors shall not be considered a process.

4.10.2 No more than 34 kg (75 lb) of the combined weight of propellant, delay, and ejection composition shall be permitted at any one time in any mixing room or process building.

4.10.3 No more than 34 kg (75 lb) of the combined weight of the propellant, delay, or ejection composition shall be permitted at any one time in a pressing system, with no more than 5 lb (2.3 kg) of propellant, delay, or ejection composition in the pressing room itself.

4.11 Fire and Explosion Prevention.

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

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4.11.2 Spills of propellant, delay, or ejection composition shall be cleaned up and desensitized or removed immediately from the building. The spilled material shall be destroyed by burning in a manner acceptable to the authority having jurisdiction.

4.11.3 Rags, combustible scrap, and paper shall be kept separate from waste or propellant, delay, or ejection composition. They shall be kept in containers until removed from the building.

4.11.3.1 Disposal containers shall be removed from buildings on a regular basis and removed from the plant at regular intervals.

4.11.3.2 Waste propellant, delay, or ejection composition shall be destroyed as described in 4.11.2.

4.11.4* 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.

4.11.5 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, delay, or ejection composition is prohibited.

4.11.6 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.

4.11.7 Personnel whose clothing is contaminated with propellant, delay, or ejection composition to a degree that can endanger personnel safety shall not be permitted in smoking areas.

4.11.8 Manufacturers shall have procedures and equipment in place to control the accumulation and discharge of electrostatic energy in all manufacturing and processing areas.

4.12 Personnel Safety.

4.12.1 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.

4.12.2 Personnel working at or supervising mixing, pressing, and loading operations shall be provided with and shall wear cotton or flame-retardant clothing.

4.12.2.1 Other protective clothing, eye protection, and respiratory protection shall be worn as needed.

4.12.2.2 Short-sleeved shirts and short pants shall not be permitted.

4.12.3 Washing, shower, and changing facilities shall be provided.

4.12.4 Work clothing shall be washed frequently to prevent accumulation of propellant, delay, or ejection composition.

4.12.5 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.

4.12.5.1 The safety officer shall provide formal instruction regarding proper methods and procedures, safety requirements, and procedures for handling propellant, delay, or ejection composition and devices to all employees upon their commencing employment and at least annually thereafter.

4.12.6 Only nonsparking hand tools shall be used in areas where exposed propellant, delay, or ejection composition are present.

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

4.13 Fire Protection, Training, and Emergency Procedures.

4.13.1 Each manufacturer shall develop and document emergency procedures.

4.13.2 Each manufacturer shall train its personnel with regard to hazards and emergency procedures and document such training.

4.13.3* Training shall be conducted at initial employment, upon reassignment, and at least annually thereafter.

4.13.3.1 Employees shall be instructed to abandon firefighting efforts if the fire involves or can spread to propellant, delay, or ejection composition or devices. In such cases, employees shall be instructed to evacuate the building immediately and to alert other plant personnel.

4.13.3.2 Portable fire extinguishers shall be provided in all rooms or buildings in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*.

4.13.3.3 Extinguishers shall be prohibited in rooms that contain exposed propellant, delay, or ejection composition. Extinguishers shall not be located in buildings in which more than 2.3 kg (5 lb) combined weight of propellant, delay, or ejection composition is exposed.

4.13.4 A rocket motor manufacturing facility shall be posted as being in compliance with NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*.

4.13.5 The authority having jurisdiction for fire safety in the locality in which explosive materials are to be stored shall be notified of the type, magazine capacity, and location of each site in accordance with 27 CFR 55.20(f). The notification shall be made verbally before the end of the day and in writing within 48 hours of when storage has commenced in accordance with 27 CFR 55.20(f).

4.13.6 The local emergency planning committee, local fire authority, and the EPA shall be notified of chemicals in quantities when required by 40 CFR U.S. EPA, SARA, Title III.

4.14 Testing of Rocket Motors.

4.14.1 Testing of rocket motors, modules, and motor components shall be performed only in an area at a location or facility specifically designed for that purpose to not endanger plant employees and eliminate the possibility of providing a source of ignition to hazardous materials stored or used at the manufacturing plant.

4.14.2 The test site shall be located at a safe distance from all plant buildings and structures.

Chapter 5 Limited Quantity Manufacturing Operations for Composite Propellant Rocket Motors

5.1 Basic Requirements.

5.1.1 The requirements of Chapter 5 shall apply to the manufacture of composite propellant rocket motors as defined in Chapter 3 and that also meet the following criteria:

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(1) Neither the raw materials nor the finished propellant shall be high explosives as defined by the Bureau of Alcohol, Tobacco, Firearms, and Explosives, U.S. Department of the Treasury.
(2) 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.
(3) The propellant batch being mixed at any one time shall not exceed a weight of 16 kg (35 lb).
(4) The propellant formulation shall not include solid ferrocene.

5.1.2 Composite propellant manufacturing processes that do not meet the requirements of 5.1.1 shall adhere to the requirements of Chapter 4.

5.1.3 The manufacture of any composite propellant rocket motor, as defined in Chapter 3, shall be prohibited unless it is authorized by federal license, as required, and is conducted in accordance with this code.

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

5.1.5 The manufacture of any rocket motor shall be in compliance with 29 CFR 1910.119.

5.2 License and Permit Requirements.

5.2.1 Any person engaged in the manufacture of composite propellant rocket motors, motor-reloading kits, or pyrotechnic modules shall possess a federal license or permit as required by 18 USC Chapter 40, Title XI, Regulation of Explosives, of the Crime Control Act of 1970 and shall comply with all applicable federal, state, and local laws and regulations.

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

5.2.1.2 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.

5.2.1.3 Licenses or permits shall not be reassigned or transferred.

5.2.2 The issuing authority shall be notified when required of any change of business name, controlling ownership, or address.

5.3 Site Security.

5.3.1 All means of access to the plant shall be kept closed and securely locked at all times when the plant is not in operation or occupied.

5.3.2 Representatives of federal, state, or local agencies having jurisdiction over the plant shall be allowed in the plant with permission and escort of the person in charge.

5.4 Recordkeeping and Reporting.

5.4.1 Records shall be maintained in accordance with 27 CFR 55.

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

5.5 Storage of Materials.

5.5.1 The storage of oxidizers shall comply with NFPA 430, *Code for the Storage of Liquid and Solid Oxidizers.*

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

5.5.3 Uncast propellant mix in excess of 45 kg (100 lb) shall be stored in magazines meeting the requirements of Chapter 6.

5.5.4 Storage of binder and metal fuel ingredients shall be separate from storage of oxidizer.

5.6 Process Building Construction.

5.6.1 Interior wall and ceiling surfaces shall be smooth.

5.6.2 Horizontal ledges and surfaces on which dust can settle and accumulate shall be minimized.

5.6.3 Floors and work surfaces shall not have cracks or crevices in which propellant, delay, or ejection composition can lodge.

5.6.4* Floor and work surfaces in mixing areas, processing areas, and pressing buildings shall be nonsparking and utilize methods and materials to control the buildup and discharge of electrostatic energy.

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

5.6.6 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.

5.7 Means of Egress. Means of egress in all buildings shall comply with applicable requirements of NFPA *101*, *Life Safety Code.* Means of egress in process buildings also shall comply with the following requirements:

(1) From every point in every undivided floor area of more than 9 m^2 (100 ft^2), there shall be at least two remotely located means of egress.
(2) Where process buildings are divided into rooms, there shall be at least two means of escape from each room of more than 9 m^2 (100 ft^2).
(3) Toilet rooms shall be permitted to have only one means of egress, provided the means of egress is located away from or shielded from process areas.
(4) An unobstructed means of egress shall be located so that every point within the room or undivided floor area is within 7.6 m (25 ft) of a means of egress.
(5) The routes to the exits shall be direct and avoid circuitous paths.
(6) Exit doors shall open outward and shall be capable of being pressure actuated from the inside.
(7) Workstations shall be placed to facilitate egress.

5.8 Heat, Light, and Electrical Equipment.

5.8.1 Stoves, open flames, and portable electric heaters shall be prohibited in any room or area where propellant, delay, or ejection composition or flammable materials are present.

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

5.8.2.1 Unit heaters located in rooms where propellant, delay, or ejection composition or flammable materials are being processed or stored shall be equipped with motors and electrical devices in accordance with Article 500, NFPA 70, *National Electrical Code*.

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

5.8.3 All wiring, switches, and electrical fixtures in rooms where propellant, delay, or ejection composition or flammable materials are being processed or stored shall comply with NFPA 70, *National Electrical Code*.

5.8.3.1 Temporary or loose electrical wiring shall not be used.

5.8.3.2 Where temporary lighting is necessary within a magazine, electric safety flashlights, electric safety lanterns, or chemiluminescent 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.

5.8.3.3 All presses and other mechanical devices shall be electrically bonded and grounded.

5.8.4 All artificial lighting shall be electrically powered.

5.9 Maximum Number of Occupants and Maximum Quantity Limitations.

5.9.1* With the exception of temporarily authorized persons, the number of occupants in each magazine or process building shall not exceed the number required for the specific operations taking place. The maximum number of occupants permitted in each magazine or process building shall be posted in a conspicuous location at all entrances.

5.9.2 No more than 32 kg (70 lb) of the combined weight of propellant, delay, and ejection composition shall be permitted at any one time in any mixing room or building.

5.9.3* No more than 227 kg (500 lb) of combined weight of uncased propellant and delay composition shall be permitted at any one time in a finishing or assembly room or building, with no more than 32 kg (70 lb) of combined weight exposed.

5.9.4 Limited quantity manufacturing operations for composite propellant rocket motors shall be in accordance with Section 4.6.

5.9.5 No more than 2.3 kg (5 lb) of ejection composition shall be permitted at any one time in a finishing or assembly room or building.

5.10 Fire and Explosion Prevention.

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

5.10.1.1 Spills of propellant, delay, or ejection composition shall be cleaned up and removed immediately from the building. The spilled material shall be destroyed by burning in a manner acceptable to the authority having jurisdiction.

5.10.1.2 Waste propellant, delay, ejection composition, and contaminated rags or wipes shall be kept in covered containers.

5.10.1.3 Disposal containers shall be removed from buildings on a regular basis.

5.10.2 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.

5.10.2.1 Smoking shall be prohibited in buildings or rooms where propellant, delay, or ejection composition or flammable materials are present.

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

5.10.2.3 Personnel whose clothing is contaminated with propellant, delay, or ejection composition to a degree that can endanger personnel safety shall not be allowed in smoking locations.

5.11 Personnel Safety.

5.11.1 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.

5.11.2 Personnel working at mixing and casting operations shall be provided with and shall wear cotton or flame-retardant clothing.

5.11.2.1 Other protective clothing, eye protection, and respiratory protection shall be worn as needed.

5.11.2.2 Short-sleeved shirts and short pants shall not be permitted.

5.11.2.3 Washing and changing facilities shall be provided.

5.11.2.4 Work clothing shall be washed frequently to prevent accumulations of oxidizer or propellant, delay, or ejection composition.

5.11.3 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.

5.11.4 The safety officer shall provide formal instruction regarding proper methods and procedures, safety requirements, and procedures for handling propellant, delay, or ejection composition, ingredients, and devices to all employees upon their commencing employment and at least annually thereafter.

5.11.5 Only nonsparking hand tools shall be used in areas where exposed propellant, delay, or ejection composition are present.

5.12 Fire Protection, Training, and Emergency Procedures.

5.12.1 Each manufacturer shall develop and document emergency procedures.

5.12.2 Each manufacturer shall train its personnel with regard to hazards and emergency procedures and document such training.

5.12.3* Training shall be conducted at initial employment, upon reassignment, and at least annually thereafter.

5.12.3.1 Employees shall be instructed to abandon firefighting efforts if the fire involves or can spread to propellant, delay, or ejection composition or devices. In such cases, employees shall evacuate the building immediately and alert other plant personnel.

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5.12.3.2 Portable fire extinguishers shall be provided in all rooms or buildings in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*.

5.12.3.3 Extinguishers shall be prohibited in rooms that contain exposed propellant, delay, or ejection composition.

5.12.4 A model or high power rocket motor manufacturing facility shall be posted as being in compliance with NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*.

5.12.5 The local fire authority shall be notified verbally before the end of the day and in writing within 48 hours of the commencement of storage of explosive materials in accordance with 27 CFR 55.202.

5.12.6 The local emergency planning committee, local fire authority, and the EPA shall be notified of chemicals in quantities when required by 40 CFR US EPA, SARA, Title III.

5.13 Testing of Rocket Motors.

5.13.1 Testing of rocket motors, modules, and motor components shall be performed only in an area at a location or facility specifically designed for that purpose to not endanger plant employees and eliminate the possibility of providing a source of ignition to hazardous materials stored or used at the manufacturing plant.

5.13.2 The test site shall be located at a safe distance from all plant buildings and structures.

Chapter 6 Storage of Low Explosives at Rocket Motor Manufacturing Plants

6.1 Basic Requirements.

6.1.1 Low explosives not exempt under 27 CFR 55 shall be stored only in a Type 1, 2, 3, or 4 magazine. They shall be so stored at all times unless in the process of manufacture, testing, packaging, or transport.

6.1.2 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 6.1.2.

6.2 Magazine Construction — General.

6.2.1 Magazines shall be constructed to comply with Chapter 6 or in a manner substantially equivalent to the requirements of this chapter.

6.2.2 The ground around magazines shall be graded so that water drains away from the magazines.

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

6.2.3.1 Indirect warm air shall be heated by either hot water or low-pressure steam coils located outside the magazine.

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

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

6.2.3.4 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.

6.2.3.5 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 7.6 m (25 ft) from the magazine.

Table 6.1.2 Table of Storage Distances from Low Explosives at Model and High Power Rocket Motor Manufacturing Facilities

Quantity of Low Explosives				Distance from Inhabited Building		Distance from Passenger Railroad and Public Highway		Distance from Aboveground Magazine	
Over		Not Over							
lb	kg	lb	kg	ft	m	ft	m	ft	m
0	0	1,000	454	75	23	75	23	50	15
1,000	454	5,000	2,268	115	35	115	35	75	23
5,000	2,268	10,000	4,536	150	46	150	46	100	30
10,000	4,536	20,000	9,072	190	58	190	58	125	38
20,000	9,072	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

Source: 27 CFR 55 (BATF regulations for the storage of explosive materials).

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

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

6.2.4 Where temporary lighting is necessary within a magazine, electric safety flashlights, electric safety lanterns, or chemiluminescent lighting shall be used.

6.2.4.1 Provided the area has been cleared of all explosive materials and dust or residue have been removed, listed portable lighting equipment shall be permitted to be used during repair operations.

6.2.4.2 Electric lighting shall be permitted to be used within the magazine only if the installation meets the requirements of the current edition of NFPA 70, *National Electrical Code*.

6.2.5 There shall be no exposed ferrous metal on the interior of the magazine where the magazine contacts materials stored within.

6.2.6 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.

6.2.7 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.

6.3 Magazine Construction — Requirements for Specific Types.

6.3.1 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 specifications in 6.3.1.1 through 6.3.1.8.

6.3.1.1 Walls and doors shall be bullet resistant and shall be permitted to be constructed according to any of the specifications of Annex B.

6.3.1.2 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.

6.3.1.3* 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.

6.3.1.4 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.

6.3.1.5 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.

6.3.1.6 Type 1 magazines shall be ventilated to prevent dampness or heating of explosives.

6.3.1.6.1 Ventilation openings shall be screened to prevent entrance of sparks.

6.3.1.6.2 Ventilators in sidewalls shall be offset or shielded.

6.3.1.6.3 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.

6.3.1.7 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

6.3.1.8 Padlocks shall be steel, shall have at least five tumblers, and shall have at least an 11 mm (7⁄16 in.) 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.

6.3.2 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.

6.3.2.1 Type 2 Outdoor Magazine. A Type 2 outdoor magazine shall include the following:

(1) Walls and roof or ceiling shall be constructed according to the provisions of 6.3.1.1, 6.3.1.2, and 6.3.1.3.
(2) Doors shall be of metal, constructed according to the provisions of 6.3.1.1, or shall have a metal exterior with an inner door meeting the provisions of 6.3.1.1.
(3) Floors constructed of ferrous metal shall be covered with a nonsparking surface.
(4) A top-opening magazine shall have a lid that overlaps the sides by at least 25 mm (1 in.) when in the closed position.
(5) The magazine shall be supported so that its floor does not directly contact the ground.
(6) Magazines less than 0.77 m^3 (1 yd^3) shall be fastened securely to a fixed object to prevent theft of the entire magazine.
(7) Hinges, hasps, locks, and locking hardware shall comply with 6.3.1.7.

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

(8) 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.

6.3.2.2 Type 2 Indoor Magazines. A Type 2 indoor magazine shall include the specifications in 6.3.2.2.1 through 6.3.2.2.5.

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

6.3.2.2.2 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.

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6.3.2.2.3 The magazine shall be painted red, and the top shall bear the words EXPLOSIVES — KEEP FIRE AWAY in white letters at least 76 mm (3 in.) high.

6.3.2.2.4 Magazines constructed of wood shall have sides, bottoms, and covers or doors of 51 mm (2 in.) 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.

6.3.2.2.5 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 25 mm (1 in.).

6.3.3 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 specifications in 6.3.3.1 through 6.3.3.3.

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

6.3.3.2 Magazines constructed of wood shall have sides, bottoms, and covers or doors of 102 mm (4 in.) 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.

6.3.3.3 Magazines constructed of metal shall meet the requirements of 6.3.2.2.5.

6.3.4 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.

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

(1) 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.
(2) Permanent magazines shall comply with 6.3.1.4, 6.3.1.6, and 6.3.1.7.
(3) Vehicular magazines shall comply with 6.3.2.1(7) and shall be immobilized where unattended, as described in 6.3.2.1(8).

6.3.4.2 Type 4 Indoor Magazine. A Type 4 indoor magazine shall comply with all provisions of 6.3.2.2.

6.4 Storage Within Magazines.

6.4.1 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.

6.4.2 All magazines containing explosives shall be opened and inspected at intervals not exceeding 3 days to determine whether there has been unauthorized or attempted entry or whether there has been unauthorized removal of the magazines or their contents.

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

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

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

6.4.6 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.

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

6.4.8 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.

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

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

6.4.10 Tools used for opening containers of explosive materials shall be nonsparking.

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

6.4.11 No other materials shall be stored in magazines containing propellant, delay, or ejection composition or other explosives.

6.4.11.1 Metal tools other than nonferrous conveyors shall not be stored in magazines.

6.4.11.2 Ferrous metal conveyor stands protected by a coat of paint shall be permitted to be stored within magazines.

6.4.12 Magazine floors shall be swept regularly and kept clean, dry, and free of grit, paper, empty packing materials, and rubbish.

6.4.12.1 Brooms and other cleaning utensils shall not have spark-producing metal parts.

6.4.12.2 Sweepings from magazine floors shall be disposed of according to manufacturers' instructions.

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

6.4.14 Before making repairs to the interior of a magazine, all propellant, delay, or ejection composition shall be removed and the interior shall be cleaned.

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

6.4.16 Propellant, delay, or ejection composition removed from a magazine undergoing repair shall be placed in another magazine or at 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.

6.5 Miscellaneous Safety Precautions.

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

Exception: Firearms carried by authorized guards.

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

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

6.5.4 Property on which Type 1 magazines and outdoor magazines of Types 2 and 4 are located shall be posted with signs reading EXPLOSIVES — KEEP OUT. Signs shall be located to minimize the possibility that a bullet shot at the sign will hit the magazine.

Chapter 7 Requirements for Rocket Motors and Components

7.1 Solid Propellant Rocket Motors and Components.

7.1.1 A solid propellant model or high power rocket motor, motor-reloading kit, or component shall be designed to be ignited electrically.

7.1.2 A solid propellant 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 125°C (257°F) for a duration of no less than 30 minutes.

7.2 Expendable Rocket Motor.

7.2.1 An expendable (nonreloadable) 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.

7.2.2 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.

7.3 Reloadable Rocket Motor.

7.3.1 Propellant modules packaged in motor-reloading kits for reloadable rocket motors having a total impulse equal to or greater than 30 N-sec (6.7 lb-sec) shall be shipped and stored in an insulating sleeve of equal or greater length than the propellant module.

7.3.1.1* The insulating sleeve shall have a low thermal conductivity and a thickness of not less than 0.8 mm (0.03 in.).

7.3.2 Propellant modules packaged in motor-reloading kits for reloadable rocket motors having a total impulse of less than 30 N-sec (6.7 lb-sec) shall be limited to a maximum of three modules per package.

7.3.3 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.

7.4 Motor Casing Requirements.

7.4.1 A solid propellant rocket motor shall be designed and constructed so that the temperature of the external surface of the rocket motor casing and fittings, if any, shall not exceed 200°C (392°F) during or after operation.

7.4.2 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 3 m (10 ft) for motors of less than 30 N-sec (6.7 lb-sec) total impulse, or 6 m (20 ft) for motors equal to or greater than 30 N-sec (6.7 lb-sec).

7.4.3 A high power rocket motor casing shall be so designed and constructed that, if it ruptures, it will not project any casing fragments beyond a radial distance shown in Table 7.4.3.

Table 7.4.3 High Power Rocket Motor Casing Maximum Projection Distance

Total Impulse			Maximum Distance	
N-sec	lb-sec	Motor	m	ft
160.00–320.00	13.50–72.00	H	15.0	50
320.01–640.00	72.01–144.00	I	15.0	50
640.01–1,280.00	144.01–288.00	J	15.0	50
1,280.01–2,560.00	288.01–576.00	K	30.5	100
2,560.01–5,120.00	576.01–1,151.00	L	45.5	150
5,120.01–10,240.00	1,151.01–2,302.00	M	76.0	250
10,240.01–20,480.00	2,302.01–4,604.00	N	152.5	500
20,480.01–40,960.00	4,604.01–9,208.00	O	228.5	750

7.4.4 A rocket motor casing that is metallic shall be designed and constructed so that its failure mode shall lead to all separated parts traveling along the longitudinal axis of the motor.

7.4.5 Reloadable metal motor casings shall be made of 6061-T6 aluminum alloy or other aluminum alloy with equivalent mechanical properties.

7.4.6 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.

7.5 Hybrid Propellant High Power Rocket Motors.

7.5.1 General Requirements.

7.5.1.1 A hybrid propellant high power rocket motor shall be produced by a commercial manufacturer.

7.5.1.2 A hybrid propellant high power rocket motor shall use pressurized nitrous oxide as an oxidizer combined with one or more separate fuels, one of which shall be solid.

7.5.1.3 Only ethanol, methanol, or an exclusive combination thereof shall be used in a hybrid propellant high power rocket motor that uses a supplemental liquid fuel.

7.5.1.4 The solid fuel shall be in either of the following conditions:

(1) Preloaded into the motor casing if a hybrid propellant high power rocket motor is designed to be expendable
(2) Available in a premanufactured module(s) if the fuel is designed to be used in a reloadable hybrid propellant high power rocket motor

7.5.1.5 Pyrotechnic modules intended for use in the operation of a hybrid propellant high power rocket motor shall be completely premanufactured.

7.5.1.6* Pyrotechnic modules weighing 20 g (0.7 oz) or more and packaged in motor-reloading kits for reloadable hybrid propellant high power rocket motors shall be shipped and stored in an insulating sleeve of equal or greater length than the pyrotechnic module. The insulating sleeve shall have low thermal conductivity and a thickness of not less than 0.8 mm (0.03 in.).

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7.5.1.7 Hybrid propellant high power rocket motors using pyrotechnic modules shall be so designed and constructed that the maximum pressure generated by the pyrotechnic module(s) alone shall not exceed 2760 kPa (400 psi) at 20°C ± 5°C (68°F ± 9°F).

7.5.1.8 Hybrid propellant high power rocket motors using pyrotechnic modules shall be so designed and constructed that the motor combustion chamber shall fail at a pressure no greater than one-half the flight cylinder's design yield pressure.

7.5.2 Requirements for Sealed Hybrid Motor Systems.

7.5.2.1 Flight cylinders used in sealed hybrid motor systems shall be made of aluminum alloy, composite, or a composite-overwrapped aluminum shell.

7.5.2.2 Flight cylinders used for storage of nitrous oxide shall comply with 49 CFR 178.46, 178.68, or DOT-E-7887.

7.5.2.3 Metallic components of valves used in sealed flight cylinders shall be constructed of brass, aluminum, or stainless steel.

7.5.2.4 Internal valve nonmetallic sealing components exposed to flowing pressurized nitrous oxide shall be made of noncombustible materials such as Teflon® polytetrafluoroethylene polymer.

7.5.2.5 The use of noncombustible materials shall not be required for pyrotechnic valve-sealing components that are designed to be consumed upon ignition.

7.5.2.6 Prior to ignition, pyrotechnic valve-sealing components shall be capable of maintaining their structural integrity up to the rated working pressure of the nitrous oxide flight cylinder or 10 MPa (1800 psi), whichever is greater.

7.5.2.7 Prior to ignition, pyrotechnic valve-sealing components shall be isolated from direct contact with pressurized nitrous oxide.

7.5.2.8 Sealed flight cylinders used for storage of pressurized nitrous oxide shall be equipped with a pressure relief valve that will function at a pressure no greater than one-half of the cylinder design yield pressure.

7.5.2.9 Sealed flight cylinders used for storage of pressurized nitrous oxide shall have the tare weight of the cylinder and the maximum permissible nitrous oxide fill weight clearly and legibly imprinted on the exterior surface of the cylinder or on a label affixed to the cylinder.

7.5.2.9.1 The maximum permissible nitrous oxide fill weight displayed on the cylinder shall not exceed that allowed by 49 CFR 173.304.

7.5.2.10 Warning and other labels applied by the cylinder manufacturer shall not be removed.

7.5.3 Requirements for Vented Hybrid Motor Systems.

7.5.3.1 Flight cylinders used in vented hybrid motor systems shall be made of aluminum alloy, composite, or a composite-overwrapped aluminum shell.

7.5.3.2 Flight cylinders used in vented hybrid motor systems shall have a design yield pressure of at least 21 MPa (3000 psi) and shall have been proof-tested to at least 14 MPa (2000 psi).

7.5.3.3 The manufacturers' approval and testing date shall be clearly and legibly imprinted on the exterior surface of the cylinder.

7.5.3.4 Vented flight cylinders shall be designed and constructed so that their normal failure mode shall lead to all separated parts traveling along the longitudinal axis of the cylinder.

7.5.3.5 Vented flight cylinders shall be capable of being remotely emptied of nitrous oxide at any time prior to ignition of the hybrid rocket motor.

7.5.3.6 Vented flight cylinders shall be filled and unloaded remotely from a distance at least twice that shown in Table 7.4.3 for their representative motor class.

7.6 Model Rocket Motor Limitations.

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

7.6.2 A model rocket motor shall produce a total impulse less than 80 N-sec (17.98 lb-sec).

Exception: A model rocket motor manufactured for sale to or use by individuals 18 years of age or older shall be permitted to have a total impulse not in excess of 160 N-sec (36 lb-sec).

7.6.3 A model rocket motor shall produce an average thrust of 80 N (17.98 lbf) or less.

7.6.4 A model rocket motor manufactured for sale to or use by individuals 17 years of age or younger shall be designed to comply with 16 CFR 1500.85(8) and (9) of Consumer Product Safety Commission (CPSC) Regulations.

7.6.5 The propellant of a model rocket motor shall contain no metal particles larger than 150 microns (100 mesh) and shall be designed to produce a minimum of ejected particles or sparks.

7.7 High Power Rocket Motor Limitations.

7.7.1 A high power rocket motor shall produce a total impulse no greater than 40,960 N-sec (9216 lb-sec).

7.7.2 A rocket motor that contains greater than 62.5 g (2.2 oz) of propellant shall be classified as a high power rocket motor.

7.7.3 A rocket motor that produces greater than 160 N-sec (36 lb-sec) of total impulse shall be classified as a high power rocket motor.

7.7.4 A rocket motor that produces an average thrust greater than 80 N (17.98 lbf) shall be classified as a high power rocket motor.

7.7.5 The propellant of a high power rocket motor shall contain no metal particles larger than 150 microns (100 mesh), except for titanium (Ti) sponge.

7.7.5.1 No Ti sponge particles shall be used that are larger than 12 microns (8 mesh).

7.7.5.2 No more than 12 percent by weight of Ti sponge shall be used.

7.7.5.3 The manufacturer shall provide instructions detailing additional operating hazards with motors using Ti sponge.

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7.8 Manufacturer Production Lot Testing.

7.8.1 A manufacturer of solid propellant model and high power 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 rocket motor's total impulse, delay time, and action of ejection charge for each item, if included.

7.8.2 A written quality control plan and recordkeeping shall be permitted to be maintained for production lots of propellant composition, delay composition, and motor components to ensure compliance with this code as an alternative to a random sample of 1 percent of each production lot of high power rocket motors with total impulses no less than 1200 N-sec (270 lb-sec) (Type K motors).

7.8.3 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 when thrust falls below 5 percent of peak.

7.8.4 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.

7.8.5 Total impulse shall be measured between the point when 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.

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

(1) The total impulse of any model rocket motor or model rocket motor-reloading kit varies more than 20 percent, or any high power rocket motor or high power rocket motor-reloading kit varies more than 10 percent from the established mean total impulse value.
(2) The ejection charge, if any, of any test item does not function properly.
(3) Any test item malfunctions in any other manner that affects the safety of its shipment, storage, handling, or use.
(4) The time delay of any test item varies more than 1.5 seconds or 20 percent, whichever is greater, from the established mean time delay value of the rocket motor or motor-reloading kit. In no case shall this variation exceed 3 seconds.

7.8.7 Static tests shall be conducted with the test items at ambient temperature.

7.8.8 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 7.8.6(1) through (4), the entire production lot shall be corrected or destroyed by the manufacturer.

7.9 Motor Shelf Life.

7.9.1 When the performance of a solid propellant rocket motor or motor-reloading kit deviates from the sample test criteria and limits detailed in 7.8.6 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.

7.9.2 If the expected shelf life of a rocket motor or motor-reloading kit is less than 10 years, the manufacturer shall imprint a "use before" date on the package or motor casing.

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

7.11 Rocket Motor Fuse Prohibition. No manufacturer shall manufacture, market, sell, offer to sell, expose for sale, or otherwise make available to consumers any type of fuse or other rocket motor ignition device that is intended to be initiated by a handheld flame.

7.12 Rocket Motor Instruction Requirements.

7.12.1 A rocket motor, motor-reloading kit, or component shall be shipped and sold with complete instructions for its storage, handling, and use.

7.12.2 These instructions shall include a warning to read and follow the instructions and to use the rocket motor only in accordance with the instructions.

7.12.3 The instructions shall also contain the following information:

(1) Instructions that specify how to ignite the motor by electrical means
(2) Performance data on the rocket motor or motor-reloading kit that include propellant weight, total impulse, average thrust, time delay, and representative thrust-time curve
(3) Any special first-aid data or action to be taken in the event of thermal or freeze burns, inhalation of nitrous oxide or exhaust products, or oral ingestion of any pyrotechnic components
(4) 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 could impair its performance, or, in the opinion of the user, has become unsafe
(5) Any special action that shall be taken in case of a fire in which stored rocket motors, motor-reloading kits, filled compressed gas cylinders, or pyrotechnic modules are or could become involved
(6) If a solid or hybrid propellant motor-reloading kit: safety precautions for handling the propellant and pyrotechnic materials and directions for cleaning and other necessary post-firing maintenance on the motor casing
(7) If a hybrid propellant rocket motor or hybrid motor-reloading kit: safety precautions for the handling of compressed gases used, personal protective equipment required during assembly, warnings and instructions for the avoidance of petroleum greases and oils in the vicinity of pressurized nitrous oxide or oxygen, recommendations for greases that can safely be used, proper cylinder filling weights and procedures, safe remote loading instructions, and cleaning and other necessary post-firing maintenance of the ground support equipment supplied or recommended by the manufacturer
(8) Warnings prohibiting tampering with, unauthorized disassembly, or misuse of any components of the rocket motor, motor-reloading kit, or special ground support equipment intrinsic to the safe use of the rocket motor
(9) If the casing of a reloadable motor is intended for limited use, a manufacturer statement of the maximum number of times the casing shall be permitted to be used

7.13 Rocket Motor Marking.

7.13.1 A rocket motor or motor-reloading kit shall have imprinted on its external surface, casing, or wrapper, a recognized code indicating the nominal performance parameters — for example, "C6-5" [for a model rocket motor having a

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total impulse of 5.01 to 10.0 N-sec (1.1 to 2.2 lb-sec), an average thrust of 6 N (1.35 lbf), 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.

7.13.2* Rocket motors, motor-reloading kits, and pyrotechnic components shall be marked with information complying with the Federal Hazardous Substances Act, 16 CFR 1500.

7.13.3 If the size of the rocket motor does not permit the required marking then the information required in 7.13.1 and 7.13.2 shall be printed on the packaging.

7.13.4 Reloadable motor casings that are intended for limited use shall be marked with the maximum number of times that the casing shall be permitted to be used.

7.14 Motor-Reloading Kit Package Requirements.

7.14.1 The package containing the motor-reloading kit for use in a reloadable rocket motor shall have visible identification that will identify the motor casing type into which the rocket motor shall be installed.

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

Chapter 8 Testing and Certification

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

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

8.1.2 A model rocket motor or motor-reloading kit not containing pyrotechnic materials shall not be required to have a certificate of classification.

8.1.3 Model rocket motors, motor-reloading kits, and components offered for sale, exposed for sale, sold, used, or made available to the public shall be examined and tested to determine whether they comply with the standards and requirements detailed in 8.1.7.

8.1.4* The examination and testing shall be carried out by the authority having jurisdiction or a recognized testing organization acceptable to the authority having jurisdiction.

8.1.5 A model rocket motor, motor-reloading kit, or component that complies with the standards and requirements in 8.1.7 shall be permitted to be certified as acceptable for sale and use.

8.1.6 Any changes exceeding manufacturing tolerances made to the physical design or chemical composition of a model rocket motor, motor reloading kit, or component(s) by a manufacturer after certification testing shall be reported to the recognized testing organization that originally granted the certification prior to sale or shipment. If the changes potentially affect characteristics measured in the original certification testing, that testing organization shall be permitted to require that samples of the changed product be submitted for testing.

8.1.7 Before granting such certification, samples of a motor or reloadable motor system shall be examined as follows:

(1) Static testing, conducted at or corrected to sea level and 20°C ± 5°C (68°F ± 9°F), of a minimum of 10 samples to determine that total impulse, average thrust, and delay time comply with the following requirements:
   (a) Standard deviation of the total impulse data shall be no greater than 6.7 percent of the mean measured value.
   (b) No time delay shall be measured to have a variation greater than 1.5 seconds or 20 percent (whichever is greater, but not to exceed 3 seconds) from the labeled value.
   (c) Average thrust shall be within 20 percent [or 1 N (0.22 lbf), 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.
(2) For metal-casing reloadable motors, rupture testing of one sample to ensure that the casing complies with the burst pressure and longitudinal failure mode requirements of 7.4.4
(3) Thermal testing to ensure that the casing temperature during and after static firing complies with 7.4.1
(4) Heat sensitivity testing to ensure that the motor or motor-reloading kit complies with 7.1.2
(5) Examination of the packaging, marking, and instructions to verify compliance with all provisions of 7.12 through 7.14

8.2 Certification of High Power Rocket Motors, Motor-Reloading Kits, and Components.

8.2.1 A prerequisite for certification of a high power rocket motor or reloadable motor system shall be the prior classification of the rocket motor or the motor reloading kit used in the reloadable motor system by the U.S. Department of Transportation (DOT) or competent authority, as a Division 1.3 or 1.4 explosive, or shall be a written acknowledgment from DOT, or one of its approved testing agencies, that the high power rocket motor or motor-reloading kit is a flammable solid.

8.2.2 A high power rocket motor or motor-reloading kit not containing pyrotechnic materials shall not be required to have a certificate of classification.

8.2.3 High power rocket motors, motor-reloading kits, and components offered for sale, exposed for sale, sold, used, or made available to the public shall be examined and tested to determine whether they comply with the standards and requirements detailed in 8.2.7.

8.2.4* The examination and testing shall be carried out by the authority having jurisdiction or a recognized testing organization acceptable to the authority having jurisdiction.

8.2.5 A high power rocket motor, motor-reloading kit, or component that complies with the standards and requirements in 8.2.7 shall be permitted to be certified as acceptable for sale and use.

8.2.6 Any changes exceeding manufacturing tolerances made to the physical design or chemical composition of a high power rocket motor, motor reloading kit, or component(s) by a manufacturer after certification testing shall be reported to the recognized testing organization that originally granted the

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certification prior to sale or shipment. If the changes potentially affect characteristics measured in the original certification testing, that testing organization shall be permitted to require that samples of the changed product be submitted for testing.

8.2.7 Before granting such certification, samples of a high power motor or reloadable motor system shall be examined as follows:

(1) Static testing, conducted at or corrected to sea level and 20°C ± 5°C (68°F ± 9°F), of two or more samples to determine that total impulse, average thrust, and delay time comply with the following requirements:
   (a) Standard deviation of the total impulse data shall be no greater than 6.7 percent of the mean measured value.
   (b) No time delay shall be measured to have a variation greater than 1.5 seconds or 20 percent (whichever is greater, but not to exceed 3 seconds) from the labeled value.
   (c) Imprinted average thrust shall be within 20 percent [or 10 N (2.25 lbf), 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.
(2) For metal-casing reloadable motors, rupture testing of one sample to ensure that the casing complies with the burst pressure and failure mode requirements of 7.4.3 and 7.4.4
(3) Thermal testing to ensure that the casing temperature during and after static firing complies with 7.4.1
(4) Heat sensitivity testing to ensure that the motor or motor-reloading kit complies with 7.1.2
(5) Examination of the packaging, marking, and instructions to verify compliance with all provisions of 7.12 through 7.14

8.2.8 Hybrid high power rocket motor flight cylinders shall be filled to their maximum allowable net weight for each test firing.

8.2.9 Hybrid high power rocket motor test items shall be configured and oriented so that liquid nitrous oxide is dispensed from the oxidizer cylinder into the motor combustion chamber during motor operation until just before the cylinder is empty.

8.3 Listing of Certified High Power Rocket Motors and Motor-Reloading Kits. The authority having jurisdiction shall maintain a current and complete list of all those high power rocket motors and motor-reloading kit types that are certified as complying with the standards and requirements detailed in Sections 8.1 and 8.2 and shall make copies of this list available to citizens and public safety officials who request it.

8.4 Decertification. The high power rocket motor or motor-reloading kit shall be decertified by the certifying entity if it is determined that the rocket motor or motor-reloading kit no longer complies with the original certification criteria or current certification criteria, with respect to safety.

8.5 Maintenance of Sales Records of High Power Rocket Motors and Motor-Reloading Kits.

8.5.1 A high power rocket motor or motor-reloading kit shall be sold and shipped to certified users only.

8.5.2 High power rocket motor manufacturers shall maintain a list of those who have purchased high power rocket motors or motor-reloading kits from the manufacturer. This list shall contain the following information:

(1) Name and address of the purchaser
(2) Name and address of the national user organization that has certified the user
(3) Type and number of high power solid propellant rocket motors or motor-reloading kits sold to the certified user
(4) Date of sale and shipment of high power rocket motor or motor-reloading kits to the certified user

8.5.3 The manufacturer shall make available, on request and at a reasonable time, the records specified in Section 4.3 to any law enforcement person or the authority having jurisdiction. These records shall be kept for 5 years from the date of sale.

Annex A Explanatory Material

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

A.1.1.1 For further information on propelling recoverable aero models, see NFPA 1122, *Code for Model Rocketry*, and NFPA 1127, *Code for High Power Rocketry*.

A.1.1.4 For further information on fireworks, see NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles*.

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

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

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

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whether it contains substantial enforcement and administrative provisions.

A.3.2.5 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.3.3.2 Barricade. To be effective, a barricade should 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 3.7 m (12 ft) above the center of a railway or highway, passes through the barricade.

A.3.3.2.3 Screen Barricade. Such barriers can be constructed of metal roofing, 6.4 mm to 13 mm (¼ in. to ½ in.) mesh screen, or equivalent material. The barrier 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 1.5 m (5 ft) from the top of the screen. The top 1.5 m (5 ft) of the screen are inclined toward the donor building at an angle of 30 degrees to 45 degrees.

A.3.3.3.1 Inhabited Building. This does not include any building or structure occupied in connection with a rocket motor plant.

A.3.3.5 Certified Motor. Recognized testing organizations that certify high power rocket motors include, but are not limited to, Tripoli Rocketry Association, Inc., the National Association of Rocketry, and their successor organization(s).

A.3.3.6 Certified User. A certified user includes, but is not limited to, an individual who has licenses or certificates from Tripoli Rocketry Association, Inc., the National Association of Rocketry, or their successor organization(s).

A.3.3.9 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, Firearms, and Explosives, U.S. Department of the Treasury. The classification of explosives described in the "Hazardous Materials Regulations" of the U.S. Department of Transportation is provided in Annex E of NFPA 495, *Explosive Materials Code*. These regulations were revised in 1991. The 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 includes any material 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 U.S. Department of Transportation, "Hazardous Materials Regulations," 49 CFR, 100–199. [**495,** 2006]

A.3.3.14 Manufacture. This term includes, but is not limited to, operations such as curing and drilling of model rocket or high power rocket motors or their pyrotechnic components at the manufacturers' facility.

A.4.5.1 The fence or equivalent barrier is only required for the rocket motor plant or individual buildings and not the entire facility. An example of a suitable fence would be a 1.8 m (6 ft) high chain-linked fence. Barriers could include inhospitable terrain (e.g., cliffs, rivers, or moats).

A.4.7.1 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.

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

A.4.7.4 For information on the use of conductive surfaces to minimize the hazard of static electricity, see NFPA 99, *Standard for Health Care Facilities*.

A.4.11.4 Smoking materials include matches, lighters, cigarettes, cigars, and pipes.

A.4.12.7 Oxidizers include nitrates, chlorates, and perchlorates.

A.4.13.3 Reassignment could mean different duties, processes, equipment, materials, or locations.

A.5.6.4 For information on the use of conductive surfaces to minimize the hazard of static electricity, see NFPA 99, *Standard for Health Care Facilities*.

A.5.9.1 This requirement is for purposes of minimizing personnel exposure and is distinct from any requirement on maximum building occupancy that could exist in local ordinances.

A.5.9.3 Coverings should be accomplished with wood or other nonferrous in-process storage container.

A.5.12.3 Reassignment could mean different duties, processes, equipment, materials, or locations.

A.6.3.1.3 A bullet-resistant roof should be constructed in accordance with any of the specifications in Annex 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 the following:

(1) Any construction meeting the specifications in Annex B
(2) A sand tray having a sand depth of at least 10.2 cm (4 in.)

A.7.3.1.1 Cardboard is an example of a material with a low thermal conductivity.

A.7.5.1.6 Cardboard is an example of a material with a low thermal conductivity.

A.7.13.2 See Consumer Product Safety Commission Regulations, 16 CFR 1500.83(a)(36), for additional labeling requirements for model rocket motors.

A.8.1.4 A nationally recognized testing organization that tests in accordance with NFPA 1122, *Code for Model Rocketry*, 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, Inc., or their successor organization(s).

A.8.2.4 A nationally recognized testing organization that tests in accordance with NFPA 1122, *Code for Model Rocketry*, 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, Inc., or their successor organization(s).

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Annex B Magazine Construction

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

B.1 Magazines constructed in accordance with the following minimum specifications are approved as bullet resistant. All steel and wood dimensions are actual thickness; concrete block and brick dimensions are nominal.

B.1.1 Steel Exterior. The minimum specifications approved as bullet resistant are as follows:

(1) 16 mm (5⁄8 in.) steel with an interior lining of nonsparking material
(2) 13 mm (1⁄2 in.) steel with an interior lining of plywood at least 9.5 mm (3⁄8 in.) thick
(3) 9.5 mm (3⁄8 in.) steel lined with one of the following:
  (a) 5 cm (2 in.) of hardwood
  (b) 7.6 cm (3 in.) of softwood
  (c) 5.7 cm (2¼ in.) of plywood
(4) 6.4 mm (¼ in.) steel lined with one of the following:
  (a) 7.6 cm (3 in.) of hardwood
  (b) 12.7 cm (5 in.) of softwood
  (c) 13.3 cm (5¼ in.) of plywood
  (d) 3.2 cm (1¼ in.) of plywood with an intermediate layer of 5 cm (2 in.) of hardwood
(5) 4.8 mm (3⁄16 in.) steel lined with one of the following:
  (a) 10.2 cm (4 in.) of hardwood
  (b) 17.8 cm (7 in.) of softwood
  (c) 17.1 cm (6¾ in.) of plywood
  (d) 19 mm (¾ in.) of plywood with an intermediate layer of 7.6 cm (3 in.) of hardwood
(6) 3.2 mm (1⁄8 in.) steel lined with one of the following:
  (a) 12.7 cm (5 in.) of hardwood
  (b) 23 cm (9 in.) of softwood
  (c) 19 mm (¾ in.) of plywood with an intermediate layer of 10.2 cm (4 in.) of hardwood
  (d) Two layers of 19 mm (¾ in.) plywood with an intermediate layer of 9.2 cm (3⅝ in.) of well-tamped dry sand or sand/cement mixture

B.1.2 Fire-Resistant Exterior. Exterior of any type of fire-resistant material that is structurally sound includes the following:

(1) An interior lining of 13 mm (½ in.) plywood placed securely against an intermediate 10.2 cm (4 in.) thick layer of solid concrete block, solid brick, or solid concrete
(2) An interior lining of 19 mm (¾ in.) plywood; a first intermediate layer of 19 mm (¾ in.) plywood; a second intermediate layer of 9.2 cm (3⅝ in.) of well-tamped dry sand or sand/cement mixture; a third intermediate layer of 19 mm (¾ in.) plywood; and a fourth intermediate layer of 5 cm (2 in.) hardwood or 14 gauge steel
(3) An intermediate 15 cm (6 in.) space filled with well-tamped dry sand or sand/cement mixture

B.1.3 Masonry Exterior. The minimum specifications approved as bullet resistant are as follows:

(1) Standard 20 cm (8 in.) concrete block with voids filled with well-tamped dry sand or sand/cement mixture
(2) Standard 20 cm (8 in.) solid brick
(3) 20 cm (8 in.) solid concrete
(4) Two layers of 10.2 cm (4 in.) concrete block

Annex C Sample Ordinance Adopting NFPA 1125

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

C.1 The following sample ordinance is provided to assist a jurisdiction in the adoption of this *[code, standard]* and is not part of this *[code, standard]*.

ORDINANCE NO. _____

An ordinance of the *[jurisdiction]* adopting the *[year]* edition of NFPA *[document number]*, *[complete document title]*, and documents listed in Chapter 2 of that *[code, standard]*; prescribing regulations governing conditions hazardous to life and property from fire or explosion; providing for the issuance of permits and collection of fees; repealing Ordinance No. _____ of the *[jurisdiction]* and all other ordinances and parts of ordinances in conflict therewith; providing a penalty; providing a severability clause; and providing for publication; and providing an effective date.

BE IT ORDAINED BY THE *[governing body]* OF THE *[jurisdiction]*:

SECTION 1 That the *[complete document title]* and documents adopted by Chapter 2, three (3) copies of which are on file and are open to inspection by the public in the office of the *[jurisdiction's keeper of records]* of the *[jurisdiction]*, are hereby adopted and incorporated into this ordinance as fully as if set out at length herein, and from the date on which this ordinance shall take effect, the provisions thereof shall be controlling within the limits of the *[jurisdiction]*. The same are hereby adopted as the *[code, standard]* of the *[jurisdiction]* for the purpose of prescribing regulations governing conditions hazardous to life and property from fire or explosion and providing for issuance of permits and collection of fees.

SECTION 2 Any person who shall violate any provision of this code or standard hereby adopted or fail to comply therewith; or who shall violate or fail to comply with any order made thereunder; or who shall build in violation of any detailed statement of specifications or plans submitted and approved thereunder; or fail to operate in accordance with any certificate or permit issued thereunder; and from which no appeal has been taken; or who shall fail to comply with such an order as affirmed or modified by a court of competent jurisdiction, within the time fixed herein, shall severally for each and every such violation and noncompliance, respectively, be guilty of a misdemeanor, punishable by a fine of not less than $ _____ nor more than $_____ or by imprisonment for not less than _____ days nor more than _____ days or by both such fine and imprisonment. The imposition of one penalty for any violation shall not excuse the violation or permit it to continue; and all such persons shall be required to correct or remedy such violations or defects within a reasonable time; and when not otherwise specified the application of the above penalty shall not be held to prevent the enforced removal of prohibited conditions. Each day that prohibited conditions are maintained shall constitute a separate offense.

SECTION 3 Additions, insertions, and changes — that the *[year]* edition of NFPA *[document number]*, *[complete document title]* is amended and changed in the following respects: List Amendments

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SECTION 4 That ordinance No. _____ of *[jurisdiction]* entitled *[fill in the title of the ordinance or ordinances in effect at the present time]* and all other ordinances or parts of ordinances in conflict herewith are hereby repealed.

SECTION 5 That if any section, subsection, sentence, clause, or phrase of this ordinance is, for any reason, held to be invalid or unconstitutional, such decision shall not affect the validity or constitutionality of the remaining portions of this ordinance. The *[governing body]* hereby declares that it would have passed this ordinance, and each section, subsection, clause, or phrase hereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses, and phrases be declared unconstitutional.

SECTION 6 That the *[jurisdiction's keeper of records]* is hereby ordered and directed to cause this ordinance to be published.

[NOTE: An additional provision may be required to direct the number of times the ordinance is to be published and to specify that it is to be in a newspaper in general circulation. Posting may also be required.]

SECTION 7 That this ordinance and the rules, regulations, provisions, requirements, orders, and matters established and adopted hereby shall take effect and be in full force and effect *[time period]* from and after the date of its final passage and adoption.

Annex D Informational References

D.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this code and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

D.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 99, *Standard for Health Care Facilities*, 2005 edition.

NFPA 220, *Standard on Types of Building Construction*, 2006 edition.

NFPA 1122, *Code for Model Rocketry*, 2002 edition.

NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles*, 2006 edition.

NFPA 1127, *Code for High Power Rocketry*, 2002 edition.

D.1.2 Other Publications.

D.1.2.1 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 16, Code of Federal Regulations, Part 1500.83(a)(36).

Title 18, United States Code, Chapter 40, "Importation, Manufacture, Distribution, and Storage of Explosive Materials," 1970.

Title 49, Code of Federal Regulations, "Hazardous Materials Regulations," Parts 100–199.

D.2 Informational References. (Reserved)

D.3 References for Extracts in Informational Sections.

NFPA 495, *Explosive Materials Code*, 2006 edition.

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Index

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-A-

Aero models 1.1.1, A.1.1.1
Definition 3.3.1
Applicability of code 1.1, A.1.1.1, A.1.1.4
Approved (definition) 3.2.1, A.3.2.1
Artificial barricades (definition) 3.3.2.1
Authority having jurisdiction
Definition 3.2.2, A.3.2.2
Notification of 4.13.5, 5.12.5

-B-

Barricades
Artificial (definition) 3.3.2.1
Definition 3.3.2, A.3.3.2
Natural (definition) 3.3.2.2
Screen (definition) 3.3.2.3, A.3.3.2.3
Bonding, electrical equipment 4.9.3.3, 5.8.3.3
Buildings .....*see also* Nonprocess buildings; Process buildings
Inhabited 6.1.2
Definition 3.3.3.1, A.3.3.3.1
Mixing (definition) 3.3.3.2
Storage (definition) ..... 3.3.3.5 *see also* Magazines
Bullet-resistant construction 6.3.1, 6.3.2, A.6.3.1.3

-C-

Certification
Decertification 8.4
High-power rocket motors, motor-reloading kits, and components 8.2, A.8.2.4
Listing of certified rocket motors and motor-reloading kits ... 8.3
Model rocket motors, motor-reloading kits, and components 8.1, A.8.1.4
Certified (definition) ..... 3.3.4; *see also* Certification
Certified motors (definition) ..... 3.3.5, A.3.3.5; *see also* Certification
Certified users 8.5.1, 8.5.2
Definition 3.3.6, A.3.3.6
Chemicals in quantities, SARA notification of 4.13.6, 5.12.6
Clothing, protective .....*see* Protective clothing
Code
Definition 3.2.3, A.3.2.3
Enforcement of code ..... 1.4, Annex C
Sample ordinance ..... Annex C
Commercial manufacturer ..... 7.5.1, A.7.5.1.6; *see also* Certification
Definition 3.3.7
Production lot testing 7.8
Sales records, maintenance of 8.5
Composite propellant rocket motors
Definition 3.3.25.1
Manufacturing operations, requirements for ..... Chap. 5
Basic requirements 5.1
Fire and explosion prevention 5.10
Fire protection and emergency procedures 5.12, A.5.12.3
Heat, light, and electrical equipment 5.8
Maximum occupants and quantity limitations 5.9, A.5.9.1, A.5.9.3
Means of egress 5.7
Permit requirements 5.1.3, 5.2
Process building construction 5.6, A.5.6.4
Recordkeeping and reporting 5.4
Site security 5.3
Storage of materials 5.5
Testing of motors, modules, and motor components 5.13
Composition
Clothing contaminated by 4.11.7, 4.12.4, 5.10.2.3, 5.11.2.4
Delay
Definition 3.3.8.1
Expendable rocket motor, delays for 7.2.2
Deteriorated 6.4.13
Ejection
Definition 3.3.8.2
Expendable rocket motor, charges for 7.2.2
Malfunction in lot testing of charges ..... 7.8.6(2)
Packaging of charges 7.3.3
Extinguishers, prohibition of 4.13.3.3, 5.12.3.3
Fire spread to 4.13.3.1, 5.12.3.1
Magazine storage of 6.4.11
Manufacturer production lot testing ..... 7.8.1, 7.8.2, 7.8.6(2)
Maximum quantity limitations ..... 4.10.2, 4.10.3, 5.9.2 to 5.9.5, A.5.9.3
Propellant (definition) 3.3.8.3
Removal from magazine of ..... 6.4.14 to 6.4.16
Safety precautions 4.7.3, 4.9.1, 4.9.2.1, 4.9.3, 4.11.5, 5.6.3, 5.8.1, 5.10.2.1
Safety training of employees in handling of 4.12.5.1, 5.11.3, 5.11.4
Spills 4.11.2
Waste 4.11.3, 5.10.1.2
Construction
Magazine ..... 6.2, 6.3, A.6.3.1.3, Annex B
Process building 4.7, 5.6, A.4.7.1, A.4.7.4, A.5.6.4

-D-

Definitions ..... Chap. 3
Delay composition .....*see* Composition
Deluge systems 5.6.6
Dust, accumulation of 4.7.2, 5.6.2

-E-

Egress, means of 4.8, 5.7
Ejection composition .....*see* Composition
Electrical equipment 4.9, 5.8
Emergency procedures 4.13, 5.12, A.4.13.3, A.5.12.3
Employee safety .....*see* Personnel safety
Enforcement of code ..... 1.4, Annex C
Equivalency to code 1.3
Ethanol 7.5.1.3
Evacuation 4.13.3.1, 5.12.3.1
Exits 4.8, 5.7
Expendable rocket motors 7.2
Explosion prevention 4.11, 5.10, A.4.11.4
Explosives
Definition 3.3.9, A.3.3.9
Low .....*see* Low explosives
Removal or theft of 4.3.2
Storage of .....*see* Low explosives, storage of; Magazines
Extinguishers, portable fire 4.11.6, 4.13.3.2, 4.13.3.3, 5.10.2.2, 5.12.3.2, 5.12.3.3, A.4.13.3

-F-

Facility (definition) 3.3.10
Fences ..... 4.5.1 to 4.5.3, A.4.5.1
Fire prevention 4.11, 5.10, A.4.11.4

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Fire protection 4.13, 5.12, A.4.13.3, A.5.12.3
Flammable materials 4.9.1, 4.9.2.1, 4.9.3
Flight cylinders
Certification 8.2.8, 8.2.9
Definition 3.3.11
Design yield pressure 7.5.1.8
Safety precautions ..... 7.12.3(7)
Sealed 7.5.2
Definition 3.3.11.1
Vented 7.5.3
Definition 3.3.11.2
Floors
Magazines ..... 6.3.1.5, 6.3.2.1(3), 6.4.12
Process buildings 4.7.3, 4.7.4, 5.6.3, A.4.7.4
Fuse prohibition 7.11

-G-

Grounding, electrical 4.9.3.3, 5.8.3.3, 6.2.3.4

-H-

Heating equipment and systems 4.9, 5.8, 6.2.3
High power rocket motors .....*see also* Hybrid rocket motors
Applicability to ..... 1.1.1 to 1.1.3, 1.1.6, 1.1.7
Certification ..... 8.2 to 8.4, A.8.2.4
Definition 3.3.25.2
Limitations 7.7
Manufacturer production lot testing 7.8.1
Motor casing requirements 7.4.3
Sales records, maintenance of 8.5
Highway (definition) 3.3.12
Housekeeping ..... 4.11.1 to 4.11.3, 5.10.1, 6.4.12
Hybrid rocket motors 7.5, A.7.5.1.6
Certification 8.2.8, 8.2.9
Definition 3.3.25.3
Fuels, solid and liquid ..... 7.5.1.2 to 7.5.1.4
Safety precautions ..... 7.12.3(7)
Sealed hybrid motor systems 7.5.2
Vented hybrid motor systems 7.5.3

-I-

Ignition methods ..... 7.1.1, 7.10, 7.11, 7.12.3(1)
Inhabited buildings 6.1.2
Definition 3.3.3.1, A.3.3.3.1
Instruction requirements 7.12

-L-

Labeled (definition) 3.2.4
Licenses .....*see* Permit requirements
Lighting 4.9, 5.8, 6.2.4
Limitations
High power rocket motors 7.7
Model rocket motors 7.6
Listed
Certified rocket motors and motor-reloading kits 8.3
Definition 3.2.5, A.3.2.5
Low explosives
Definition 3.3.9.1
Storage of ..... Chap. 6
Basic requirements 6.1
Magazine construction ..... 6.2, 6.3, A.6.3.1.3, Annex B
Miscellaneous safety precautions 6.5
Storage distances ..... Table 6.1.2
Storage within magazines 6.4

-M-

Magazines ..... Chap. 6
Composition storage in 6.4.11
Construction ..... 6.2, 6.3, A.6.3.1.3, Annex B
Definition 3.3.13
Indoor, Types 2 and 4 ..... 6.3.2.2, 6.3.4.2
Outdoor, Types 2 and 4 ..... 6.3.2.1, 6.3.4.1, 6.5.4
Safety precautions 6.5
Separation distances 4.6.3, 6.1.2
Storage within 4.13.5, 6.4
Manufacture (definition) 3.3.14, A.3.3.14
Manufacturer production lot testing 7.8
Manufacturing operations, general requirements for ..... Chap. 4; *see also* Composite propellant rocket motors
Applicability 4.4
Basic requirements 4.1
Emergency procedures 4.13, A.4.13.3
Fire and explosion prevention 4.11, A.4.11.4
Fire protection 4.13, A.4.13.3
Heat, light, and electrical equipment 4.9
Maximum occupant and quantity limitations 4.10
Means of egress 4.8
Permit requirements 4.2
Personnel safety 4.11.7, 4.12, 5.11, A.4.12.7
Process building construction 4.7, A.4.7.1, A.4.7.4
Recordkeeping and reporting 4.3
Separation distances 4.6
Site security 4.5, A.4.5.1
Testing of motors, modules, and motor components 4.14
Marking 7.13, A.7.13.2
Means of egress 4.8, 5.7
Methanol 7.5.1.3
Mixing buildings (definition) 3.3.3.2
Model rocket engines .....*see* Rocket motors
Model rocket motors ....*see also* Composite propellant rocket motors
Applicability to ..... 1.1.1 to 1.1.3, 11.7, 116
Certification 8.1, 8.3, 8.4, A.8.1.4
Definition 3.3.25.4
Limitations 7.6
Modules
Definition 3.3.16
Propellant, packaging of 7.3.1, 7.3.2, A.7.3.1.1
Pyrotechnic, hybrid rocket motor ..... 7.5.1.5 to 7.5.1.8, A.7.5.1.6
Solid fuel, hybrid rocket motor ..... 7.5.1.4(2)
Testing 4.14.1, 5.13.1
Motor casing requirements ..... 7.4, 7.12.3(9), 7.13.4, 8.1.7(2), 8.2.7(2)
Motor-reloading kits
Applicability to 1.1.2
Certification .....*see* Certification
Definition 3.3.17
Hybrid rocket motors 7.5.1.6, A.7.5.1.6
Instruction requirements 7.12
Manufacturer production lot testing 7.8.1
Marking 7.13, A.7.13.2
Packaging requirements 7.14
Propellant modules in 7.3, 7.3.2, A.7.3.1.1
Shelf life 7.9
Solid propellant rocket motors 7.1

-N-

Natural barricades (definition) 3.3.2.2
Nitrous oxide ..... 7.5.1.2, 7.5.2.2, 7.5.2.4, 7.5.2.6 to 7.5.2.9, 7.5.3.5, 7.12.3(7), 8.2.9
Nonprocess buildings
Definition 3.3.3.3
Separation 4.6.2, 4.6.3

-O-

Occupants, number of 4.10.1, 5.9.1, A.5.9.1
Oxidizers 4.12.7, 5.11.2.4, 7.5.1.2, 8.2.9, A.4.12.7
Oxygen 7.12.3

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-P-

Permit requirements 4.2, 5.1.3, 5.2
Personnel safety 4.11.7, 4.12, 5.10.2.3, 5.11
Persons (definition) 3.3.18
Pressing system 4.7.4, A.4.7.4
Definition 3.3.19
Process buildings
Construction 4.7, 5.6, A.4.7.1, A.4.7.4, A.5.6.4
Definition 3.3.3.4
Means of egress ..... 4.8(2), 5.7(2)
Separation distances 4.6
Smoking materials in vicinity of 4.11.4, 5.10.2, A.4.11.4
Production lot
Definition 3.3.20
Testing 7.8
Propellant composition ..... *see* Composition
Propellant (definition) ..... 3.3.21; *see also* Composition; Explosives; Low explosives; Nitrous oxide
Protective clothing 4.12.2, 4.12.4, 5.10.2.3, 5.11.2
Public conveyances (definition) 3.3.22
Purpose of code 1.2

-R-

Railways (definition) 3.3.23
Recordkeeping 4.3, 5.4, 8.5
References ..... Chap. 2, Annex D
Reloadable motor system (definition) 3.3.25.5
Reloadable rocket motors ..... 7.3, A.7.3.1.1; *see also* Motor-reloading kits
Applicability to 1.1.6
Definition 3.3.25.6
Hybrid rocket motors ..... 7.5.1.4(2), 7.5.1.6, A.7.5.1.6
Motor casing requirements ..... 7.4.5, 7.4.6, 7.12.3(9), 7.13.4, 8.1.7(2), 8.2.7(2)
Reporting 4.3, 5.4
Rocket engines ..... *see* Rocket motors
Rocket motor plants (definition) 3.3.26
Rocket motors ..... *see also* High power rocket motors; Model rocket motors; Reloadable rocket motors
Definition 3.3.25
Manufacturing of ..... *see* Manufacturing operations, general requirements for

-S-

Safety officers 4.12.5, 5.11.3, 5.11.4
Scope of code 1.1, A.1.1.1, A.1.1.4
Screen barricades (definition) 3.3.2.3, A.3.3.2.3
Sealed flight cylinders 7.5.2
Definition 3.3.11.1
Security, site 4.5, 5.3, A.4.5.1
Separation distances
Magazines ..... 4.6.3, 6.1.2, Table 6.1.2
Process buildings ..... 4.6, Table 4.6.1, Table 4.6.2
Shall (definition) 3.2.6
Shelf life of motors 7.9
Shipping prohibitions 7.10
Should (definition) 3.2.7
Signs, warning 4.5.3, 6.3.2.2.3, 6.5.4
Site security 4.5, 5.3, A.4.5.1
Smoking/smoking materials ..... 4.11.4 to 4.11.7, 5.10.2, 6.5.1, A.4.11.4
Solid propellant rocket motors 7.1
Definition 3.3.25.7
Manufacturer production lot testing 7.8.1
Motor casing 7.4.1, 7.4.2
Shelf life 7.9
Shipping and storage prohibitions 7.10
Sprinkler systems 5.6.6
Storage buildings (definition) ..... 3.3.3.5; *see also* Magazines
Storage of materials ..... 4.13.5, 4.13.6, 5.5, 5.12.5, 5.12.6; *see also* Low explosives, storage of
Prohibitions 7.10

-T-

Testing
Certification 8.1.3, 8.1.4, 8.1.7, 8.2.3, 8.2.4, 8.2.7, A.8.1.4, A.8.2.4
Manufacturer production lot testing 7.8
Of motors, modules, and components 4.14, 5.13
Titanium sponge 7.7.5
Tools, nonsparking 4.12.6, 5.11.5, 6.4.10
Training, employee 4.12.5, 4.13.2, 4.13.3, 5.11.3, 5.11.4, 5.12.2, 5.12.3, A.4.13.3, A.5.12.3

-V-

Vented flight cylinders 7.5.3
Definition 3.3.11.2
Ventilation 6.2.6

-W-

Warehouse (definition) 3.3.28
Work surfaces 4.7.3, 4.7.4, A.4.7.4

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3.3.78 Effective Ground-Fault Current Path. An intentionally constructed, permanent, low impedance electrically conductive path designed and intended to carry ~~underground~~ electric fault current ~~conditions~~ from the point of a ground fault on a wiring system to the electrical supply source.

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