NFPA®

495

Explosive Materials Code

2018

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NFPA® 495

Explosive Materials Code

2018 Edition

This edition of NFPA 495, *Explosive Materials Code*, was prepared by the Technical Committee on Explosives. It was issued by the Standards Council on November 10, 2017, with an effective date of November 30, 2017, and supersedes all previous editions.

This edition of NFPA 495 was approved as an American National Standard on November 30, 2017.

Origin and Development of NFPA 495

This code was originally issued in 1912 under the title *Suggested State Law to Regulate the Manufacture, Storage, Sale, and Use of Explosives*. The second edition was issued in 1941 by the Committee on Laws and Ordinances and retitled Suggested Explosives Ordinance for Cities. Later, the document was designated as NFPA 495L.

After being assigned to the Committee on Chemicals and Explosives, a new edition was issued in 1959. This was retitled as the *Code for the Manufacture, Transportation, Storage, and Use of Explosives and Blasting Agents* and redesignated as NFPA 495.

Following the reorganization of the committee in 1960, the responsibility for amendments to NFPA 495 was assigned to the Sectional Committee on Explosives. This committee reported to the Correlating Committee of the Committee on Chemicals and Explosives. Revised editions were issued in 1962, 1965, 1967, 1968, 1969, and 1970. A new edition was issued in 1972, with the document title revised to *Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials*. A subsequent edition followed in 1973.

Following the issuance of the 1973 edition, the Sectional Committee on Explosives was redesignated as a Technical Committee. In 1976, the committee began a detailed review intended to amend requirements to eliminate conflicts with the regulations promulgated by the various federal agencies concerned with explosive materials (e.g., U.S. Bureau of Alcohol, Tobacco, and Firearms; U.S. Mine Safety and Health Administration; and U.S. Department of Transportation [DOT]). This effort resulted in the 1982 edition, which was followed by a new edition in 1985. In 1990, the document was again revised and the title changed to *Explosive Materials Code*. The 1992 edition incorporated various technical and editorial amendments.

The 1996 edition incorporated changes in the classification of explosives to conform with DOT's "Hazardous Materials Regulations," which in turn was based on United Nations Recommendations on the Transport of Dangerous Goods. The 1996 edition also included technical and editorial amendments.

The 2001 edition of NFPA 495 included technical and editorial amendments highlighted by an increase in the amount of smokeless propellants permitted to be stored on the shelves of retail establishments. The change was needed due to the reclassification of certain explosive materials by DOT.

In the 2006 edition, a new chapter on Manufacturing and Testing was added. The code added updated tables based on the most current IME industry practices. The committee also prepared technical and editorial amendments to comply with the *Manual of Style for NFPA Technical Committee Documents*.

The 2010 edition updated definitions reflecting changes in federal regulatory provisions. A security plan was required as part of the permitting process for explosive materials, and new requirements for site control were included. The 2010 code allowed quantitative risk assessment (QRA) to be used where the quantity–distance (Q–D) requirements cannot be met. With the introduction of QRA, the siting requirements recognized the QRA method in addition to the traditional American Table of Distances. The committee also modified quantity limits for display or storage of certain small arms primers.

The 2013 edition contained updates to the ground vibration limitations in Chapter 11, Ground Vibration, Air Overpressure, Flyrock, and Gases to reflect the advancement and availability of blasting seismograph equipment. The code presented two options for limiting ground vibrations: monitoring with a blasting seismograph or using the scaled distance equations. The committee also made several editorial and reference updates to the code.

The 2018 edition contains updates to Chapter 5 requirements on the Electrical Wiring and Equipment section, providing better guidance on where to design and install watertight and dusttight equipment when in proximity of explosive materials. Chapter 10, Use of Explosive Materials for Blasting, added responsibilities for the blaster-in-charge to prevent potential conflict with project manager responsibilities. Additionally, Chapter 10 adopted requirements for recording blast records to better align with federal and state regulations. The committee also has made several editorial and reference updates to the code.

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

Committee Scope: This Committee shall have primary responsibility for documents on the manufacture, transportation, storage and use of explosives and related materials. This Committee does not have responsibility for documents on consumer and display fireworks, model and high power rockets and motors, and pyrotechnic special effects.

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Explosive Materials Code

2018 Edition

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

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

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

Chapter 1 Administration

1.1 Scope. This code shall apply to the manufacture, transportation, storage, sale, and use of explosive materials.

1.2 Purpose. This code is intended to provide reasonable safety in the manufacture, storage, transportation, and use of explosive materials.

1.3 Application.

1.3.1 This code shall not apply to the transportation of explosive materials where under the jurisdiction of the U.S. Department of Transportation (DOT). It shall apply, however, to state and municipal supervision of compliance with U.S. DOT 49 CFR 100–199.

1.3.2 This code shall not apply to the transportation and use of military explosives by federal or state military agencies, nor shall it apply to the transportation and use of explosive materials by federal, state, or municipal agencies while engaged in normal or emergency performance of duties.

1.3.3 This code shall not apply to the manufacture of explosive materials under the jurisdiction of the U.S. Department of Defense (DOD). This code also shall not apply to the distribution or storage of explosive materials by military agencies of the United States, nor shall it apply to arsenals, navy yards, depots, or other establishments owned or operated by, or on behalf of, the United States.

Δ **1.3.4** This code shall not apply to pyrotechnics such as flares, fuses, and railway torpedoes. It also shall not apply to fireworks and pyrotechnic special effects as defined in NFPA 1123, NFPA 1124, and NFPA 1126.

Δ **1.3.5** This code shall not apply to model and high power rocketry as defined in NFPA 1122, NFPA 1125, and NFPA 1127.

1.3.6 This code shall not apply to the use of explosive materials in medicines and medicinal agents in the forms prescribed by the United States Pharmacopeia or the National Formulary.

1.4 Retroactivity. The provisions in this code reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this code at the time the code was issued.

1.4.1 Unless otherwise specified, the provisions in this code shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the code. Where specified the provisions in this code shall be retroactive.

1.4.2 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this code deemed appropriate.

1.4.3 The retroactive requirements of this code shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

1.5 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.

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

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

1.6 Enforcement. This code shall be administered and enforced by the authority having jurisdiction designated by the governing authority. *(See Annex B 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 1, *Fire Code,* 2018 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2016 edition.

NFPA 70®, National Electrical Code®, 2017 edition.

NFPA 498, *Standard for Safe Havens and Interchange Lots for Vehicles Transporting Explosives,* 2018 edition.

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

NFPA 1123, *Code for Fireworks Display,* 2018 edition.

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

NFPA 1125, *Code for the Manufacture of Model Rocket and High-Power Rocket Motors,* 2017 edition.

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

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

NFPA 5000®, Building Construction and Safety Code®, 2018 edition.

2.3 Other Publications.

2.3.1 IAPMO Publications. International Association of Plumbing and Mechanical Officials, 4755 E. Philadelphia Street, Ontario, CA 91761.

Uniform Mechanical Code, 2015.

2.3.2 IME Publications. Institute of Makers of Explosives, 1120 19th Street, NW, Suite 310, Washington, DC 20036-3605.

IME SLP 2, "American Table of Distances (ATD)," June 1991 (incorporates changes through October 2011).

2.3.3 ISEE Publications. International Society of Explosives Engineers, 30325 Bainbridge Road, Cleveland, OH 44139.

"Field Practice Guidelines for Blasting Seismographs," 2015.

"Performance Specifications for Blasting Seismographs," 2011.

N **2.3.4 UN Publications.** 1 United Nations Plaza, New York, NY 10017.

Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, 6th revised edition, 2015.

Δ 2.3.5 U.S. Government Publications. U.S. Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

ATF Publication 5400.7, *Federal Explosives Law and Regulations*, 2012.

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

Title 18, United States Code, Chapter 44, "Firearms."

Title 27, Code of Federal Regulations, Part 555, "Commerce in Explosives."

Title 49, Code of Federal Regulations, Parts 100–199, "Pipeline and Hazardous Materials Safety Administration, Department of Transportation."

Title 49, Code of Federal Regulations, Part 397, "Transportation of Hazardous Materials; Driving and Parking Rules."

2.3.6 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls,* 2018 edition.

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

NFPA 5000®, Building Construction and Safety Code®, 2018 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 Acceptor. A charge of explosives or blasting agent receiving an impulse from an exploding donor charge.

3.3.2 Ammonium Nitrate. A chemical compound represented by the formula NH_4NO_3.

3.3.3 ANFO (Ammonium Nitrate Fuel Oil Mixture). A blasting agent (Explosive 1.5D) that contains no essential ingredients other than prilled ammonium nitrate and fuel oil.

3.3.4 Blast Area. The area in which concussion (shock wave), flying material, or gases from an explosion can cause injury to persons.

3.3.5* Blast Site. The area where explosive material is handled during loading of the borehole, including 15.2 m (50 ft) in all directions from the perimeter formed by loaded holes.

3.3.6 Blaster. A person qualified to assist in the loading and firing of a blast.

3.3.7 Blaster-in-Charge. A person qualified to be in charge of and responsible for the loading and firing of a blast.

Δ **3.3.8* Blasting Agent.** A material or mixture intended for blasting that meets the requirements of the DOT "Hazardous Materials Regulations," as set forth in 49 CFR 173.56, 49 CFR 173.57, and 49 CFR 173.58, Explosive 1.5D.

3.3.9* Borehole. A hole drilled in the material to be blasted for the purpose of containing an explosive charge; also called *blast hole* or *drill hole*.

3.3.10 Building.

3.3.10.1* *Inhabited Building.* A building regularly occupied in whole or part as a habitation for human beings, or any church, schoolhouse, railroad station, store, or other structure where people are accustomed to assemble, but not including any building or structure occupied in connection with the manufacture, transportation, storage, or use of explosive materials.

3.3.10.2* *Operating Building.* A building utilized in conjunction with the manufacture, transportation, or use of explosive materials.

3.3.11 Bulk Mix. A mass of explosive material prepared for use in bulk form without packaging.

3.3.12 Bulk Mix Delivery Equipment. Equipment (usually a motor vehicle with or without a mechanical delivery device) that transports explosive materials in bulk form for mixing or loading directly into boreholes, or both.

3.3.13* Bullet-Resistant Construction. Refers to magazine walls or doors, constructed to resist penetration of a bullet of 150-grain M2 ball ammunition having a nominal muzzle velocity of 824 mps (2700 fps) when fired from a 0.30-caliber rifle from a distance of 30.5 m (100 ft) perpendicular to the wall or door.

3.3.14 Day Box. A Type 3 magazine.

3.3.15 Detonating Cord. A flexible cord containing a center core of high explosive used to detonate other explosives.

3.3.16* Detonator. Any device containing an initiating or primary explosive that is used for initiating detonation.

3.3.16.1 *Electronic Detonator.* A detonator that utilizes stored electrical energy as a means of powering an electronic timing delay element/module and that provides initiation energy for firing the base charge.

3.3.16.2 *No. 8 Test Detonator.* A detonator with 0.40 to 0.45 g PETN (pentaerythritol tetranitrate) base charge pressed to a specific gravity of 1.4 g/cc and primed with standard weights of primer, depending on manufacturer.

3.3.17 Device.

3.3.17.1* *Explosive-Actuated Device.* Any tool or special mechanized device that is actuated by explosive materials.

3.3.17.2* *Propellant-Actuated Device.* Any tool or special mechanized device or gas generator system that is actuated by a propellant or that releases or directs work through a propellant charge.

3.3.17.3 *Special Industrial Explosives Device.* Explosive-actuated devices and propellant-actuated devices.

3.3.18 Distance.

3.3.18.1 *Intermagazine Distance (IMD).* The minimum separation distance between magazines.

3.3.18.2 *Intraline Distance (ILD) or Intraplant Distance (IPD).* The distance to be maintained between any two operating buildings on an explosives manufacturing site, at least one of which contains or is designed to contain explosives; the distance between a magazine and an operating building.

3.3.18.3 *Minimum Separation Distance (D_0).* The minimum separation distance between adjacent buildings occupied in conjunction with the manufacture, transportation, storage, or use of explosive materials where one of the buildings contains explosive materials and the other building does not.

3.3.18.4* *Quantity–Distance (Q–D).* The quantity of explosive material and the separation distance relationships providing protection.

3.3.19 Donor. An exploding charge producing an impulse that impinges upon an explosive acceptor charge.

3.3.20* Explosive. Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion.

3.3.20.1 *Binary Explosive.* A blasting explosive formed by mixing or combining two precursor chemicals, for example ammonium nitrate and nitromethane.

3.3.20.2 *Emulsion Explosive.* An explosive material containing substantial amounts of oxidizer dissolved in water droplets surrounded by an immiscible fuel or droplets of an immiscible fuel surrounded by water containing substantial amounts of oxidizer.

3.3.20.3 *Primary Explosive.* A sensitive explosive such as lead azide, which detonates by simple ignition from such means as spark, flame, impact, friction, or other primary heat sources of appropriate magnitude.

3.3.20.4 *Two-Component Explosive.* See 3.3.20.1, Binary Explosive.

3.3.21 Fire Barrier Wall. A wall, other than a fire wall, having a fire resistance rating. [**221,** 2018]

3.3.22* Fire Extinguisher Rating. This rating is identified on an extinguisher by a number (e.g., 5, 20, 70), indicating relative effectiveness, followed by a letter (e.g., A, B, C, or D) indicating the class or classes of fires for which the extinguisher has been found to be effective.

3.3.23* Flash Point. The minimum temperature at which a liquid or a solid emits vapor sufficient to form an ignitible mixture with air near the surface of the liquid or the solid.

3.3.24 Fuel. Any substance that reacts with the oxygen in the air or with the oxygen yielded by an oxidizer to produce combustion.

3.3.25 Hardwood. Any close-grained wood such as oak, maple, ash, or hickory that is free from loose knots, wind shakes, or similar defects.

3.3.26* Hazards Analysis (HA). The process of identifying situations or conditions that have the potential to cause injury to people, damage to property, or damage to the environment.

3.3.27 Magazine. A building or structure, other than an explosives manufacturing building, approved for the storage of explosive materials. [**1124,** 2017]

3.3.28 Manufacturing. Mixing, blending, extruding, assembling articles outside the blast site, disassembling, chemical synthesis, and other functions involved in making a product or device that is intended to explode.

3.3.29 Mass Detonate (Mass Explode). Simultaneous detonation or explosion of the total amount or a substantial amount of a quantity of explosive material caused by the explosion of a unit or part of the explosive material.

3.3.30 Material.

3.3.30.1 ***Explosive Material.*** Any explosive, blasting agent, emulsion explosive, water gel, or detonator.

3.3.30.1.1* ***Bullet-Sensitive Explosive Material.*** Explosive material that can be detonated by 150-grain M2 ball ammunition having a nominal muzzle velocity of 824 mps (2700 fps) when fired from a 0.30-caliber rifle at a distance of 30.5 m (100 ft), measured perpendicularly.

3.3.30.1.2* ***Cap-Sensitive Explosive Material.*** Any explosive material that can be detonated by means of a No. 8 blasting cap or its equivalent.

3.3.30.1.3 ***High Explosive Material.*** Explosive materials that are characterized by a very high rate of reaction, high pressure development, and the presence of a detonation wave.

3.3.30.1.4 ***Low Explosive Material.*** Explosive material that is characterized by deflagration or a low rate of reaction and the development of low pressure.

3.3.30.1.5* ***Special Industrial Explosive Material.*** Shaped materials, sheet forms, and various other extrusions, pellets, and packages of high explosives used for high-energy-rate forming, expanding, and shaping in metal fabrication and for dismemberment and reduction of scrap metal.

Δ **3.3.30.2** ***Hazardous Material.*** A chemical or substance that is a physical hazard or health hazard as defined and classified in NFPA 1 whether the material is in usable or waste condition.

Δ **3.3.30.2.1** ***Health Hazard Material.*** A chemical or substance classified as a toxic, highly toxic, or corrosive material in accordance with the definitions set forth in NFPA 1.

3.3.30.2.2* ***Incompatible Material(s).*** Materials that, when in contact with each other and outside of the condition of intended use, have the potential to react in a manner that generates heat, fumes, gases, or by-products that are hazardous to life and property.

Δ **3.3.30.2.3** ***Physical Hazard Material.*** A chemical or substance classified as a combustible liquid, combustible fiber, explosive, flammable cryogen, flammable gas, flammable liquid, flammable solid, organic peroxide, oxidizer, oxidizing cryogen, pyrophoric, unstable (reactive), or water reactive material, in accordance with the definitions set forth in this code or in NFPA 1.

3.3.30.3* ***Oxidizing Material.*** Any solid or liquid that readily yields oxygen or other oxidizing gas or that readily reacts to oxidize combustible material.

3.3.31 Misfire. A charge of explosive material that fails to detonate completely after initiation.

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

3.3.33 Net Explosive Weight (NEW). The aggregate amount of explosive materials, expressed in pounds, contained in a manufactured article or within buildings, magazines, structures, or portions thereof.

3.3.34 Nonsparking Metal. A metal that resists producing a spark when impacted with tools, rock, or hard surfaces.

3.3.35 Operating Line. A group of buildings, facilities, or workstations so arranged as to permit performance of the steps in the manufacture of an explosive or in the loading, assembly, modification, and maintenance of ammunition or devices containing explosive materials.

3.3.36 Person. Any individual, firm, partnership, corporation, company, association, or joint-stock association, including any trustee, receiver, assignee, or personal representative thereof. [**5000,** 2018]

3.3.37 Plywood. Exterior grade plywood.

3.3.38 Precursor Chemicals. Two or more unmixed, commercially manufactured prepackaged chemical ingredients (including oxidizers, flammable liquids or solids, or similar ingredients) that are *not* classified as explosives but that, where mixed or combined, form a blasting explosive.

3.3.39 Primer. A unit, package, or cartridge of explosive material used to initiate other explosives or blasting agents and that contains (1) a detonator or (2) a detonating cord to which is attached a detonator designed to initiate the cord.

3.3.39.1 ***Small Arms Ammunition Primers.*** Small percussion-sensitive explosive charges encased in a cap and used to ignite propellant powder.

3.3.40* Propellant. An explosive that normally functions by deflagration and is used for propulsion purposes.

3.3.40.1 ***Composite Propellant.*** A mixture consisting of an elastomeric-type fuel and an oxidizer used in gas generators and rocket motors.

3.3.40.2 ***Smokeless Propellants.*** Solid propellants, commonly referred to as smokeless powders, used in small arms ammunition, cannons, rockets, or propellant-actuated devices.

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

3.3.42* Public Highway. Any road, street, or way, whether on public or private property, open to public travel.

3.3.43 Railway. Any steam, electric, diesel electric, or other railroad or railway that carries passengers for hire on a particular line or branch in the vicinity of an explosives storage or manufacturing facility.

3.3.44 Resistant.

3.3.44.1* ***Fire Resistant.*** Construction designed to provide reasonable protection against fire.

3.3.44.2 ***Theft Resistant.*** Construction designed to deter illegal entry into facilities for the storage of explosive material.

3.3.44.3 ***Weather Resistant.*** Construction designed to offer protection against weather.

3.3.45* Semiconductive Hose. Any hose with an electrical resistance sufficient to limit the flow of stray electric currents to safe levels, yet not high enough to prevent the relaxation of static electric charges to ground.

3.3.46 Sensitivity. A characteristic of an explosive material, classifying its ability to detonate upon receiving an external impulse such as impact shock, flame, or other influence that can cause explosive decomposition.

3.3.47* Shock Tube. A small diameter plastic tube used for initiating detonators.

3.3.48 Slurry. An explosive material containing substantial portions of a liquid, oxidizers and fuel, plus a thickener.

3.3.49* Small Arms Ammunition. Any shotgun, rifle, or pistol cartridge and any cartridge for propellant-actuated devices.

3.3.50 Softwood. Any coarse-grained wood such as fir, hemlock, spruce, or pine that is free from loose knots, wind shakes, or similar defects.

3.3.51* Steel. General purpose, hot- or cold-rolled, low carbon steel.

3.3.52* Water Gel. An explosive material that contains substantial portions of water, oxidizers, and fuel, plus a cross-linking agent.

Chapter 4 Security and Safety of Explosive Materials

4.1 Basic Requirements. This chapter shall not apply to handloading of small arms ammunition prepared for personal use and not for resale. *(See Chapter 14.)*

4.1.1 Response to Fires.

4.1.1.1* No attempt shall be made to fight a fire that cannot be contained or controlled before it reaches explosive materials other than Division 1.4S.

4.1.1.2 In such cases, all personnel shall be evacuated immediately to a safe location.

4.1.1.3 In all such cases, the area shall be guarded from entry by spectators or intruders.

4.1.2 Fire Department Notification.

4.1.2.1 The local fire department and other local emergency response agencies shall be notified of the location of all magazines and of any changes in location.

4.1.2.2 Such notification shall be made verbally before the end of the day on which storage of the explosive materials commenced and in writing within 48 hours from the time such storage commenced.

4.1.3 The manufacture of any explosive material, as defined by this code, shall be prohibited unless such manufacture is authorized by federal license and is conducted in accordance with recognized safe practices.

4.1.4 The manufacture of explosive materials shall be prohibited where such manufacture presents an undue hazard to life or property.

4.1.4.1 Prior to manufacturing or testing of explosives, ammunition, or blasting agents, the authority having jurisdiction shall be furnished with the following information:

(1) The exact location of the place of manufacture or testing
(2) The type and net explosive weight (NEW) of explosives ammunition, blasting agents to be manufactured or tested, and the in-process classification of the materials to be used
(3) A plot plan of the operating premises with the operating buildings indicated in which greater than 0.45 kg (1 lb) of explosives is to be manufactured, used, tested, or stored
(4) The plot plan dimensioned so as to accurately portray the size of each operating building and its location relative to barricades, storage magazines, property lines, inhabited buildings, and public transportation routes
(5)* Information from hazard assessments as required by process safety management (PSM)

4.1.5 All explosive materials and any newly developed and unclassified explosive materials shall meet the license and permit requirements of this chapter.

4.1.5.1 The requirement in 4.1.5 shall not apply to stocks of small arms ammunition and components thereof, to the extent that they are covered by the provisions of 18 USC 44.

4.1.6 A person intending to engage in business as an importer, manufacturer, dealer, or user of explosive materials shall obtain a federal license in accordance with 18 USC 40.

4.1.7 The requirements contained in this chapter are intended to supplement existing federal laws and regulations; therefore, any person who possesses a license or permit under 18 USC 40, which properly covers the activities of such person, shall not be required to obtain a permit under this chapter.

4.1.8 Warning Signs.

4.1.8.1 All normal access roads to explosive storage magazines shall be posted with the following warning sign:

DANGER.

NEVER FIGHT EXPLOSIVE FIRES.

EXPLOSIVES ARE STORED ON THIS SITE.

CALL_____.

4.1.8.2 The sign shall be weather resistant with a reflective surface and lettering at least 50 mm (2 in.) high.

4.1.9 Transportation Placards.

4.1.9.1 Placards required by the U.S. Department of Transportation regulations in 49 CFR 172, Subpart F, for the transportation of blasting agents (Division 1.5 materials) shall be displayed on all Type 5 magazines that contain blasting agents (Division 1.5 materials).

4.1.9.2 Emptied Type 5 magazines (including over-the-road trailers) that have previously contained packaged blasting agents (Division 1.5 materials) shall not be required to display placards.

4.2 Permit Requirements.

4.2.1 No person shall be in possession of explosive materials, or conduct an operation or activity requiring the use of explosive materials, or perform or supervise the loading and firing of explosive materials without first obtaining the correct permit.

4.2.2 Explosive materials shall not be sold, given, delivered, or transferred to any person not possessing a valid permit.

4.2.3 Responsibility.

4.2.3.1 Every person conducting an operation or activity that uses explosive materials shall obtain a permit to use explosive materials.

4.2.3.2 Such persons shall be responsible for the results and consequences of any loading or firing of explosive materials.

4.2.3.3 Such person shall also ensure that loading and firing are performed or supervised by a person possessing a permit to blast.

4.2.3.4 Laboratories engaged in testing explosive materials, other than where conducting test blast explosions, shall require only a permit to use.

4.2.4 Where required by the authority having jurisdiction, the permit applicant shall provide evidence of a public liability insurance policy.

4.2.5* Applicants for licenses and permits shall have a security plan.

4.3 Permit Classes.

4.3.1 Permit to Use. Before a person conducts an operation or activity that uses explosive materials, that person shall obtain a license or permit from the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) as required, which provides authorization to purchase, possess, store, and use such materials.

4.3.2 Permit to Blast. Before a blaster-in-charge supervises the loading and firing of explosive materials, that individual shall obtain the appropriate permit to blast, as specified in Table 4.3.2.

4.4 Requirements for Blaster's Permit.

4.4.1 The applicant for an initial permit to supervise and perform the loading and firing of explosive materials, as specified in 4.3.2, shall demonstrate training and experience in the use of explosive materials in the class authorized by the specific permit for which application is made.

Table 4.3.2 Classifications for Permit to Blast

Class	Category	Blasting Permitted
A	Unlimited	All types of blasting
B	General aboveground	All phases of blasting operations in quarries, open pit mines, and aboveground construction
C	General underground	All phases of blasting operations in underground mines, shafts, tunnels, and drifts
D	Demolition	All phases of blasting in demolition projects
E	Seismic	All phases of blasting in seismic prospecting
F	Agriculture	All phases of blasting in agriculture, but limited to not more than 22.7 kg (50 lb) per blast
G	Special	Special blasting as described on the permit

4.4.2 Qualifying Examination.

4.4.2.1 Each applicant shall pass a qualifying examination.

4.4.2.2 The examination shall be administered in written or oral format, or by such other means as necessary to determine that the applicant is competent to conduct blasting operations and to perform the duties of a blaster.

4.4.3 The applicant shall be approved by the ATF as an explosives possessor or responsible person.

4.4.4 Any holder of a permit to blast who is convicted of a violation of any explosives law or regulation shall be required to pass a qualifying examination as a condition of retention of the permit.

4.4.5 Any person whose permit to blast has been revoked shall be required to pass a qualifying examination as a condition of reinstatement of the permit.

4.4.6 Any person whose permit to blast has lapsed for a period of 1 year or longer shall be required to pass a qualifying examination as a condition of renewal of the permit.

4.5 Posting of Permits.

4.5.1 Permit to Use. A copy of the permit shall be posted at each place of operation.

4.5.2 Permit to Blast. A copy of the permit shall be carried by the permit holder during blasting operations.

4.5.3 Permit Loss or Damage.

4.5.3.1 Permit holders shall take every reasonable precaution to protect their permits from loss, theft, defacement, destruction, or unauthorized duplication.

4.5.3.2 Any such occurrence shall be reported immediately to the issuing authority.

4.6 Permit Restrictions.

4.6.1 No permit shall be permitted to be assigned or transferred.

4.6.2 No permit shall be issued to a person under 21 years old.

4.6.3 Permits shall be dated and numbered.

4.6.4 Permits shall be valid for no longer than 3 years from the date of issue.

4.7 Denial or Revocation of Permits.

4.7.1 A permit for the possession and use of explosive materials shall be denied or revoked for any of the following reasons:

(1) Noncompliance with any order of the issuing authority within the time specified by such order
(2) Proof that the permit applicant or holder is under indictment for, or has been convicted of, a crime punishable by imprisonment for a term exceeding 1 year
(3) The applicant or holder is a fugitive from justice
(4) The applicant or holder is an unlawful user of, or is addicted to, narcotics or dangerous drugs
(5) The applicant has been adjudicated as mentally defective
(6) Proof that the permit applicant or holder advocates, or knowingly belongs to, any organization or group that advocates violent overthrow of, or violent action against, any federal, state, or local government
(7) Proof that the permit applicant or holder suffers from a mental or physical defect that would interfere with the safe handling of explosives
(8) Violation by the permit applicant or holder of any provision of any explosives law or regulation, or proof that false information was provided or a misrepresentation was made to obtain the permit by the applicant or holder

4.7.2 Notification of Permit Denial or Revocation.

4.7.2.1 In any case in which the issuing authority denies or revokes a permit, the issuing authority shall notify the permit applicant or holder promptly.

4.7.2.2 Such notification as described in 4.7.2.1 shall specify the basis for denial or revocation of the permit.

4.7.2.3 Such notification shall also state that, upon written request by the applicant or holder, a hearing before the issuing authority is to be held within 10 days after the date of the request.

4.7.3 In cases where a hearing is held, the issuing authority shall state its findings and conclusions in writing.

4.7.4 The issuing authority shall transmit a copy of the findings and conclusions to the applicant or former permit holder promptly.

4.7.5 Upon notice of the revocation of any permit, the former permit holder immediately shall surrender the revoked permit and all copies thereof to the issuing authority.

4.8 Record Keeping and Reporting.

4.8.1 Records.

4.8.1.1 A holder of a permit to use shall keep a record of all transactions or operations involving explosive materials.

4.8.1.2 Such record shall be retained for 5 years.

4.8.1.3 Permits shall be made available to the issuing authority upon request.

4.8.2 An accumulation of invoices, sales slips, delivery tickets or receipts, or similar records representing individual transactions shall be considered to satisfy the requirements for record keeping, provided they include the signature of the receiver of the explosive materials.

4.8.3 Daily Records.

4.8.3.1 A holder of a permit to blast shall keep a daily record of all explosive materials received and fired or otherwise disposed of by the permit holder.

4.8.3.2 Such records shall be retained for 5 years.

4.8.3.3 Records shall be made available to the issuing authority upon request.

4.8.4 A holder of a permit shall notify the issuing authority promptly of any change in address.

4.8.5* The loss, theft, or unlawful removal of explosive materials shall be reported within 24 hours to the Bureau of Alcohol, Tobacco, Firearms and Explosives, to the permit-issuing authority, and to the local law enforcement agency.

4.8.6 Accidents involving explosive material that cause a lost-time injury or property damage shall be reported immediately to the authority having jurisdiction.

4.9 Applications.

4.9.1 An application for a permit or for renewal of a permit shall be made to the issuing authority on forms provided by the authority.

4.9.2 Such applications shall contain such information as is required.

4.10 Renewals.

4.10.1 Where an application for renewal is filed with the issuing authority before expiration of the current permit, the renewal shall become effective upon expiration of the current permit.

4.10.2 No renewal permit shall be issued more than 30 days prior to the expiration date of the current permit.

4.10.3 An application for renewal filed after the expiration date of the current permit shall be considered an application for a new permit.

Chapter 5 Manufacturing and Testing

5.1 Scope. Manufacture and testing of explosives shall be in accordance with the requirements of this chapter.

5.1.1 Blasting agents shall not be subject to the requirements of this chapter *(see Chapter 6)*.

5.1.2 Water gels, slurries, and emulsion explosives shall not be subject to the requirements of this chapter *(see Chapter 7)*.

5.1.3 This chapter shall not apply to handloading of small arms ammunition prepared for personal use and not for resale *(see Chapter 14)*.

5.2 General Requirements.

5.2.1 Emergency Procedures. Emergency procedures shall be developed for each manufacturing facility.

5.2.2 Posting of Pertinent Information. Standard operating procedures governing the manufacturing process shall be located in a location and form accessible to workers.

5.2.3 Training. Persons handling explosive materials or working in operating buildings shall be trained in the following areas:

(1) The physical and health hazards of the explosive materials to be manufactured
(2) The operational activities involved in processing the materials to include instructions in emergencies that are anticipated in the manufacturing process
(3) The operating rules applicable to the materials in the manufacturing process
(4) Plans for emergency procedures in the event of a fire or explosion

5.2.3.1 Personnel shall be made aware of emergency warning signals and actions to take in the event the warning signal is activated.

5.2.3.2 Contract personnel working in explosive manufacturing areas shall be instructed in site-specific operating procedures, emergency procedures, and hot work operations, prior to engaging in any activity, whether maintenance-related or not.

5.2.3.3 Visitors entering operational areas shall receive orientation training and be accompanied by a trained escort.

5.2.4* Containers. Bulk explosive materials shall be stored in approved containers when not in use.

5.2.5* Waste. When waste receptacles are provided for the collection of waste and debris, such receptacles shall be approved and equipped with covers.

5.2.5.1 Emptying Waste Containers. Waste receptacles shall be emptied and cleaned in accordance with operating procedures.

5.2.5.2 Collection of Spilled Material.

5.2.5.2.1 Explosive materials that are spilled or dropped outside of designated containment or confinement zones shall be collected promptly for disposal.

5.2.5.2.2 The area in which the materials were spilled shall be cleaned.

5.2.5.3 Contaminated Materials. Cleaning materials or materials that have been contaminated with explosives shall be removed daily and disposed of in an approved manner.

5.2.5.3.1 Shipping Containers. Shipping containers used for explosive materials shall be allowed to be retained for reuse as required.

5.2.6 Maintenance. Nonroutine maintenance and repair work shall not be performed in an explosive manufacturing area until cleanup and decontamination have been performed as required by operating procedures.

5.2.6.1 Repair Work. Maintenance and repair that is not addressed by the operating procedures shall be reviewed and approved by supervisory personnel prior to conducting the work.

5.2.7 Ignition Source Control.

5.2.7.1 Smoking. Smoking shall be prohibited on the plant site, except where permit notices are posted.

5.2.7.2 Flame-Producing Devices. Matches, torches, or other flame-producing devices shall be prohibited from explosives manufacturing areas without a written permit signed by an authorized supervisor.

5.2.7.3* Portable Electrical and Electronic Equipment. Portable electrical and electronic equipment shall be permitted only when designated by the manufacturing process and incorporated into the operating instructions described in 5.2.2.

5.2.7.4 A hazards analysis that evaluates and documents the essential safety design of the process shall be performed for processes involving the manufacturing, movement, storage, testing, or development of energetic materials.

5.2.8 Clothing.

5.2.8.1 Type of Clothing. Clothing to be worn by persons involved in the manufacturing process shall be of a type approved by management.

5.2.8.2 Accessories. Watches, jewelry, finger rings, earrings, and items intended for use as accessories shall not be worn in areas where explosive materials are manufactured.

5.2.8.3 Contaminated Clothing. Persons wearing clothing that has been contaminated with explosive materials shall not be permitted to enter areas where smoking is permitted or where operations involving the use of open flame or open ignition sources are present.

5.2.9 Clearance from Combustibles. The area within 7.6 m (25 feet) of operating buildings shall be kept clear of combustible materials.

5.2.10 Limited Access by Authorized Personnel. Manufacturing areas shall be secured against unauthorized entry.

Δ **5.2.11 Separation of Incompatible Materials.** Incompatible materials that are in storage and storage of materials that are incompatible with materials in use shall be separated by one of the following methods:

(1) Segregating incompatible materials in storage from those materials in use by a distance of not less than 6.1 m (20 ft)
(2) Isolating incompatible materials in storage by a noncombustible partition extending not less than 457 mm (18 in.) above and to the sides of the stored material
(3) Storing liquid and solid materials in hazardous materials storage cabinets that comply with NFPA 1

5.2.12 Housekeeping.

5.2.12.1 Floors. Floors of manufacturing areas shall be swept or otherwise maintained to prevent the accumulation of explosive materials.

5.2.12.2 Tools and Equipment. Tools and equipment shall be kept in designated areas when not in use during manufacturing operations.

Δ **5.2.13 Hot Work.** Hot work operations shall be conducted in accordance with the requirements of NFPA 1.

5.2.13.1 Management. Management shall be responsible for the supervision of hot work activity.

5.2.13.2 Permits. Permits to conduct hot work operations shall be required.

5.3 Classification and Characterization of Energetic Materials Used in Process Operations.

5.3.1* In-Process Hazard Classification. Explosive materials being processed shall be classified with an in-process hazard classification based on the hazards of the material in its configuration and the quantity employed.

5.3.1.1 High Explosion Hazard. The classification of materials that has not been established by testing, or where the quantity or configuration of materials used exhibits a high explosion hazard shall be classified as a high explosion hazard.

5.3.1.1.1 Materials of known character or composition in the configuration and quantity specific to the process where the in-process hazard classification is approved by the AHJ shall be allowed to be classified as other than a high explosion hazard.

5.3.1.1.2 Physical Hazards Established by Testing. When testing is performed, the test methods shall be those established by the DOD, the ATF, the United Nations (UN) *Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria*, the DOT, or other approved criteria.

5.3.1.1.3 Technical Assistance. The AHJ shall be permitted to require a review by an independent third party with expertise in the matter to be reviewed at the submitter's expense.

Δ **5.3.1.2 Health Hazard Classification.** The health hazards of materials used in the manufacturing process shall be determined in accordance with the requirements of NFPA 1.

5.3.1.2.1 In addition to physical hazards that are present, materials classified as toxic, highly toxic, or corrosive shall be classified as health hazards.

5.3.1.3 Multiple Hazards. Materials that have multiple hazards shall conform to this code's requirements for each applicable hazard category specified.

5.3.2* Quantity of Explosives. The quantity–distance (Q–D) tables in 5.3.3 shall apply to operating buildings.

5.3.2.1 If the Q–D tables cannot be met, the use of a quantitative risk assessment shall be permitted to determine minimum distances from potential explosion sites.

Δ **5.3.2.2** The net explosive weight shall be determined in accordance with the following:

(1) Mass explosion hazards — Division 1.1 or 1.2 explosives
   (a) The total net explosive weight is used.
   (b) See Table 5.3.3(a) for operating buildings, and Table 9.4.1(a) through Table 9.4.1(d) for all other cases.
   (c) When the TNT equivalence of the explosive material has been determined, the equivalence is allowed to be used to establish the net explosive weight.

(2) Non–mass explosion hazards (excluding Division 1.4)
   (a) Division 1.3 propellants
      i. The total weight of the propellants alone is the net explosive weight.
      ii. The net weight of the propellants is used. *[See Table 5.3.3(b).]*
   (b) Combinations of bulk metal powder and pyrotechnic compositions
      i. The sum of the net weights of metal powders and pyrotechnic compositions in the containers is used.

(3) Combinations of mass explosion and non–mass explosion hazard explosives (excluding Division 1.4)
   (a)* When Division 1.1 and 1.2 explosives are located in the same site, determine the distances for the total quantity first as 1.1 and then as 1.2.
      i. The required distance is the greater of the two.
      ii. When the Division 1.1 requirements are controlling and the TNT equivalence of the 1.2 is known, the TNT equivalent weight of the 1.2 items is added to the total explosive weight of Division 1.1 items to determine the net explosive weight of explosives for Division 1.1 distance determination. See Table 5.3.3(a) or Table 5.3.3(b) as applicable.
   (b)* When Division 1.1 and 1.3 explosives are located in the same site, determine the distances for the total quantity first as 1.1 and then as 1.3.
      i. The required distance is the greater of the two.
      ii. When the Division 1.1 requirements are controlling and the TNT equivalence of the 1.3 items is known, the TNT equivalent weight of the 1.3 items is added to the total explosive weight of Division 1.1 items to determine the net explosive weight of explosives for Division 1.1 distance determination. See Table 5.3.3(a) or Table 5.3.3(b) as applicable.
   (c)* When Division 1.1, 1.2, and 1.3 explosives are located in the same site, determine the distances for the total quantity first as 1.1, next as 1.2, and finally as 1.3.
      i. The required distance is the greatest of the three.
      ii. As permitted by 5.3.2.2(3)(a) and 5.3.2.2(3)(b) above, TNT equivalent weights for 1.2 and 1.3 items are allowed to be used to determine the net weight of explosives for Division 1.1 distance determination.
      iii. Table 5.3.3(a) or Table 5.3.3(b) shall be used when TNT equivalency is used to establish the net explosive weight.

(4) Combinations of non–mass-exploding ammunition and explosives of different divisions are treated as follows:
   (a) Determine the required separation for each division.
   (b) Use the greatest separation of those determined.

Δ **5.3.3* Separation of Operating Buildings.** Operating buildings, including those where explosives are assembled, manufactured, prepared, or loaded, utilizing Division 1.1, 1.2, 1.3, or 1.4 explosives, shall be separated from all other operating buildings, magazines, inhabited buildings, public highways, and passenger railways at a distance not less than those shown in Table 9.4.1(a) through Table 9.4.1(d) and Table 5.3.3(a) through Table 5.3.3(c) as applicable.

Δ Table 5.3.3(a) Minimum Intraline (Intraplant) Separation Distances (ILD or IPD) Between Barricaded Operating Buildings Containing Explosives — Division 1.1 or 1.2 — Mass Explosion Hazard

Net Explosive Weight (lb)		Intraline Distance (ILD) or Intraplant Distance (IPD)
Pounds Over	Pounds Not Over	(ft)
2	5	16
5	10	20
10	20	25
20	30	28
30	40	31
40	50	34
50	75	38
75	100	42
100	125	45
125	150	48
150	200	53
200	250	57
250	300	60
300	400	66
400	500	71
500	600	76
600	700	80
700	800	84
800	900	87
900	1,000	90
1,000	1,200	96
1,200	1,400	101
1,400	1,600	106
1,600	1,800	110
1,800	2,000	113
2,000	2,500	122
2,500	3,000	130
3,000	4,000	143
4,000	5,000	154
5,000	6,000	164
6,000	7,000	172
7,000	8,000	180
8,000	9,000	190
9,000	10,000	200
10,000	12,000	210
12,000	14,000	220
14,000	16,000	230
16,000	18,000	238
18,000	20,000	245
20,000	25,000	265
25,000	30,000	280
30,000	35,000	295
35,000	40,000	310
40,000	45,000	320
45,000	50,000	330
50,000	55,000	340
55,000	60,000	350
60,000	65,000	360
65,000	70,000	370
70,000	75,000	380
75,000	80,000	390
80,000	85,000	395
85,000	90,000	400
90,000	95,000	410
95,000	100,000	420
100,000	110,000	430
110,000	120,000	445
120,000	130,000	455
130,000	140,000	465
140,000	150,000	475
150,000	160,000	485
160,000	170,000	495
170,000	180,000	505
180,000	190,000	515
190,000	200,000	525
200,000	210,000	535
210,000	230,000	555
230,000	250,000	575
250,000	275,000	600
275,000	300,000	635

(continues)

Δ Table 5.3.3(a) *Continued*

For SI units, 1 lb = 0.454 kg; 1 ft = 0.30 m.

Notes:

(1) Where a building or magazine containing explosives is not barricaded, the intraline distances shown in this table shall be doubled.

(2) Linear interpolation between tabular values shall not be allowed. Nonlinear interpolation of the values shall be allowed subject to an approved technical opinion and report prepared in accordance with the requirements of NFPA 1.

(3) Minimum separation distance (D_0) shall be a minimum of 60 ft. Where a building or magazine containing explosives is barricaded, the D_0 shall be 30 ft.

Δ 5.3.3.1 Distances to assumed property lines drawn for the purposes of determination of exterior wall and opening protection under the requirements of the *NFPA 5000* shall not be used to establish the minimum distance for separation between buildings on an operating line.

Δ 5.3.3.2 The minimum separation distance (D_0) required by Note (3) to Table 5.3.3(a) shall be allowed to be reduced to less than 18.3 m (60 ft) when the fire resistance of exterior walls and protection of wall openings is in accordance with *NFPA 5000*.

5.3.4 Determination of Net Explosive Weight for Operating Buildings. In addition to the requirements of 5.3.2 to determine the net explosive weight for materials stored or used in operating buildings, quantities of explosive materials stored in magazines located at distances less than ILDs from the operating building shall be added to the contents of the operating building to determine the net explosive weight for the operating building.

Table 5.3.3(b) Table of Distances (Q–D) for Buildings Containing Explosives — Division 1.3 Mass Fire Hazard

Quantity of Division 1.3 Explosives (Net Explosive Weight) (lb)		Distances (ft)			
Pounds Over	Pounds Not Over	Inhabited Buildings Distance (IBD)	Distance to Public Traffic Route (PTR)	Intermagazine Distance (IMD)	Intraline Distance (ILD) or Intraplant Distance (IPD)
0	1,000	75	75	50	50
1,000	5,000	115	115	75	75
5,000	10,000	150	150	100	100
10,000	20,000	190	190	125	125
20,000	30,000	215	215	145	145
30,000	40,000	235	235	155	155
40,000	50,000	250	250	165	165
50,000	60,000	260	260	175	175
60,000	70,000	270	270	185	185
70,000	80,000	280	280	190	190
80,000	90,000	295	295	195	195
90,000	100,000	300	300	200	200
100,000	200,000	375	375	250	250
200,000	300,000	450	450	300	300

For SI units, 1 lb = 0.454 kg; 1 ft = 0.30 m.

Notes:

(1) Black Powder, when stored in magazines, is defined as low explosive by the ATF.

(2) For quantities less than 1,000 lb, the required distances are those specified for 1,000 lb. The user of lesser distances shall be permitted when supported by test data and/or analysis.

(3) Linear interpolation of explosive quantities between table entries is permitted. For quantities over 300,000 lb, the formula $D = 8W^{1/3}$ shall be used for IBD and PTR minimum distances and the formula $D = 5W^{1/3}$ shall be used for IMD and IPD minimum distances, where D = distance and W = weight in pounds. $W^{1/3}$ means the explosives' weight to the one third power.

(4) Minimum separation distances (D_0) shall be a minimum of 50 ft.

Table 5.3.3(c) Table of Distances (Q–D) for Buildings Containing Explosives — Division 1.4

Quantity of Division 1.4 Explosives (Net Explosive Weight) (lb)		Distances (ft)			
Pounds Over	Pounds Not Over	Inhabited Buildings Distance (IBD)	Distance to Public Traffic Route (PTR)	Intermagazine Distance (IMD)	Intraline Distance (ILD) or Intraplant Distance (IPD)
50	Not limited	100	100	50	50

For SI units, 1 lb = 0.454 kg; 1 ft = 0.30 m.

Notes:

(1) A separation distance of 100 ft is required for buildings of other than Type I and Type II construction as defined in *NFPA 5000*.

(2) For earth-covered magazines, no specified separation is required.

(3) Restricted to articles, including articles packaged for shipment, that are not regulated as an explosive by ATF regulations, or to unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles.

(4) Linear interpolation between tabular values is not applicable.

(5) Minimum separation distances (D_0) shall be a minimum of 50 ft.

5.3.4.1 Indoor Magazines. The storage of explosive materials located in indoor magazines in operating buildings shall be limited to a net explosive weight not to exceed 22.7 kg (50 lb).

5.3.4.2 Outdoor Magazines with a Net Explosive Weight Less Than 22.7 Kilograms (50 Pounds). The storage of explosive materials in outdoor magazines located at less than ILDs from operating buildings shall be limited to a net explosive weight not to exceed 22.7 kg (50 lb).

5.3.4.3 Outdoor Magazines with a Net Explosive Weight Greater Than 22.7 Kilograms (50 Pounds). The storage of explosive materials in outdoor magazines in quantities exceeding 22.7 7 kg (50 lb) net explosive weight shall be limited to storage in outdoor magazines located not less than the ILDs from the operating building in accordance with 5.3.3.

5.3.4.4 Net Explosive Weight of Materials Stored in Combination Indoor and Outdoor Magazines. The aggregate quantity of explosive materials stored in any combination of indoor magazines or outdoor magazines located at less than the ILDs from an operating building shall not exceed 22.7 kg (50 lb).

5.4 Buildings and Equipment.

Δ **5.4.1 Construction.** Operating buildings shall be constructed in accordance with the requirements of *NFPA 5000*.

5.4.1.1 Location. Operating buildings shall be located in accordance with 5.3.3 based on the net explosive weight of materials contained.

5.4.2 Plans.

5.4.2.1 A copy of the construction plans shall be kept on the premises of the manufacturing site.

5.4.2.2 The construction plans shall be provided to the authority having jurisdiction upon request.

Δ **5.4.3 Means of Egress.** Obstructions, including storage, shall not be placed in the required width of a means of egress, except projections as allowed by *NFPA 5000*.

5.4.3.1 Obstructions. Means of egress shall not be obstructed in any manner and shall remain free of any material or matter where its presence would obstruct or render the means of egress hazardous.

5.4.3.2 Maintenance of Exits. The required fire-resistive rating of walls, ceilings, and openings that are part of a means of egress shall be maintained.

5.4.3.3 Locking of Exits. Exits throughout operating buildings shall be unlocked and verified operable before operations are begun.

5.4.4 General Site Control for Permanent Locations.

5.4.4.1 Fences and Gates.

5.4.4.1.1 Where high explosives are manufactured at permanent locations, the facilities shall be enclosed by fences with gates capable of being locked.

5.4.4.1.2* The integrity of the fences and gates shall be checked periodically.

5.4.4.2 Entrances.

5.4.4.2.1 The number of entrances shall be limited to the minimum number necessary to conduct operations.

5.4.4.2.2 Entrance to the facility shall be restricted and controlled to only those authorized to have access.

5.4.4.2.3 Entrances shall have a gate or other barrier that requires a vehicle to stop.

5.4.4.2.4 All buildings containing in-process explosives and precursor chemicals shall be secured or attended by workers or security personnel.

5.4.4.2.5 The land within 3.05 m (10 ft) of any fence or gate shall be maintained for a clear field of view.

5.4.5 Electrical Wiring and Equipment.

5.4.5.1 General. The rating of electrical equipment located in each building, bay, or area that manufactures, processes, or stores explosive materials shall be documented and constructed according to the criteria listed in 5.4.5.

N **5.4.5.1.1** The term electrical equipment shall include fittings, devices, fixtures and other apparatus, used as a part of an electrical installation.

N **5.4.5.1.2** The requirements in 5.4.5 shall be applied to areas containing explosive materials in any form.

N **5.4.5.2 Energetic Area 1.** Areas designated as Energetic Area 1 shall include locations where direct contact with explosive materials is likely under normal conditions, including locations where direct contact with explosive materials is possible due to incremental buildup over time.

N **5.4.5.2.1** Electrical equipment shall be constructed to prevent the entry of explosive materials.

N **5.4.5.2.2** Where subject to wash-down or deluge water, electrical equipment shall be constructed to prevent the entry of water.

N **5.4.5.2.3** Heat-generating equipment shall have a temperature rating below the autoignition temperature of the explosive materials that are present for both normal and fault conditions.

N **5.4.5.2.4** Electrical equipment in an Energetic Area 1 location shall, at minimum, meet one of the following design requirements:

(1) NFPA Class II, Division 1 and constructed to prevent entry of water where subject to wash-down or deluge water
(2) NEMA 4 or NEMA 6
(3) IP 65, IP 66, IP 67, or IP 68
(4) Other equipment designed or modified to meet the requirements of 5.4.4.2

N **5.4.5.2.5** Suitability of identified equipment shall be determined by one of the following requirements:

(1) Evidence of equipment evaluation from a nationally recognized testing laboratory or inspection agency concerned with product evaluation
(2) In addition to the manufacturer's self-evaluation, evidence acceptable to the authority having jurisdiction (e.g., an owner's engineering judgment)

N **5.4.5.2.6** NFPA hazardous location–rated equipment shall be listed and labeled as required by *NFPA 70*.

N **5.4.5.3 Energetic Area 2.** Areas designated as Energetic Area 2 shall include locations where direct contact with explo-

sive materials is not likely under normal operating conditions but possible under upset conditions.

N **5.4.5.3.1** Electrical equipment shall be constructed to prevent the entry of explosive materials.

N **5.4.5.3.2** Where subject to wash-down or deluge water, electrical equipment shall be constructed to prevent the entry of water.

N **5.4.5.3.3** Electrical equipment in an Energetic Area 2 location shall, at minimum, meet one of the following design requirements:

(1) NFPA Class II, Division 2 and constructed to prevent the entry of water where subject to wash-down or deluge water
(2) NEMA 4 or NEMA 6
(3) IP 65, IP 66, IP 67, or IP 68
(4) Other equipment designed or modified to meet the requirements of

N **5.4.5.3.4** Suitability of identified equipment shall be determined by one of the following requirements:

(1) Evidence of equipment evaluation from a nationally recognized testing laboratory or inspection agency concerned with product evaluation
(2) In addition to the manufacturer's self-evaluation, evidence acceptable to the authority having jurisdiction (e.g., an owner's engineering judgment)

N **5.4.5.3.5** NFPA hazardous location–rated equipment shall be listed and labeled as required by *NFPA 70*.

N **5.4.5.4 Energetic Area 3.** Areas designated as Energetic Area 3 shall include locations with exposed, sealed, or packaged explosive materials, including test bays and laboratories where a hazard analysis has determined that the quantity of explosive materials is such that electrically-rated equipment is not required.

N **5.4.5.4.1*** Electrical equipment shall be general purpose.

N **5.4.5.4.2** Lighting fixtures shall be enclosed.

N **5.4.5.4.3** If the area is subject to wash-down or deluge water, electrical equipment shall be constructed to prevent the entry of water.

N **5.4.5.4.4** General purpose electrical equipment shall be allowed in an Energetic Area 3 location unless wash-down or deluge water is used, in which case the equipment shall be constructed to prevent the entry of water.

N **5.4.5.5 Combined Locations.**

N **5.4.5.5.1** Combined locations shall be areas identified as having both *NFPA 70* defined hazards as well as explosive material hazards as defined in 5.4.5.

N **5.4.5.5.2*** Explosive material processing areas that have both NFPA defined hazardous locations and energetic materials processing areas shall meet the requirements of both this standard and *NFPA 70*.

N **5.4.5.6* Other Locations.** All electrical equipment and lighting fixtures installed in other unclassified (nonhazardous) rooms or areas of operating buildings shall, at minimum, meet the requirements of *NFPA 70*.

5.4.5.7 Bonding and Grounding.

Δ **5.4.5.7.1** The non-current-carrying metal parts of electrical equipment, including electric motors, generators, proportioning devices, and other electrical enclosures serving individual manufacturing processes, shall be electrically bonded together in accordance with the requirements of *NFPA 70*.

Δ **5.4.5.7.2** Where the electrical system is required to be grounded, the grounding conductors shall be connected together and to the supply system grounding conductor in accordance with the requirements of *NFPA 70*.

5.4.6* Static Electricity Hazards.

5.4.6.1 Static Accumulation. When processes or conditions exist where the materials in process are able to be ignited by static electricity with an intensity capable of propagating ignition, means shall be provided to prevent the accumulation of hazardous levels of static charge.

5.4.6.2 Static Control. The working area where screening, grinding, blending, and other processing of static-sensitive explosive materials is done shall be provided with approved static controls.

5.4.7 Ventilation. Mechanical ventilation systems shall be in accordance with *NFPA 5000* and the IAPMO *Uniform Mechanical Code*.

5.4.7.1 Local Exhaust. Local exhaust systems shall be provided to collect and remove moisture and odors, fumes, smoke, gas, mist, heat, dust, or other materials that are present in quantities above the limits according to applicable federal, state, or local regulations.

5.4.7.2 Electric Motors. Electric motors used to power fans or blowers used in the ventilation system shall be located outside of the duct or portion of the system exposed to explosive materials.

5.4.7.3 Explosive Dust. Explosive dust shall not be exhausted into the atmosphere.

5.4.7.3.1 Dust Collection. Explosive dust shall be collected using a "wet" collector system or other approved means. Wetting agents shall be compatible with the explosive materials being collected.

5.4.7.3.2 Cleaning of Collection Systems. Explosive dusts shall be removed from the collection system on a regular basis to prevent overloading and accumulation within the system.

5.4.7.3.3 Cleaning Frequency. The system shall be cleaned at a frequency that eliminates hazardous concentrations of explosive dusts from accumulating in pipes, tubing, or ducts.

5.5 Operations.

5.5.1 Posted Limits.

5.5.1.1 Personnel and explosive limits shall be posted within each operating building.

5.5.1.2 The posted limits shall be able to be seen by operating personnel or those that inspect operating buildings upon entry.

5.5.2 Workstation Protection. Workstations shall be separated by distance, barrier, or other means that provide equivalent protection.

5.5.2.1 Fire. Means shall be provided so that fire in one workstation will not ignite material in the next workstation.

5.5.2.2 Shielding. Workstations shall be evaluated to determine the need for operator shielding to protect operators from the effects of an inadvertent fire or explosion.

5.5.2.2.1 When determined to be necessary, operators shall be protected by a personnel shield located between the operator and the explosive device or material being processed.

5.5.2.2.2 Construction. When provided, shields and supports shall be constructed to withstand the effects from the maximum amount of explosive materials for which they are designed.

5.5.3 Remote Processing. When the type of material and processing warrants, mechanical operations involving the processing of more than 0.45 kg (1 lb) of explosive material shall be performed at isolated stations or at IPDs.

5.5.3.1 Operator Location. When remote processing operations are conducted, operators and controls shall be located behind barricades or at separation distances that provide operator protection while machinery is operating.

5.5.4 Protection Against Entry of Foreign Objects.

5.5.4.1 Procedures. Procedures shall be followed to prevent foreign objects or materials from entering the process in other than a controlled manner.

5.5.4.2 Equipment. Equipment shall be designed in a manner that prevents foreign objects or materials from entering the process in other than a controlled manner.

5.5.5 Equipment Repair. Repairs to explosive material processing equipment shall not be undertaken until prescribed decontamination of the equipment has been performed.

5.5.5.1 Supervision. Repair work to be conducted in process areas shall be approved by supervisory personnel before repair work commences.

5.5.5.2 Examination of Repairs.

5.5.5.2.1 Repaired process equipment shall be examined and tested for operability before being placed back into service.

5.5.5.2.2 The required testing shall be verified by supervisory personnel.

5.5.5.3 Tools. Tools used for repair, construction, cleanup, or maintenance in processing areas shall be limited to those described in the operating procedures for the process being operated.

5.5.6 Temperature Extremes. Process temperatures and surface temperatures of equipment that will be in contact with explosive materials, ingredients, or mixtures being processed shall be maintained at less than the decomposition temperature of such materials.

5.6 Explosive Materials Testing Sites.

5.6.1 Location. Detonation or ignition of explosive materials shall be performed in isolated areas or areas that have been designed specifically for the tests to be conducted.

5.6.1.1 Personnel Protection. Protection shall be provided through the use of barricades, shielding, or other means to protect personnel and property from the effects of explosion or ignition of the materials being tested.

5.6.1.2 Personal Protective Equipment. Protective clothing and equipment shall be provided to protect persons engaged in the testing, ignition, or detonation of explosive materials.

5.6.1.3 Safeguards.

5.6.1.3.1 Authorized Personnel. Test areas shall be restricted to access by authorized personnel.

5.6.1.3.2 Posting. Where test areas are located outdoors, areas where explosives are to be ignited shall be provided with means to prevent access by unauthorized personnel.

5.6.1.3.3 Warning Devices. Warning devices shall be used before igniting or detonating explosive materials in test areas to warn persons from any direction of approach that they are approaching a danger zone.

Chapter 6 Blasting Agents

6.1 Scope.

6.1.1 Unless otherwise specified in this chapter, blasting agents shall be transported, stored, and used in the same manner as other explosive materials.

6.1.2 Water gels, slurries, and emulsion explosives shall not be subject to the requirements of this chapter. *(See Chapter 7.)*

6.2 Fixed Location Mixing.

Δ **6.2.1** Buildings or other facilities used for mixing blasting agents shall be located, in relation to inhabited buildings, passenger railroads, and public highways, in accordance with the "American Table of Distances (ATD)." *[See Table 9.4.1(a) through Table 9.4.1(d).]*

6.2.2 Distance Separating Inhabited Buildings.

6.2.2.1 In determining the distance separating inhabited buildings, passenger railroads, or public highways from potential explosions, the sum of all masses that could propagate [i.e., that are closer than the distances specified in Table 9.4.2.2(a) or Table 9.4.2.2(b)] from either individual or combined donor masses shall be included.

6.2.2.2 Where ammonium nitrate is required to be included, only one-half of its mass shall be used due to its reduced blast effect.

6.2.3 Buildings used for the mixing of blasting agents shall comply with the requirements of 6.2.3.1 through 6.2.3.6, unless otherwise specifically approved by the authority having jurisdiction.

6.2.3.1 Buildings shall be constructed of noncombustible materials or of sheet metal on wood studs.

6.2.3.2 Floors.

6.2.3.2.1 Floors shall be of concrete or other noncombustible material.

6.2.3.2.2 Floors shall be constructed without open floor drains and without piping into which molten materials could flow and become confined in the event of fire.

6.2.3.3 All fuel oil storage facilities shall be separated from the mixing building and located so that the oil drains away from the mixing plant building if the tank ruptures.

6.2.3.4 The mixing building shall be well ventilated.

6.2.3.5 Heat.

6.2.3.5.1 Heating units that do not depend on the combustion of fuel shall be permitted to be used within the mixing building where correctly designed and located.

6.2.3.5.2 All direct sources of heat shall be provided exclusively from units located outside of the mixing building.

6.2.3.6 Internal Combustion Engines.

6.2.3.6.1 Internal combustion engines used to generate electrical power shall be located outside of the mixing building.

6.2.3.6.2 If located inside of the mixing building, internal combustion engines shall be ventilated and isolated by a fire barrier wall having a fire resistance rating of not less than 1 hour.

6.2.3.6.3 The engine exhaust system shall be located so that any spark emission cannot endanger any materials in or adjacent to the mixing building.

6.2.4 Equipment used for mixing blasting agents shall comply with the requirements of 6.2.4.1 through 6.2.4.3.

6.2.4.1 Mixing Equipment Design.

6.2.4.1.1 The design of the mixer shall minimize the possibility of frictional heating, compaction, and confinement.

6.2.4.1.2 All bearings and drive assemblies shall be mounted outside the mixer and protected against the accumulation of dust.

6.2.4.1.3 All surfaces shall be accessible for cleaning.

6.2.4.2 Mixing and packaging equipment shall be constructed of materials compatible with the blasting agent composition.

6.2.4.3 Flow of Fuel.

6.2.4.3.1 Means shall be provided to prevent the flow of fuel oil to the mixer in case of fire.

6.2.4.3.2 In gravity flow systems, an automatic spring-loaded shutoff valve with a fusible link or other equivalent method shall be installed.

6.2.5 The requirements of 6.2.5.1 through 6.2.5.6 shall apply where blasting agent compositions are mixed and handled.

6.2.5.1 Oxidizers of small particle size, such as crushed ammonium nitrate prills or fines, shall be handled with special care, due to the possibility of their greater sensitivity.

6.2.5.2 Flash Points.

6.2.5.2.1 No hydrocarbon liquid fuel with a flash point lower than that of No. 2 fuel oil [i.e., 51.7°C (125°F) minimum or legal minimum] shall be used.

6.2.5.2.2 Fuel oils with flash points no lower than 37.8°C (100°F) shall be permitted to be used at ambient air temperatures below 7.2°C (45°F).

6.2.5.3 Reclaimed crankcase oil shall be permitted to be used, provided each new supply of oil is checked for its compliance with 6.2.5.2.

6.2.5.4 Material Handling.

6.2.5.4.1 Metal powders, such as aluminum, shall be kept dry and shall be stored in containers or bins that are moisture-resistant and weathertight.

6.2.5.4.2 Solid fuels shall be handled so that dust explosion hazards are minimized.

6.2.5.5 Peroxides or chlorates shall not be used.

6.2.5.6 The requirements of 6.2.5.3, 6.2.5.4, and 6.2.5.5 shall not apply to compositions that have been tested, classified, and approved by the associate administrator for hazardous materials safety in accordance with the provisions of 49 CFR.

Δ **6.2.6** All electrical switches, controls, motors, and lights located in the mixing room shall comply with *NFPA 70*, Article 502, except for electrical wiring and equipment located outside the mixing building.

6.2.7 The frame of the mixer and all other equipment that is used shall be electrically bonded and grounded.

6.2.8 Safety precautions at mixing plants shall include the following requirements:

(1) Floors shall have no drains or piping into which molten materials could flow and become confined during a fire.
(2) The floors and equipment of the mixing and packaging rooms or areas shall be cleaned thoroughly on a regular basis to prevent accumulations of oxidizers, fuels, and sensitizers.
(3) The entire building shall be cleaned thoroughly on a regular basis to prevent the excessive accumulation of dust.
(4) Smoking, matches, open flames, spark-producing devices, and firearms shall not be permitted inside of or within 15.25 m (50 ft) of any building or facility used for the mixing of blasting agents.
(5) Firearms shall be permitted to be carried by authorized guards where approved by the authority having jurisdiction.
(6) The area surrounding the mixing plant shall be kept clear of brush, dried grass, leaves, and other materials for a distance of at least 7.63 m (25 ft).
(7) Empty ammonium nitrate bags shall be disposed of daily in a safe manner.
(8) No welding or open flames shall be permitted in or around the mixing or storage area, except where the equipment and the area have been completely washed down and all oxidizing material has been removed.
(9) Before welding on or making repairs to hollow shafts, all oxidizing material shall be removed from the outside and inside of the shaft.
(10) The shaft shall be vented with a minimum 13 mm (0.51 in.) diameter opening.
(11) Other explosive materials shall not be stored inside of or within 15.25 m (50 ft) of any building or facility used for mixing blasting agents.

6.3 Bulk Mixing and Delivery Vehicles.

6.3.1 Application.

6.3.1.1 The provisions of Section 6.3 shall apply to all bulk mixing and delivery vehicles.

6.3.1.2 The requirements of 6.2.5 also shall apply to bulk delivery and mixing vehicles.

6.3.2 The body of a vehicle for mixing and delivering blasting agents in bulk shall comply with the following requirements:

(1) The body shall be constructed of noncombustible materials.
(2) Vehicles used to transport bulk, premixed blasting agents shall have covered bodies.
(3) All moving parts of the mixing system shall be designed so that heat buildup is prevented.
(4) Shafts or axles that make contact with the product shall have outboard bearings with a minimum 25.4 mm (1 in.) clearance between the bearings and the outside of the product container.
(5) Attention shall be given to clearance on all moving parts.
(6) The bulk delivery vehicle shall be strong enough to carry the load without difficulty.
(7) The bulk delivery vehicle shall be in good mechanical condition.

6.3.3 Operation of bulk delivery vehicles shall comply with the following requirements:

(1) Vehicles transporting blasting agents shall be driven by and in the charge of only those drivers who are at least 21 years old; who are capable, careful, and reliable; and who possess a valid motor vehicle operator's license.
(2) Drivers shall be familiar with all traffic regulations, applicable federal and state regulations pertaining to explosive materials and with the requirements of this code.
(3) The vehicle operator shall be trained in the safe operation of the vehicle and knowledgeable of its mixing, conveying, and related equipment.
(4) The operator shall be familiar with the commodities being delivered and the general procedures for handling emergencies.
(5) No person shall be permitted to ride upon, drive, load, or unload a vehicle containing blasting agents while smoking or while under the influence of intoxicants, narcotics, or other dangerous drugs.
(6) Vehicles transporting blasting agents shall be in safe operating condition at all times.
(7) No person shall smoke, carry matches or any flame-producing device, or carry any firearms while in or around bulk vehicles affecting the mixing, transfer, or down-the-hole loading of blasting agents at or near the blasting site.
(8) Caution shall be exercised in moving the vehicle within the blasting area to avoid driving the vehicle over or dragging hoses over firing lines, cap wires, or explosive materials.
(9) The driver shall obtain the assistance of a second person to guide the driver's movements while moving the vehicle.
(10) Material shall not be mixed while in transit.

6.3.4 Pneumatic loading from bulk delivery vehicles into blast holes primed with electric blasting caps or other static-sensitive systems shall comply with the following requirements:

(1) A positive grounding device shall be used to prevent the accumulation of static electricity.
(2) A semiconductive discharge hose shall be used.
(3) A qualified person shall evaluate all systems to determine that they dissipate static electricity under potential field conditions.

6.3.5 Repairs to bulk delivery vehicles shall comply with the following requirements:

(1) No welding or open flames shall be used on or around any part of the delivery equipment until all oxidizing material has been removed and the equipment has been washed down completely.
(2) Before welding on or making repairs to hollow shafts, all oxidizing material shall be removed from the outside and inside of the shaft, and the shaft shall be vented with a minimum 13 mm (0.51 in.) diameter opening.

6.4 Bulk Storage Bins.

6.4.1 The bin shall be a Type 5 magazine.

6.4.2 The bin shall be waterproof.

6.4.3* The bin, including supports, shall be constructed of compatible materials.

6.4.4 The bin shall be supported and braced to withstand the combination of all loads, including impact forces arising from product movement within the bin and accidental contact between vehicles and the support legs of the bin.

6.4.5 Discharge Gate.

6.4.5.1 The bin discharge gate shall be designed to provide a closure tight enough to prevent leakage of the stored product.

6.4.5.2 Provision also shall be made for locking the discharge gate.

6.4.6 Bin-loading manways or access hatches shall be hinged or otherwise attached to the bin.

6.4.7 The manways or access hatches shall be designed to allow locking.

6.4.8 Conveyors.

Δ **6.4.8.1** Any electrically driven conveyors for loading or unloading bins shall comply with the requirements of *NFPA 70*.

6.4.8.2 They shall be designed to minimize damage from corrosion.

6.4.9 Bins containing blasting agents shall be located in accordance with Table 9.4.1(a) or Table 9.4.1(b) with respect to inhabited buildings, passenger railroads, and public highways.

6.4.10 Bins containing blasting agents shall be located in accordance with Table 9.4.1(a) or Table 9.4.1(b) and with Table 9.4.2.2(a) or Table 9.4.2.2(b) with respect to the storage of other blasting agents or explosives.

6.4.11 Bins containing ammonium nitrate shall be separated from the storage of blasting agents and explosives in accordance with 9.4.2.

6.4.12 Good housekeeping shall be maintained in the vicinity of any bin containing ammonium nitrate or other blasting agent.

6.4.12.1 This housekeeping shall include keeping weeds and other combustible materials cleared within 7.63 m (25 ft) of the bin.

6.4.12.2 Accumulations of spilled product shall be prevented.

6.5 Storage of Blasting Agents and Supplies.

6.5.1 Blasting agents and oxidizers used for the mixing of blasting agents shall be stored in accordance with the following requirements:

(1) Blasting agents or ammonium nitrate stored with other explosive materials shall be stored in accordance with the requirements of Section 6.5.
(2) The total mass of the blasting agents and one-half of the mass of ammonium nitrate shall be included when computing the total quantity of explosive materials for determining separation distance requirements.
(3) Blasting agents stored entirely separate from other explosive materials shall be stored in a Type 5 magazine or a magazine of higher classification (i.e., lower number).
(4) Magazines in which blasting agents are stored shall be constructed so that there are no open floor drains or piping into which molten materials could flow and become confined in the event of fire.
(5) Semitrailer and trailer vans used for highway or on-site transportation of blasting agents shall be permitted to be used for temporary storage of these materials, provided they are located in accordance with Table 9.4.1(a) through Table 9.4.1(d) with respect to inhabited buildings, passenger railways, and public highways, and in accordance with Table 9.4.2.2(a) or Table 9.4.2.2(b) with respect to each other.
(6) Trailers and semitrailers shall be provided with substantial means for locking.
(7) The doors of the trailers or semitrailers shall be kept locked.
(8) Where stocks of blasting agents are actually being placed or removed, the doors of trailers and semitrailers shall not be required to be locked.

6.5.2 Piles of ammonium nitrate and warehouses containing ammonium nitrate shall be separated from readily combustible fuels.

6.5.3 Caked oxidizer, either in bags or in bulk, shall not be loosened by blasting.

6.5.4 Every magazine used for the storage of blasting agents shall be under the supervision of a competent person who is at least 21 years old.

6.6 Transportation of Packaged Blasting Agents.

6.6.1 Where blasting agents are transported in the same vehicle with other explosive materials, all the requirements of Chapter 8 shall be met.

6.6.2 Vehicles Transporting Blasting Agents.

6.6.2.1 Vehicles transporting blasting agents shall be driven by and in the charge of only those drivers who are at least 21 years old, who are capable, careful, and reliable, and who possess a valid motor vehicle operator's license.

6.6.2.2 The driver shall be familiar with state vehicle and traffic laws.

6.6.3 No matches, firearms, acids, or other corrosive liquids shall be carried in the bed or body of any vehicle carrying blasting agents.

6.6.4 No person shall be permitted to ride on, drive, load, or unload a vehicle containing blasting agents while smoking or while under the influence of intoxicants, narcotics, or other dangerous drugs.

6.6.5 No person shall transport or carry any blasting agents on any public vehicle carrying passengers for hire.

6.6.6 Vehicles transporting blasting agents shall be in safe operating condition at all times.

6.6.7 Where blasting agents are transported over public highways, the packaging, marking, and labeling of containers of blasting agents shall comply with U.S. DOT regulations.

6.6.8 Vehicles used for transporting blasting agents on public highways shall be placarded in accordance with U.S. DOT regulations.

6.7 Use of Blasting Agents. Persons using blasting agents shall comply with all applicable requirements of Chapters 4 and 10.

Chapter 7 Water Gel, Slurry, and Emulsion Explosive Materials

7.1 Scope. Water gels, slurries, and emulsions classified as Division 1.1D or Division 1.5D explosives in accordance with U.S. DOT regulations shall be manufactured, transported, stored, and used as specified by this code, except as otherwise specified in this chapter.

7.2 Fixed Location Mixing.

7.2.1 Buildings or other facilities used for mixing water gels, slurries, or emulsions shall be located in accordance with Table 9.4.1(a) through Table 9.4.1(d) with respect to inhabited buildings, passenger railroads, and public highways.

7.2.1.1 In determining the distances separating highways, railroads, and inhabited buildings from potential explosions, as specified in Table 9.4.1(a) through Table 9.4.1(d), the sum of all masses that can propagate [i.e., that lie at distances less than those specified by Table 9.4.2.2(a) or Table 9.4.2.2(b)] from either individual or combined donor masses shall be included.

7.2.1.2 Where ammonium nitrate is required to be included, only one-half of its mass shall be used because of its reduced blast effects.

7.2.2 Buildings used for the mixing of water gels, slurries, or emulsions shall comply with the following requirements, except where otherwise specifically approved by the authority having jurisdiction:

(1) Buildings shall be constructed of noncombustible materials or of sheet metal on wood studs.
(2) Floors shall be of concrete or other noncombustible material.
(3) Floors shall be constructed without open floor drains and without piping into which molten materials could flow and become confined in the event of fire.
(4) Where fuel oil is used, fuel oil storage facilities shall be separated from the mixing plant and located so that the oil will drain away from the mixing building in case of tank rupture.

(5) The mixing building shall be well ventilated.
(6) Heating units that do not depend on the combustion of fuel shall be permitted to be used in the mixing building, where correctly designed and located.
(7) Direct-fired heating units shall be located outside of the mixing building.
(8) Internal combustion engines used to generate electrical power shall be located outside of the mixing building.
(9) If located inside of the mixing building, internal combustion engines shall be isolated by a fire partition and shall be ventilated.
(10) The engine exhaust system shall be located so that any sparks emission cannot endanger any materials in or adjacent to the mixing building.

7.2.3 The ingredients used in water gels, slurries, or emulsions shall comply with the following requirements:

(1) Ingredients classified as explosives shall be stored as required by Chapter 9.
(2) Nitrate–water solutions shall be stored in tank cars, tank trucks, or fixed tanks without quantity–distance limitations.
(3) Spills or leaks that could contaminate combustible materials shall be cleaned up immediately.
(4) Metal powders, such as aluminum, shall be kept dry and shall be stored in containers or bins that are moisture resistant or weathertight.
(5) Ingredients shall not be stored with incompatible materials.
(6) Peroxides or chlorates shall not be used.

Δ **7.2.4** Mixing equipment shall meet the following requirements:

(1) The design of the processing equipment, including mixing and conveying equipment, shall be compatible with the materials being handled.
(2) The equipment shall be designed to minimize frictional heating, compaction, overloading, and confinement.
(3) Equipment and handling procedures shall be designed to prevent the introduction of foreign objects or material.
(4) Mixers, pumps, valves, and related equipment shall be designed to allow regular and periodic flushing, cleaning, dismantling, and inspection.
(5) All electrical equipment and wiring shall comply with *NFPA 70*.
(6) Electric motors and generators shall be provided with overload protection devices.
(7) All motors, generators, proportioning devices, and all other electrical enclosures shall be bonded.
(8) The grounding conductor to all such equipment shall be effectively bonded to the service-entrance ground connection and to all equipment ground connections in order to provide a continuous path to ground.

7.2.5 Mixing facilities shall meet the following requirements:

(1) The mixing, loading, and ingredient transfer areas where residues and spilled materials can accumulate shall be kept safe.
(2) A cleaning and collection system shall be provided for dangerous residues.
(3) A visual inspection of the mixing, conveying, and electrical equipment shall be made daily to ensure that all equipment is in good operating condition.
(4) A program of systematic maintenance shall be carried out on a regular schedule.
(5) Heating units that do not depend on the combustion of fuel shall be permitted to be used within the confines of the processing building or area, provided they are equipped with temperature and safety controls and provided they are located away from combustible materials and finished product.

7.3 Bulk Mixing and Delivery Vehicles.

7.3.1 Vehicle design shall meet the following requirements:

(1) Vehicles used for bulk transportation of water gels shall meet the requirements of Chapter 8 and Section 6.6.
(2) Where electrical power is supplied by a self-contained motor-generator located on the vehicle, the generator shall be separated from the discharge point of the water gel.
(3) Processing equipment shall comply with 7.2.3 and 7.2.4.
(4) A positive action parking brake that sets the brakes on at least one axle shall be provided on vehicles equipped with air brakes.
(5) This brake shall be used during bulk delivery operations.
(6) Where required, wheel chocks shall be used.

7.3.2 Operation of bulk mixing and delivery vehicles shall meet the following requirements:

(1) The vehicle operator shall be trained in the safe operation of the vehicle and knowledgeable of its mixing, conveying, and related equipment.
(2) The operator shall be familiar with the commodities being delivered and the general procedures for handling emergencies.
(3) No person shall smoke, carry matches or any other flame-producing device, or carry any firearms while in or around bulk vehicles affecting the mixing, transfer, or down-the-hole loading of water gels at or near the blasting site.
(4) Caution shall be exercised in moving the vehicle within the blasting area to avoid driving the vehicle over or dragging hoses over firing lines, cap wires, or explosive materials.
(5) The driver shall obtain the assistance of a second person to guide the driver's movements while moving the vehicle.
(6) Material shall not be mixed while in transit.
(7) The location chosen for transferring the water gel or its ingredients from a support vehicle to the borehole-loading vehicle shall be away from the blast hole site where the boreholes are loaded or are in the process of being loaded.

7.4 Storage of Water Gels, Slurries, and Emulsions.

7.4.1 Water gels, slurries, or emulsions shall be stored as required by Chapter 9.

7.4.2 Where tests on specific formulations result in a Division 1.5 explosives classification from the DOT, bullet-resistant magazines shall not be required. *(See 9.2.4.)*

7.4.3 Temporary Storage in Transportation Vehicles.

7.4.3.1 Semitrailer vans, trailer vans, or tanks used for the transportation of water gels, slurries, or emulsions shall be permitted to be used for temporary storage of Division 1.5 materials.

7.4.3.1.1 These vehicles shall be located in accordance with Table 9.4.1(a) through Table 9.4.1(d) with respect to inhabited buildings, passenger railways, and public highways.

7.4.3.1.2 Table 9.4.2.2(a) or Table 9.4.2.2(b) shall be used to determine the effective quantity on site.

7.4.3.2 Trailers and semitrailers shall be provided with substantial means for locking.

7.4.3.2.1 The doors, hatches, and valves of the trailers and semitrailers shall be kept locked.

7.4.3.2.2 Locking mechanisms shall be as specified for Type 5 magazines. *(See 9.6.5.)*

7.4.3.2.3 Where stocks of water gels are actually being loaded or removed, the doors of trailers and semitrailers shall not be required to be locked.

Chapter 8 Transportation of Explosive Materials on Highways

8.1 Basic Requirements.

Δ **8.1.1** In addition to all other applicable requirements of this code, the transportation of explosive materials shall comply with U.S. Department of Transportation, 49 CFR 100–179 and 49 CFR 397.

8.1.2 This chapter shall not apply to the transportation of small arms ammunition and components. *(See Chapter 14.)*

8.1.3 Explosive materials shall not be transported through any prohibited vehicular tunnel or subway or over any prohibited bridge, roadway, or elevated highway.

8.1.4 No person shall smoke or carry matches, flame-producing devices, or unauthorized firearms or cartridges while transporting explosive materials.

8.1.5 No person shall drive, load, or unload a motor vehicle transporting explosive materials in a careless or reckless manner.

8.1.6 Explosive materials shall not be carried or transported in or upon a public conveyance or vehicle carrying passengers for hire.

8.1.7 Transfer of Explosives.

8.1.7.1 Explosive materials shall not be transferred from one vehicle to another without informing the local authority having jurisdiction.

8.1.7.2 In the event of breakdown or collision, the local authority having jurisdiction shall be notified promptly to help safeguard such emergencies.

8.1.7.3 Explosive materials shall be transferred from the disabled vehicle to another vehicle, only where qualified supervision is provided.

8.1.8 Detonators shall not be transported in the same vehicle with other Class 1 materials, except as permitted by the U.S. Department of Transportation in 49 CFR 177.835(g).

8.2 Transportation Vehicles.

8.2.1 Vehicles used for transporting explosive materials shall be strong enough to carry the load and in good mechanical condition.

8.2.2 Where explosive materials are transported on a vehicle with an open body, a portable magazine, securely fastened to the vehicle body, shall be used to store the explosive materials.

8.2.3 Vehicles used for transporting frictional spark-sensitive explosive materials such as Black Powder and primary explosives shall have no exposed spark-producing surface inside of the cargo body.

8.2.4 The floors of transportation vehicles shall be tight.

8.2.5 Motor vehicles used for transporting any quantity of explosive materials on public highways shall display all placards, lettering, or numbering required by the U.S. DOT.

8.2.6 Each motor vehicle used for transporting explosive materials shall be equipped with at least two fire extinguishers, each with a rating of at least 4-A:40-B:C.

8.2.6.1 Only listed fire extinguishers shall be used.

8.2.6.2 Fire extinguishers shall be designed, constructed, and maintained to allow a visual determination that extinguishers are fully charged.

8.2.6.3 Extinguishers shall be located where they are accessible for immediate use.

8.2.6.4 Extinguishers shall be examined and recharged periodically according to manufacturers' recommendations.

8.2.6.5 Where motor vehicles are operated in temperatures below –17.8°C (0°F), dry chemical extinguishers shall be pressurized with nitrogen.

8.2.7 Transporting Explosive Materials.

8.2.7.1 A motor vehicle used for transporting explosive materials shall be inspected to determine that it is in proper condition.

8.2.7.2 The following items shall be verified:

(1) The fire extinguisher is filled and in working order.
(2) All electrical wiring is completely protected and securely fastened to prevent short-circuiting.
(3) The chassis, motor, oil pan, and body undersides are reasonably clean and free of excess oil and grease.
(4) The fuel tank and fuel lines are secure and free of leaks.
(5) The brakes, lights, horn, windshield wipers, and steering apparatus are functioning.
(6) The tires are inflated to the correct pressure and are free of defects.
(7) The vehicle is in the proper condition in every other respect and is acceptable for handling explosive materials.

8.2.8 Tire Maintenance.

8.2.8.1 Flat or overheated tires shall be removed from the vehicle immediately.

8.2.8.2 After removal, the tire shall be placed far enough from the vehicle so that a spontaneous ignition of the tire does not endanger the vehicle or its cargo.

8.2.8.3 The tire shall be cooled below the danger of ignition.

8.2.8.4 The problem with the tire shall be corrected before it is replaced on the vehicle.

8.3 Operation of Transportation Vehicles.

8.3.1 Vehicles transporting explosive materials shall be driven by and be in the charge of only a licensed driver who is physically fit, careful, capable, reliable, and able to read and write the English language and who is not addicted to the use of, or under the influence of, intoxicants, narcotics, or other dangerous drugs.

8.3.2 Drivers.

8.3.2.1 The driver of a vehicle transporting explosive materials on public highways shall be not less than 21 years old.

8.3.2.2 The driver shall be familiar with traffic regulations, applicable federal and state regulations concerning explosive materials, and the provisions of this chapter.

8.3.2.3 The driver shall be familiar with the selection and use of available safety equipment, including the fire extinguishers required in 8.2.6.

8.3.3 No vehicle transporting explosive materials shall be parked before reaching its destination, even while attended, on any public street adjacent to or in proximity to any bridge, tunnel, dwelling, building, or place where people work, congregate, or assemble except under emergency conditions.

8.3.4 Every motor vehicle transporting any quantity of Division 1.1, 1.2, or 1.3 materials shall, at all times, be attended by a driver or other qualified representative of the motor carrier operating the vehicle.

8.3.5 Vehicles transporting Division 1.4, 1.5, or 5.1 materials shall be attended unless its driver is performing duties that are incident and necessary to the driver's duties as the operator of the vehicle and the Division 1.4, 1.5, or 5.1 materials and vehicle are secured from unauthorized access or use.

8.3.6 Attended Vehicle Requirements.

8.3.6.1 For the purpose of this chapter, a motor vehicle shall be considered "attended" only when the driver or attendant is physically on or in the vehicle or when the vehicle is within his or her field of vision and the driver can reach it quickly and without interference.

8.3.6.2 "Attended" also shall mean that the driver or attendant is awake, alert, and not engaged in other duties or activities that could divert attention from the vehicle.

8.3.6.2.1 This requirement shall not apply where communication with public officers or representatives of the shipper, carrier, or consignee who are absent from the vehicle to obtain food or provide for physical comfort is necessary.

Δ **8.3.6.2.2** A vehicle carrying explosive materials shall be permitted to be left unattended, provided it is parked in an area where such parking is permitted, such as an area meeting the requirements of NFPA 498.

8.3.6.3 The attendant shall have been made aware of the class of the explosive in the vehicle and its inherent dangers and been instructed in the procedures to be followed in order to protect the public from those dangers.

8.3.6.4 The attendant shall be familiar with the vehicle assigned and provided with the training, necessary means, and authorization to move the vehicle where required.

8.3.7 No spark-producing metal or tools, oils, matches, firearms, electric storage batteries, flammable materials, acids, oxidizers, or corrosives shall be carried in the cargo body of any motor vehicle transporting explosive materials, except where permitted by the U.S. DOT 49 CFR.

8.3.8 Vehicle Routing.

8.3.8.1 Vehicles transporting explosive materials shall avoid congested areas and heavy traffic.

8.3.8.2 Where routes through congested areas have been designated by the authority having jurisdiction, such routes shall be followed.

8.3.9 Delivery shall be made only to authorized persons and into authorized magazines or approved temporary storage or handling areas.

Chapter 9 Aboveground Storage of Explosive Materials

9.1 Scope.

9.1.1 Explosive materials shall be kept in magazines meeting the requirements of this chapter.

9.1.2 This chapter shall not apply to the storage of small arms ammunition, propellant-actuated cartridges, small arms ammunition primers, and smokeless propellants. *(See Chapter 14.)*

9.2 Basic Requirements.

9.2.1 All explosive materials not in the process of manufacture, transportation, or use shall be kept in storage magazines.

9.2.2 Ammonium nitrate shall be permitted to be stored in the same magazine with blasting agents.

9.2.2.1 Ammonium nitrate and blasting agents shall be permitted to be stored in the same magazine with other explosive materials. *(See 9.2.3.)*

9.2.2.2 Where ammonium nitrate is stored in the same magazine with blasting agents, the magazine shall be designed for the storage of blasting agents.

9.2.2.3 Where ammonium nitrate is stored in the same magazine with explosives or with explosives and blasting agents, the magazine shall be designed for the storage of explosives.

9.2.2.4 In determining the maximum quantity of explosive material that is permitted to be placed in a magazine, one-half the weight of the ammonium nitrate shall be added to the weight of the explosive material.

9.2.3 Detonators shall be stored in a separate magazine for blasting supplies and not be stored in a magazine with other explosive materials.

9.2.4 Explosive materials classified as Division 1.1 or Division 1.2 by the U.S. DOT shall be stored in Type 1, 2, or 3 magazines.

9.2.5 Black Powder shall be permitted to be stored in a Type 4 magazine or a magazine of higher classification (i.e., lower type number).

9.2.6 Division 1.5 explosive materials (blasting agents) shall be permitted to be stored in a Type 5 magazine or a magazine of higher classification (i.e., lower type number).

9.3 Classification and Use of Magazines.

Δ **9.3.1** Outdoor magazines shall be classified and used in accordance with Table 9.3.1(a) and Table 9.3.1(b).

9.3.2 Indoor magazines used for the storage of 22.7 kg (50 lb) or less of explosive materials in warehouses and in wholesale or retail establishments shall be fire resistant and theft resistant and subject to the approval of the AHJ.

9.4 Location of Magazines.

Δ **9.4.1** All outdoor magazines other than Type 3 shall be located to comply with the "American Table of Distances (ATD)" as shown in Table 9.4.1(a) through Table 9.4.1(d), as applicable.

Δ **9.4.1.1** If the ATD cannot be met, the use of a quantitive risk assessment shall be permitted to determine minimum distances from magazines.

9.4.1.2 Indoor or outdoor magazines utilized in conjunction with operating buildings shall be in accordance with the requirements of 5.3.3 and 5.3.4 as applicable.

9.4.2 Blasting Agents.

9.4.2.1 Blasting agent manufacturing plants and storage of blasting agents and ammonium nitrate shall be located in compliance with the ATD, Table 9.4.1(a) through Table 9.4.1(d), in regards to their proximity to inhabited buildings, public highways, and passenger railways.

Δ **9.4.2.2** If magazine locations are closer to each other than specified in the Table of Recommended Separation Distances of Ammonium Nitrate and Blasting Agents (also known as the Separation Distance Table, or SDT), as shown in Table 9.4.2.2(a) or Table 9.4.2.2(b), the quantities shall be added together when determining distances in the ATD.

Δ **Table 9.3.1(a) Construction Features of Magazines**

Classification and Use of Magazines/ Construction Features	Magazine Types 1	2	3	4	5
Permanent	X			X	X
Portable		X	X	X	X
Bullet resistant	X	X			
Fire resistant	X	X	X	X*	X*
Theft resistant	X	X	X	X	X†
Weather resistant	X	X	X	X	X
Ventilated	X	X	X	X*	X*

X: Permitted.

*Over-the-road trucks or semitrailers used for temporary storage as Type 4 or Type 5 magazines shall not be required to be fire resistant or ventilated.

†Each door of a mobile Type 5 magazine shall be equipped with at least one five-tumbler padlock having a 9.5 mm (⅜ in.) case-hardened shackle. The lock shall not be required to be hooded.

Δ **Table 9.3.1(b) Allowable Storage in Magazines**

Storage in Magazines	Magazine Types 1	2	3	4	5
High explosives (1.1D), including dynamites, cap-sensitive emulsions, slurries and water gels, cast boosters	X	X	X		
Black Powder (1.1D); defined as low explosive by the ATF for storage	X	X	X	X	
Detonators (1.1B)	X	X	X		
Detonating cords (1.1D, 1.2D, 1.4G)	X	X	X		
Detonators (1.4B, 1.4S)	X	X	X	X	
Safety fuse, electric squibs, igniters, and igniter cord (1.4G, 1.4S)	X	X	X	X	
Blasting agents (1.5D) (blasting agents)	X	X	X	X	X
Propellants (1.3C); defined as low explosive by the ATF for storage	X	X	X	X	

X: Permitted.

Notes:

(1) Detonators that are mass detonating shall not be stored in the same magazine with other explosive materials.

(2) Detonators that are not mass detonating shall be permitted to be stored with safety fuses, electric squibs, igniters, or igniter cord in Type 1, 2, 3, or 4 magazines.

Δ Table 9.4.1(a) Metric American Table of Distances as Revised and Approved by the Institute of Makers of Explosives (IME)

Quantity of Explosive Materials		Distances in Meters							
		Inhabited Buildings		Public Highways with Traffic Volume of Less Than 3,000 Vehicles/Day		Passenger Railways and Public Highways with Traffic Volume of More Than 3,000 Vehicles/Day		Separation of Magazines	
Kilograms Over	Kilograms Not Over	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded
0	3	21.3	46.6	9.1	19.3	15.5	33.6	1.8	4.1
3	5	29.4	56.1	11.7	23.3	21.2	42.4	2.6	5.3
5	10	34.0	68.9	13.9	27.7	25.1	50.1	3.7	6.2
10	15	39.0	79.0	15.6	31.1	29.0	57.9	3.4	6.5
15	20	43.6	87.8	17.2	34.5	32.0	64.1	3.8	7.7
20	25	48.2	93.9	19.5	39.1	35.6	71.3	4.4	8.8
25	35	53.1	105	21.6	43.3	39.5	78.9	4.6	9.3
35	50	58.2	118	23.0	46.0	42.7	85.3	4.9	9.9
50	65	62.8	129	25.0	50.0	46.8	93.7	5.6	11.2
65	80	70.0	138	28.1	56.3	52.0	104	6.2	12.5
80	100	74.8	148	30.6	61.1	55.6	111	6.7	13.4
100	120	79.6	158	32.6	65.3	59.1	118	7.1	14.3
120	150	84.5	169	34.4	68.8	63.0	126	7.6	15.2
150	200	92.3	186	37.5	75.0	69.0	138	8.4	16.8
200	250	100	201	40.2	80.5	74.4	149	9.1	18.2
250	300	106	213	42.7	85.4	79.1	158	9.6	19.2
300	350	112	225	45.1	90.3	83.3	167	9.9	19.9
650	400	118	236	46.8	93.6	87.1	174	10.5	21.0
400	450	121	243	48.5	97.0	90.8	182	10.9	21.8
450	500	129	252	50.2	100	96.5	193	11.8	23.6
500	600	133	268	51.1	102	99.7	200	12.2	24.4
600	700	141	283	52.8	106	105	211	12.8	25.9
700	800	148	297	54.4	109	110	222	13.3	26.7
800	900	153	307	56.1	113	115	230	13.8	27.4
900	1,100	165	329	57.8	115	124	246	14.5	29.5
1,100	1,300	175	348	59.2	118	131	259	14.5	31.2
1,300	1,500	189	364	62.8	126	141	282	17.2	34.4
1,500	1,900	198	393	65.4	131	148	296	18.0	35.9
1,900	2,300	211	420	69.2	138	158	317	18.8	37.6
2,300	2,800	223	449	71.8	144	167	334	19.9	39.8
2,800	3,300	236	474	74.9	150	176	352	20.9	41.9
3,300	3,800	247	496	76.6	153	185	370	22.2	44.4
3,800	4,400	258	522	78.3	157	193	385	23.2	46.4
4,400	5,000	266	530	81.4	163	206	411	24.6	49.3
4,900	5,550	277	554	83.1	166	214	428	25.8	51.6
5,600	6,500	271	541	84.1	168	222	444	26.7	53.4
6,500	7,500	276	555	85.6	171	232	464	27.6	55.3
7,500	8,500	289	581	87.3	175	242	484	29.0	58.0
8,500	10,000	306	601	91.2	182	255	510	30.7	61.3
10,000	12,000	331	610	99.1	198	274	548	32.9	65.8
12,000	14,000	351	610	105	211	289	577	34.8	69.5
14,000	16,000	371	610	111	222	301	600	36.5	73.1
16,000	18,500	390	610	116	232	313	610	37.9	75.8
18,500	21,000	411	610	123	246	327	610	39.6	79.2
21,000	23,500	432	610	130	259	339	610	41.5	83.1

(continues)

Δ **Table 9.4.1(a)** *Continued*

Quantity of Explosive Materials		Distances in Meters							
		Inhabited Buildings		Public Highways with Traffic Volume of Less Than 3,000 Vehicles/Day		Passenger Railways and Public Highways with Traffic Volume of More Than 3,000 Vehicles/Day		Separation of Magazines	
Kilograms Over	Kilograms Not Over	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded
23,500	26,000	451	610	136	272	351	610	43.2	86.4
26,000	28,500	469	610	141	282	362	610	44.9	89.8
28,500	31,000	485	610	146	292	373	610	46.6	93.2
31,000	33,500	500	610	151	302	382	610	48.3	96.5
33,500	36,000	514	610	155	310	392	610	49.9	99.9
36,000	38,500	526	610	158	316	401	610	51.6	103
38,500	40,500	536	610	162	323	410	610	53.3	107
40,500	42,500	544	610	164	326	416	610	54.6	109
42,500	44,500	551	610	166	331	422	610	56.0	112
44,500	47,000	557	610	167	334	433	610	58.3	117
47,000	50,000	562	610	168	336	443	610	60.5	121
50,000	55,000	566	610	169	338	451	610	62.6	125
55,000	60,000	572	610	174	342	465	610	65.9	132
60,000	65,000	577	610	194	345	477	610	69.3	139
65,000	70,000	583	610	175	350	489	610	72.6	145
70,000	75,000	594	610	178	356	501	610	76.0	152
75,000	80,000	603	610	182	363	512	610	79.4	159
80,000	85,000	610	612	184	368	523	610	82.7	165
85,000	90,000	617	618	186	371	533	610	86.1	172
90,000	95,000	625	626	189	377	542	610	89.4	179
95,000	100,000	639	634	193	387	559	610	95.7	191
100,000	110,000	649	651	196	392	568	610	99.2	198
110,000	120,000	668	668	202	403	588	610	105	213
120,000	135,000	686	692	208	416	603	610	114	228

Source: Approved by the IME Board of Governors on October 26, 2001.

9.4.3 Tables.

9.4.3.1 The separation distances provided by the ATD [Table 9.4.1(a) through Table 9.4.1(d)] or the SDT [Table 9.4.2.2(a) or Table 9.4.2.2(b)], or both, shall be used to determine minimum separation of storage facilities for explosives, blasting agents, and ammonium nitrate.

9.4.3.2 The tables to be used shall be as specified in Table 9.4.3.2.

9.4.4 Indoor Magazine Location — General Requirements.

9.4.4.1 An indoor magazine shall be located only on a floor that has an entrance at or a ramp to grade level.

9.4.4.2 An indoor magazine shall be located no more than 3 m (10 ft) from the entrance.

9.4.4.3 An indoor magazine shall be located as approved by the authority having jurisdiction to facilitate rapid removal in an emergency.

9.4.5 Magazine Location.

9.4.5.1 Two magazines shall be permitted to be located in the same building, provided one magazine is used solely for the storage of detonators in quantities not exceeding 5000.

9.4.5.2 A distance of 3 m (10 ft) shall be maintained between the magazines.

9.4.6 Notification of Authorities.

9.4.6.1 Any person who stores explosive materials shall notify the AHJ for fire safety in the locality in which the explosive materials are being stored of the type, magazine capacity, and location of each site where such explosive materials are stored.

9.4.6.2 Such notification shall be made orally before the end of the day on which storage of the explosive materials commenced and in writing within 48 hours from the time such storage commenced.

9.4.7 Type 3 magazines shall be attended where explosive materials are stored within.

Table 9.4.1(b) American Table of Distances

Quantity of Explosive Materials[1,2,3,4,5]		Distances in Feet							
		Inhabited Buildings[10]		Public Highways Traffic Volume of 3,000 Vehicles/Day or Less[12]		Passenger Railways — Public Highways with Traffic Volume of More Than 3,000 Vehicles/Day[11,12]		Separation of Magazines[6,13]	
Pounds Over	Pounds Not Over	Barricaded[7,8,9]	Unbarricaded	Barricaded[7,8,9]	Unbarricaded	Barricaded[7,8,9]	Unbarricaded	Barricaded[7,8,9]	Unbarricaded
0	5	70	140	30	60	51	102	6	12
5	10	90	180	35	70	64	128	8	16
10	20	110	220	45	90	81	162	10	20
20	30	125	250	50	100	93	186	11	22
30	40	140	280	55	110	103	206	12	24
40	50	150	300	60	120	110	220	14	28
50	75	170	340	70	140	127	254	15	30
75	100	190	380	75	150	139	278	16	32
100	125	200	400	80	160	150	300	18	36
125	150	215	430	85	170	159	318	19	38
150	200	235	470	95	190	175	350	21	42
200	250	255	510	105	210	189	378	23	46
250	300	270	540	110	220	201	402	24	48
300	400	295	590	120	240	221	442	27	54
400	500	320	640	130	260	238	476	29	58
500	600	340	680	135	270	253	506	31	62
600	700	355	710	145	290	266	532	32	64
700	800	375	750	150	300	278	556	33	66
800	900	390	780	155	310	289	578	35	70
900	1,000	400	800	160	320	300	600	36	72
1,000	1,200	425	850	165	330	318	636	39	78
1,200	1,400	450	900	170	340	336	672	41	82
1,400	1,600	470	940	175	350	351	702	43	86
1,600	1,800	490	980	180	360	366	732	44	88
1,800	2,000	505	1,010	185	370	378	756	45	90
2,000	2,500	545	1,090	190	380	408	816	49	98
2,500	3,000	580	1,160	195	390	432	864	52	104
3,000	4,000	635	1,270	210	420	474	948	58	116
4,000	5,000	685	1,370	225	450	513	1,026	61	122
5,000	6,000	730	1,460	235	470	546	1,092	65	130
6,000	7,000	770	1,540	245	490	573	1,146	68	136
7,000	8,000	800	1,600	250	500	600	1,200	72	144
8,000	9,000	835	1,670	255	510	624	1,248	75	150
9,000	10,000	865	1,730	260	520	645	1,290	78	156
10,000	12,000	875	1,750	270	540	687	1,374	82	164
12,000	14,000	885	1,770	275	550	723	1,446	87	174
14,000	16,000	900	1,800	280	560	756	1,512	90	180
16,000	18,000	940	1,880	285	570	786	1,572	94	188
18,000	20,000	975	1,950	290	580	813	1,626	98	196
20,000	25,000	1,055	2,000	315	630	876	1,752	105	210
25,000	30,000	1,130	2,000	340	680	933	1,866	112	224
30,000	35,000	1,205	2,000	360	720	981	1,962	119	238
35,000	40,000	1,275	2,000	380	760	1,026	2,000	124	248
40,000	45,000	1,340	2,000	400	800	1,068	2,000	129	258
45,000	50,000	1,400	2,000	420	840	1,104	2,000	135	270
50,000	55,000	1,460	2,000	440	880	1,140	2,000	140	280
55,000	60,000	1,515	2,000	455	910	1,173	2,000	145	290
60,000	65,000	1,565	2,000	470	940	1,206	2,000	150	300
65,000	70,000	1,610	2,000	485	970	1,236	2,000	155	310
70,000	75,000	1,655	2,000	500	1,000	1,263	2,000	160	320
75,000	80,000	1,695	2,000	510	1,020	1,293	2,000	165	330
80,000	85,000	1,730	2,000	520	1,040	1,317	2,000	170	340
85,000	90,000	1,760	2,000	530	1,060	1,344	2,000	175	350
90,000	95,000	1,790	2,000	540	1,080	1,368	2,000	180	360
95,000	100,000	1,815	2,000	545	1,090	1,392	2,000	185	370
100,000	110,000	1,835	2,000	550	1,100	1,437	2,000	195	390
110,000	120,000	1,855	2,000	555	1,110	1,479	2,000	205	410
120,000	130,000	1,875	2,000	560	1,120	1,521	2,000	215	430
130,000	140,000	1,890	2,000	565	1,130	1,557	2,000	225	450

(continues)

Table 9.4.1(b) *Continued*

Quantity of Explosive Materials[1,2,3,4,5]		Distances in Feet							
		Inhabited Buildings[10]		Public Highways Traffic Volume of 3,000 Vehicles/Day or Less[12]		Passenger Railways — Public Highways with Traffic Volume of More Than 3,000 Vehicles/Day[11,12]		Separation of Magazines[6,13]	
Pounds Over	Pounds Not Over	Barricaded[7,8,9]	Unbarricaded	Barricaded[7,8,9]	Unbarricaded	Barricaded[7,8,9]	Unbarricaded	Barricaded[7,8,9]	Unbarricaded
140,000	150,000	1,900	2,000	570	1,140	1,593	2,000	235	470
150,000	160,000	1,935	2,000	580	1,160	1,629	2,000	245	490
160,000	170,000	1,965	2,000	590	1,180	1,662	2,000	255	510
170,000	180,000	1,990	2,000	600	1,200	1,695	2,000	265	530
180,000	190,000	2,010	2,010	605	1,210	1,725	2,000	275	550
190,000	200,000	2,030	2,030	610	1,220	1,755	2,000	285	570
200,000	210,000	2,055	2,055	620	1,240	1,782	2,000	295	590
210,000	230,000	2,100	2,100	635	1,270	1,836	2,000	315	630
230,000	250,000	2,155	2,155	650	1,300	1,890	2,000	335	670
250,000	275,000	2,215	2,215	670	1,340	1,950	2,000	360	720
275,000	300,000	2,275	2,275	690	1,380	2,000	2,000	385	770

Superscript numerals refer to explanatory footnotes.

Explanatory Notes Essential to the Application of the American Table of Distances.

[1]"Explosive materials" means explosives, blasting agents, and detonators.

[2]"Explosives" means any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion. A list of explosives determined to be within the coverage of 18 USC 40, "Importation, Manufacture, Distribution and Storage of Explosive Materials," is issued at least annually by the Director of the Bureau of Alcohol, Tobacco, and Firearms of the Department of the Treasury. For quantity and distance purposes, detonating cord of 50 grains per foot should be calculated as equivalent to 3.7 kg (8 lb) of high explosives per 305 m (1000 ft). Heavier or lighter core loads should be rated proportionately.

[3]"Blasting agents" means any material or mixture consisting of fuel and oxidizer, intended for blasting, and not otherwise defined as an explosive, provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a No. 8 test blasting cap where unconfined.

[4]"Detonator" means any device containing any initiating or primary explosive that is used for initiating detonation. A detonator may not be permitted to contain more than 10 g of total explosives by weight, excluding ignition or delay charges. The term includes, but is not limited to, electric blasting caps of instantaneous and delay types, blasting caps for use with safety fuses, detonating cord delay connectors, and nonelectric instantaneous and delay blasting caps that use detonating cord, shock tube, or any other replacement for electric leg wires. All types of detonators in strengths through No. 8 cap should be rated at 0.7 kg (1½ lb) of explosives per 1000 caps.

[5]For strengths higher than No. 8 cap, the manufacturer should be consulted.

[6]"Magazine" means any building, structure, or container, other than an explosives manufacturing building, approved for the storage of explosive materials.

[7]"Natural barricade" means natural features of the ground, such as hills, or timber of sufficient density that the surrounding exposures that need protection cannot be seen from the magazine when the trees are bare of leaves.

[8]"Artificial barricade" means an artificial mound or revetted wall of earth of a minimum thickness of 0.9 m (3 ft).

[9]"Barricaded" means the effective screening of a building containing explosive materials from the magazine or another building, a railway, or a highway by a natural or an artificial barrier. A straight line from the top of any sidewall of the building containing explosive materials to the eave line of any magazine or other building or to a point 3.7 m (12 ft) above the center of a railway or highway shall pass through such barrier.

[10]"Inhabited building" means a building regularly occupied in whole or part as a habitation for human beings, or any church, schoolhouse, railroad station, store, or other structure where people are accustomed to assemble, but does not include any building or structure occupied in connection with the manufacture, transportation, storage, or use of explosive materials.

[11]"Railway" means any steam, electric, or other railroad or railway that carries passengers for hire.

[12]"Public highway" means any road, street, or way, whether on public or private property, open to public travel.

[13]Where two or more storage magazines are located on the same property, each magazine shall comply with the minimum distances specified from inhabited buildings, railways, and highways, and, in addition, they should be separated from each other by not less than the distances shown for "separation of magazines," except that the quantity of explosive materials contained in detonator magazines shall govern with regard to the spacing of said detonator magazines from magazines containing other explosive materials. If any two or more magazines are separated from each other by less than the specified "separation of magazines" distances, such magazines, as a group, shall be considered as one magazine, and the total quantity of explosive materials stored in such group shall be treated as if stored in a single magazine located on the site of any magazine of the group, and shall comply with the minimum specified distances from other magazines, inhabited buildings, railways, and highways.

[14]Storage in excess of 136,200 kg (300,000 lb) of explosive materials in one magazine generally is not necessary for commercial enterprises.

[15]This table applies only to the manufacture and permanent storage of commercial explosive materials. It is not applicable to the transportation of explosives or any handling or temporary storage necessary or incident thereto. It is not intended to apply to bombs, projectiles, or other heavily encased explosives.

[16]Where a manufacturing building on an explosive materials plant site is designed to contain explosive materials, the building shall be located at a distance from inhabited buildings, public highways, and passenger railways in accordance with the American Table of Distances based on the maximum quantity of explosive materials permitted to be in the building at one time.

Source: Reprinted from *IME Safety Library Publication No. 2*, with permission of the Institute of Makers of Explosives, revised in June 1991.

Δ Table 9.4.1(c) Metric Table of Distances for Storage of Low Explosives

kg				
Over	Not Over	From Inhabited Building Distance (m)	From Public Railroad and Highway Distance (m)	From Aboveground Magazine (m)
0	454	23	23	15
454	2,268	35	35	23
2,268	4,536	46	46	30
4,536	9,072	58	58	38
9,072	13,620	66	66	44
13,620	18,144	72	72	47
18,144	22,680	76	76	50
22,680	27,240	79	79	53
27,240	31,780	82	82	56
31,780	36,288	85	85	58
36,288	40,860	90	90	59
40,860	45,360	92	92	60
45,360	90,720	114	114	76
90,720	136,080	137	137	92

Source: 27 CFR 555, Table: Department of Defense Ammunition and Explosives Standards, Table 5-4.1 Extract; 4145.27 M, March 1969.

Δ Table 9.4.1(d) Table of Distances for Storage of Low Explosives

Pounds				
Over	Not Over	From Inhabited Building Distance (ft)	From Public Railroad and Highway Distance (ft)	From Aboveground Magazine (ft)
0	1,000	75	75	50
1,000	5,000	115	115	75
5,000	10,000	150	150	100
10,000	20,000	190	190	125
20,000	30,000	215	215	145
30,000	40,000	235	235	155
40,000	50,000	250	250	165
50,000	60,000	260	260	175
60,000	70,000	270	270	185
70,000	80,000	280	280	190
80,000	90,000	295	295	195
90,000	100,000	300	300	200
100,000	200,000	375	375	250
200,000	300,000	450	450	300

Source: 27 CFR 555, Table: Department of Defense Ammunition and Explosives Standards, Table 5-4.1 Extract; 4145.27 M, March 1969.

Δ Table 9.4.2.2(a) Metric Table of Recommended Separation Distances of Ammonium Nitrate and Blasting Agents from Explosives or Blasting Agents

Donor Weight		Minimum Separation Distance of Acceptor When Barricaded (m)		Minimum Thickness of Artificial Barricades (cm)
Kilograms Over	Kilograms Not Over	Ammonium Nitrate	Blasting Agent	
0	50	0.9	3.4	31
50	135	1.2	4.3	31
135	275	1.5	5.5	31
275	450	1.8	6.7	31
450	725	2.1	7.6	31
725	900	2.4	8.8	31
900	1,400	2.7	9.9	38
1,400	1,800	3.0	11.0	38
1,800	2,800	3.4	12.3	39
2,800	3,600	3.7	13.1	50
3,600	4,500	4.0	14.3	51
4,500	5,500	4.3	15.2	51
5,500	7,250	4.6	16.5	63
7,250	9,000	4.9	17.7	64
9,000	11,500	5.5	19.9	65
11,500	13,500	5.8	20.7	76
13,500	16,000	6.1	22.0	76
16,000	18,000	6.4	23.1	76
18,000	20,000	6.6	23.9	87
20,000	23,000	7.0	25.4	89
23,000	25,000	7.3	26.2	89
25,000	28,000	7.6	27.3	89
28,000	32,000	7.9	28.8	102
32,000	36,000	8.5	30.7	102
36,000	40,000	9.0	32.5	102
40,000	45,000	9.7	34.9	102
45,000	54,000	10.4	37.1	126
54,000	64,000	11.3	40.7	127
64,000	73,000	12.3	44.1	127
73,000	82,000	13.4	48.5	127
82,000	91,000	14.6	57.0	128
91,000	100,000	15.8	57.1	152
100,000	113,000	17.1	61.5	152
113,000	125,000	18.3	65.8	152
125,000	136,000	19.5	70.1	152

Source: Approved by the IME Board of Governors on October 26, 2001.

Table 9.4.2.2(b) Table of Recommended Separation Distances of Ammonium Nitrate and Blasting Agents from Explosives or Blasting Agents

Donor Weight		Minimum Separation Distance of Acceptor When Barricaded (ft)		
Pounds Over	Pounds Not Over	Ammonium Nitrate	Blasting Agent	Minimum Thickness of Artificial Barricades (in.)
0	100	3	11	12
100	300	4	14	12
300	600	5	18	12
600	1,000	6	22	12
1,000	1,600	7	25	12
1,600	2,000	8	29	12
2,000	3,000	9	32	15
3,000	4,000	10	36	15
4,000	6,000	11	40	15
6,000	8,000	12	43	20
8,000	10,000	13	47	20
10,000	12,000	14	50	20
12,000	16,000	15	54	25
16,000	20,000	16	58	25
20,000	25,000	18	65	25
25,000	30,000	19	68	30
30,000	35,000	20	72	30
35,000	40,000	21	76	30
40,000	45,000	22	79	35
45,000	50,000	23	83	35
50,000	55,000	24	86	35
55,000	60,000	25	90	35
60,000	70,000	26	94	40
70,000	80,000	28	101	40
80,000	90,000	30	108	40
90,000	100,000	32	115	40
100,000	120,000	34	122	50
120,000	140,000	37	133	50
140,000	160,000	40	144	50
160,000	180,000	44	158	50
180,000	200,000	48	173	50
200,000	220,000	52	187	60
220,000	250,000	56	202	60
250,000	275,000	60	216	60
275,000	300,000	64	230	60

Notes:

(1) Recommended separation distances to prevent explosion of ammonium nitrate and ammonium nitrate-based blasting agents by propagation from nearby stores of high explosives or blasting agents referred to in the table as the "donor." Ammonium nitrate by itself is not considered to be a donor when applying this table. Ammonium nitrate, ammonium nitrate-fuel oil, or combinations thereof are acceptors. If stores of ammonium nitrate are located within the sympathetic detonation distance of explosives or blasting agents, one-half the mass of the ammonium nitrate should be included in the mass of the donor.

(2) When the ammonium nitrate and/or blasting agent is not barricaded, the distances shown in the table shall be multiplied by 6. These distances allow for the possibility of high velocity metal fragments from mixers, hoppers, truck bodies, sheet metal structures, metal containers, and the like, which may enclose the "donor." Where storage is in bullet-resistant magazines recommended for explosives, or where the storage is protected by a bullet-resistant wall, distances and barricade thicknesses in excess of those prescribed in the American Table of Distances are not required. For construction of bullet-resistant magazines see U. S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms, and Explosives, ATF Publication 5400.7, *Federal Explosives Law and Regulations*.

(3) The distances in the table apply to ammonium nitrate and ammonium-nitrate-based materials that show "negative" (–) result in the UN Test Series 2 Gap Test and show "positive" (+) result in the UN Test Series 1 Gap Test. Ammonium nitrate and ammonium-nitrate-based materials that are DOT hazard Class 1 sensitive shall be stored at separation distances determined by the American Table of Distances (ATD).

(4) These distances apply to blasting agents that pass the insensitivity test prescribed in regulations of the U.S. Department of Transportation and the U.S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms, and Explosives.

(5) Earth, sand dikes, or enclosures filled with the prescribed minimum thickness of earth or sand are acceptable artificial barricades. Natural barricades, such as hills or timber of sufficient density that the surrounding exposures that require protection cannot be seen from the "donor" when the trees are bare of leaves, are also acceptable.

(6) For determining the distances to be maintained from inhabited buildings, passenger railways, and public highways, use the American Table of Distances. *[See Table 9.4.1(a) through Table 9.4.1(d).]*

Table 9.4.3.2 Application of Separation Distance Tables

Type of Donor	Type of Acceptor	Table	Distances Listed Under
Explosives	Explosives	ATD	Separation of magazines
Explosives	Ammonium nitrate	SDT	Ammonium nitrate
Explosives	Blasting agent	SDT	Blasting agent
Blasting agent	Explosives	ATD	Separation of magazines
Blasting agent	Blasting agent	SDT	Blasting agent
Blasting agent	Ammonium nitrate	SDT	Ammonium nitrate

9.4.8 All explosive materials shall be removed to appropriate storage magazines for unattended storage at the end of the work day.

9.4.9 Two Type 3 magazines shall be permitted to be located at a blasting site, provided one magazine is used solely for the storage of detonators.

9.4.10 A Type 5 magazine shall not be located in a residence or dwelling.

9.5 Magazine Construction — Basic Requirements.

9.5.1 Magazines shall be constructed to comply with Section 9.5 or in a manner substantially equivalent to the requirements for safety and security embodied in Section 9.5.

9.5.2 The ground in the vicinity of a magazine shall be graded so that water drains away from the magazine.

9.5.3 Heated magazines shall be heated by either hot water radiant heating within the magazine building or by indirect warm air heating.

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

Δ **9.5.5** Magazine heating systems shall meet the following requirements:

(1) Radiant heating coils within the building shall be installed so that explosive materials or their containers cannot contact the coils and so that air is free to circulate between the coils and the explosive materials.
(2) The surface temperature of the coils shall not exceed 74°C (165°F).
(3) Heating ducts shall be installed so that the hot air discharged from the ducts is not directed against explosive materials or containers.
(4) The heating system shall be controlled so that the ambient temperature of the magazine does not exceed 54°C (130°F).
(5) Any electric fan or pump used in the heating system shall be located outside the magazine, separate from the magazine walls, and grounded.
(6) Any electric motor and any controls for electric heating devices used to heat water or produce steam shall have overload devices and disconnects that comply with *NFPA 70*.
(7) All electrical switchgear shall be located at least 7.6 m (25 ft) from the magazine.
(8) 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).
(9) The area between the heating unit and the magazine shall be cleared of all combustible material.
(10) Explosive materials stored in magazines shall be arranged so that uniform circulation of air is ensured.

9.5.6 Electric Lighting.

9.5.6.1 Electric lighting, electric safety flashlights, or electric safety lanterns shall be permitted to be used within a magazine.

Δ **9.5.6.2** The installation of electric lighting shall meet the following requirements:

(1) Junction boxes containing fuses or circuit breakers and electrical disconnects shall be located at least 7.6 m (25 ft) from the magazine.
(2) Disconnects, fuses, and circuit breakers shall be protected by a voltage surge arrester capable of handling 2500 amperes for 0.1 second.
(3) All wiring from switches, both inside and outside the magazine, shall be installed in rigid conduit.
(4) Wiring leading to the magazine shall be installed underground.
(5) Conduit and light fixtures inside the magazine shall be protected from physical damage by guards or by their location.
(6) Light fixtures shall be enclosed to prevent sparks or hot metal from falling onto the floor or onto material stored in the magazine.
(7) Junction boxes located within the magazine shall have no openings.
(8) Junction boxes shall be equipped with close-fitting covers.
(9) Magazines containing explosive materials that could release flammable vapors shall have wiring and fixtures that meet the requirements of *NFPA 70*, Article 501.
(10) Lights inside magazines shall not be left on while the magazine is unattended.

9.5.7 There shall be no exposed ferrous metal on the interior of a magazine, except for Type 5 magazines, where the metal has the potential to contact packages of explosives.

9.6 Magazine Construction — Requirements for Specific Types.

9.6.1 Type 1 Magazines. A Type 1 magazine shall be a permanent structure, such as a building or an igloo, that is bullet resistant, fire resistant, theft resistant, weather resistant, and ventilated as follows:

(1) Walls and doors shall be bullet resistant.
(2) Walls and doors shall be permitted to be constructed in accordance with any of the specifications in Annex C.
(3) 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.
(4)* 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, the roof or the ceiling shall be of bullet-resistant construction.

(5) The foundation shall be permitted to be of masonry, wood, or metal.
(6) The foundation shall be enclosed completely.
(7) A wood foundation enclosure shall be covered on the exterior with metal of not less than 26 gauge thickness.
(8) Openings to provide cross ventilation shall not be required to be enclosed.
(9) The floor shall be constructed of wood or other suitable material.
(10) Floors constructed of materials that could cause sparks shall be covered with a nonsparking surface.
(11) If a nonsparking floor surface is not provided, the packages of explosive materials shall be placed on pallets of nonsparking material.
(12) Type 1 magazines shall be ventilated to prevent dampness or heating of explosive materials.
(13) Ventilation openings shall be screened to prevent the entrance of sparks.
(14) Ventilators in sidewalls shall be offset or shielded.
(15) Magazines having foundation and roof ventilators, with the air circulating between the sidewalls and floor and between the sidewalls and ceiling, shall have a wood lattice lining or equivalent means to prevent packages of explosive materials from being stacked against the sidewalls and blocking air circulation.
(16) A 51 mm (2 in.) air space shall be provided between the sidewalls and the floor.
(17) Each door of a Type 1 magazine shall be equipped with one of the following locking systems:
    (a) Two mortise locks
    (b) Two padlocks in separate hasps and staples
    (c) A mortise lock and a padlock
    (d) A mortise lock that requires two keys to open
    (e) A three-point lock or an equivalent lock that secures the door to the frame at more than one point

9.6.1.1 Padlocks shall be steel, having at least five tumblers and a case-hardened shackle at least 9.5 mm (⅜ in.) in diameter.

9.6.1.2 All padlocks shall be protected by steel hoods installed to discourage the insertion of bolt cutters.

9.6.1.3 Doors secured by a substantial internal bolt shall not require additional locking devices.

9.6.1.4 Hinges and hasps shall be fastened securely to the magazine.

9.6.1.5 All locking hardware shall be secured rigidly and directly to the door frame.

9.6.2 Type 2 Magazines. 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.

9.6.2.1 Where used for outdoor storage, Type 2 magazines also shall be bullet resistant.

9.6.2.2 Type 2 Outdoor Magazines.

Δ **9.6.2.2.1** The walls and roof or ceiling shall be constructed in accordance with the provisions of 9.6.1(1), 9.6.1(2), and 9.6.1(3).

Δ **9.6.2.2.2** Doors shall be of metal and constructed in accordance with the provisions of 9.6.1(1) or shall have a metal exterior with an inner door meeting the provisions of 9.6.1(1).

9.6.2.2.3 Floors constructed of ferrous metal shall be covered with a nonsparking surface.

9.6.2.2.4 A top-opening magazine shall have a lid that overlaps the sides by at least 25.4 mm (1 in.) when in the closed position.

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

9.6.2.2.6 Magazines of less than 0.766 m^3 (1 yd^3) shall be fastened securely to a fixed object to prevent theft of the entire magazine.

Δ **9.6.2.2.7** Hinges, hasps, locks, and locking hardware shall comply with 9.6.1(17).

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

9.6.2.2.9 Whenever a vehicular magazine is left unattended, its wheels shall be removed and its kingpins locked, or it otherwise shall be effectively immobilized.

9.6.2.3 Type 2 Indoor Magazines.

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

9.6.2.3.2 The cover or door of the magazine shall have substantial hinges and a means for locking the magazine.

9.6.2.3.3 The magazine shall be kept locked with a five-tumbler padlock or its equivalent.

9.6.2.3.4 The magazine shall be permitted to be unlocked during placement or removal of explosive materials.

9.6.2.3.5 The magazine shall be painted red and bear the warning "Explosives — Keep Fire Away" in white letters at least 76 mm (3 in.) high so that the warning is visible from the approach side or sides of the magazine.

9.6.2.3.6 Type 2 indoor magazines constructed of wood shall have sides, bottoms, and covers or doors that are constructed of 51 mm (2 in.) hardwood and are well braced at corners.

9.6.2.3.7 The magazines shall be covered with sheet metal of not less than 26 gauge.

9.6.2.3.8 Nails exposed to the interior of the magazines shall be countersunk, be made of nonsparking metal, or be covered with a nonsparking coating.

9.6.2.3.9 Type 2 indoor magazines constructed of metal shall be of 12 gauge sheet metal and lined with a nonsparking material.

9.6.2.3.10 The edges of metal covers shall overlap the side by at least 25.4 mm (1 in.).

9.6.3 Type 3 Magazines. A Type 3 magazine shall be a "day box" or portable structure used for the temporary storage of explosive materials.

9.6.3.1 Type 3 magazines shall be located as far away as practicable or on a risk basis as determined by a quantitative risk assessment, from neighboring inhabited buildings, railways, highways, and other magazines.

9.6.3.2 A Type 3 magazine shall be fire resistant, theft resistant, and weather resistant.

9.6.3.3 The magazine shall be equipped with one steel padlock (which shall not be required to be protected by a steel hood) having at least five tumblers and a case-hardened steel shackle at least 9.5 mm (⅜ in.) in diameter.

9.6.3.4 Doors shall overlap the sides by at least 25.4 mm (1 in.).

9.6.3.5 Hinges and hasps shall be attached by welding, riveting, or bolting (nuts on inside).

9.6.3.6 The magazine shall be constructed of not less than 12 gauge [2.66 mm (0.1046 in.)] steel, lined with at least 12.7 mm (½ in.) plywood or 12.7 mm (½ in.) masonite-type hardboard or the equivalent wood, plastic, rubber, foam, cement board, or gypsum board.

9.6.3.7 Type 3 magazines containing explosive materials shall be within line-of-sight vision of a competent person.

9.6.4 Type 4 Magazines. 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.

9.6.4.1 Type 4 Outdoor Magazine.

9.6.4.1.1 A Type 4 outdoor magazine shall be constructed of masonry and wood covered with sheet metal, fabricated metal, or a combination of these materials.

9.6.4.1.2 Doors shall be metal or wood covered with metal.

Δ **9.6.4.1.3** Permanent Type 4 magazines shall comply with 9.6.1(5) through 9.6.1(8) and 9.6.1(12) through 9.6.1(17).

9.6.4.1.4 Vehicular Type 4 magazines shall comply with 9.6.2.2.7 and 9.6.2.2.8.

9.6.4.1.5 Vehicular Type 4 magazines shall be immobilized while unattended, as described in 9.6.2.2.9.

9.6.4.2 Type 4 Indoor Magazine. A Type 4 indoor magazine shall comply with all provisions of 9.6.2.3.

9.6.5 Type 5 Magazines. A Type 5 magazine shall be a permanent, portable, or mobile structure such as a building, igloo, box, bin, tank, semitrailer, bulk trailer, tank trailer, bulk truck, tank truck, or other mobile container that is theft resistant.

9.6.5.1 No ventilation shall be required.

9.6.5.2 Ferrous metal shall not be required to be covered with nonsparking material.

9.6.5.3 Type 5 Outdoor Magazine.

9.6.5.3.1 A Type 5 permanent outdoor magazine shall be weather resistant and locked with at least one steel five-tumbler padlock having at least a 9.5 mm (⅜ in.) case-hardened shackle.

9.6.5.3.2 A hood for the padlock shall not be required.

9.6.5.3.3 Hinges and hasps shall be fastened securely to the magazine.

9.6.5.3.4 All locking hardware shall be secured rigidly and directly to the door frame.

9.6.5.3.5 A vehicular Type 5 magazine shall be immobilized while unattended as described in 9.6.2.2.

9.6.5.4 Type 5 Indoor Magazine.

9.6.5.4.1 A Type 5 indoor magazine shall be constructed in accordance with the requirements for Type 5 outdoor magazines.

9.6.5.4.2 A Type 5 indoor magazine shall not be required to be weather resistant.

9.7 Storage Within Magazines.

9.7.1 Magazines shall be supervised at all times by a competent person who is at least 21 years old and who is responsible for the enforcement of all safety precautions.

9.7.2 All magazines containing explosive materials shall be opened and inspected at maximum intervals of 3 days to determine whether there has been unauthorized or attempted entry into the magazines or whether there has been unauthorized removal of the magazines or their contents.

9.7.3 Magazine doors shall be kept locked, except where permitted to be unlocked, such as during placement or removal of explosives, during inspection, or if no explosives are in the magazine.

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

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

9.7.6 Corresponding grades and brands of explosive materials shall be stored together so that brand and grade markings are readily visible.

9.7.7 All stocks shall be stored in a manner that allows them to be easily counted and checked.

9.7.8* Containers of explosive materials shall be arranged in a stable manner.

9.7.9 Use of Open Containers — Basic Requirements.

9.7.9.1 Open containers of explosive materials shall be closed securely before being returned to a magazine.

9.7.9.2 No container without a closed lid shall be permitted to be stored in the magazine.

9.7.9.3 Only fiberboard containers shall be permitted to be opened in the magazine.

9.7.10 Containers of explosive materials other than fiberboard shall not be unpacked or repacked inside or within 15.25 m (50 ft) of a magazine or in close proximity to other explosive materials.

9.7.11 Tools used for opening containers of frictional spark-sensitive explosive materials such as Black Powder and primary explosives shall be constructed of nonsparking material.

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

9.7.13 Magazines shall be used exclusively for the storage of explosive materials, blasting materials, and blasting accessories.

9.7.14 Metal tools other than nonferrous transfer conveyors shall not be stored in a magazine containing explosives or detonators.

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

9.7.16 Magazine Housekeeping.

9.7.16.1 Magazine floors shall be regularly swept and kept clean, dry, and free of grit, paper, empty packages, and rubbish.

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

9.7.16.3 Sweepings from magazine floors shall be disposed of in accordance with the manufacturers' instructions.

9.7.17 Where any explosive material has deteriorated to the extent that it is in an unstable or dangerous condition or if nitroglycerine or other liquid is leaking from any explosive, the person responsible for the explosives shall contact the manufacturer for immediate assistance.

9.7.18 Magazine floors stained with nitroglycerine or other liquid shall be cleaned in accordance with the manufacturers' instructions.

9.7.19 Before making repairs to the interior of a magazine, all explosive materials shall be removed and the floor cleaned.

9.7.20 In making repairs that could result in sparks or fire to the exterior of a magazine, all explosive materials shall be removed.

9.7.21 Storage of Explosive Materials During Magazine Repair.

9.7.21.1 Explosive materials removed from a magazine undergoing repair shall be placed either in another magazine or at a safe distance from the magazine.

9.7.21.2 Explosive materials removed from a magazine undergoing repair shall be guarded and protected properly.

9.7.21.3 Upon completion of the repairs, explosive materials removed from a magazine undergoing repair shall be returned to the magazine promptly.

9.8 Miscellaneous Safety Precautions.

9.8.1 Smoking, matches, open flames, spark-producing devices, and firearms shall not be permitted inside of or within 15.25 m (50 ft) of a magazine, except for firearms carried by authorized guards.

9.8.2 The area around a magazine shall be kept clear of brush, dried grass, leaves, and similar combustibles for a distance of at least 7.63 m (25 ft).

9.8.3 Combustible materials shall not be stored within 15.25 m (50 ft) of magazines.

9.8.4 Handling of Explosive Material from Misfires.

9.8.4.1 Explosive materials recovered from blasting misfires shall be stored in a separate magazine until disposal instructions have been received from the manufacturer.

9.8.4.2 Such explosive materials then shall be disposed of in the manner recommended by the manufacturer.

9.8.4.3 Detonators recovered from blasting misfires shall not be reused.

9.8.5 Signs.

9.8.5.1 Property on which Type 1 magazines and outdoor magazines of Types 2, 4, and 5 are located shall be posted with signs reading "Explosives — Keep Off."

9.8.5.2 Such signs shall be located to minimize the possibility that a bullet shot at the sign hits the magazine.

9.8.6 When packaged blasting agents (Division 1.5 materials) are stored in an over-the-road trailer Type 5 storage magazine, the trailer shall be placarded with approved U.S. DOT placards for Division 1.5 explosives (blasting agents) until the trailer is empty.

Chapter 10 Use of Explosive Materials for Blasting

10.1 Basic Requirements.

10.1.1 All federal, state, and local laws and regulations applicable to obtaining, owning, transporting, storing, handling, and using explosive materials shall be followed.

10.1.2 Explosive materials shall be protected from unauthorized possession.

10.1.3 Explosive materials shall not be abandoned.

10.1.4 Explosive materials shall be used only by experienced persons who are familiar with the hazards involved and who hold all required permits.

10.1.4.1 Loading and firing shall be performed or supervised only by a person possessing a blaster's permit.

10.1.4.2 Trainees, helpers, and other persons who do not hold the required permits shall work only under the supervision of persons holding such permits.

10.1.5 No explosive materials shall be located or stored where they have the potential to be exposed to flame, excessive heat, sparks, or impact.

10.1.5.1 No firearms shall be discharged into or in the vicinity of a vehicle containing explosive materials, or into or in the vicinity of a location where explosive materials are being handled, used, or stored.

10.1.5.2 No smoking shall be permitted within 15.25 m (50 ft) of any location where explosives are being handled or used.

10.1.5.3 No person within 15.25 m (50 ft) of any location where explosives are being handled or used shall carry any matches, open light, or other fire or flame, except for approved devices for lighting safety fuses.

10.1.6 No person under the influence of intoxicating beverages, narcotics, or other dangerous drugs shall be permitted to handle explosive materials.

10.1.7 Response to Fires.

10.1.7.1* No attempt shall be made to fight a fire that cannot be contained or controlled before it reaches explosive materials other than Division 1.4S explosives.

10.1.7.2 In such cases, all personnel shall be evacuated immediately to a safe location, and the area guarded from entry by spectators or intruders.

10.1.8 Unauthorized or unnecessary personnel shall not be present where explosive materials are being handled, used, or stored.

10.1.9 Explosive materials shall be kept in closed containers or packages while being transported between the storage magazine and the blasting site.

10.1.10 Partial reels of detonating cord shall not be required to be kept in closed containers, unless transported over public highways.

10.1.11 Containers of explosive materials, except for explosive materials in fiberboard containers, shall not be opened in any magazine or within 15.25 m (50 ft) of any magazine.

10.1.12 Nonsparking tools shall be used for opening any package or container of frictional spark-sensitive explosive materials such as Black Powder or primary explosives, except that metal slitters shall be permitted to be used for opening fiberboard containers.

10.1.13 No blasting operation shall be performed in a manner contrary to the instructions of the manufacturer of the explosive materials being used.

10.1.14 Where blasting is done, precautions shall be taken to prevent damage to property or injury to people.

10.1.15 Blasting mats or other protective devices shall be used when determined to be necessary by the blaster-in-charge to prevent fragments from being thrown beyond the blast area.

10.1.16 Persons authorized to prepare explosive charges or to conduct blasting operations shall use every reasonable precaution including, but not limited to, warning signals, flags, barricades, mats, or other equally effective means to ensure the safety of the general public and workers.

10.1.17 Surface blasting operations shall be conducted during daylight hours only, except where approved by the authority having jurisdiction.

10.1.18 Where blasting is conducted in the vicinity of utility lines or rights-of-way, the blaster shall notify the representatives of the utilities at least 24 hours in advance of blasting, specifying the location and the intended time of such blasting.

10.1.18.1 Verbal notice shall be confirmed with written notice.

10.1.18.2 In an emergency situation, the time limit given in 10.1.18 shall be permitted to be waived by the authority having jurisdiction.

10.1.19 Precautions shall be taken to prevent accidental discharge of electric detonators from currents induced by radar and radio transmitters, lightning, adjacent power lines, dust and snow storms, or other sources of extraneous electricity.

10.1.19.1 These precautions shall include the following:

(1) The posting of signs warning against the use of mobile radio transmitters on all roads within 107 m (350 ft) of blasting operations
(2)* Observance of the latest recommendations with regard to blasting in the vicinity of radio transmitters or power lines
(3) The discontinuance of surface use, underground use, and all handling of explosive materials during the approach of and for the duration of an electrical storm
(4) Consideration of the fact that lightning has been known to follow steel, piping, and conductive ore into underground mines

10.1.19.2 During the approach of and for the duration of an electrical storm, all personnel shall move to a safe location.

10.1.20 Precautions shall be taken to prevent accidental initiation of nonelectric detonators from stray currents induced by lightning or static electricity.

10.2 Preblast Operations.

10.2.1 Blast Site.

10.2.1.1 During the time that holes are being loaded or are loaded with explosive materials, blasting agents, or detonators, the blast site shall be off limits to all but those persons authorized to engage in the drilling and loading operations or who are otherwise authorized to enter the site.

10.2.1.2 The blast site shall be guarded or barricaded and posted.

10.2.2 Drill holes shall be large enough to allow free insertion of cartridges of explosive materials.

10.2.2.1 Drill holes shall not be collared in bootlegs or in holes that previously contained explosive materials.

10.2.2.2 Holes shall not be drilled where there is a danger of intersecting another hole containing explosive material.

10.2.3 All drill holes shall be inspected and cleared of any obstruction before loading.

10.2.4 Pneumatic loading of blasting agents into blast holes primed with electric detonators or other static-sensitive initiation systems shall comply with the following requirements:

(1) A positive grounding device shall be used for the equipment to prevent the accumulation of static electricity.
(2) A semiconductive discharge hose shall be used.
(3) A qualified person shall evaluate all systems to ensure that they dissipate static charges under field conditions.

10.2.5 Tamping shall be performed only with wooden rods or approved plastic poles having no exposed metal parts.

10.2.5.1 Nonsparking metal connectors shall be permitted to be used on jointed tamping poles.

10.2.5.2 Violent tamping shall be avoided.

10.2.5.3 The primer shall not be tamped at any time.

10.2.6 After the loading for a blast is completed and before firing, all excess explosive materials shall be removed from the area and returned to the storage facilities.

10.2.7 As soon as practicable after all blast holes are connected, prior to connecting to a source of initiation such as a blasting machine, and continuing until the shot has been fired and subjected to post-blast examination, the blast area shall be guarded or barricaded and posted.

N **10.2.8** The blaster-in-charge shall be responsible for determining the blast area, based on site conditions, and ensuring that the blast area is secure.

10.3 Initiating Blasts.

10.3.1 Cap and fuse shall not be used to initiate blasts in congested areas, or on or adjacent to highways open to traffic.

10.3.2 Safety Fuse.

10.3.2.1 Where safety fuse is used, the burning rate shall be determined and in no case shall fuse lengths of less than 0.91 m (3 ft) or with a burn time less than 120 seconds be used.

10.3.2.2 The detonator shall be attached securely to the fuse with a standard ring-type cap crimper.

10.3.3 Stray Current Control.

10.3.3.1 Where electric detonators are used, stray current tests shall be made as frequently as necessary.

10.3.3.2 Maximum stray current shall not exceed 0.05 ampere through a 1 ohm resistor, measured at the blast site.

10.3.3.3 Nonelectric or electronic initiating systems shall be used unless corrective action is taken to reduce the stray current below the limits indicated in 10.3.3.2.

10.3.4 Electric or electronic detonators of different brands shall not be used in the same firing circuit.

10.3.5 All electric blasting circuits and other initiating systems whose continuity can be tested (such as gas detonator initiating systems) shall be tested with a blasting galvanometer or other blast continuity test instrument, as appropriate, that has been designed and approved for the purpose.

10.3.6 All electrically initiated blasts shall be made by using blasting machines suitable for the circuitry being fired.

10.3.7 No detonator shall be inserted in explosive materials that do not have a cap well without first making a hole in the cartridge with a proper size nonsparking tool or the appropriate pointed handle of an approved cap crimper.

10.3.7.1 Primers shall not be assembled closer than 15.25 m (50 ft) from any magazine.

10.3.7.2 Primers shall be assembled only when and as necessary for immediate needs.

10.3.7.3 Adequate priming shall be used.

10.3.7.4 If any uncertainty exists regarding the amount of priming necessary, the manufacturer shall be consulted.

10.3.7.5 Primers shall be assembled only at the time of use and as close to the blast site as conditions allow.

10.3.7.6 Where using nonelectric initiation systems, all of the following shall apply:

(1) The selection of the initiation system and the design of the blast shall be under the supervision of the blaster-in-charge.
(2) The initiation system shall be used in accordance with the manufacturers' instructions.
(3) The blaster-in-charge shall conduct a visual check after blast hookup.
(4) The blast layout shall be tested for continuity as recommended by the manufacturer where using a system that can be tested for continuity.
(5) A double trunk line or closed-loop hookup shall be used where judged to be necessary by the blaster-in-charge.

10.3.8 Only the person making the lead line connections or the blaster-in-charge shall fire the blast.

10.3.8.1 All connections shall be made progressively from the borehole back to the initiation point.

10.3.8.2* Blasting lead lines for electric detonators shall remain shunted (shorted) until immediately before blasting.

10.3.8.3 Blasting lead lines shall not be connected to the blasting machine or other source of current until the blast is to be fired.

10.3.9 No blast shall be fired until the blaster-in-charge has made certain that all surplus explosive materials are in a safe place, all persons and equipment are at a safe distance or under sufficient cover, and an adequate warning signal has been given.

10.3.10 Connections between boreholes shall be made as near to the planned time of initiation as possible and involve the minimum necessary number of blast crew members or blasters.

10.4 Procedures After Blasting.

10.4.1 No person shall return to the blast area until permitted to do so by the blaster-in-charge.

10.4.2 Blasters shall allow sufficient time for smoke and fumes to dissipate and for dust to settle before returning to the blast site.

10.4.3 The blaster-in-charge shall inspect the entire blast site for misfires before allowing other personnel to return to the blast area.

N **10.4.4** The blaster-in-charge shall make a record of each blast.

N **10.4.4.1** Upon request, copies of these records shall be made available to the AHJ.

N **10.4.4.2** Such records shall contain, at a minimum, the following data:

(1) Name of the company conducting the blast
(2) Location, date, and time of the blast
(3) Name, signature, and permit number of the blaster-in-charge conducting the blast
(4) Identification, direction, and distance (ft) from the nearest blast hole to the nearest dwelling, public building, school, church, community, or institutional building outside the blast site
(5) Weather conditions, including those which might cause possible adverse blasting effects
(6) Type of material blasted
(7) Sketches of the blast pattern, including number of holes, burden, spacing, decks, and delay pattern
(8) Diameter and depth of holes
(9) Types of explosives used
(10) Total weight of explosives used per hole
(11) Maximum weight of explosives detonated in an 8-millisecond period
(12) Initiation system
(13) Type and length of stemming
(14) Mats or other protection types used

N **10.4.4.3** Ground vibration and air blast records, if required, shall include the following:

(1) Type of instrument, sensitivity, and calibration signal or certification of annual calibration

(2) Exact location of instrument and the date, time, and distance from the blast
(3) Name of the person and firm taking the reading
(4) Ground vibration and/or air blast levels and time histories recorded

10.5 Misfires.

10.5.1 Where a misfire is found, the blaster-in-charge shall provide the proper safeguards for excluding all personnel from the blast area.

10.5.2 Misfires shall be reported to the supervisor immediately.

10.5.3 No additional work, other than that necessary to remove the hazard, shall be performed.

10.5.3.1 Only those persons needed to do such work shall remain at the blast site.

10.5.4 No attempt shall be made to extract explosive materials from a misfired hole.

10.5.4.1 A new primer shall be inserted, and the hole reblasted.

10.5.4.2 Where reblasting presents a hazard, the explosive materials shall be permitted to be washed out with water, or, where the misfire is under water, blown out with air.

10.5.5 Whenever there is a misfire, all personnel shall remain at a safe distance for at least 15 minutes (30 minutes if electronic or cap and fuse initiation is used).

10.5.6 Misfires shall be the responsibility of the person in charge of the blasting operation.

10.5.7 Where a misfire is suspected, all initiating circuits (electric or nonelectric) shall be traced carefully and a search made for unexploded charges.

10.5.8 No drilling, digging, or picking shall be permitted until all misfires have been detonated or until the authority having jurisdiction approves the resumption of work.

10.6 Disposal of Explosive Materials.

10.6.1 Empty containers and paper and fiber packing materials that previously contained explosive materials shall be disposed of or reused in an approved manner.

10.6.2 All personnel shall remain at a safe distance from the disposal area.

10.6.3 Deteriorated or Damaged Materials.

10.6.3.1 All explosive materials that are obviously deteriorated or damaged shall not be used.

10.6.3.2 Deteriorated or damaged explosive materials shall be destroyed in accordance with the requirements of 9.7.17 and 9.7.18.

10.6.4* Destroying Explosives.

10.6.4.1 In the event that it becomes necessary to destroy any explosives, because of damage to containers, deterioration, or any other reason, all handling of explosives shall cease and the manufacturer contacted for assistance immediately.

10.6.4.2 The manufacturer's advice shall be followed without deviation.

Chapter 11 Ground Vibration, Air Overpressure, Flyrock, and Gases

11.1* Basic Requirements.

11.1.1* This chapter shall apply to buildings and other structures.

11.1.2 This chapter shall not apply to buildings or other structures owned, leased, or contracted by the blasting company or on property for which the owner has provided a written waiver to the blasting company.

11.1.3* Blasting seismographs used to monitor ground vibrations and air overpressure shall comply with the ISEE document, "Performance Specifications for Blasting Seismographs."

11.1.4* Where used, blasting seismographs shall be deployed in the field according to the ISEE document, "Field Practice Guidelines for Blasting Seismographs."

11.2* Ground Vibration.

Δ **11.2.1** At all blasting operations, the ground vibration on any axis (particle velocity) shall not exceed the limitations specified in Figure 11.2.1 at the location of any building or structure.

11.2.2* When blasting is not monitored with a blasting seismograph, the operation shall comply with the scaled distance factors at the nearest building or structure as shown in Table 11.2.2.

11.2.3 Ground vibration limits for buildings and other structures or for structures not defined in 11.1.1, such as public utilities, shall be permitted to be independently established based on technical justifications by engineers or qualified personnel familiar with blasting-related projects, subject to the approval of the AHJ.

11.3* Air Overpressure.

11.3.1* Air overpressure due to blasting operations shall not exceed the maximum limit of 133 dB(L) (0.013 psi) at the location of any building or structure.

11.3.2 Air overpressure limits for buildings and other structures or for structures not defined in 11.1.1, such as public utilities, shall be permitted to be independently established based on technical justifications by engineers or qualified personnel familiar with blasting related projects, subject to the approval of the AHJ.

11.4 Flyrock.

11.4.1 Flyrock traveling in the air or along the ground shall not be cast from the blast site in an uncontrolled manner that could result in personal injury or property damage.

11.4.2 Flyrock shall not be propelled from the blast site onto property not contracted by the blasting operation or onto property for which the owner has not provided a written waiver to the blasting operation.

11.4.3 Where blasting operations do not conform to 11.4.1 and 11.4.2, the AHJ shall require that special precautions be employed to reduce or control flyrock.

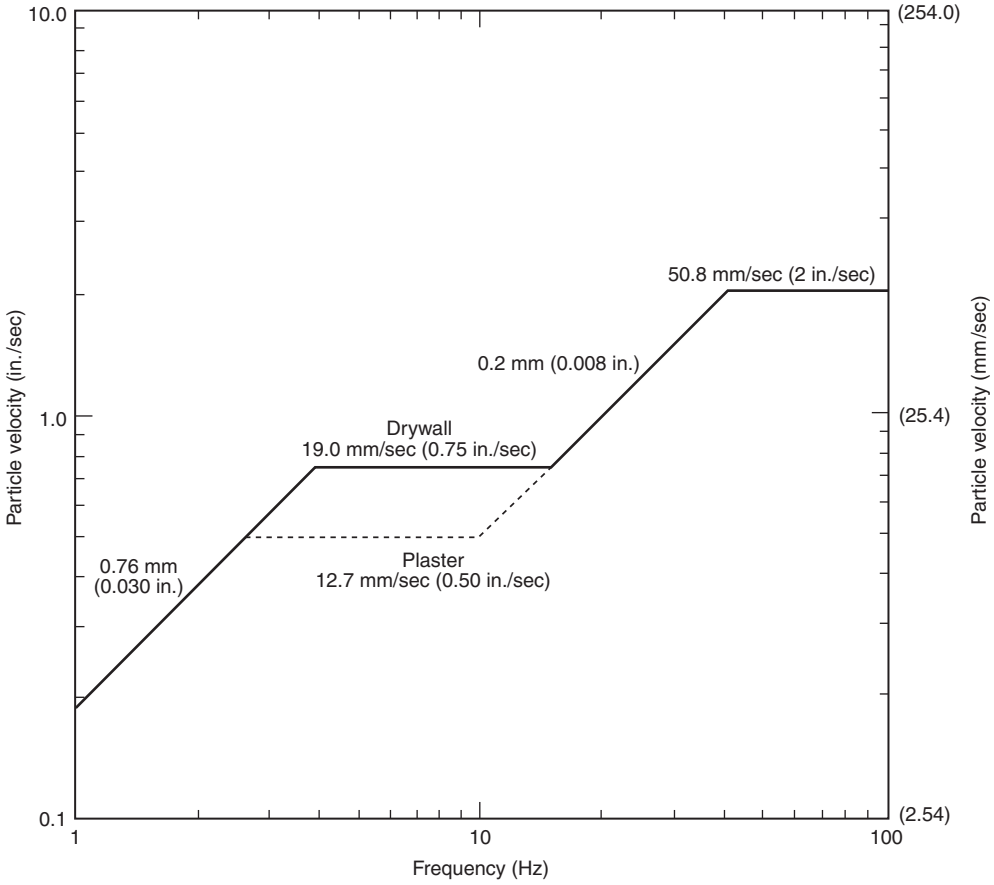

Figure 11.2.1 Frequency vs. Particle Velocity Graph.

Table 11.2.2 Scaled Distance Equations

Distance from Blasting Site		Scaled Distance Equation*	
ft	**m**	**lb**	**kg**
0–300	0–91.4	W (lb) = $[D\ (\text{ft})/50]^2$	W (kg) = $[D\ (\text{m})/22.6]^2$
301–1000	91.7–304.8	W (lb) = $[D\ (\text{ft})/55]^2$	W (kg) = $[D\ (\text{m})/24.9]^2$
≥1001	≥305.1	W (lb) = $[D\ (\text{ft})/65]^2$	W (kg) = $[D\ (\text{m})/29.4]^2$

(1) *W* equals the maximum weight of explosives in pounds (or kilograms) that can be detonated per delay interval of 8 milliseconds or longer.
(2) *D* equals the distance in feet (or meters) from the blast to the nearest building, not owned, leased, or contracted by the blasting operation, or on property for which the owner has not provided a written waiver to the blasting operation.
*To convert U.S. units of scaled distances ($\text{ft/lb}^{1/2}$) to metric units ($\text{m/kg}^{1/2}$), divide by a factor of 2.21.

11.5 Gases.

N **11.5.1** Gases traveling in the air or through the ground shall be controlled in a manner to prevent injury to persons or damage to property outside the blast area.

N **11.5.2** To minimize hazardous carbon monoxide exposure produced by blasting, blasters shall be responsible for the following:

(1) Being aware that lack of ground displacement can prevent venting of the blasted material and result in the entrapment of gases
(2)* Excavating blasted material as soon as practical after blasting
(3) Being aware of and look for geologic pathways for gases such as old trenches, horizontal partings, faults, joints, hillseams, unconsolidated material, water, and voids that would allow movement of gas towards underground enclosed spaces

(4) Being aware that when blasting very close to underground enclosed spaces, fractures caused by the detonation can create a pathway for the gases to enter the enclosed space
(5) Conducting a preblast survey to determine any possible problem areas when blasting near inhabited buildings or underground facilities (tunnels, manholes, etc.)
(6) Monitoring possible problem areas to determine if any gases have migrated from the blasting operation
(7) If gases are detected, using positive ventilation (open windows and exhaust fans) to limit the accumulation of gases at inhabited buildings or other facilities from the blasting operation until the gas is removed from the ground

Chapter 12 Explosive Materials at Piers and Railway, Truck, and Air Terminals

12.1 Basic Requirements. This chapter shall not apply to the transportation of small arms ammunition and components. *(See Chapter 14.)*

12.1.1 Railway Cars.

12.1.1.1 Explosive materials shall not be kept in a railway car unless the car, its contents, and methods of loading comply with the regulations of the U.S. DOT.

12.1.1.2 The requirement in 12.1.1.1 shall be permitted to be waived in an emergency with the approval of the AHJ.

12.1.2 Explosive materials shall not be delivered to any carrier unless the explosives comply in all respects, including marking and packing, with the regulations of the U.S. DOT.

12.1.3 Every railway car containing explosive materials that has reached its destination, or has stopped in transit so it no longer is considered in interstate commerce, shall remain placarded in accordance with U.S. DOT regulations.

12.1.4 Any explosive materials at a railway facility, truck terminal, pier, wharf, harbor facility, or airport terminal, whether for delivery to a consignee or forwarded to some other destination, shall be kept in a safe place and isolated as far as practicable and in such a manner that they can be removed easily and quickly.

Δ **12.1.5** Truck terminals for explosives vehicles shall meet the requirements of NFPA 498.

12.2 Notifications. A consignee, having been notified that a shipment of explosives is in the hands of any carrier, shall remove the explosives within 48 hours, excluding Saturdays, Sundays, and holidays, to a storage area meeting the requirements of this code.

Δ **12.3 Facilities for Trailer-on-Flatcar and Container-on-Flatcar.** Rail shipments of explosives by trailer-on-flatcar (TOFC) or container-on-flatcar (COFC) shall meet the following requirements:

(1) Shipments by TOFC or COFC shall be unloaded at a nonagency station only where a consignee is present to receive them or where properly locked and secure storage facilities are available.
(2) If delivery cannot be made, the shipment shall be taken to the next or nearest agency station for delivery.
(3)* Carriers shall require the consignee to remove TOFC and COFC shipments from the carrier's property within 48 hours after notice of arrival, excluding Saturdays, Sundays, and holidays.
(4) If the trailers or containers are not so removed, the carrier shall dispose of the shipment immediately by means of storage, disposal, or, where necessary for safety, destruction under the supervision of a competent person.
(5) If storage is required to comply with 12.3(3), it shall be located in an interchange lot meeting the requirements of Chapters 4 and 5 of NFPA 498 or in a location that provides equivalent safety to the public.
(6) Where local conditions make the acceptance, transportation, or delivery of explosive materials unusually hazardous, applicable local restrictions shall be imposed by the carrier.
(7) All rail carriers shall report complete information on their restrictions regarding the acceptance, delivery, or transportation of explosive materials over any portion of their lines to the Bureau of Explosives of the Association of American Railroads for publication by the Bureau.
(8) Where shipping explosives, regularly scheduled days for receiving trailers and containers for shipment shall be assigned wherever it is practicable to do so.
(9) To enable the carrier to provide suitable flatcars for the shipment of Division 1.1 or Division 1.2 explosives, the shipper shall give the carrier at least 24 hours' notice of the shipments and their destinations.
(10) Where a regularly scheduled day has been appointed for receipt of trailers and containers for shipment, the notice required by 12.3(9) shall be permitted to be waived by the carrier, and in such cases, the shipments shall be delivered on the assigned days in time to allow inspection, billing, and loading on that day.
(11) Carriers shall forward shipments promptly within 48 hours after acceptance at the originating point or after receipt at any yard transfer station or interchange point, excluding Saturdays, Sundays, and holidays, except that where biweekly or weekly service is provided, shipments shall be forwarded on the next train.
(12) The Bureau of Explosives of the Association of American Railroads shall be consulted by rail carriers to determine that the storage facility required by 12.3(3) is safe, adequate, and complies with Chapter 4 of NFPA 498.
(13) Cars loaded with explosive materials shall be placed so that they are safe from all probable danger from fire.
(14) Cars loaded with explosive materials shall not be placed under bridges or overhead highway crossings, or in or alongside passenger sheds or stations.

12.4 Designation of Facilities. The local AHJ shall have the authority to designate the location for, and limit the quantity of, explosive materials that are loaded, unloaded, reloaded, or temporarily retained at any facility within the jurisdiction.

Chapter 13 Precursor Chemicals

13.1* Basic Requirements.

13.1.1 Mixed or combined precursor chemicals shall be transported, stored, and used in the same manner as explosive materials. *(See Chapters 4, 8, 9, and 10.)*

13.1.2 For transportation and storage, individual packages of each precursor component shall be packaged in separate shipping containers in compliance with the U.S. DOT, 49 CFR 100–199.

13.2 Storage.

13.2.1 Precursor Components.

13.2.1.1 Precursor components shall be stored in separate locked containers.

13.2.1.2 If any component possesses a hazard classification, it shall be stored in a location and manner appropriate to its hazard class.

13.2.2 Precursor Chemicals.

13.2.2.1 Precursor chemicals shall be permitted to be stored in the same magazine with explosive materials, provided their total weight is included in the weight of explosives permitted in the magazine in order to comply with the quantity–distance (Q–D) requirements of Table 9.4.1(a) through Table 9.4.1(d).

13.2.2.2 Storage shall not introduce a hazard due to chemical incompatibility.

13.3 Use.

13.3.1 Where precursor chemicals are mixed or combined at the point of use, the procedures recommended by the manufacturer shall be followed strictly.

13.3.2 Since the mixing or combining of precursor components produces an explosive material, the number of packages combined at any one time shall be limited to the number needed for immediate use.

13.3.2.1 The requirement in 13.3.2 shall be permitted to be waived, provided the extra explosive material produced can be handled and stored as such.

13.4 Record Keeping and Reporting.

13.4.1 Dealers in precursor chemicals shall record all transactions on appropriate federal, state, and local forms, as required for transactions with explosive materials.

13.4.2 Thefts of precursor chemicals during transportation, storage, and use shall be reported to the authority having jurisdiction, as required for thefts of explosive materials.

13.4.3 Licenses.

13.4.3.1 Dealers in precursor chemicals shall require that all purchasers possess a license or permit to use explosive materials.

13.4.3.2 The license or permit number shall be recorded with other records of the sale.

Chapter 14 Small Arms Ammunition and Primers, Smokeless Propellants, and Black Powder Propellants

14.1 Basic Requirements.

14.1.1 In addition to all other applicable requirements of this code, intrastate transportation of small arms ammunition, small arms primers, smokeless propellants, and Black Powder shall comply with the U.S. DOT, 49 CFR 100–199.

14.1.2 This chapter shall apply to the users and distribution channels of small arms ammunition, small arms primers, smokeless propellants, and Black Powder.

14.1.3 This chapter shall not apply to in-process storage and intraplant transportation during manufacture.

14.1.4 This chapter shall apply to the transportation and storage of small arms ammunition and components.

14.1.5 This chapter shall not apply to safety procedures in the use of small arms ammunition and components.

14.1.6 The bulk repackaging of small arms ammunition, primers, smokeless propellants, or Black Powder propellants shall not be performed in retail stores.

14.2 Small Arms Ammunition.

14.2.1 No restrictions shall be imposed on transportation of small arms ammunition other than those imposed by the U.S. DOT or by the presence of other hazardous materials.

14.2.2 No quantity limitations shall be imposed on the storage of small arms ammunition in warehouses, retail stores, and other occupancies other than those imposed by the limitations of the storage facility and by public safety regulations.

14.2.3 Small arms ammunition shall be separated from materials classified by the U.S. DOT as flammable liquids, flammable solids, and oxidizing materials by a distance of 4.6 m (15 ft) or by a fire partition having a fire resistance of at least 1 hour.

14.2.4 Small arms ammunition shall not be stored together with Division 1.1, Division 1.2, or Division 1.3 explosives, except where the storage facility is suitable for the storage of explosive materials.

14.2.5* Damaged Ammunition.

14.2.5.1 Small arms ammunition that has been exposed to fire or has been damaged by exposure to water shall not be returned to commercial channels for reasons of consumer safety.

14.2.5.2 The manufacturer shall be contacted to obtain recommendations for the disposal of damaged ammunition.

14.3 Smokeless Propellants.

14.3.1 Quantities of smokeless propellants not exceeding 11.3 kg (25 lb) in shipping containers approved by the U.S. DOT shall be permitted to be transported in a private vehicle.

14.3.2 Quantities of smokeless propellants exceeding 11.3 kg (25 lb), but not exceeding 22.7 kg (50 lb), transported in a private vehicle, shall be transported in a portable magazine having wood walls of at least 25.4 mm (1 in.) nominal thickness.

14.3.3 Transportation of more than 22.7 kg (50 lb) of smokeless propellants in a private vehicle shall be prohibited.

14.3.4 Commercial shipments of smokeless propellants for small arms that have been classed in Division 1.3 shall be permitted to be reclassed as a Division 4.1 flammable solid for transportation purposes for shipment by motor vehicle, rail car, vessel, or cargo-only aircraft, subject to the conditions stated in the U.S. DOT, 49 CFR 173.171.

14.3.5 Commercial shipments of smokeless propellants exceeding 45.4 kg (100 lb) or not packaged in accordance with the regulations cited in 14.3.4 shall be transported in accordance with the U.S. DOT regulations for Division 1.1 or Division 1.3 explosives.

14.3.6 Smokeless propellants shall be stored in shipping containers specified by U.S. DOT, 49 CFR 100–199.

14.3.7 Quantities.

14.3.7.1 Smokeless propellants intended for personal use in quantities not exceeding 9.1 kg (20 lb) shall be permitted to be stored in original containers in residences.

14.3.7.2 Quantities exceeding 9.1 kg (20 lb), but not exceeding 22.7 kg (50 lb), shall be permitted to be stored in residences where kept in a wooden box or cabinet having walls of at least 25.4 mm (1 in.) nominal thickness.

14.3.8 Not more than 22.7 kg (50 lb) of smokeless propellants, in containers of a 0.45 kg (1 lb) maximum capacity, shall be displayed in commercial establishments.

Δ **14.3.9** Commercial stocks of smokeless propellants shall be stored as follows:

(1) Quantities exceeding 22.7 kg (50 lb), but not exceeding 45.4 kg (100 lb), shall be stored in portable wooden boxes having walls of at least a 25.4 mm (1 in.) nominal thickness.
(2) Quantities exceeding 45.4 kg (100 lb), but not exceeding 363 kg (800 lb), shall be stored in nonportable storage cabinets having walls of at least a 25.4 mm (1 in.) nominal thickness.
(3) Not more than 181 kg (400 lb) shall be permitted to be stored in any one cabinet.
(4) Cabinets shall be separated by a distance of at least 7.63 m (25 ft) or by a fire partition having a fire resistance of at least 1 hour.
(5) Quantities exceeding 363 kg (800 lb) but not exceeding 2268 kg (5000 lb) shall be permitted to be stored in a building, provided the following requirements are met:
    (a) The warehouse or storage room shall not be accessible to unauthorized personnel.
    (b) Smokeless propellants shall be stored in nonportable storage cabinets having wood walls of at least 25.4 mm (1 in.) nominal thickness and having shelves with no more than 0.92 m (3 ft) of separation between shelves.
    (c) No more than 181 kg (400 lb) shall be stored in any one cabinet.
    (d) Cabinets shall be located against the walls of the storage room or warehouse with at least 12.2 m (40 ft) between cabinets.
    (e) The separation between cabinets shall be permitted to be reduced to 6.1 m (20 ft) where barricades twice the height of the cabinets are attached to the wall, midway between each cabinet.
    (f) The barricades shall extend at least 3 m (10 ft) outward, be firmly attached to the wall, and be constructed of 6.4 mm (¼ in.) boiler plate, 51 mm (2 in.) thick wood, brick, or concrete block.
    (g) Smokeless propellants shall be separated from materials classified by the U.S. DOT as flammable liquids, flammable solids, and oxidizing materials by a distance of 7.63 m (25 ft) or by a fire partition having a fire resistance of at least 1 hour.
    (h) The building shall be protected by an automatic sprinkler system installed in accordance with NFPA 13.
(6) Smokeless propellants not stored in accordance with 14.3.9(1) through 14.3.9(5) shall be stored in a Type 4 magazine constructed and located in accordance with Chapter 9.

14.4 Black Powder.

14.4.1 Black Powder shall be transported in accordance with the U.S. DOT. *(See also Chapter 8.)*

14.4.2 Black Powder shall be stored in shipping containers approved by the U.S. DOT.

14.4.3 Black Powder intended for personal use in quantities not exceeding 9.1 kg (20 lb) shall be permitted to be stored in residences where kept in the original containers and stored in a wooden box or cabinet having walls of at least a 25.4 mm (1 in.) nominal thickness.

14.4.4 No more than 0.45 kg (1 lb) of Black Powder shall be displayed in commercial establishments.

14.4.5 Commercial stocks stored in buildings in quantities not exceeding 22.7 kg (50 lb) shall be stored in a Type 4 indoor magazine.

14.4.6 Commercial stocks in quantities exceeding 22.7 kg (50 lb) shall be stored in a Type 4 outdoor magazine.

14.4.7 Where smokeless propellants are stored in the same magazine with Black Powder, the total quantity shall not exceed that permitted for Black Powder.

14.4.8 Commercial shipments of Black Powder for small arms that have been classed in Division 1.3 shall be permitted to be reclassed as a Division 4.1 flammable solid for transportation purposes for shipment by motor vehicle, rail car, vessel, or cargo-only aircraft, subject to the conditions stated in the U.S. DOT, 49 CFR 173.171.

14.5 Small Arms Primers.

14.5.1 Small arms primers shall be transported or stored in containers approved by the U.S. DOT.

14.5.2 Transportation of small arms primers shall comply with U.S. DOT Regulations.

14.5.3 No more than 25,000 small arms primers shall be permitted to be transported in a private vehicle.

14.5.4 For small arms primers classified by the U.S. DOT as 1.4S, the limit shall be permitted to be increased to 150,000.

14.5.5 No more than 10,000 small arms primers shall be permitted to be stored in residences.

14.5.6 For small arms primers classified by the U.S. DOT as 1.4S, the limit stored in residences shall be permitted to be increased to 150,000.

14.5.7 No more than 10,000 small arms primers shall be permitted to be displayed in commercial establishments.

14.5.8 For small arms primers classified by the U.S. DOT as 1.4S, the limit displayed in commercial establishments shall be permitted to be increased to 150,000.

Δ **14.5.9** Commercial stocks of small arms primers shall be stored as follows:

(1) Quantities not exceeding 750,000 shall be permitted to be stored in a building where not more than 100,000 are stored in any one pile and where piles are at least 4.6 m (15 ft) apart.

(2) Quantities exceeding 750,000 shall be permitted to be stored in a building, provided the following conditions are met:

(a) The warehouse or storage room shall not be accessible to unauthorized personnel.
(b) Primers, other than DOT type 1.4S, shall be stored in cabinets.
(c) No more than 200,000 primers, other than DOT type 1.4S, shall be stored in any one cabinet.
(d) Shelves in cabinets shall have a vertical separation of at least 0.6 m (2 ft).
(e) Cabinets shall be located against the walls of the warehouse or storage room with at least 12.2 m (40 ft) between cabinets.
(f) The separation between cabinets shall be permitted to be reduced to 6.1 m (20 ft) where barricades twice the height of the cabinets are attached to the wall, midway between each cabinet.
(g) The barricades shall extend at least 3 m (10 ft) outward, be firmly attached to the wall, and be constructed of 6.4 mm (¼ in.) boiler plate, 51 mm (2 in.) thick wood, brick, or concrete block.
(h) Primers shall be separated from materials classified by the U.S. DOT as flammable liquids, flammable solids, and oxidizing materials by a distance of 7.63 m (25 ft) or by a fire partition having a fire resistance of at least 1 hour.
(i) The building shall be protected by an automatic sprinkler system installed in accordance with NFPA 13.

(3) Small arms primers not stored in accordance with 14.5.9(1) and 14.5.9(2) shall be stored in a magazine meeting the requirements of Chapter 9.

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

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

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

A.3.2.5 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.3.3.5 Blast Site. This definition applies only to explosives used during mining, quarrying, or construction activities. A minimum of 9.1 m (30 ft) can replace the 15.2 m (50 ft) requirement if the perimeter for loaded holes is marked and separated from nonblast site areas by a barrier. The word *barrier* means an object(s) that separates, keeps apart, or demarcates in a conspicuous manner by means of cones, a warning sign, or tape. The 15.2 m (50 ft) or 9.1 m (30 ft) distance requirements, as applicable, apply in all directions along the full depth of the borehole. In underground mines, at least 4.6 m (15 ft) of a solid rib, pillar, or broken rock can be substituted for the 15.2 m (50 ft) distance.

A.3.3.8 Blasting Agent. Such materials or mixtures have been found to be so insensitive that there is little probability of accidental initiation of explosion or of transition from deflagration to detonation. Blasting agents are 1.5D materials, and tests required to classify these materials are specified in the U.S. Department of Transportation (DOT), 49 CFR 173.56, 49 CFR 173.57, and 49 CFR 173.58.

A.3.3.9 Borehole. For additional information on boreholes, see IME Safety Library Publication No. 17, "Safety in the Transportation, Storage, Handling, and Use of Explosive Materials."

A.3.3.10.1 Inhabited Building. For further clarification, see ATF Ruling 2005-3.

A.3.3.10.2 Operating Building. Operating buildings are separated from one another with the use of intraplant or intraline distances.

A.3.3.13 Bullet-Resistant Construction. Tests to determine bullet resistance are to be conducted on test panels or empty magazines. The panels or magazines are to resist penetration of five out of five shots placed independently of each other in an area at least 0.9 m × 0.9 m (3 ft × 3 ft). If hardwood or softwood is used, its water content is not to exceed 15 percent.

Where a magazine roof or ceiling is required to be bullet resistant, it should be constructed of materials comparable to the sidewalls or of other materials that can withstand the pene-

tration of bullets fired at an angle of 45 degrees from perpendicular.

A.3.3.16 Detonator. A detonator is not permitted to contain more than 10 g (0.35 oz) of total explosive material per unit, excluding ignition or delay charges. The term includes, but is not limited to, electric detonators of the instantaneous and delay types, detonators for use with safety fuses, detonating cord delay connectors, and nonelectric detonators of the instantaneous and delay types that consist of a detonating cord, a shock tube, or any other replacement for electric leg wires.

A.3.3.17.1 Explosive-Actuated Device. This term does not include propellant-actuated devices *(see 3.3.17.2)*. Examples of explosive-actuated devices are jet tappers and jet perforators.

A.3.3.17.2 Propellant-Actuated Device. A propellant-actuated device is any tool or special mechanized device or gas generator system that is actuated by a propellant or that releases or directs work through a propellant charge.

A.3.3.18.4 Quantity–Distance (Q–D). These relationships are based on levels of risk considered acceptable for the stipulated exposures and are tabulated in the appropriate Q–D tables. The separation distances specified afford less than absolute safety.

Δ **A.3.3.20 Explosive.** Explosives in Class 1 are divided into six divisions as follows:

(1) Division 1.1 consists of explosives that have a mass explosion hazard. A mass explosion is one that affects almost the entire load instantaneously.
(2) Division 1.2 consists of explosives that have a projection hazard but not a mass explosion hazard.
(3) Division 1.3 consists of explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard, or both, but not a mass explosion hazard.
(4) Division 1.4 consists of explosives that present a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package.
(5) Division 1.5 consists of very insensitive explosives. (The probability of transition from burning to detonation is greater when large quantities are transported in a vessel.) This division is comprised of substances that have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.
(6) Division 1.6 consists of extremely insensitive articles that do not have a mass explosion hazard. (The risk from articles of Division 1.6 is limited to the explosion of a single device.) This division is comprised of articles that contain only extremely insensitive detonating substances and that demonstrate a negligible probability of accidental initiation or propagation.

A list of explosives determined to be within the scope of 18 USC 40 is published at least annually by the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF), U.S. Department of Justice. The classification of explosives described in the "Hazardous Materials Regulations" of the U.S. DOT is provided in Annex E. 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 18 USC 40 and also includes any material classified as an explosive by the U.S. DOT in 49 CFR 100–199.

Δ **A.3.3.22 Fire Extinguisher Rating.** Ratings are set forth in NFPA 10.

Δ **A.3.3.23 Flash Point.** See also NFPA 30.

A.3.3.26 Hazards Analysis (HA). A documentation, discovery, and decision tool using methods such as Failure Modes and Effects Analysis (FMEA), Hazard and Operability Study (HAZOPS), fault tree analysis, and/or what-if analysis to identify scenarios where the process delivers energy to the energetic material. Each scenario is evaluated for the potential energy developed in the process compared to the minimum energy required to initiate the material. Sources of energy evaluated in the HA include, but are not limited to, electrical, electrostatic discharge, friction, impact, impingement, shock, and thermal. The HA should also evaluate the potential for out of place materials, inclusion of foreign objects, chemical compatibility, propagation of the fire or detonation, product damage, equipment damage, and environmental damage.

A.3.3.30.1.1 Bullet-Sensitive Explosive Material. The test material is at a temperature of 21°C to 24°C (70°F to 75°F) and is placed against a 12.7 mm (½ in.) steel plate.

A.3.3.30.1.2 Cap-Sensitive Explosive Material. A No. 8 blasting cap contains 0.40 g to 0.45 g (0.014 oz to 0.016 oz) of pentaerythritol tetranitrate (PETN) base charge pressed into an aluminum shell having a bottom thickness not greater than 0.8 mm (0.03 in.) to a specific gravity of not less than 1.4 g/cc (87.4 lb/ft^3) and primed with standard weights of primer, in accordance with the manufacturers' specifications.

A.3.3.30.1.5 Special Industrial Explosive Material. The high explosives used include dynamite, trinitrotoluene (TNT), PETN, and cyclotrimethylenetrinitramine (RDX).

A.3.3.30.2.2 Incompatible Material(s). Explosive materials are unique in that they contain materials otherwise considered to be incompatible (e.g., fuels and oxidizers that could be in intimate contact with one another). The conditions of containment and the design of the packaging are such that the reaction that occurs between the materials is controlled by the user. On the other hand, explosive materials as such are not necessarily compatible with all other materials and means must be taken to ensure that the materials in their manufactured state will not cause unexpected reactions should inadvertent spills or mixing occur.

Δ **A.3.3.30.3 Oxidizing Material.** See NFPA 400.

A.3.3.40 Propellant. It is classified by the U.S. DOT, "Hazardous Materials Regulations" as Division 1.1 or 1.3, depending on its susceptibility to detonation, and it can be reclassed as Division 4.1 *(see also 14.3.4)*.

A.3.3.42 Public Highway. "Open to public travel" means that the road section is available, except during scheduled periods, extreme weather, or emergency conditions, passable by four-wheel standard passenger cars, and open to the general public for use without restrictive gates, prohibitive signs, or regulation other than restrictions based on size, weight, or class of registration. Toll plazas of public toll roads are not considered restrictive gates.

A.3.3.44.1 Fire Resistant. For exterior walls of magazines constructed of wood, this is defined as the fire resistance equivalency provided by sheet metal of not less than 26 gauge.

A.3.3.45 Semiconductive Hose. Any hose having a resistance of no more than 2.0 megohms over its entire length and a resistance of no less than 3280 ohms/m (1000 ohms/ft) meets this definition.

A.3.3.47 Shock Tube. A shock tube contains only a limited quantity of reactive material so that the energy transmitted through the tube by means of a detonation wave is guided through and confined within the walls of the tube.

A.3.3.49 Small Arms Ammunition. This definition does not include military ammunition containing bursting charges or incendiary, tracer, spotting, or pyrotechnic projectiles.

A.3.3.51 Steel. Examples of steel can be found in ASTM A1008/A1008M, *Standard Specifications for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy with Improved Formability,* or equivalent.

A.3.3.52 Water Gel. Water gels (or slurries) are manufactured with varying degrees of sensitivity to initiation and are classified as Division 1.1D or 1.5D explosives, as appropriate. Water gels can be sensitized by a material that itself is classified as an explosive material, such as TNT or smokeless powder, or they cannot contain any ingredient classified as an explosive. Water gels in this latter category are sensitized using metals such as aluminum or using other fuels.

A.4.1.1.1 If fire threatens packages bearing the 1.4S label or packages containing material classified as 1.4S, consider isolating at least 15 m (50 ft) in all directions. Fire should be fought with normal precautions from a reasonable distance.

A.4.1.4.1(5) Process safety management should be according to U.S. Department of Labor OSHA regulations in 29 CFR 1910.119.

A.4.2.5 Such a plan can be developed using IME Safety Library Publication No. 27, "Security in Manufacturing, Transportation, Storage and Use of Commercial Explosives."

A.4.8.5 The toll-free telephone number for reporting incidents to the ATF is 800-800-3855.

A.5.2.4 Approved containers include those that are non–static generating, nonsparking, or otherwise designed in such a manner as to avoid inadvertent ignition of the contained material. Tests or analysis might be required to determine the acceptability of the container used.

A.5.2.5 The disposal of hazardous waste might be further regulated by authorities charged with environmental protection, transportation, or regulations of the jurisdiction in which the facility operates.

A.5.2.7.3 In determining equipment that is appropriate to be included, management should be aware that there is a wide variety of electronic equipment employed today, including hearing aids, writing instruments, communication devices, and so forth. Procedures for acceptance should consider devices other than portable tools, which have been the traditional point of control.

Δ **A.5.3.1** The hazard classification (e.g., Division 1.1, Division 1.3, and so forth) of explosive materials when packaged for transportation or storage could be different from the hazard classification for these same materials as the materials are moving within the manufacturing process. The differences in classification can be due to quantity or mass of material present, its physical form, the configuration (or arrangement) of the material, as well as other extrinsic or intrinsic factors. An in-process hazard classification is used to characterize the hazards of a given material as it exists outside of its packaging within the manufacturing process.

The hazard classification of high explosion hazard materials is generally considered to be the most severe. Materials that are known to have a high explosion hazard are treated as those that mass explode. The classification code allows the user to either assume that the material presents a high explosion hazard or demonstrate that the in-process hazard classification is other than a high explosion hazard through documentation, experience with a given process, or testing. An example of each method of demonstration is as follows:

(1) A documented method of demonstration can include explosives manufactured to a published military standard or explosives manufactured to another established process that is documented by qualified operating procedures. To be qualified, either the procedures should assign an in-process hazard classification that can be demonstrated or a high explosion hazard classification can be assumed.
(2) An example of experience with a given process can include a process, equipment, and procedures that have been used by multiple manufacturers over a prolonged period of time so that there is an ample database establishing the incident history of the manufacturing process as to its hazards.
(3) By testing with an agreed-upon protocol, an in-process hazard classification can be assigned to one or more steps in the process.

The hazard classification of packaged explosive materials might vary as the material is removed from the original shipping container for use in an assembly operation. Similarly, the hazard classification for materials that are in the process of being formulated might vary and the hazard classification of the bulk form of the material can be quite different from that of the same material in its packaged state. The hazard classification of some materials can be said to be "package dependent," with the hazard classification subject to change depending on the type or construction of the packaging used as well as the quantity contained within the package.

An analogy can be made between packaged materials and unpackaged materials that are being handled in processing operations through the use of mechanical equipment such as mixing, blending, or formulation processes. The quantity of material used and the shape of the containers (or configuration), including the physical dimensions, can all have a bearing on the hazard classification of the material. The critical mass (critical height and/or critical diameter) is frequently used as a measure of safety in establishing the parameters of the manufacturing process.

The intrinsic chemical or physical properties alone of a material can determine the hazard classification, or the hazard classification can be influenced by extrinsic factors such as temperature, pressure, arrangement, or the mechanical aspects of the process operations. Various methods can be used to establish the in-process hazard classification for the materials being manufactured or used within the manufacturing process. Some materials might have well-established process parameters

where the nature of the process and the nature of the formulations have long been known. Other materials or processes to which the materials are exposed could be new, or the methods or equipment in which they are to be manufactured or handled are either new or outside of the established parameters. In all cases, an in-process hazard classification for the material being manufactured or used is required. When decisions are made regarding the siting, occupancy, or use of a building in which manufacturing occurs, it is critical that each step of the manufacturing process be evaluated so that the appropriate in-process hazard classification is assigned. The appropriate building location can then be established, and the area of the building being utilized can be assigned the proper occupancy classification.

When testing is used to establish the hazard classifications, tests defined by the Department of Defense (DOD), the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF), United Nations Transport of Dangerous Goods (UN), or Department of Transportation (DOT) are generally used. Regardless of the specific tests being performed, the protocol as well as the acceptance criteria should be agreed upon between the user and the AHJ. Figure A.5.3.1(a) and Figure A.5.3.1(b) provide examples of a test protocol in which the in-process hazard classifications of materials are established by testing. Figure A.5.3.1(a) is used for the in-process classification of substances, and Figure A.5.3.1(b) is used for the in-process classification for unpackaged articles. These figures and additional information can be found in the Explosives Testing Users Group (ETUG) document, ETUG-GS01-15, *ETUG Standard for In-Process Hazard Classification of Explosives.*

A.5.3.2 The classification of the explosives and the weight of the explosives are primary characteristics governing the use of these tables.

A.5.3.2.2(3)(a) When TNT equivalency is used, the highest TNT equivalency measured on impulse or overpressure should be used as the basis to determine quantity.

A.5.3.2.2(3)(b) When TNT equivalency is used, the highest TNT equivalency measured on impulse or overpressure should be used as the basis to determine quantity.

A.5.3.2.2(3)(c) When TNT equivalency is used, the highest TNT equivalency measured on impulse or overpressure should be used as the basis to determine quantity.

A.5.3.3 The case for separation of Division 1.2 materials represents a special case due to the potential production of hazardous fragments. Unbarricaded operating buildings or magazines containing Division 1.2 explosives might require additional separation distances than those indicated in Table 5.3.3(a). Such separation is determined on a case-by-case basis. Paragraph 5.3.1.1.2 can be used as the basis by which to engage a third party to assist in this evaluation.

A.5.4.4.1.2 The frequency for the integrity inspection should be determined by a vulnerability assessment. The expectation is that the inspection of fences and gates should occur at least annually.

N **A.5.4.5.4.1** Areas meeting the Energetic Area 3 definition are typically rated as electrically unclassified.

N **A.5.4.5.5.2** Examples of these areas might include vent hoods, destruct areas, and cleaning areas that use flammable liquids or generate flammable gases.

N **A.5.4.5.6** Examples include offices, break rooms, utility areas, and other similar areas.

Δ **A.5.4.6** For guidance on static electricity hazards, see NFPA 77.

Δ **A.6.4.3** See NFPA 400 for guidance in choosing compatible materials.

A.9.6.1(4) A bullet-resistant roof can be permitted to be constructed in accordance with any of the specifications in Annex D. A bullet-resistant ceiling can be permitted to be constructed at the eave line, covering the entire area of the magazine, excluding the necessary ventilation space. Examples of bullet-resistant ceiling construction include the following:

(1) Any construction meeting the specifications in Annex C
(2) A sand tray having a sand depth of at least 102 mm (4 in.)

A.9.7.8 Markings regarding the orientation of the containers should be followed.

A.10.1.7.1 If fire threatens packages bearing the 1.4S label or packages containing material classified as 1.4S, consider isolating at least 15 m (50 ft) in all directions. Fire should be fought with normal precautions from a reasonable distance.

A.10.1.19.1(2) For further information, see IME Safety Library Publication No. 20, "Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Commercial Electric Detonators (Blasting Caps)."

A.10.3.8.2 This section does not apply to electronic, exploding bridge wire, exploding foil initiator, and other detonators designed to be resistant to stray currents.

A.10.6.4 The member companies of the Institute of Makers of Explosives have agreed to supply advice on or assistance in destroying commercial explosives to law enforcement agencies, fire departments, and inspection and regulatory officials, as well as to users of explosives. The manufacturer, if known, should be consulted for assistance. If the manufacturer is not known, a member company of the Institute of Makers of Explosives can provide advice or assistance.

A.11.1 This chapter provides a high level of non-damage probability concerning damage of any sort, including small, hairline cosmetic cracks in weak wall coverings, even in those structures that are old and distressed. Engineered structures and utilities, including those constructed of masonry and concrete, can withstand higher levels of excitation (vibration). Wherever the term *damage* is used in this document, it can be construed to apply to threshold cosmetic cracking.

A.11.1.1 This chapter applies to dwellings, public buildings, schools, churches, and commercial or institutional buildings. Other structures can be included as required by the AHJ.

A.11.1.3 For information on ISEE documents, go to www.isee.org.

A.11.1.4 See A.11.1.3.

A.11.2 The ground vibration requirements of this chapter are based upon scientific visual observations of cosmetic cracking as documented in U.S. Bureau of Mines RI 8507 and 8896, and any change requires similar documented technical justification.

Test Series 1
(Required fundamental processing and handling tests)
Impact Sensitivity Test
Friction Sensitivity Test
ESD Sensitivity Test
Thermal Stability Test

Test Series 2
UN/DOT Zero Gap Test or
NOL Zero Card Gap Test
Internal Ignition 20 g
(0.705 oz) bag

Test Series 3
Small-Scale Burning Test
#8 Cap Test
NOL Card Gap Test
Koenen Test
Time/Pressure Test

Test Series 4
Appropriate Process/Equipment Simulation and/or
Critical Diameter Test
Critical Height (Mass) Test
Venting Parameters
(Internal Ignition 10 g (0.353 oz) bag and/or Koenen Test)

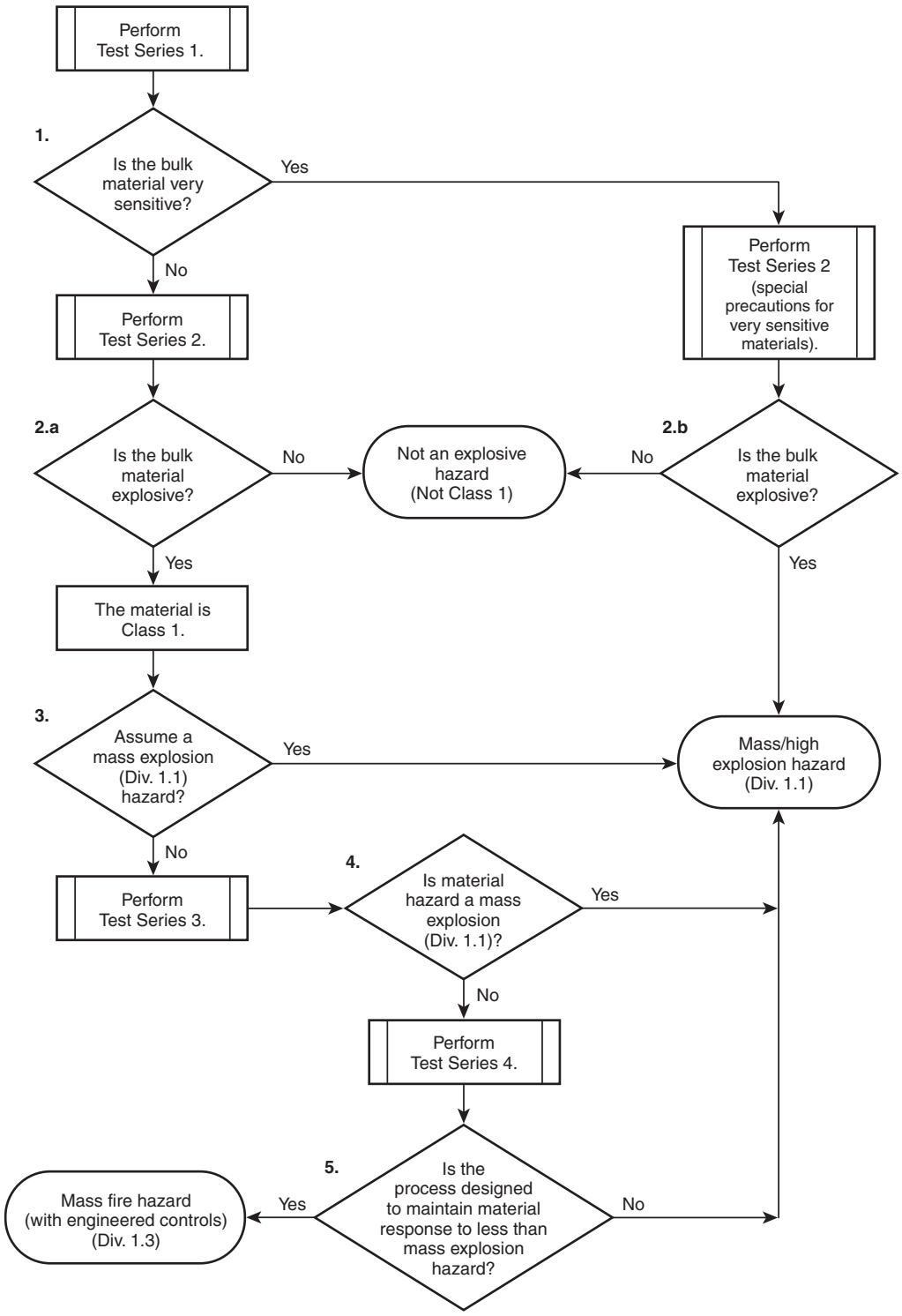

Figure A.5.3.1(a) In-Process Classification of Substances.

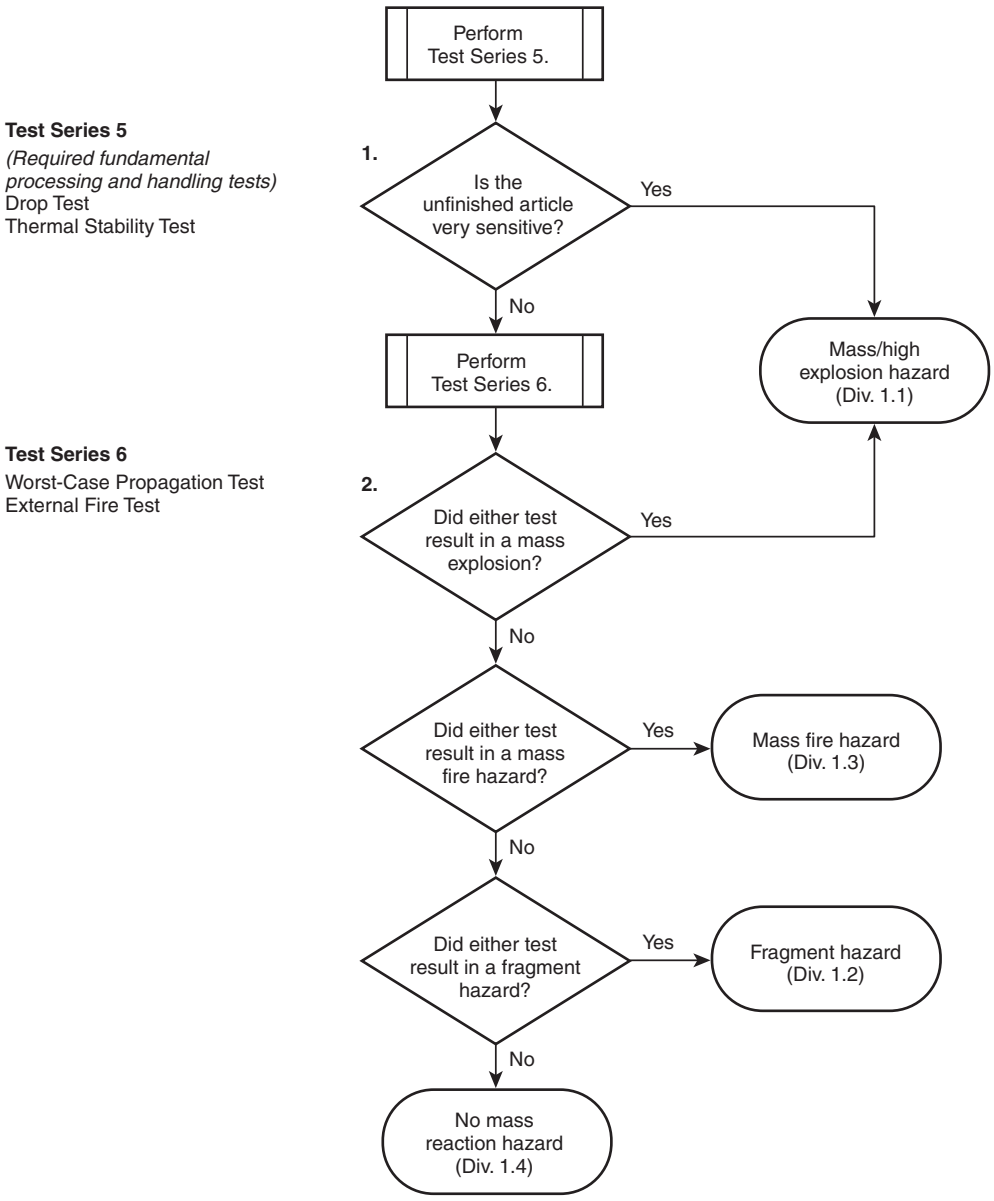

Figure A.5.3.1(b) In-Process Classification for Unpackaged Articles.

A.11.2.2 *Scaled distance* is defined as the distance to the building or structure in feet divided by the square root of the maximum charge weight in pounds detonated within any 8 millisecond interval. The use of the scaled distance factors provides a high level of confidence for the prevention of damage. However, seismograph monitoring provides the best data for gauging the effect of vibrations. Thus, monitoring with a blasting seismograph supersedes the necessity of designing blasts with the ultraconservative scaled distance factors.

A.11.3 The air overpressure requirements of this chapter are based upon scientific visual observations of window damage as documented in U.S. Bureau of Mines RI 8485, and any change requires similar documented technical justification.

A.11.3.1 The limit of 133 dB(L) (0.013 psi) is primarily based on perception and has no substantiated potential to cause damage to buildings.

N **A.11.5.2(2)** Excavation of blasted material should start as close to the underground enclosed space as possible in order to provide for venting of any entrapped gases. Equipment operators and other personnel should be aware of the possible hazards that could result from the release of entrapped gases in and around blasted materials during excavation. Operators and other personnel should consider the usage of proper PPE for this application.

A.12.3(3) The specific requirement is provided in the U.S. Department of Transportation, 49 CFR 174.16.

A.13.1 Plosophoric materials, or plosophors, also are known as two-component or binary explosives.