NFPA 10

Standard for Portable Fire Extinguishers

2002 Edition

NFPA, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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This edition of NFPA 10, *Standard for Portable Fire Extinguishers,* was prepared by the Technical Committee on Portable Fire Extinguishers and acted on by NFPA at its May Association Technical Meeting held May 19–23, 2002, in Minneapolis, MN. It was issued by the Standards Council on July 19, 2002, with an effective date of August 8, 2002, and supersedes all previous editions.

This edition of NFPA 10 was approved as an American National Standard on July 19, 2002.

Origin and Development of NFPA 10

In 1918 and 1919, the NFPA Committee on Field Practice (predecessor of the present committee) was active in developing a standard on first aid protection. The earliest official NFPA standard on this subject was adopted in 1921. Revised editions were adopted by the Association in 1926, 1928, 1929, 1930, 1931, 1932, 1936, 1938, 1942, 1945, 1950, 1953, 1955, 1956, 1957, 1958, 1959, 1961, 1962, 1963, 1965, 1966, 1967, 1968, 1969, 1970, 1972, 1973, 1974, 1975, 1978, and 1981. In 1965, the previous editions were divided into two separate texts, one covering installation and the second covering maintenance and use. The 1974 edition recombined all the information previously contained in NFPA 10 and NFPA 10A. A new appendix was added to the 1974 edition to include information about the selection of fire extinguishers for home hazards. Information on selection and distribution of fire extinguishers was added to the appendix of the 1978 edition. Major revisions to provide simplification and uniformity were made in the 1984 edition. The standard was revised in 1988, 1990, and 1994.

In 1998, NFPA 10R, *Recommended Practice for Portable Fire Extinguishing Equipment in Family Dwelling Units and Living Units,* was withdrawn. Information on this topic was included in a separate appendix in that document.

This standard was revised for 2002.

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Committee Scope: This Committee shall have primary responsibility for documents on the installation, maintenance and use of portable fire extinguishers and equipment. Does not apply to permanently installed fire extinguishing systems even though portions of those systems are portable, such as hose and nozzles which may be attached to a fixed supply of extinguishing agent.

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

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

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

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet between the paragraphs that remain.

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, Annex J lists the complete title and edition of the source documents for both mandatory and nonmandatory extracts. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the appropriate technical committee.

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

Chapter 1 Administration

1.1* Scope. The provisions of this standard apply to the selection, installation, inspection, maintenance, and testing of portable extinguishing equipment. The requirements given herein are *minimum*. Portable fire extinguishers are intended as a first line of defense to cope with fires of limited size. They are needed even if the property is equipped with automatic sprinklers, standpipe and hose, or other fixed protection equipment *(see 4.3.2, 5.1.1, 5.2.1, and 5.2.3)*. They do not apply to permanently installed systems for fire extinguishment, even where portions of such systems are portable (such as hose and nozzles attached to a fixed supply of extinguishing agent).

1.2* Purpose. This standard is prepared for the use and guidance of persons charged with selecting, purchasing, installing, approving, listing, designing, and maintaining portable fire-extinguishing equipment. The fire protection requirements of this standard are general in nature and are not intended to abrogate the specific requirements of other NFPA standards for specific occupancies.

1.2.1 Nothing in this standard shall be construed as a restriction on new technologies or alternative arrangements, provided that the level of protection as herein described is not lowered and is acceptable to the authority having jurisdiction.

1.3 Classification, Ratings, and Performance of Fire Extinguishers. *(See Annex G.)*

1.3.1 Portable fire extinguishers used to comply with this standard shall be listed and labeled and shall meet or exceed all the requirements of one of the fire test standards and one of the appropriate performance standards shown below:

(1) Fire Test Standards:

(a) ANSI/UL 711, *Standard for Rating and Fire Testing of Fire Extinguishers*

(b) CAN/ULC-S508-M90, *Standard for Rating and Fire Testing of Fire Extinguishers and Class D Extinguishing Media*

(2) Performance Standards:

(a) Carbon Dioxide Types. ANSI/UL 154, *Standard for Carbon Dioxide Fire Extinguishers*; CAN/ULC-S503-M90, *Standard for Carbon Dioxide Hand and Wheeled Fire Extinguishers*

(b) Dry Chemical Types. ANSI/UL 299, *Standard for Dry Chemical Fire Extinguishers*; CAN/ULC-S504-M86, *Standard for Dry Chemical and Dry Powder Hand and Wheeled Fire Extinguishers*

(c) Water Types. ANSI/UL 626, *Standard for 2½-Gallon Stored-Pressure, Water-Type Fire Extinguishers*; CAN/ULC-S507-92, *Standard for 9 Litre Stored Pressure Water Type Fire Extinguishers*

(d) Halon Types. ANSI/UL 1093, *Standard for Halogenated Agent Fire Extinguishers*; CAN/ULC-S512-M87, *Standard for Halogenated Agent Hand and Wheeled Fire Extinguishers*

(e) Film-Forming Foam Types. ANSI/UL 8, *Standard for Foam Fire Extinguishers*

(f) Halocarbon Type. ANSI/UL 2129, *Standard for Halocarbon Agent Fire Extinguishers*

1.3.2* The identification of the listing and labeling organization, the fire test, and the performance standard that the fire extinguisher meets or exceeds shall be clearly marked on each fire extinguisher.

1.3.2.1 Fire extinguishers manufactured prior to January 1, 1986, shall not be required to comply with 1.3.2.

1.3.3* An organization listing fire extinguishers used to comply with the requirements of this standard shall utilize a third-party certification program for portable fire extinguishers that meets or exceeds ANSI/UL 1803, *Standard for Factory Follow-up on Third Party Certified Portable Fire Extinguishers*.

1.3.3.1 Fire extinguishers manufactured prior to January 1, 1989, shall not be required to comply with 1.3.3.

1.3.3.2 Certification organizations accredited by the Standards Council of Canada shall not be required to comply with 1.3.3.

1.3.4 Extinguishers listed for the Class C rating shall not contain an agent that is a conductor of electricity. In addition to successfully meeting the requirements of ANSI/UL 711, *Standard for Rating and Fire Testing of Fire Extinguishers*, water-based agents shall be tested in accordance with ASTM D 5391-93, *Standard Test for Electrical Conductivity and Resistivity of a Flowing High Purity Water Sample*. Fire extinguishers containing water-based agents that have a conductivity higher than 1.00 microsiemens/cm at 25°C (77°F) shall be considered a conductor of electricity and therefore shall not be rated Class C. This requirement shall apply only to water-based extinguishers manufactured after August 15, 2002.

1.4 Classification of Hazards.

1.4.1 Light (Low) Hazard. Light hazard occupancies are locations where the total amount of Class A combustible materials, including furnishings, decorations, and contents, is of minor quantity. This can include some buildings or rooms occupied as offices, classrooms, churches, assembly halls, guest room areas of hotels/motels, and so forth. This classification anticipates that the majority of content items are either noncombus-

tible or so arranged that a fire is not likely to spread rapidly. Small amounts of Class B flammables used for duplicating machines, art departments, and so forth, are included, provided that they are kept in closed containers and safely stored.

1.4.2 Ordinary (Moderate) Hazard. Ordinary hazard occupancies are locations where the total amount of Class A combustibles and Class B flammables are present in greater amounts than expected under light (low) hazard occupancies. These occupancies could consist of dining areas, mercantile shops and allied storage, light manufacturing, research operations, auto showrooms, parking garages, workshop or support service areas of light (low) hazard occupancies, and warehouses containing Class I or Class II commodities as defined by NFPA 13, *Standard for the Installation of Sprinkler Systems.*

1.4.3 Extra (High) Hazard. Extra hazard occupancies are locations where the total amount of Class A combustibles and Class B flammables present, in storage, production, use, finished product, or combination thereof, is over and above those expected in occupancies classed as ordinary (moderate) hazard. These occupancies could consist of woodworking; vehicle repair; aircraft and boat servicing; cooking areas; individual product display showrooms; product convention center displays; and storage and manufacturing processes such as painting, dipping, and coating, including flammable liquid handling. Also included is warehousing of or in-process storage of other than Class I and Class II commodities.

1.5 General Requirements.

1.5.1 The classification of fire extinguishers shall consist of a letter that indicates the class of fire on which a fire extinguisher has been found to be effective, preceded by a rating number (Class A and Class B only) that indicates the relative extinguishing effectiveness.

1.5.1.1 Fire extinguishers classified for use on Class C, Class D, or Class K hazards shall not be required to have a number preceding the classification letter.

1.5.2 Portable fire extinguishers shall be maintained in a fully charged and operable condition and shall be kept in their designated places at all times when they are not being used.

1.5.3 Fire extinguishers shall be conspicuously located where they will be readily accessible and immediately available in the event of fire. Preferably, they shall be located along normal paths of travel, including exits from areas.

1.5.4 The following types of fire extinguishers are considered obsolete and shall be removed from service:

(1) Soda acid
(2) Chemical foam (excluding film-forming agents)
(3) Vaporizing liquid (e.g., carbon tetrachloride)
(4) Cartridge-operated water
(5) Cartridge-operated loaded stream
(6) Copper or brass shell (excluding pump tanks) joined by soft solder or rivets
(7) Carbon dioxide extinguishers with metal horns
(8) Solid charge–type AFFF extinguishers (paper cartridge)

1.5.5 Cabinets housing fire extinguishers shall not be locked, except where fire extinguishers are subject to malicious use and cabinets include a means of emergency access.

1.5.6* Fire extinguishers shall not be obstructed or obscured from view. In large rooms, and in certain locations where visual obstructions cannot be completely avoided, means shall be provided to indicate the extinguisher location.

1.5.7* Portable fire extinguishers other than wheeled extinguishers shall be installed securely on the hanger, or in the bracket supplied by the extinguisher manufacturer, or in a listed bracket approved for such purpose, or placed in cabinets or wall recesses. Wheeled fire extinguishers shall be located in a designated location.

1.5.8 Fire extinguishers installed under conditions where they are subject to dislodgement shall be installed in manufacturer's strap-type brackets specifically designed to cope with this problem.

1.5.9 Fire extinguishers installed under conditions where they are subject to physical damage, (e.g., from impact, vibration, the environment) shall be adequately protected.

1.5.10 Fire extinguishers having a gross weight not exceeding 40 lb (18.14 kg) shall be installed so that the top of the fire extinguisher is not more than 5 ft (1.53 m) above the floor. Fire extinguishers having a gross weight greater than 40 lb (18.14 kg) (except wheeled types) shall be so installed that the top of the fire extinguisher is not more than 3½ ft (1.07 m) above the floor. In no case shall the clearance between the bottom of the fire extinguisher and the floor be less than 4 in. (10.2 cm).

1.5.11 Extinguishers' operating instructions shall be located on the front of the extinguisher and shall be clearly visible. Hazardous materials identification systems (HMIS) labels, six-year maintenance labels, hydrostatic test labels, or other labels shall not be located or placed on the front of the extinguisher. These restrictions shall not apply to original manufacturer's labels, labels that specifically relate to the extinguisher's operation or fire classification, or inventory control labels specific to that extinguisher.

1.5.12 Fire extinguishers mounted in cabinets or wall recesses shall be placed so that the fire extinguisher operating instructions face outward. The location of such fire extinguishers shall be marked conspicuously. *(See 1.5.6.)*

1.5.13* Where fire extinguishers are installed in closed cabinets that are exposed to elevated temperatures, the cabinets shall be provided with screened openings and drains.

1.5.14* Fire extinguishers shall not be exposed to temperatures outside of the listed temperature range shown on the fire extinguisher label.

1.5.15 Fire extinguishers containing plain water only can be protected to temperatures as low as –40°F (–40°C) by the addition of an antifreeze that is stipulated on the fire extinguisher nameplate. Calcium chloride solutions shall not be used in stainless steel fire extinguishers.

1.5.16* The owner or the owner's agent shall be provided with a fire extinguisher instruction manual that details condensed instructions and cautions necessary to the installation, operation, inspection, and maintenance of the fire extinguisher(s). The manual shall refer to this standard as a source of detailed instruction.

1.6* Identification of Contents. A fire extinguisher shall have a label, tag, stencil, or similar indicator attached to it providing the following information:

(1) The contents product name as it appears on the manufacturer's Material Safety Data Sheet (MSDS)

(2) Listing of the hazardous material identification in accordance with hazardous materials identification systems (HMIS) [in Canada, workplace hazardous materials identification systems (WHMIS)] developed by the National Paint & Coatings Association
(3) List of any hazardous materials that are in excess of 1.0 percent of the contents
(4) List of each chemical in excess of 5.0 percent of the contents
(5) Information as to what is hazardous about the agent in accordance with the Material Safety Data Sheet (MSDS)
(6) Manufacturer's or service agency's name, mailing address, and phone number

1.7* Units. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). One unit (liter), outside of but recognized by SI, is commonly used in international fire protection. The units are listed in Table 1.7 with conversion factors.

Table 1.7 Metric Units of Measurement

Name of Unit	Unit Symbol	Conversion Factor
liter	L	1 gal = 3.785 L
centimeter	cm	1 in. = 2.540 cm
meter	m	1 ft = 0.305 m
kilogram	kg	1 lb (mass) = 0.454 kg
degree Celsius	°C	$\frac{5}{9}$(°F – 32) = °C
bar	bar	1 psi = 0.0689 bar

1.7.1 If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated is to be regarded as the requirement. A given equivalent value can be considered approximate.

1.7.2 The conversion procedure for the SI units has been to multiply the quantity by the conversion factor and then round the result to the appropriate number of significant digits.

Chapter 2 Referenced Publications

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

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

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2002 edition.

NFPA 14, *Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems,* 2000 edition.

NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages,* 2000 edition.

NFPA 32, *Standard for Drycleaning Plants,* 2000 edition.

NFPA 58, *Liquefied Petroleum Gas Code,* 2001 edition.

NFPA 86, *Standard for Ovens and Furnaces,* 1999 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations,* 2001 edition.

NFPA 120, *Standard for Coal Preparation Plants,* 1999 edition.

NFPA 122, *Standard for Fire Prevention and Control in Underground Metal and Nonmetal Mines,* 2000 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations,* 2000 edition.

NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft,* 1998 edition.

NFPA 303, *Fire Protection Standard for Marinas and Boatyards,* 2000 edition.

NFPA 385, *Standard for Tank Vehicles for Flammable and Combustible Liquids,* 2000 edition.

NFPA 407, *Standard for Aircraft Fuel Servicing,* 2001 edition.

NFPA 408, *Standard for Aircraft Hand Portable Fire Extinguishers,* 1999 edition.

NFPA 410, *Standard on Aircraft Maintenance,* 1999 edition.

NFPA 418, *Standard for Heliports,* 2001 edition.

NFPA 430, *Code for the Storage of Liquid and Solid Oxidizers,* 2000 edition.

NFPA 498, *Standard for Safe Havens and Interchange Lots for Vehicles Transporting Explosives,* 2001 edition.

NFPA 1192, *Standard on Recreational Vehicles,* 2002 edition.

NFPA 1194, *Standard for Recreational Vehicle Parks and Campgrounds,* 2002 edition.

2.3 Other Publications.

2.3.1 ASTM Publication. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 5391, *Standard Test for Electrical Conductivity and Resistivity of a Flowing High Purity Water Sample,* 1993.

2.3.2 CGA Publication. Compressed Gas Association, 1725 Jefferson Davis Highway, Arlington, VA 22202-4100.

CGA C-1, *Methods of Hydrostatic Testing of Compressed Gas Cylinders,* 1996.

2.3.3 NPCA Publication. National Paint & Coating Association, 1500 RI Avenue NW, Washington, DC 20005.

Hazardous Materials Identification System Revised, Implementational Manual, 1981.

2.3.4 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

ANSI/UL 8, *Standard for Foam Fire Extinguishers,* 1995.

ANSI/UL 154, *Standard for Carbon Dioxide Fire Extinguishers,* 1995.

ANSI/UL 299, *Standard for Dry Chemical Fire Extinguishers,* 1995.

ANSI/UL 626, *Standard for 2½-Gallon Stored-Pressure, Water-Type Fire Extinguishers,* 1995.

ANSI/UL 711, *Standard for Rating and Fire Testing of Fire Extinguishers,* 1995.

ANSI/UL 1093, *Standard for Halogenated Agent Fire Extinguishers,* 1995.

ANSI/UL 1803, *Standard for Factory Follow-up on Third Party Certified Portable Fire Extinguishers,* 1994.

ANSI/UL 2129, *Standard for Halocarbon Agent Fire Extinguishers.*

2.3.5 ULC Publications. Underwriters' Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario M1R 3A9, Canada.

CAN/ULC-S503, *Standard for Carbon Dioxide Hand and Wheeled Fire Extinguishers,* 1990, amended 1993.

CAN/ULC-S504, *Standard for Dry Chemical and Dry Powder Hand and Wheeled Fire Extinguishers*, 1986, amended 1996.

CAN/ULC-S507, *Standard for 9 Litre Stored Pressure Water Type Fire Extinguishers*, 1992, amended 1996.

CAN/ULC-S508, *Standard for Rating and Fire Testing of Fire Extinguishers and Class D Extinguishing Media,* 1990, amended 1996.

CAN/ULC-S512, *Standard for Halogenated Agent Hand and Wheeled Fire Extinguishers*, 1987, amended 1993.

2.3.6 U.S. Government Publication. U.S. Government Printing Office, Washington, DC 20402.

Title 49, *Code of Federal Regulations*, 1989.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not included, common usage of the terms shall apply.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

3.2.3 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.

3.2.4* 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.

3.2.5 Shall. Indicates a mandatory requirement.

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

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 ANSI. American National Standards Institute.

3.3.2 Antifreeze Charge. See 3.3.16, Loaded Stream Charge.

3.3.3* Carbon Dioxide. A colorless, odorless, electrically nonconductive inert gas that is a suitable medium for extinguishing Class B and Class C fires.

3.3.4 Classifications for Fires.

3.3.4.1 Class A Fires. Fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.

3.3.4.2 Class B Fires. Fires in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

3.3.4.3 Class C Fires. Fires that involve energized electrical equipment.

3.3.4.4 Class D Fires. Fires in combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium.

3.3.4.5 Class K Fires. Fires in cooking appliances that involve combustible cooking media (vegetable or animal oils and fats).

3.3.5 Closed Recovery System.

3.3.5.1 Dry Chemical Closed Recovery System. A system that provides for the transfer of dry chemical agent between fire extinguishers and recovery containers that is closed to prevent the loss of agent to the atmosphere.

3.3.5.2 Halogenated Closed Recovery System. A system that provides for the transfer of halogenated agents between fire extinguishers, supply containers, and recharge and recovery containers so that none of the halogenated agent escapes to the atmosphere. Closed recovery systems for halogenated agents with an ozone depleting potential (ODP) of 0.2 or greater shall be listed for use with that agent. The system's supply or recharge and recovery container shall be capable of maintaining the agent in a sealed environment until it is reused or returned to the agent manufacturer.

3.3.6 DOT. U.S. Department of Transportation. [**57:**3.3]

3.3.7* Dry Chemical. A mixture of finely divided solid particles, usually sodium bicarbonate-, potassium bicarbonate-, or ammonium phosphate–based with added particulate material supplemented by special treatment to provide resistance to packing, and moisture absorption (caking), and to promote proper flow characteristics.

3.3.8* Dry Powder. Solid materials in powder or granular form designed to extinguish Class D combustible metal fires by crusting, smothering, or heat-transferring means.

3.3.9* Electronic Monitoring. A method of electronic communication (data transmission) between an in-place fire extinguisher and an electronic monitoring device/system.

3.3.10 Extinguisher Inspection. A "quick check" that a fire extinguisher is available and is in operating condition. It is intended to give reasonable assurance that the fire extinguisher is fully charged. This is done by verifying that it is in its designated place, that it has not been actuated or tampered with, and that there is no obvious physical damage or condition to prevent its operation.

3.3.11* Film-Forming Foam Agents. The film-forming foam agents referenced in this standard are AFFF (aqueous film-forming foam) and FFFP (film-forming fluoroprotein foam).

3.3.12* Halogenated Agents. Halogenated (clean) agents referenced in this standard are of the following types.

3.3.12.1 Halocarbons. Halocarbon agents include hydrochlorofluorocarbon (HCFC), hydrofluorocarbon (HFC), perfluorocarbon (PFC), and fluoroiodocarbon (FIC) types of agents.

3.3.12.2 Halons. Halons include bromochlorodifluoromethane (Halon 1211), bromotrifluoromethane (Halon 1301), and mixtures of Halon 1211 and Halon 1301 (Halon 1211/1301).

3.3.13 High-Pressure Cylinder. For the purposes of this standard, high-pressure cylinders (and cartridges) are those containing nitrogen, compressed air, carbon dioxide, or other gases at a pressure higher than 500 psi (3447 kPa) at 70°F (21°C).

3.3.14 Hydrostatic Testing. Pressure testing of the extinguisher to verify its strength against unwanted rupture.

3.3.15 ICC. The Interstate Commerce Commission, which had jurisdiction over high-pressure cylinders and cartridges prior to 1967.

3.3.16* Loaded Stream Charge. A water-based extinguishing medium that uses an alkali metal salt as a freezing point depressant.

3.3.17 Low-Pressure Cylinder. For the purposes of this standard, low-pressure cylinders are those containing fire extinguishing agent (medium), nitrogen, compressed air, or other compressed gases at a service pressure of 500 psi (3447 kPa) or lower at 70°F (21°C).

3.3.18 Maintenance. A thorough examination of the fire extinguisher. It is intended to give maximum assurance that a fire extinguisher will operate effectively and safely. It includes a thorough examination for physical damage or condition to prevent its operation and any necessary repair or replacement. It will normally reveal if hydrostatic testing or internal maintenance is required.

3.3.19 Mild Steel Shell. All steel shells other than stainless steel and steel shells used for high-pressure cylinders.

3.3.20 Pressure.

3.3.20.1 Extinguisher Service Pressure. The normal operating pressure as indicated on the nameplate or cylinder of a fire extinguisher.

3.3.20.2 Factory Test Pressure. The pressure at which a shell was tested at time of manufacture. This pressure is shown on the nameplate.

3.3.21 Recharging. The replacement of the extinguishing agent (also includes the expellant for certain types of fire extinguishers).

3.3.22 Servicing. Includes one or more of the following: (a) maintenance, (b) recharging, (c) hydrostatic testing.

3.3.23 TC. Transport Canada, formerly Canada Transport Commission (CTC), which has jurisdiction over high- and low-pressure cylinders and cartridges in Canada.

3.3.24 Travel Distance. The actual walking distance from any point to the nearest fire extinguisher fulfilling hazard requirements.

3.3.25* Wet Chemical. Wet chemicals include, but are not limited to, solutions of water and potassium acetate, potassium carbonate, potassium citrate, or any combinations thereof.

3.3.26 Wetting Agent. A surface-active material added to water to materially reduce the surface tension of the water and thus increase penetrating and spreading characteristics.

3.4 Fire Extinguisher Definitions.

3.4.1 Cartridge/Cylinder-Operated Fire Extinguisher. A fire extinguisher in which the expellant gas is in a separate container from the agent storage container.

3.4.2* Nonrechargeable Fire Extinguisher. A nonrechargeable (nonrefillable) fire extinguisher is not capable of (nor intended to be capable of) undergoing complete maintenance, hydrostatic testing, and being restored to its full operating capability by the standard practices used by fire equipment dealers and distributors.

3.4.3 Portable Fire Extinguisher. A portable device, carried or on wheels and operated by hand, containing an extinguishing agent that can be expelled under pressure for the purpose of suppressing or extinguishing fire.

3.4.4* Rechargeable (Refillable) Fire Extinguisher. A rechargeable (refillable) fire extinguisher is capable of undergoing complete maintenance, including internal inspection of the pressure vessel, replacement of all substandard parts and seals, and hydrostatic testing.

3.4.5 Residential Fire Extinguisher.

3.4.5.1 Automatic Residential Fire Extinguisher Unit. A fixed extinguishing device, fitted with an automatic means of operation that is designed, tested, and listed for use on a particular type of hazard as identified on its label.

3.4.5.2 General Use Residential Fire Extinguisher. A fire extinguisher that has been specifically investigated, tested, and listed for use only in and around the home (one- and two-family dwellings and living units within multifamily structures) for the purpose of suppressing or extinguishing a fire.

3.4.5.3 Special Purpose Residential Fire Extinguisher. A fire extinguisher designed, tested, and listed for a particular type of hazard as specified on its label.

3.4.6 Self-Expelling Fire Extinguisher. A fire extinguisher in which the agents have sufficient vapor pressure at normal operating temperatures to expel themselves.

3.4.7 Stored-Pressure Fire Extinguisher. A fire extinguisher in which both the extinguishing material and expellant gas are kept in a single container, and that includes a pressure indicator or gauge.

3.4.8 Water Mist Fire Extinguisher. A water-type portable fire extinguisher containing distilled water and employing a nozzle that discharges the agent in a fine spray.

3.4.9 Water-Type Fire Extinguisher. A water-type fire extinguisher contains water-based agents, such as water, AFFF, FFFP, antifreeze, and loaded stream.

3.4.10 Wheeled Fire Extinguisher. A portable fire extinguisher equipped with a carriage and wheels intended to be transported to the fire by one person. *(See A.4.1.2.)*

Chapter 4 Selection of Fire Extinguishers

4.1 General Requirements. The selection of fire extinguishers for a given situation shall be determined by the character of the fires anticipated, the construction and occupancy of the individual property, the vehicle or hazard to be protected, ambient-temperature conditions, and other factors *(see Table H.2)*. The number, size, placement, and limitations of use of

fire extinguishers required shall meet the requirements of Chapter 5.

4.1.1* Use of halogenated agent fire extinguishers shall be limited to applications where a clean agent is necessary to extinguish fire efficiently without damaging the equipment or area being protected, or where the use of alternate agents can cause a hazard to personnel in the area.

4.1.1.1 Placement of portable fire extinguishers containing halogenated agents shall conform to minimum volume requirement warnings contained on the fire extinguisher nameplates.

4.1.2* Wheeled Fire Extinguishers. Wheeled fire extinguishers shall be considered for hazard protection where fulfillment of the following requirements is necessary:

(1) High agent flow rates
(2) Increased agent stream range
(3) Increased agent capacity
(4) High hazard areas

4.2 Selection by Hazard.

4.2.1 Fire extinguishers shall be selected for the class(es) of hazards to be protected in accordance with the subdivisions in 4.2.1.1 through 4.2.1.5. *(For specific hazards, see Section 4.3.)*

4.2.1.1* Fire extinguishers for protecting Class A hazards shall be selected from types that are specifically listed and labeled for use on Class A fires. *(For halon agent–type extinguishers, see 4.1.1.)*

4.2.1.2* Fire extinguishers for the protection of Class B hazards shall be selected from types that are specifically listed and labeled for use on Class B fires. *(For halon agent–type extinguishers, see 4.1.1.)*

4.2.1.3* Fire extinguishers for protection of Class C hazards shall be selected from types that are specifically listed and labeled for use on Class C hazards. *(For halon agent–type fire extinguishers, see 4.1.1.)*

4.2.1.4* Fire extinguishers and extinguishing agents for the protection of Class D hazards shall be of the types specifically listed and labeled for use on the specific combustible metal hazard.

4.2.1.5 Fire extinguishers for the protection of Class K hazards shall be selected from types that are specifically listed and labeled for use on Class K fires.

4.3 Application for Specific Hazards.

4.3.1 Class B Fire Extinguishers for Pressurized Flammable Liquids and Pressurized Gas Fires. Fires of this nature are considered to be a special hazard. Class B fire extinguishers containing agents other than dry chemical are relatively ineffective on this type of hazard due to stream and agent characteristics. Selection of fire extinguishers for this type of hazard shall be made on the basis of recommendations by manufacturers of this specialized equipment. The system used to rate the effectiveness of fire extinguishers on Class B fires (flammable liquids in depth) is not applicable to these types of hazards. It has been determined that special nozzle design and rates of agent application are required to cope with such hazards.

CAUTION: It is undesirable to attempt to extinguish this type of fire unless there is reasonable assurance that the source of fuel can be promptly shut off.

4.3.2* Class K Fire Extinguishers for Cooking Oil Fires. Fire extinguishers provided for the protection of cooking appliances that use combustible cooking media (vegetable or animal oils and fats) shall be listed and labeled for Class K fires. Class K fire extinguishers manufactured after January 1, 2002, shall not be equipped with "extended wand–type" discharge devices.

4.3.2.1 Fire extinguishers installed specifically for the protection of cooking appliances that use combustible cooking media (animal, vegetable oils and fats) prior to June 30, 1998, shall not be required to comply with 4.3.2. *(Also see 4.3.2.3.)*

4.3.2.2* A placard shall be conspicuously placed near the extinguisher that states that the fire protection system shall be activated prior to using the fire extinguisher.

4.3.2.3 Existing dry chemical extinguishers without a Class K listing that were installed for the protection of Class K hazards shall be replaced with an extinguisher having Class K listing when the dry chemical extinguishers become due for either a 6-year maintenance or hydrostatic test.

4.3.3* Three-Dimensional Class B Fires. A three-dimensional Class B fire involves Class B materials in motion such as pouring, running, or dripping flammable liquids, and generally includes vertical as well as one or more horizontal surfaces. Fires of this nature are considered to be a special hazard. Selection of fire extinguishers for this type of hazard shall be made on the basis of recommendations by manufacturers of this specialized equipment. The system used to rate fire extinguishers on Class B fires (flammable liquids in depth) is not directly applicable to this type of hazard.

4.3.4 Water-Soluble Flammable Liquid Fires (Polar Solvents). AFFF- and FFFP-types of fire extinguishers shall not be used for the protection of water-soluble flammable liquids, such as alcohols, acetone, esters, ketones, and so forth, unless specifically referenced on the fire extinguisher nameplate.

4.3.5* Electronic Equipment Fires. Fire extinguishers for the protection of delicate electronic equipment shall be selected from types specifically listed and labeled for Class C. *(See 4.2.1.3.)*

4.4 Application for Specific Locations. Where portable fire extinguishers are required to be installed, the following documents shall be reviewed for the occupancies outlined in their respective scopes. However, in no case shall the requirements be less than those specified in this standard.

(1) NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*
(2) NFPA 32, *Standard for Drycleaning Plants*
(3) NFPA 58, *Liquefied Petroleum Gas Code*
(4) NFPA 86, *Standard for Ovens and Furnaces*
(5) NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*
(6) NFPA 120, *Standard for Coal Preparation Plants*
(7) NFPA 122, *Standard for Fire Prevention and Control in Underground Metal and Nonmetal Mines*
(8) NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*
(9) NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*
(10) NFPA 303, *Fire Protection Standard for Marinas and Boatyards*
(11) NFPA 385, *Standard for Tank Vehicles for Flammable and Combustible Liquids*

(12) NFPA 407, *Standard for Aircraft Fuel Servicing*
(13) NFPA 408, *Standard for Aircraft Hand Portable Fire Extinguishers*
(14) NFPA 410, *Standard on Aircraft Maintenance*
(15) NFPA 418, *Standard for Heliports*
(16) NFPA 430, *Code for the Storage of Liquid and Solid Oxidizers*
(17) NFPA 498, *Standard for Safe Havens and Interchange Lots for Vehicles Transporting Explosives*
(18) NFPA 1192, *Standard on Recreational Vehicles*
(19) NFPA 1194, *Standard for Recreational Vehicle Parks and Campgrounds*

Chapter 5 Distribution of Fire Extinguishers

5.1 General Requirements.

5.1.1* The minimum number of fire extinguishers needed to protect a property shall be determined as outlined in this chapter. Frequently, additional extinguishers can be installed to provide more suitable protection. Fire extinguishers having ratings less than specified in Table 5.2.1 and Table 5.3.1 can be installed, provided they are not used in fulfilling the minimum protective requirements of this chapter.

5.1.2* Fire extinguishers shall be provided for the protection of both the building structure and the occupancy hazards contained therein.

5.1.2.1 Required building protection shall be provided by fire extinguishers suitable for Class A fires.

5.1.2.2* Occupancy hazard protection shall be provided by fire extinguishers suitable for such Class A, B, C, D, or K fire potentials as might be present.

5.1.2.3 Fire extinguishers provided for building protection can be considered also for the protection of occupancies having a Class A fire potential.

5.1.2.4 Buildings having an occupancy hazard subject to Class B or Class C fires, or both, shall have a standard complement of Class A fire extinguishers for building protection, plus additional Class B or Class C fire extinguishers, or both. Where fire extinguishers have more than one letter classification (such as 2-A:20-B:C), they can be considered to satisfy the requirements of each letter class.

5.1.3 Rooms or areas shall be classified generally as light (low) hazard, ordinary (moderate) hazard, or extra (high) hazard. Limited areas of greater or lesser hazard shall be protected as required.

5.1.4 On each floor level, the area protected and the travel distances shall be based on fire extinguishers installed in accordance with Table 5.2.1 and Table 5.3.1.

5.2 Fire Extinguisher Size and Placement for Class A Hazards.

5.2.1 Minimal sizes of fire extinguishers for the listed grades of hazards shall be provided on the basis of Table 5.2.1, except as modified by 5.2.2. Fire extinguishers shall be located so that the maximum travel distances shall not exceed those specified in Table 5.2.1, except as modified by 5.2.2. *(See Annex E.)*

5.2.1.1 Certain smaller fire extinguishers that are charged with a multipurpose dry chemical or a halogenated agent are rated on Class B and Class C fires, but have insufficient effectiveness to earn the minimum 1-A rating even though they have value in extinguishing smaller Class A fires. They shall not be used to meet the requirements of 5.2.1.

5.2.2 Up to one-half of the complement of fire extinguishers as specified in Table 5.2.1 shall be permitted to be replaced by uniformly spaced 1½ in. (3.81 cm) hose stations for use by the occupants of the building. Where hose stations are so provided, they shall conform to NFPA 14, *Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems*. The location of hose stations and the placement of fire extinguishers shall be such that the hose stations do not replace more than every other fire extinguisher.

5.2.3 Where the area of the floor of a building is less than that specified in Table 5.2.1, at least one fire extinguisher of the minimum size recommended shall be provided.

5.2.4 The protection requirements shall be permitted to be fulfilled with fire extinguishers of higher rating, provided the travel distance to such larger fire extinguishers does not exceed 75 ft (22.7 m).

Table 5.2.1 Fire Extinguisher Size and Placement for Class A Hazards

Criteria	Light (Low) Hazard Occupancy	Ordinary (Moderate) Hazard Occupancy	Extra (High) Hazard Occupancy
Minimum rated single extinguisher	2-A*	2-A*	4-A†
Maximum floor area per unit of A	3000 ft^2	1500 ft^2	1000 ft^2
Maximum floor area for extinguisher	11,250 ft‡	11,250 ft‡	11,250 ft‡
Maximum travel distance to extinguisher	75 ft	75 ft	75 ft

For SI units: 1 ft = 0.305 m; 1 ft^2 = 0.0929 m^2.
*Up to two water-type extinguishers, each with 1-A rating, can be used to fulfill the requirements of one 2-A rated extinguisher.
†Two 2½ gal (9.46 L) water-type extinguishers can be used to fulfill the requirements of one 4-A rated extinguisher.
‡See E.3.3.

5.3* Fire Extinguisher Size and Placement for Class B Fires Other Than for Fires in Flammable Liquids of Appreciable Depth.

5.3.1 Minimal sizes of fire extinguishers for the listed grades of hazard shall be provided on the basis of Table 5.3.1. Fire extinguishers shall be located so that the maximum travel distances do not exceed those specified in the table used. *(See Annex E.)*

Table 5.3.1 Fire Extinguisher Size and Placement for Class B Hazards

Type of Hazard	Basic Minimum Extinguisher Rating	Maximum Travel Distance to Extinguishers	
		ft	m
Light (low)	5-B	30	9.15
	10-B	50	15.25
Ordinary (moderate)	10-B	30	9.15
	20-B	50	15.25
Extra (high)	40-B	30	9.15
	80-B	50	15.25

Notes:
(1) The specified ratings do not imply that fires of the magnitudes indicated by these ratings will occur, but rather they are provided to give the operators more time and agent to handle difficult spill fires that could occur.
(2) For fires involving water-soluble flammable liquids, see 4.3.4.
(3) For specific hazard applications, see Section 4.3.

5.3.1.1 Fire extinguishers of lesser rating, desired for small specific hazards within the general hazard area, shall be permitted to be installed but shall not be considered as fulfilling any part of the requirements of Table 5.3.1.

5.3.2 Up to three AFFF or FFFP fire extinguishers of at least 2½ gal (9.46 L) capacity shall be permitted to be used to fulfill extra (high) hazard requirements.

5.3.3 Two AFFF or FFFP fire extinguishers of at least 1½ gal (6 L) capacity shall be permitted to be used to fulfill ordinary (moderate) hazard requirements.

5.3.4 Two or more fire extinguishers of lower rating shall not be used to fulfill the protection requirements of Table 5.3.1 except as permitted by 5.3.2 and 5.3.3.

5.3.5 The protection requirements shall be permitted to be fulfilled with fire extinguishers of higher ratings, provided the travel distance to such larger fire extinguishers does not exceed 50 ft (15.25 m).

5.4* Fire Extinguisher Size and Placement for Class B Fires in Flammable Liquids of Appreciable Depth.

5.4.1* Portable fire extinguishers shall not be installed as the sole protection for flammable liquid hazards of appreciable depth where the surface area exceeds 10 ft^2 (0.93 m^2). Where personnel who are trained in extinguishing fires in the protected hazards are available on the premises, the maximum surface area shall not exceed 20 ft^2 (1.86 m^2).

5.4.2 For flammable liquid hazards of appreciable depth, a Class B fire extinguisher shall be provided on the basis of at least two numerical units of Class B extinguishing potential per ft^2 (0.0929 m^2) of flammable liquid surface of the largest hazard area. AFFF- or FFFP-type fire extinguishers shall be permitted to be provided on the basis of 1-B of protection per ft^2 (0.09 m^2) of hazard. (For fires involving cooking grease or water-soluble flammable liquids, see 4.3.2 and 4.3.4.)

5.4.3 Two or more fire extinguishers of lower ratings, other than AFFF- or FFFP-type fire extinguishers, shall not be used in lieu of the fire extinguisher required for the largest hazard area. Up to three AFFF- or FFFP-type fire extinguishers shall be permitted to fulfill the requirements, provided the sum of the Class B ratings meets or exceeds the value required for the largest hazard area.

5.4.4 Travel distances for portable fire extinguishers shall not exceed 50 ft (15.25 m). *(See Annex E.)*

5.4.4.1 Scattered or widely separated hazards shall be individually protected. A fire extinguisher in the proximity of a hazard shall be carefully located to be accessible in the presence of a fire without undue danger to the operator.

5.5* Fire Extinguisher Size and Placement for Class C Hazards. Fire extinguishers with Class C ratings shall be required where energized electrical equipment can be encountered. This requirement includes situations where fire either directly involves or surrounds electrical equipment. Since the fire itself is a Class A or Class B hazard, the fire extinguishers shall be sized and located on the basis of the anticipated Class A or Class B hazard.

5.6 Fire Extinguisher Size and Placement for Class D Hazards.

5.6.1 Fire extinguishers or extinguishing agents with Class D ratings shall be provided for fires involving combustible metals.

5.6.2 Fire extinguishers or extinguishing agents (media) shall be located not more than 75 ft (23 m) of travel distance from the Class D hazard. *(See Section E.6.)*

5.6.3 Portable fire extinguishers or extinguishing agents (media) for Class D hazards shall be provided in those work areas where combustible metal powders, flakes, shavings, chips, or similarly sized products are generated.

5.6.4 Size determination shall be on the basis of the specific combustible metal, its physical particle size, area to be covered, and recommendations by the fire extinguisher manufacturer on data from control tests conducted.

5.7 Fire Extinguisher Size and Placement for Class K Fires.

5.7.1 Class K fire extinguishers shall be provided for hazards where there is a potential for fires involving combustible cooking media (vegetable or animal oils and fats).

5.7.2 Maximum travel distance shall not exceed 30 ft (9.15 m) from the hazard to the extinguishers.

Chapter 6 Inspection, Maintenance, and Recharging

6.1 General.

6.1.1 This chapter is concerned with the rules governing inspection, maintenance, and recharging of fire extinguishers. These factors are of prime importance in ensuring operation at the time of a fire.

6.1.2 The procedure for inspection and maintenance of fire extinguishers varies considerably. Minimal knowledge is necessary to perform a monthly "quick check" or inspection in order to follow the inspection procedure as outlined in Section 6.2. A trained person who has undergone the instructions necessary to reliably perform maintenance and has the manufacturer's service manual shall service the fire extinguishers not more than 1 year apart, as outlined in Section 6.3.

6.1.3 The owner or designated agent or occupant of a property in which fire extinguishers are located shall be responsible for such inspection, maintenance, and recharging. *(See 6.1.2 and 6.1.4.)*

6.1.4* Maintenance, servicing, and recharging shall be performed by trained persons having available the appropriate servicing manual(s), the proper types of tools, recharge materials, lubricants, and manufacturer's recommended replacement parts or parts specifically listed for use in the fire extinguisher.

6.1.5 Tags or labels shall not be placed on the front of the fire extinguisher.

6.1.6 Labels indicating fire extinguisher use or classification or both shall be permitted to be placed on the front of the fire extinguisher.

6.2 Inspection.

6.2.1* Frequency. Fire extinguishers shall be inspected when initially placed in service and thereafter at approximately 30-day intervals. Fire extinguishers shall be inspected, manually or by electronic monitoring, at more frequent intervals when circumstances require.

6.2.2* Procedures. Periodic inspection of fire extinguishers shall include a check of at least the following items:

(1) Location in designated place
(2) No obstruction to access or visibility
(3) Operating instructions on nameplate legible and facing outward
(4)*Safety seals and tamper indicators not broken or missing
(5) Fullness determined by weighing or "hefting"
(6) Examination for obvious physical damage, corrosion, leakage, or clogged nozzle
(7) Pressure gauge reading or indicator in the operable range or position
(8) Condition of tires, wheels, carriage, hose, and nozzle checked (for wheeled units)
(9) HMIS label in place

6.2.3 Corrective Action. When an inspection of any fire extinguisher reveals a deficiency in any of the conditions listed in 6.2.2, immediate corrective action shall be taken.

6.2.3.1 Rechargeable Fire Extinguishers. When an inspection of any rechargeable fire extinguisher reveals a deficiency in any of the conditions listed in 6.2.2(3), (4), (5), (6), (7), and (8), it shall be subjected to applicable maintenance procedures.

6.2.3.2 Nonrechargeable Dry Chemical Fire Extinguisher. When an inspection of any nonrechargeable dry chemical fire extinguisher reveals a deficiency in any of the conditions listed in 6.2.2(3), (5), (6), and (7), it shall be removed from further use, discharged, and destroyed at the direction of the owner or returned to the manufacturer.

6.2.3.3 Nonrechargeable Halon Agent Fire Extinguisher. When an inspection of any nonrechargeable fire extinguisher containing a halon agent reveals a deficiency in any of the conditions listed in 6.2.2(3), (5), (6), and (7), it shall be removed from service, not discharged, and returned to the manufacturer. If the fire extinguisher is not returned to the manufacturer, it shall be returned to a fire equipment dealer or distributor to permit recovery of the halon.

6.2.4 Inspection Recordkeeping.

6.2.4.1 Personnel making inspections shall keep records of all fire extinguishers inspected, including those found to require corrective action.

6.2.4.2 At least monthly, the date the inspection was performed and the initials of the person performing the inspection shall be recorded.

6.2.4.3 Records shall be kept on a tag or label attached to the fire extinguisher, on an inspection checklist maintained on file or by an electronic method that provides a permanent record.

6.3* Maintenance.

6.3.1 Frequency. Fire extinguishers shall be subjected to maintenance at intervals of not more than 1 year, at the time of hydrostatic test, or when specifically indicated by an inspection or electronic notification.

6.3.1.1 Stored-pressure types containing a loaded stream agent shall be disassembled on an annual basis and subjected to complete maintenance. Prior to disassembly, the fire extinguisher shall be fully discharged to check the operation of the discharge valve and pressure gauge. The loaded stream charge shall be permitted to be recovered and re-used, provided it is subjected to agent analysis in accordance with manufacturer's instructions.

6.3.1.2* A conductivity test shall be conducted annually on all carbon dioxide hose assemblies. Hose assemblies found to be nonconductive shall be replaced. Carbon dioxide hose assemblies that pass a conductivity test shall have the test information recorded on a suitable metallic label or equally durable material that has a minimum size of ½ in. × 3 in. (1.3 cm × 7.6 cm). The label shall be affixed to the hose by means of a heatless process. The label shall include the following information:

(1) Month and year the test was performed, indicated by perforation, such as is done by a hand punch
(2) Name or initials of person performing the test and the name of the agency performing the test

6.3.1.3 Pressure regulators provided with wheeled-type fire extinguishers shall be tested for outlet static pressure and flow rate in accordance with manufacturer's instructions.

6.3.1.4 Fire extinguishers removed from service for maintenance or recharge shall be replaced by a fire extinguisher suitable for the type of hazard being protected and shall be of at least equal rating.

6.3.2 Procedures. Maintenance procedures shall include a thorough examination of the basic elements of a fire extinguisher as determined below:

(1) Mechanical parts of all fire extinguishers
(2) Extinguishing agent of cartridge- or cylinder-operated dry chemical, stored-pressure, loaded stream, and pump tank fire extinguishers
(3) Expelling means of all fire extinguishers

6.3.2.1 Internal examination during annual maintenance shall not be required for nonrechargeable fire extinguishers, carbon dioxide fire extinguishers, or stored-pressure fire extinguishers, except for those types specified in 6.3.1.1. These fire extinguishers shall be thoroughly examined externally in accordance with the applicable items of 6.3.2(1).

6.3.2.2 Seals or Tamper Indicators. At the time of the maintenance, the tamper seal of rechargeable fire extinguishers shall be removed by operating the pull pin or locking device. After the applicable maintenance procedures are completed, a new tamper seal shall be installed.

6.3.2.3* Boots, Foot Rings, and Attachments. All removable extinguisher boots, foot rings, and attachments shall be removed to accommodate thorough annual cylinder examinations.

6.3.3* Six-Year Maintenance. Every 6 years, stored-pressure fire extinguishers that require a 12-year hydrostatic test shall be emptied and subjected to the applicable maintenance procedures. The removal of agent from halon agent fire extinguishers shall only be done using a listed halon closed recovery system. When the applicable maintenance procedures are performed during periodic recharging or hydrostatic testing, the 6-year requirement shall begin from that date.

6.3.3.1 Nonrechargeable fire extinguishers shall not be hydrostatically tested but shall be removed from service at a maximum interval of 12 years from the date of manufacture. Nonrechargeable halon agent fire extinguishers shall be disposed of in accordance with 6.2.3.3.

6.3.4* Maintenance Recordkeeping. Each fire extinguisher shall have a tag or label securely attached that indicates the month and year the maintenance was performed and that identifies the person performing the service.

6.3.4.1* Fire extinguishers that pass the applicable 6-year requirement of 6.3.3 shall have the maintenance information recorded on a suitable metallic label or equally durable material having a minimum size of 2 in. × 3½ in. (5.1 cm × 8.9 cm). The new label shall be affixed to the shell by a heatless process, and any old maintenance labels shall be removed. These labels shall be of the self-destructive type when removal from a fire extinguisher is attempted. The label shall include the following information:

(1) Month and year the maintenance was performed, indicated by a perforation such as is done by a hand punch
(2) Name or initials of the person performing the maintenance and name of the agency performing the maintenance

6.3.4.2* Verification of Service (Maintenance or Recharging). Each extinguisher that has undergone maintenance that includes internal examination or that has been recharged *(see 6.4.5)* shall have a "Verification of Service" collar located around the neck of the container. The collar shall contain a single circular piece of uninterrupted material forming a hole of a size that will not permit the collar assembly to move over the neck of the container unless the valve is completely removed. The collar shall not interfere with the operation of the fire extinguisher. The "Verification of Service" collar shall include the month and year the service was performed, indicated by a perforation such as is done by a hand punch.

6.3.4.2.1 Fire extinguishers undergoing maintenance before January 1, 1999, shall not be required to comply with 6.3.4.2.

6.3.4.2.2 Cartridge/cylinder-operated fire extinguishers shall not be required to comply with 6.3.4.2.

6.3.4.2.3 New extinguishers requiring an initial charge in the field (such as pressurized water extinguishers, AFFF, FFFP, or wet chemical) shall not be required to have a "Verification of Service" collar installed.

6.4 Recharging.

6.4.1* General.

6.4.1.1 All rechargeable-type fire extinguishers shall be recharged after any use or as indicated by an inspection or when performing maintenance.

6.4.1.2* When performing the recharging, the recommendations of the manufacturer shall be followed. *(For recharge chemicals, see 6.4.3.1.)*

6.4.1.3* The amount of recharge agent shall be verified by weighing. The recharged gross weight shall be the same as the gross weight that is marked on the label. For those fire extinguishers that do not have the gross weight marked on the label, a permanent label that indicates the gross weight shall be affixed to the cylinder. The label containing the gross weight shall be a durable material of a pressure-sensitive, self-destruct type.

6.4.1.4 Conversion of Fire Extinguisher Types. No fire extinguisher shall be converted from one type to another, nor shall any fire extinguisher be converted to use a different type of extinguishing agent. Fire extinguishers shall not be used for any other purpose than that of a fire extinguisher.

6.4.1.5* Leak Test. After recharging, a leak test shall be performed on stored-pressure and self-expelling types of fire extinguishers.

6.4.2 Frequency.

6.4.2.1 Pump Tank. Every 12 months, pump tank water and pump tank calcium chloride–based antifreeze types of fire extinguishers shall be recharged with new chemicals or water, as applicable.

6.4.2.2 Wetting Agent. The agent in stored-pressure wetting agent fire extinguishers shall be replaced annually. Only the agent specified on the nameplate shall be used for recharging. The use of water or other agents is prohibited.

6.4.2.3 AFFF and FFFP. The premixed agent in liquid charge–type AFFF (aqueous film-forming foam) and FFFP (film-forming fluoroprotein foam) fire extinguishers shall be replaced at least once every 3 years. The agent in solid charge–type AFFF fire extinguishers shall be replaced once every 5 years.

6.4.2.3.1 The agent in nonpressurized AFFF and FFFP fire extinguishers that is subjected to agent analysis in accordance with manufacturer's instructions shall not be required to comply with 6.4.2.3.

6.4.3 Procedures.

6.4.3.1* Recharge Agents. Only those agents specified on the nameplate or agents proven to have equal chemical composition, physical characteristics, and fire extinguishing capabilities shall be used. Agents listed specifically for use with that fire extinguisher shall be considered to meet these requirements.

6.4.3.2* Mixing of Dry Chemicals. Multipurpose dry chemicals shall not be mixed with alkaline-based dry chemicals.

6.4.3.3 Topping Off. The remaining dry chemical in a discharged fire extinguisher shall be permitted to be re-used, provided that it is thoroughly checked for the proper type, contamination, and condition. Dry chemical found to be of the wrong type, or contaminated, shall not be re-used.

6.4.3.4 Dry Chemical Agent Re-use. Fire extinguishers removed for 6-year maintenance or hydrostatic testing shall be emptied. The dry chemical agent shall be permitted to be re-used, provided a closed recovery system is used and the agent is stored in a sealed container to prevent contamination. Prior to re-use, the dry chemical shall be thoroughly checked for the proper type, contamination, and condition. Where doubt exists with respect to the type, contamination, or condition of the dry chemical, the dry chemical shall be discarded.

6.4.3.5 Dry Powder. Pails or drums containing dry powder agents for scoop or shovel application for use on metal fires shall be kept full and covered at all times. The dry powder shall be replaced if found damp. *(See A.6.4.3.1.)*

6.4.3.6* Removal of Moisture. For all nonwater types of fire extinguishers, any moisture shall be removed before recharging.

6.4.3.7* Halogenated Agent. Halogenated agent fire extinguishers shall be charged only with the proper type and weight of agent as specified on the nameplate.

6.4.3.8 Halogenated Agent Re-use. The removal of Halon 1211 from fire extinguishers shall be done only using a listed halon closed recovery system. The removal of agent from other halogenated agent fire extinguishers shall be done only using a closed recovery system. The fire extinguisher shall be examined internally for contamination or corrosion, or both. The halogenated agent retained in the system recovery cylinder shall be re-used only if no evidence of internal contamination is observed in the fire extinguisher cylinder. Halogenated agent removed from fire extinguishers that exhibits evidence of internal contamination or corrosion shall be processed in accordance with the fire extinguisher manufacturer's instructions.

6.4.3.9* Carbon Dioxide. The vapor phase of carbon dioxide shall be not less than 99.5 percent carbon dioxide. The water content of the liquid phase shall be not more than 0.01 percent by weight [–30°F (–34.4°C) dew point]. Oil content of the carbon dioxide shall not exceed 10 ppm by weight.

6.4.3.10 Water Types. When stored-pressure fire extinguishers are recharged, overfilling will result in improper discharge. The proper amount of liquid agent shall be determined by using one of the following:

(1) Exact measurement by weight
(2) Exact measurement in volume
(3) An anti-overfill tube, if provided
(4) A fill mark on fire extinguisher shell, if provided

6.4.3.11 Wet Chemical Agent Re-use. These agents are not to be re-used. If a wet chemical extinguisher is partially discharged, all remaining wet chemical shall be discarded. Wet chemical agent shall be discarded and replaced at the hydrostatic test interval.

6.4.4 Precautionary Pressurization Measures.

6.4.4.1* Pressure Gauges. Replacement pressure gauges shall have the proper indicated charging (service) pressure, shall be marked for use with the agent in the fire extinguisher, and shall be compatible with the fire extinguisher valve body material.

6.4.4.2 Stored-Pressure Fire Extinguishers. A rechargeable stored-pressure-type fire extinguisher shall be pressurized only to the charging pressure specified on the fire extinguisher nameplate. The manufacturer's pressurizing adapter shall be connected to the valve assembly before the fire extinguisher is pressurized. A regulated source of pressure, set no higher than 25 psi (172 kPa) above the operating (service) pressure, shall be used to pressurize fire extinguishers. The gauge used to set the regulated source of pressure shall be calibrated at least annually.

6.4.4.2.1 An unregulated source of pressure, such as a nitrogen cylinder without a pressure regulator, shall never be used because the fire extinguisher could be overpressurized and possibly rupture.

6.4.4.2.2 A fire extinguisher shall never be left connected to the regulator of a high-pressure source for an extended period of time. A defective regulator could cause the container to rupture due to excess pressure.

6.4.4.3* Pressurizing Gas. Only standard industrial-grade nitrogen with a dew point of –60°F (–51°C) or lower (CGA nitrogen specification G10.1, grades D through P) shall be used to pressurize stored-pressure dry chemical and halogenated-type fire extinguishers. Compressed air through moisture traps shall not be used for pressurizing even though so stated in the instructions on older fire extinguishers.

6.4.4.3.1 Compressed air shall be permitted to be used from special compressor systems capable of delivering air with a dew point of –60°F (–51.1°C) or lower. The special compressor system shall be equipped with an automatic monitoring and alarm system to ensure that the dew point remains at or below –60°F (–51.1°C) at all times.

6.4.4.3.2* Class D and halocarbon fire extinguishers shall be repressurized only with the type of expellant gas referred to on the fire extinguisher label.

6.4.5 Recharge Recordkeeping. Each fire extinguisher shall have a tag or label securely attached that indicates the month and year recharging was performed and that identifies the person performing the service. A "Verification of Service" (maintenance or recharging) collar in accordance with 6.3.4.2 shall also be attached to the extinguisher.

6.4.5.1 Liquefied gas, halogenated agent, and carbon dioxide extinguishers that have been recharged without valve removal shall not be required to have a "Verification of Service" collar installed following recharge.

6.4.5.2 Cartridge and cylinder-operated extinguishers shall not be required to have a "Verification of Service" collar installed. *(See 6.3.4.2.)*

Chapter 7 Hydrostatic Testing

7.1 General.

7.1.1 This standard requires hydrostatic testing of pressure vessels used as fire extinguishers and specified components of fire extinguishers.

7.1.2 Hydrostatic testing shall be performed by persons trained in pressure testing procedures and safeguards who have suitable testing equipment, facilities, and appropriate servicing manual(s) available.

7.1.2.1 A hydrostatic test shall always include both an internal and external visual examination of the cylinder.

7.1.2.2 Hydrostatic testing shall be conducted using water or some other noncompressible fluid as the test medium. Air or other gases shall not be used as the sole medium for pressure testing. All air shall be vented prior to hydrostatic testing to prevent violent and dangerous failure of the cylinder.

7.1.3 If, at any time, a fire extinguisher shows evidence of dents, mechanical injury, or corrosion to the extent as to indicate weakness, it shall be condemned or hydrostatically retested subject to the provisions of 7.1.4 and 7.1.5.

7.1.3.1 Pump tanks shall not be required to comply with 7.1.3.

7.1.3.2 Nonrechargeable fire extinguishers other than halogenated agent types shall not be required to comply with 7.1.3 but shall be discharged and discarded where the fire extinguisher shows evidence of dents, mechanical injury, or corrosion to the extent of indicating weakness.

7.1.3.3 Nonrechargeable halon agent–type fire extinguishers shall not be required to comply with 7.1.3. *(See 6.2.3.3.)*

7.1.4* Examination of Cylinder Condition. Where a fire extinguisher cylinder or shell has one or more of the following conditions, it shall not be hydrostatically tested, but shall be condemned or destroyed by the owner or at the owner's direction:

(1)*Where repairs by soldering, welding, brazing, or use of patching compounds exist
(2) Where the cylinder threads are worn, corroded, broken, cracked, or nicked
(3) Where there is corrosion that has caused pitting, including pitting under a removable nameplate or nameband assembly
(4) Where the fire extinguisher has been burned in a fire
(5) Where a calcium chloride–type of extinguishing agent was used in a stainless steel fire extinguisher
(6) Where the shell is of copper or brass construction joined by soft solder or rivets
(7) Where the depth of a dent exceeds 1/10 of the greatest dimension of the dent if not in a weld, or exceeds 1/4 in. (0.6 cm) if the dent includes a weld
(8) Where any local or general corrosion, cuts, gouges, or dings have removed more than 10 percent of the minimum cylinder wall thickness
(9) Where a fire extinguisher has been used for any purpose other than that of a fire extinguisher

7.1.5 When a fire extinguisher cylinder, shell, or cartridge fails a hydrostatic pressure test, or fails to pass a visual examination as specified in 7.1.4, it shall be condemned or destroyed by the owner or the owner's agent. When a cylinder is required to be condemned, the retester shall notify the owner in writing that the cylinder is condemned and that it cannot be re-used. Condemned cylinders shall be stamped "CONDEMNED" on the top, head, shoulder, or neck with a steel stamp. Minimum letter height shall be 1/8 in. (0.3 cm).

7.1.5.1 A condemned cylinder shall not be repaired. No person shall remove or obliterate the "CONDEMNED" marking.

7.1.6* Aluminum Shell Cylinder. Fire extinguishers having aluminum cylinders or shells suspected of being exposed to temperatures in excess of 350°F (177°C) shall be removed from service and subjected to a hydrostatic test.

7.2 Frequency. At intervals not exceeding those specified in Table 7.2, fire extinguishers shall be hydrostatically retested. The hydrostatic retest shall be conducted within the calendar year of the specified test interval. In no case shall an extinguisher be recharged if it is beyond its specified retest date. *(For nonrechargeable fire extinguishers, see 6.4.3.1.)*

Table 7.2 Hydrostatic Test Interval for Extinguishers

Extinguisher Type	Test Interval (Years)
Stored-pressure water, loaded stream, and/or antifreeze	5
Wetting agent	5
AFFF (aqueous film-forming foam)	5
FFFP (film-forming fluoroprotein foam)	5
Dry chemical with stainless steel shells	5
Carbon dioxide	5
Wet chemical	5
Dry chemical, stored-pressure, with mild steel shells, brazed brass shells, or aluminum shells	12
Dry chemical, cartridge- or cylinder-operated, with mild steel shells	12
Halogenated agents	12
Dry powder, stored-pressure, cartridge- or cylinder-operated, with mild steel shells	12

Note: Stored-pressure water extinguishers with fiberglass shells (pre-1976) are prohibited from hydrostatic testing due to manufacturer's recall.

7.2.1 Nitrogen cylinders, argon cylinders, carbon dioxide cylinders, or cartridges used for inert gas storage that are used as an expellant for wheeled fire extinguishers and carbon dioxide extinguishers shall be hydrostatically tested every 5 years.

7.2.1.1 Cylinders (except those charged with carbon dioxide) complying with 49 CFR 173.34(e)16 shall be permitted to be hydrostatically tested every 10 years in lieu of the requirement in 7.2.1.

7.2.2 Nitrogen cartridges, argon cartridges, and carbon dioxide cartridges used as an expellant for hand portable fire extinguishers that have DOT or TC markings shall be hydrostatically tested or replaced according to the requirements of DOT or TC.

7.2.2.1 Cartridges not exceeding 2 in. (5.1 cm) outside diameter and having a length less than 2 ft (0.61 m) shall be exempt from periodic hydrostatic retest.

7.2.2.2 Cartridges with DOT stamp 3E shall be exempt from periodic hydrostatic retest.

7.2.3 A hydrostatic test shall be performed on fire extinguisher hose assemblies equipped with a shutoff nozzle at the end of the hose. The test interval shall be the same as specified for the fire extinguisher on which the hose is installed.

7.2.3.1 High-pressure and low-pressure accessory hose (other than agent discharge hose) used on wheeled extinguishers shall be hydrostatically tested. The test interval shall be the same as that specified for the fire extinguisher agent cylinder on which the hose is installed.

7.3 Test Pressures.

7.3.1 High-Pressure Cylinders.

7.3.1.1 DOT 3A, 3AA, or 3AL cylinders used as carbon dioxide extinguishers or nitrogen cylinders, argon cylinders, or carbon dioxide cylinders that are used with wheeled extinguishers shall be tested at 5/3 the service pressure as stamped into the cylinder.

7.3.1.1.1 Carbon dioxide fire extinguishers having cylinder specification ICC3 shall be tested at 3000 psi (20.68 MPa).

7.3.2 Hose Assemblies.

7.3.2.1 Carbon dioxide hose assemblies requiring a hydrostatic pressure test shall be tested at 1250 psi (8619 kPa).

7.3.2.2 Dry chemical, dry powder, water, foam, and halogenated agent discharge hose assemblies requiring a hydrostatic pressure test shall be tested at 300 psi (2068 kPa) or at service pressure, whichever is higher.

7.3.2.3 Low-pressure accessory hose used on wheeled extinguishers shall be tested at 300 psi (2068 kPa).

7.3.2.4 High-pressure accessory hose used on wheeled extinguishers shall be tested at 3000 psi (20.68 MPa).

7.3.3 Low-Pressure Cylinders.

7.3.3.1 Stored-Pressure Types. Stored-pressure fire extinguishers shall be hydrostatically tested to the pressure specified on the extinguisher nameplate. Where there is no pressure specified on the extinguisher nameplate, the extinguisher shall be tested at the factory test pressure, not to exceed three times the normal operating pressure. Fire extinguishers that are required to be returned to the manufacturer for recharging shall be hydrostatically tested only by the manufacturer.

7.3.3.2 Cartridge-Operated Types. Cartridge- or cylinder-operated dry chemical and dry powder types of extinguishers shall be hydrostatically tested at their original factory test pressure as shown on the nameplate or shell.

7.4 Test Equipment.

7.4.1 General.

7.4.1.1 This standard only permits the hydrostatic testing of pressure vessels used as fire extinguishers and specified components of fire extinguishers.

7.4.1.2 Test pressure gauges shall be certified accurate to ±0.5 percent or better of the full range of the gauge.

7.4.1.3 Test pressure gauges shall be capable of being read to within 1 percent of the test pressure. Interpolation of midpoint between smallest graduations is acceptable.

7.4.1.4 Test pressure gauges shall be capable of indicating 90 percent to 110 percent of the test pressure.

7.4.1.5 Pressure gauges used on test equipment shall be calibrated at least semiannually. Master gauges or dead weight testers shall be calibrated at least annually.

7.4.1.6 Drying Equipment. All hydrostatically tested cylinders and apparatus, except water-type extinguishers, shall be thoroughly dried after testing. The temperature used for drying shall not exceed 150°F (65.6°C) inside the shell.

7.4.2 Test Equipment for High-Pressure Cylinders (Water-Jacket Test).

7.4.2.1 The equipment for hydrotesting high-pressure cylinders and cartridges (DOT 3 series) shall be of the water-jacket type that meets the specifications of CGA C-1, *Methods of Hydrostatic Testing of Compressed Gas Cylinders.*

7.4.3 Test Equipment for Low-Pressure Cylinders and Hose Assemblies (Proof Pressure Test).

7.4.3.1 Cylinders and hose assemblies shall be tested within a protective cage device, or placed behind a protective shield, that will permit visual observation while under pressure for leaks, bulges, and other harmful defects.

7.4.3.2 A hydrostatic test pump, hand- or power-operated, shall be capable of producing not less than 150 percent of the test pressure. It shall include appropriate check valves and fittings.

7.4.3.3 A flexible connection between the test pump and the test cylinder shall be provided so that it is possible to test through the cylinder opening, test bonnet, hose outlet, or nozzle, as applicable.

7.5 Testing Procedures.

7.5.1 General.

7.5.1.1 The pressure in a hydrostatic test of a cylinder shall be maintained for a minimum of 30 seconds, but for no less time than is required for complete expansion of the cylinder and to complete the visual examination of the cylinder.

7.5.1.2 All valves, internal parts, and hose assemblies shall be removed and the fire extinguisher emptied before testing.

7.5.1.2.1 On some dry chemical and dry powder fire extinguishers (cartridge-operated), where the manufacturer recommends that certain internal parts not be removed, those parts shall not be removed.

7.5.1.3 All types of extinguishers except water type shall have all traces of extinguishing agents removed from the inside of the extinguisher before they are filled with water.

7.5.1.4 A complete internal and external visual examination shall be conducted before any hydrostatic test. The procedures for the visual examination shall be in accordance with 7.1.4.

7.5.2 Low-Pressure Cylinders.

7.5.2.1 The hydrostatic testing of dry chemical and dry powder fire extinguishers having an externally mounted gas cartridge shall have the cartridge and cartridge receiver removed and a suitable plug inserted into the opening.

7.5.2.2 All hose shall be removed from cylinders prior to hydrostatic testing.

7.5.2.3 All stored-pressure extinguishers shall have the valve removed from the cylinder and replaced with a suitable test bonnet or adapter.

7.5.2.4 All cartridge- or cylinder-operated wheeled extinguishers shall have pressure relief devices removed prior to the test. All tests shall be conducted using suitable test fittings and adapters. The manufacturer's recommendations shall be followed.

7.5.2.5 Any distortion of the cylinder shall be cause for rejection. A drop in pressure of the test gauge is an indication of a leak and is cause for rejection or retest.

7.5.2.6 Cylinders passing the hydrostatic test shall be thoroughly dried internally before being returned to service. If heated air is used to dry the cylinders, the temperature shall not exceed 150°F (66°C) inside the shell.

7.5.3 High-Pressure Cylinders.

7.5.3.1 The hydrostatic testing of high-pressure cylinders and cartridges shall be in accordance with the procedures of TC, DOT, and CGA C-1, *Methods of Hydrostatic Testing of Compressed Gas Cylinders.*

7.5.3.2 Cylinders passing the hydrostatic test shall be thoroughly dried internally before being returned to service. If heated air is used to dry the cylinders, the temperature shall not exceed 150°F (66°C) inside the shell.

7.5.4 Hose Assemblies.

7.5.4.1 The discharge valve shall be removed from the hose assembly without removal of any hose couplings.

7.5.4.2 The location of all couplings shall be marked prior to the hydrostatic test.

7.5.4.3 The hose shall be completely filled with water before testing.

7.5.4.4 For dry chemical and dry powder types, all traces of dry chemical or dry powder shall be removed prior to testing.

7.5.4.5 The hose assembly shall be placed in a protective cage or device whose design will permit visual observation during the test. Pressure shall be applied at a rate-of-rise such that the test pressure is reached in 1 minute.

7.5.4.6 Test pressure for hose assemblies shall be maintained for 1 minute. Observations shall be made to note any distortion or leakage while the hose is pressurized. Leakage, distortion, or permanent movement of couplings shall constitute a failure of the hydrostatic test.

7.5.4.7 Hose passing the hydrostatic test shall be thoroughly dried internally. If heat is used, the temperature shall not exceed 150°F (66°C).

7.6 Recording of Hydrostatic Tests.

7.6.1* A permanent record shall be maintained for each cylinder tested.

7.6.2 High-Pressure Cylinders and Cartridges. Cylinders or cartridges that pass the hydrostatic test shall be stamped with the retester's identification number and month and year of the retest per TC/DOT requirements.

7.6.2.1 Stamping shall be placed only on the shoulder, top head, neck, or foot ring (where provided) of the cylinder.

7.6.3 Hose Assemblies. Hose assemblies that pass a hydrostatic test do not require recording, labeling, or marking.

7.6.4* Low-Pressure Cylinders. Fire extinguisher cylinders of the low-pressure type that pass a pressure hydrostatic test shall have the information recorded on a suitable metallic label with a minimum size of 2 in. × 3½ in. (5.1 cm × 8.9 cm). The label shall be affixed by a heatless process. These labels shall be of the type that self-destructs when removal from a fire extinguisher cylinder shell is attempted.

7.6.4.1 The following information shall be included on the label:

(1) Month and year the test was performed, indicated by a perforation, such as is done by a hand punch
(2) Test pressure used
(3) Name or initials of the person performing the test, and name of the agency performing the test

7.6.4.2 In addition, the following information shall also be included for DOT specification cylinders:

(1) Cylinders tested by volumetric (water jacket) test method shall be marked with a retesters identification number (R.I.N.#) on the label. The use of a label instead of stamping shall be performed in accordance with DOT Exemption # 11372. A current copy of DOT E-11372 must be maintained at each facility where alternate marking is being performed.
(2) Cylinders tested by modified (proof pressure) test method shall be marked with the letter "S" following the test date.

Annex A Explanatory Material

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

A.1.1 Many fires are small at origin and can be extinguished by the use of proper portable fire extinguishers. It is strongly recommended that the fire department be notified as soon as a fire is discovered. This alarm should not be delayed by awaiting results of the application of portable fire extinguishers.

Fire extinguishers can represent an important segment of any overall fire protection program. However, their successful functioning depends upon the following conditions having been met:

(1) The fire extinguisher is properly located and in working order.
(2) The fire extinguisher is of the proper type for a fire that can occur.
(3) The fire is discovered while still small enough for the fire extinguisher to be effective.
(4) The fire is discovered by a person ready, willing, and able to use the fire extinguisher.

Fixed systems are covered by the following NFPA standards: NFPA 11, *Standard for Low-Expansion Foam;* NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems;* NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems;* NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems;* NFPA 13, *Standard for the Installation of Sprinkler Systems;* NFPA 14, *Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems;* NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection;* NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems;* NFPA 17, *Standard for Dry Chemical Extinguishing Systems;* NFPA 17A, *Standard for Wet Chemical Extinguishing Systems;* NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations;* NFPA 750, *Standard on Water Mist Fire Protection Systems;* and NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems.*

A.1.2 The owner or occupant of a property in which fire extinguishers are located has an obligation for the care and use

of these extinguishers at all times. The nameplate(s) and instruction manual should be read and thoroughly understood by all persons who could be expected to use the fire extinguishers.

To discharge this obligation, the owner or occupant should give proper attention to the inspection, maintenance, and recharging of this fire-protective equipment and should also train personnel in the correct use of fire extinguishers on the different types of fires that could occur on the property.

An owner or occupant should recognize fire hazards on his or her property and plan in advance the exact means and equipment with which a fire will be fought. The owner/occupant should ensure that everyone knows how to call the fire department and stress that they do so for every fire, no matter how small.

On larger properties, a private fire brigade should be established and trained. Personnel need to be assigned to inspect each fire extinguisher periodically. Other personnel can have the duty of maintaining and recharging such equipment at proper intervals.

Portable fire extinguishers are appliances to be used principally by the occupants of a fire-endangered building or area who are familiar with the location and operation of the extinguisher through education or training. Portable fire extinguishers are primarily of value for immediate use on small fires. They have a limited quantity of extinguishing material and, therefore, need to be used properly so that this material is not wasted.

Fire extinguishers are mechanical devices. They need care and maintenance at periodic intervals to ensure that they are ready to operate properly and safely. Parts or internal chemicals can deteriorate in time and need replacement. They are pressure vessels, in most cases, and so need to be treated with respect and handled with care.

A.1.3.2 Authorities having jurisdiction should determine the acceptability and credibility of the organization listing or labeling fire extinguishers. Authorities should determine if the organization tests to all the requirements of the standard. Factors such as the structure of the organization, its principal fields of endeavor, its reputation and established expertise, its involvement in the standards-writing process, and the extent of its follow-up service programs should all be assessed before recognition is given.

A.1.3.3 Authorities having jurisdiction should determine the thoroughness of the factory follow-up quality assurance program exercised by third-party certification organizations listing and labeling portable fire extinguishers. The specified factory follow-up standard provides a minimum basis for that determination. Application of the factory follow-up standard provides a reasonable assurance that portable fire extinguishers sold to the public continue to have the same structural reliability and performance as the fire extinguishers the manufacturer originally submitted to the listing and labeling organization for evaluation.

A.1.5.6 Acceptable means of identifying the fire extinguisher locations could include arrows, lights, signs, or coding of the wall or column.

A.1.5.7 In situations where it is necessary that fire extinguishers be provided temporarily, a good practice is to provide portable stands, consisting of a horizontal bar on uprights with feet, on which the fire extinguishers can be hung.

A.1.5.13 Vented fire extinguisher cabinets should utilize tinted glass and should be constructed to prevent the entrance of insects and the accumulation of water. Vented fire extinguisher cabinets constructed in this manner will lower the maximum internal temperature 10°F to 15°F (5.6°C to 8.3°C).

A.1.5.14 The following precautions should be noted where fire extinguishers are located in areas that have temperatures outside the range of 40°F to 120°F (4°C to 49°C).

(1) AFFF and FFFP fire extinguishers cannot be protected against temperatures below 40°F (4°C) by adding an antifreeze charge because it will tend to destroy the effectiveness of the extinguishing agent.
(2) Plain water fire extinguishers should not be protected against temperatures below 40°F (4°C) with ethylene glycol antifreeze. Calcium chloride solutions should not be used in stainless steel fire extinguishers.
(3) Fire extinguishers installed in machinery compartments, diesel locomotives, automotive equipment, marine engine compartments, and hot processing facilities can easily be subjected to temperatures above 120°F (49°C). Selection of fire extinguishers for hazard areas with temperatures above the listed limits should be made on the basis of recommendations by manufacturers of this equipment.

A.1.5.16 The manual can be specific to the fire extinguisher involved or it can cover many types.

A.1.6 OSHA federal regulations require that manufacturers communicate information as to the type of chemicals in a product that can be hazardous and the level of hazard. This information is contained in the Material Safety Data Sheet (MSDS) created for each chemical or mixture of chemicals and is summarized on labels or tags attached to the product. Additionally, state and local authorities have enacted similar acts and regulations requiring identification of chemicals and hazardous ingredients in products. MSDSs for fire extinguisher agents are available on request from a fire equipment dealer or distributor, or the fire equipment manufacturer.

The identification of contents information will enable determination of the type of chemicals contained in the fire extinguisher and help to resolve complications arising from an unusual use of the agent. The hazardous materials identification systems (HMIS) [in Canada, workplace hazardous materials identification systems (WHMIS)] developed by the National Paint & Coatings Association uses a three-place format with numerical indexes from 0 to 4. The first place is for "toxic properties," the second place is for "flammability," and the third place is for "reactivity" with other chemicals. Most fire extinguishers have a 0 numerical index in the second and third places because they are nonflammable and relatively inert.

Information on the HMIS can be obtained from Label Master, Inc., Chicago, IL, or National Paint & Coatings Association, Washington, DC. Extinguisher contents information can be integrated into the standard fire extinguisher label in some form or can be contained on a separate label or tag. The following is a typical chemical contents identification marking.

CONTENTS: ABC DRY CHEMICAL/HMIS 1-0-0 MUSCOVITE MICA, MONOAMMONIUM PHOSPHATE AMMONIUM SULFATE/NUISANCE DUST IRRITANT/CONTENTS UNDER PRESSURE [Manufacturer's Name, Mailing Address, Phone Number]

A.1.7 For additional conversion and information, see ASTM E 380, *Standard for Metric Practice*.

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.3.2.4 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.3.3.3 Carbon Dioxide. Liquid carbon dioxide forms dry ice ("snow") when released directly into the atmosphere. Carbon dioxide gas is 1½ times heavier than air. Carbon dioxide extinguishes fire by reducing the concentrations of oxygen, the vapor phase of the fuel, or both in the air to the point where combustion stops.

A.3.3.7 Dry Chemical. European and ISO standards do not distinguish between dry chemical agents and dry powder agents. Their use of the term *dry powder* includes both dry chemical and dry powder as defined in this standard.

A.3.3.8 Dry Powder. See A.3.3.7.

A.3.3.9 Electronic Monitoring. Electronic monitoring can be accomplished utilizing low-voltage wiring or a wireless communication method, and can convey information about an in-place fire extinguisher that includes status, pressure level, presence, condition, and if there is an obstruction to the extinguisher.

Electronic monitoring can satisfy many of the monthly inspection requirements currently within the standard, can monitor the extinguisher at more frequent intervals if desired or when more frequent inspections are required, and can create an electronically maintained record of the fire extinguisher.

A.3.3.11 Film-Forming Foam Agents. AFFF and FFFP include both grades: those that are not approved for polar solvents (water-soluble flammable liquids), and those that are approved for polar solvents.

A.3.3.12 Halogenated Agents. Halon 1211 and Halon 1301 are included in the "Montreal Protocol on Substances that Deplete the Ozone Layer," signed September 16, 1987. In compliance with national regulations, production of halons ceased on January 1, 1994.

See NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems,* for more information on halocarbon agents.

A.3.3.16 Loaded Stream Charge. While loaded stream and wet chemical agent charges can be comprised of similar materials, their formulation could dictate different maintenance procedures.

A.3.3.25 Wet Chemical. While loaded stream and wet chemical agent charges can be comprised of similar materials, their formulation could dictate differing maintenance procedures.

A.3.4.2 Nonrechargeable Fire Extinguisher. Nonrechargeable (nonrefillable) fire extinguishers are marked "Discharge and Dispose of After Any Use" or "Discharge and Return to the Manufacturer After Any Use" or with a similar equivalent marking. Some fire extinguishers that are physically rechargeable are marked "nonrechargeable" and are therefore considered by this standard to be nonrechargeable (nonrefillable) fire extinguishers.

A.3.4.4 Rechargeable (Refillable) Fire Extinguisher. The fire extinguisher is capable of being recharged with agent and restored to its full operating capability by the standard practices used by fire equipment dealers and distributors. Rechargeable (refillable) fire extinguishers are marked "Recharge Immediately After Any Use" or with a similar equivalent marking.

A.4.1.1 Halon agent is highly effective for extinguishing fire and evaporates after use, leaving no residue. Halon agent is, however, included in the Montreal Protocol list of controlled substances developed under the United Nations Environment Program. Where agents other than halon can satisfactorily protect the hazard, they should be used instead of halon. Halon use should be limited to extinguishment of unwanted fire; halon should not be used for routine training of personnel.

A.4.1.2 Wheeled fire extinguishers are available in capacities of 33 gal (125 L) for foam units and range from 30 lb to 350 lb (13.6 kg to 158.8 kg) for other types of extinguishers. These fire extinguishers are capable of delivering higher agent flow rates and greater agent stream range than the normal portable-type fire extinguishers. Wheeled fire extinguishers are capable of furnishing increased fire-extinguishing effectiveness for high hazard areas and have added importance when a limited number of people are available.

A.4.2.1.1 It is recommended that inverting types of fire extinguishers be replaced with currently available models. Manufacture of inverting types of fire extinguishers and their listing by Underwriters Laboratories Inc. was discontinued in 1969. As the availability of suitable replacement parts and recharge materials diminishes, it has become increasingly difficult to maintain these types of fire extinguishers in a safe and reliable operating condition. Inverting-type fire extinguishers (e.g., soda acid, foam, and cartridge-operated water) are now considered obsolete and are required to be removed from service no later than the next required date for hydrostatic testing.

Examples of extinguishers for protecting Class A hazards are as follows:

(1) Water type
(2) Halogenated agent type *(For halogenated agent–type fire extinguishers, see 4.1.1.)*
(3) Multipurpose dry chemical type
(4) Wet chemical type

A.4.2.1.2 Examples of extinguishers for protecting Class B hazards are as follows:

(1) Aqueous film forming foam (AFFF)
(2) Film forming fluoroprotein foam (FFFP)
(3) Carbon dioxide
(4) Dry chemical type
(5) Halogenated agent type *(For halogenated agent–type fire extinguishers, see 4.1.1.)*

A.4.2.1.3 The use of dry chemical fire extinguishers on wet energized electrical equipment (such as rain-soaked utility poles, high-voltage switch gear, and transformers) could aggravate electrical leakage problems. The dry chemical in combination with moisture provides an electrical path that can reduce the effectiveness of insulation protection. The removal of all traces of dry chemical from such equipment after extinguishment is recommended.

A.4.2.1.4 Extinguishers and extinguishing agents for Class D hazards include the following:

(1) Chemical reaction between burning metals and many extinguishing agents (including water) can range from explosive to inconsequential, depending in part on the type, form, and quantity of metal involved. In general, the hazards from a metal fire are significantly increased when such extinguishing agents are applied. The advantages and limitations of a wide variety of commercially available metal fire extinguishing agents are discussed in Section 6, Chapter 26, of the NFPA *Fire Protection Handbook*. Consult the MSDS of the Class D hazard being protected or the extinguisher manufacturer.
(2) The agents and fire extinguishers discussed in this section are of specialized types, and their use often involves special techniques peculiar to a particular combustible metal. A given agent will not necessarily control or extinguish all metal fires. Some agents are valuable in working with several metals; others are useful in combating only one type of metal fire. The authorities having jurisdiction should be consulted in each case to determine the desired protection for the particular hazard involved.
(3) Certain combustible metals and reactive chemicals require special extinguishing agents or techniques. If there is doubt, applicable NFPA standards should be consulted or reference made to NFPA 49, *Hazardous Chemicals Data*, or NFPA 325, *Guide to Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids*. (Note: Although NFPA 49 and 325 have been officially withdrawn from the *National Fire Codes*®, the information is still available in NFPA's *Fire Protection Guide to Hazardous Materials*.)
(4) Reference should be made to the manufacturer's recommendations for use and special technique for extinguishing fires in various combustible metals.
(5) Fire of high intensity can occur in certain metals. Ignition is generally the result of frictional heating, exposure to moisture, or exposure from a fire in other combustible materials. The greatest hazard exists when these metals are in the molten state, in finely divided forms of dust, turnings, or shavings.

The properties of a wide variety of combustible metals and the agents available for extinguishing fires in these metals are discussed in Section 4, Chapter 16, and Section 6, Chapter 26, of the NFPA *Fire Protection Handbook*.

A.4.3.2 Fire extinguishers for cooking media (vegetable or animal oils and fats) traditionally followed Table 5.3.1 for extra (high) hazard, requiring a minimum 40-B rated sodium bicarbonate or potassium bicarbonate dry chemical extinguisher. The evolution of high-efficiency cooking appliances and the change to hotter-burning vegetable shortening has created a more severe fire hazard. Testing has shown that wet chemical extinguishers have several times the cooking fire–extinguishing capability of a minimum 40-B rated sodium bicarbonate or potassium bicarbonate dry chemical extinguisher, which has prompted the creation of a new classification and a new listing test protocol. The test protocol is found in ANSI/UL-711, *Standard for Rating and Fire Testing of Fire Extinguishers*, 1995.

See NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations,* for further information. Class K fire extinguishers equipped with "extended wand–type" discharge devices that can permit subsurface injection of wet chemical extinguishing agents into hot cooking media are not safe for use. Subsurface injection causes a thermodynamic reaction comparable to an explosion, which can cause serious injury or death and can contribute to the rapid spread of fire.

A.4.3.2.2 Figure A.4.3.2.2(a) and Figure A.4.3.2.2(b) show the recommended wording for the Class K placard. Recommended size is 7⅝ in. × 11 in.

A.4.3.3 The installation of fixed systems should be considered where applicable.

A.4.3.5 Delicate electronic equipment includes, but is not limited to, data processing, computers, CAD, CAM, robotics, and reproduction equipment. Use of other fire extinguishers and extinguishing agents can damage beyond repair both the equipment at the source of the fire and related equipment in the immediate vicinity of the fire. Dry chemical residue will probably not be able to be completely and immediately removed and, in addition, multipurpose dry chemical, when exposed to temperatures in excess of 250°F (121°C) or relative humidity in excess of 50 percent, can cause corrosion.

A.5.1.1 The following are items that affect distribution of portable fire extinguishers:

(1) Area and arrangement of the building occupancy conditions
(2) Severity of the hazard
(3) Anticipated classes of fire
(4) Other protective systems or devices
(5) Distances to be traveled to reach fire extinguishers

In addition, the following factors should be considered:

(1) Anticipated rate of fire spread
(2) Intensity and rate of heat development
(3) Smoke contributed by the burning materials
(4) Accessibility of a fire to close approach with portable fire extinguishers

Wheeled fire extinguishers have additional agent and range and should be considered for areas where the additional protection is needed. Portable fire extinguishers offer the occupant a means to assist in evacuation of a building or occupancy. They are useful to knock down the fire if it occurs along the evacuation route. Whenever possible, the individual property should be surveyed for actual protection requirements.

FIGURE A.4.3.2.2(a) Typical Class K Placard (English/Spanish).

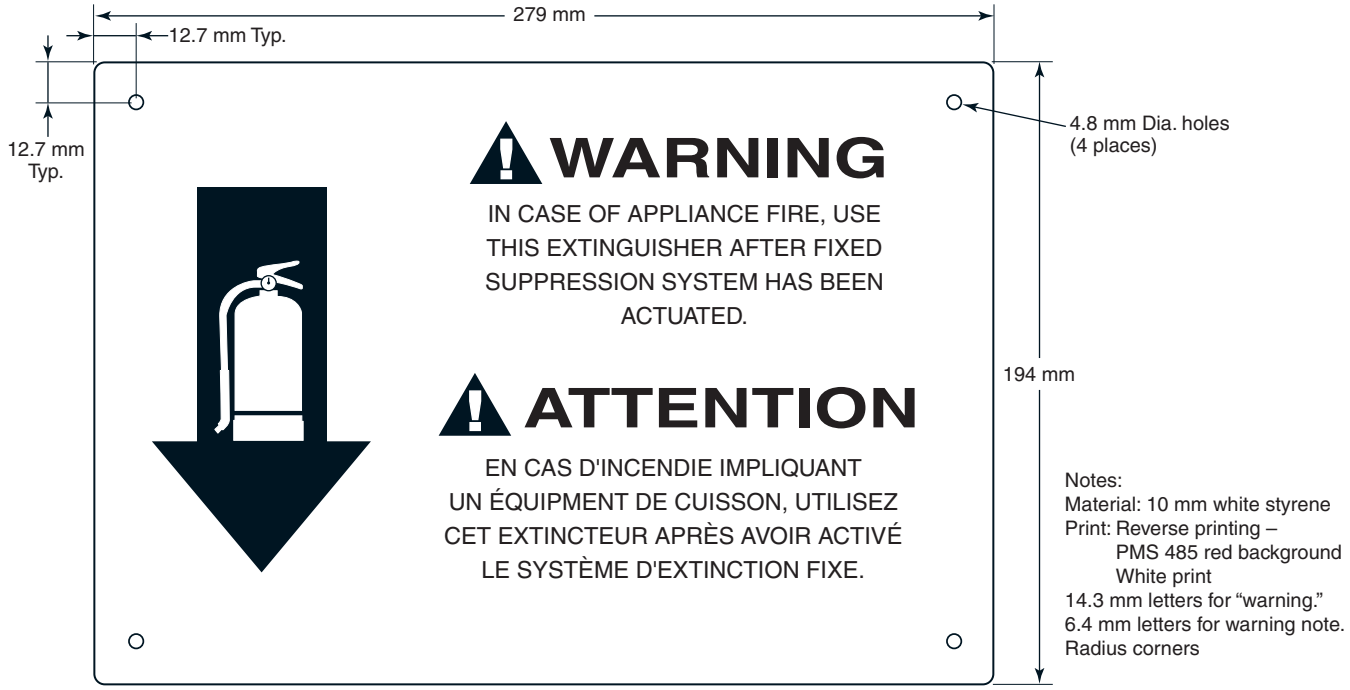


FIGURE A.4.3.2.2(b) Typical Class K Placard (English/French).

A.5.1.2 Most buildings have Class A fire hazards. In any occupancy, there could be a predominant hazard as well as special hazard areas requiring supplemental protection. For example, a hospital will generally have need for Class A fire extinguishers covering patients' rooms, corridors, offices, and so forth, but will need Class B fire extinguishers in laboratories, and where flammable anesthetics are stored or handled, Class C fire extinguishers in electrical switch gear or generator rooms, and Class K extinguishers in kitchens.

A.5.1.2.2 If fire extinguishers intended for different classes of fires are grouped, their intended use should be marked

conspicuously to aid in the choice of the proper fire extinguisher at the time of a fire. In an emergency, the tendency is to reach for the closest fire extinguisher. If this fire extinguisher is of the wrong type, the user could endanger himself or herself and the property he or she is endeavoring to protect. Wherever possible, it is preferable to have only those fire extinguishers available that can be safely used on any type of fire in the immediate vicinity.

A.5.3 Flammable liquids of appreciable depth are those with a depth greater than ¼ in. (0.64 cm).

A.5.4 See A.5.3.

A.5.4.1 Where such personnel are not available, the hazard should be protected by fixed systems.

A.5.5 Electrical equipment should be de-energized as soon as possible to prevent reignition.

A.6.1.4 A fire equipment servicing agency is usually the most reliable means available to the public for having maintenance and recharging performed. Large industries could find it desirable to establish their own maintenance and recharge facilities, training personnel to perform these functions. Service manuals and parts lists should be obtained from the fire extinguisher manufacturer.

A.6.2.1 Frequency of fire extinguisher inspections should be based on the need of the area in which fire extinguishers are located. The required monthly inspection is a minimum. An inspection should be more frequent if any of the following conditions exist:

(1) High frequency of fires in the past
(2) Severe hazards
(3) Susceptibility to tampering, vandalism, or malicious mischief
(4) Possibility of, or experience with, theft of fire extinguishers
(5) Locations that make fire extinguishers susceptible to mechanical injury
(6) Possibility of visible or physical obstructions
(7) Exposure to abnormal temperatures or corrosive atmospheres
(8) Characteristics of fire extinguishers, such as susceptibility to leakage

Due to these conditions, more frequent inspections might be enhanced through electronic monitoring of the fire extinguisher.

A.6.2.2 The following procedure permits rapid removal of the hose by one person without kinking and obstruction of flow of extinguishing agent. See Figure A.6.2.2(a) through Figure A.6.2.2(e).

(1) Form a loop over hose supports. *[See Figure A.6.2.2(a).]*
(2) Follow with a reverse loop so that hose passes behind loop as shown in Figure A.6.2.2(b).
(3) Repeat Steps (1) and (2) until all hose is coiled on support. *[See Figure A.6.2.2(c).]*
(4) Adjust coil so that nozzle is in the downward position as shown in Figure A.6.2.2(d). (Hose coiled in this manner will pull off free of twists).
(5) Place nozzle in holder with handle forward in the closed position. *[See Figure A.6.2.2(e).]*

A.6.2.2(4) Where a safety seal or tamper indicator is missing, it can be evidence that the fire extinguisher has been used and therefore should be removed from service. Extreme caution should be exercised before replacing a tamper seal on a nonrechargeable fire extinguisher.

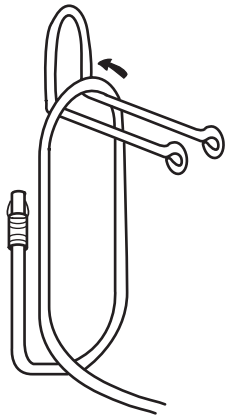


FIGURE A.6.2.2(a) Counterclockwise Loop.

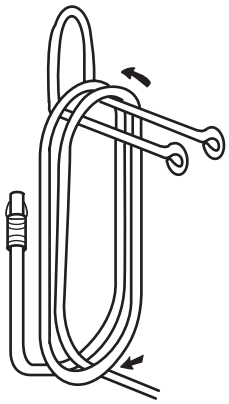


FIGURE A.6.2.2(b) Reverse Loop.

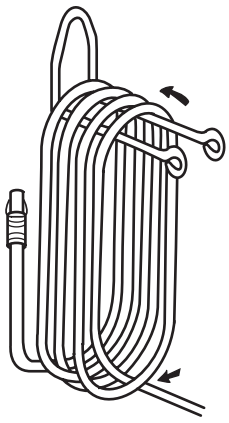


FIGURE A.6.2.2(c) Continued Reverse Loops.

A.6.3 Persons performing maintenance operations usually come from two major groups:

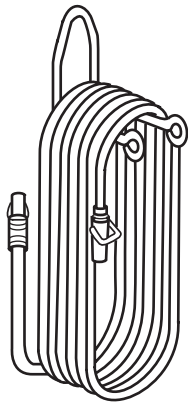


FIGURE A.6.2.2(d) Nozzle in Downward Position.

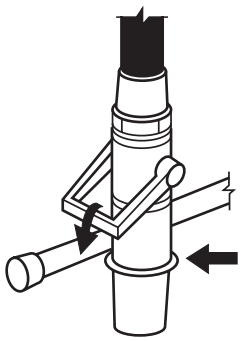


FIGURE A.6.2.2(e) Nozzle in Holder.

(1) Fire extinguisher service agencies
(2) Trained industrial safety or maintenance personnel

Fire extinguishers owned by individuals are often neglected because there is no planned periodic follow-up program. It is recommended that such owners become familiar with their fire extinguishers so they can detect telltale warnings during inspection that could suggest the need for maintenance. When maintenance is indicated, it should be performed by trained persons having proper equipment. *(See 6.1.4.)*

The purpose of a well-planned and well-executed maintenance program for a fire extinguisher is to maximize the following probabilities:

(1) The extinguisher will operate properly between the time intervals established for maintenance examinations in the environment to which it is exposed.
(2) The extinguisher will not constitute a potential hazard to persons in its vicinity or to operators or rechargers of fire extinguishers.

Any replacement parts needed should be obtained from the manufacturer or a representative.

A.6.3.1.2 Carbon dioxide hose assemblies have a continuous metal braid that connects to both couplings to minimize the static shock hazard. The reason for the conductivity test is to determine that the hose is conductive from the inlet coupling to the outlet orifice. A basic conductivity tester consists of a flashlight having an open circuit and a set of two wires with a conductor (clamps or probe) at each end.

	CONDUCTIVITY TESTED	
2002	DISTRIBUTION NAME	2004
	Dist. license no. _____	
2003	Employee name _____	2005
	Employee lic. no. _____	
	Jan/Feb/March/April/May/June/July/Aug/Sept/Oct/Nov/Dec	

FIGURE A.6.3.1.2 Conductivity Test Label.

Figure A.6.3.1.2 provides a guide to the design of a conductivity test label.

A.6.3.2.3 Removable extinguisher boots and foot rings are those that are not put on by the extinguisher manufacturer with glue or welded.

A.6.3.3 Halon removed from a fire extinguisher is kept in a closed recovery charging system until disposition can be made as to whether to recharge the halon back into a fire extinguisher or return unsatisfactory halon to a manufacturer for proper disposal. A listed halon 1211 closed recovery/recharge system will have the following:

(1) Clear sight glass for monitoring the cleanliness of the Halon 1211
(2) A means of determining if the acceptable water content of the halon has been exceeded
(3) A means of mechanically filtering the Halon 1211 and removing excess water

Such a recovery system will also have a motor-driven pump system that permits the transfer of halon into a fire extinguisher or supply container without the need to vent the receiving container to reduce its pressure before halon transfer. Closed recovery/charging systems also include the plumbing, valves, regulators, and safety relief devices to permit convenient, quick transfer of the Halon 1211.

A.6.3.4 In addition to the required tag or label *(see 6.3.4)*, a permanent file record should be kept for each fire extinguisher. This file record should include the following information, as applicable:

(1) The maintenance date and the name of the person or agency performing the maintenance
(2) The date when last recharged and the name of the person or agency performing the recharge
(3) The hydrostatic retest date and the name of the person or agency performing the hydrostatic test
(4) Description of dents remaining after passing a hydrostatic test
(5) The date of the 6-year maintenance for stored-pressure dry chemical and halogenated agent types *(See 6.3.3.)*

As stated in Section 1.2, "Nothing in this standard shall be construed as a restriction on new technologies or alternative arrangements, provided that the level of protection as herein described is not lowered and is acceptable to the authority having jurisdiction." It is recognized that an electronic bar coding system is often acceptable to the authority having jurisdiction in lieu of a tag or label for maintenance recordkeeping.

Under special circumstances or when local requirements are in effect, additional information can be desirable or required.

A.6.3.4.1 Labels should be printed in black with a light blue background.

A.6.3.4.2 A number of states have regulations requiring an internal marking of an extinguisher, which is used to verify if the extinguisher was depressurized, if the valve was removed, and if a complete maintenance was performed. The "Verification of Service" collar design also requires that the valve be removed before the collar can be attached to the extinguisher. The collar provides the authorities having jurisdiction with a more convenient visual proof that the extinguisher was disassembled and that maintenance was performed.

This standard does not specifically require a "Verification of Service" collar when a hydrostatic test is performed on a fire extinguisher cylinder. All extinguishers are to have the valve removed for hydrotesting and are to be subsequently recharged before they are returned to service. To be valid, the date on the "Verification of Service" collar should always be the same or more recent than the date on the hydrotest label.

Figure A.6.3.4.2 provides a guide to the design of a "Verification of Service" collar.

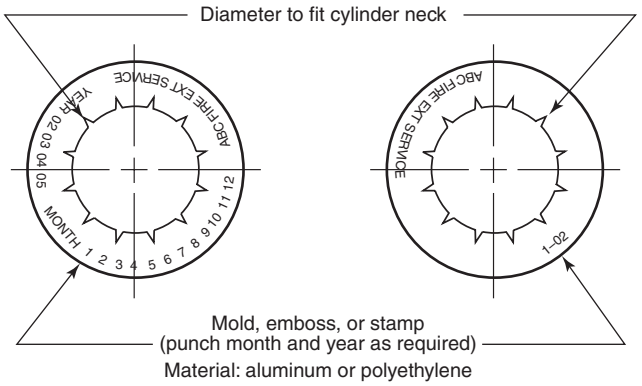


FIGURE A.6.3.4.2 Design of a "Verification of Service" Collar.

A.6.4.1 General safety guidelines for recharging include the following:

(1) Make sure all pressure is vented from fire extinguisher before attempting to remove valve body or fill closure.
WARNING: Do not depend on pressure-indicating devices to tell if container is under pressure because they could malfunction.

(2) Use proper recharge materials when refilling a fire extinguisher. Mixing of some extinguishing agents could cause a chemical reaction, resulting in a dangerous pressure buildup in the container.

(3) The weight of agent as specified on the nameplate is critical. Overfilling could render the fire extinguisher dangerous or ineffective.

(4) All sealing components should be cleaned and properly lubricated to prevent leakage after recharge.

(5) Check pressure-indicating device to ascertain that it is reading properly.

(6) Most manufacturers recommend the use of dry nitrogen as an expellant gas for stored-pressure fire extinguishers. Limiting charging pressure regulator setting to 25 psi (172 kPa) above service pressure as per 6.4.4.2 prevents gauge damage and loss of calibration.
WARNING: Never connect the fire extinguisher to be charged directly to the high-pressure source. Connecting directly to the high-pressure source could cause the container to rupture, resulting in injury. Never leave a fire extinguisher connected to the regulator of a high-pressure source for an extended period of time. A defective regulator could cause the container to rupture due to excess pressure.

(7) Use the manufacturer's recommended charging adaptor to prevent damage to a valve and its components.

(8) When recharging separate expellant source fire extinguishers, make sure filled enclosure is in place and tightened down. Replace all safety devices prior to installing replacement cartridges.

(9) Use only gas cartridges recommended by the manufacturer. Cartridge features such as pressure relief, puncturing capabilities, fill density, and thread compatibility are designed and approved to specific functional requirements.

(10) Use proper safety seals, as other types, such as meter seals, could possibly fail to break at the prescribed requirements.

(11) Regulators utilized on wheeled fire extinguishers are factory pinned at the operating pressure and should not be field adjusted.

A.6.4.1.2 Some manufacturers require that their fire extinguishers be returned to the factory for recharging.

A.6.4.1.3 To determine the gross weight, the entire fire extinguisher should be weighed empty. The weight of the specified recharge agent should be added to this amount.

A.6.4.1.5 The leak test required for stored-pressure and self-expelling types should be sufficiently sensitive to ensure that the fire extinguisher will remain operable for at least 1 year. Any tamper indicators or seals need to be replaced after recharging.

A.6.4.3.1 On properties where fire extinguishers are maintained by the occupant, a supply of recharging agents should be kept on hand. These agents should meet the requirements of 6.4.3.1.

The intent of this provision is to maintain the efficiency of each fire extinguisher as produced by the manufacturer and as labeled by one or more of the fire testing laboratories. For example, the extinguishing agent and the additives used in the various types of dry chemical fire extinguishers vary in chemical composition and in particle size and, thus, in flow characteristics. Each fire extinguisher is designed to secure maximum efficiency with the particular formulation used. Changing the agent from that specified on the fire extinguisher nameplate could affect flow rates, nozzle discharge characteristics, and the quantity of available agent (as influenced by density), and would void the label of the testing laboratory.

Certain recharging materials deteriorate with age, exposure to excessive temperature, and exposure to moisture. Storage of recharge agents for long periods of time should be avoided.

Dry powder used for combustible metal fires (Class D) should not become damp, as the powder will not be free flowing. In addition, when dry powder contains sufficient moisture, a hazardous reaction could result when applied to a metal fire.

A.6.4.3.2 Mixing multipurpose dry chemicals with alkaline-based dry chemicals could result in a chemical reaction ca-

pable of developing sufficient pressures to rupture a fire extinguisher. Substituting a different formulation for the one originally employed could cause malfunctioning of the fire extinguisher or result in substandard performance.

A.6.4.3.6 Moisture within a nonwater-type fire extinguisher creates a serious corrosion hazard to the fire extinguisher shell and also indicates what is probably an inoperative fire extinguisher. Moisture could possibly enter at the following times:

(1) After a hydrostatic test
(2) When recharging is being performed
(3) When the valve has been removed from the cylinder
(4) When using compressed air and a moisture trap for pressurizing nonwater types

It is extremely important to remove any water or moisture from any fire extinguisher before recharging. Excess moisture in a dry chemical fire extinguisher will cause the agent to cake and lump and become unusable. It also will cause corrosion to the fire extinguisher shell and valve. In carbon dioxide and halogenated fire extinguishers, excess moisture will cause extremely corrosive acids to form when combined with the extinguishing agent. These acids can corrode the fire extinguisher shell and valve.

A.6.4.3.7 If the fire extinguisher valve is removed for servicing, it is recommended that the fire extinguisher be purged with nitrogen or argon (as appropriate) or that a vacuum be drawn on the fire extinguisher cylinder prior to recharging.

A.6.4.3.9 In general, carbon dioxide obtained by converting dry ice to liquid will not be satisfactory unless it is properly processed to remove excess water and oil. If dry ice converters are used, the following required steps should be taken.

(1) Moisture-absorbent cartridges containing silica gel or activated alumina of adequate capacity should be employed. These cartridges need to be reactivated periodically by heating at 300°F (149°C) for 2 hours in an open-vented condition in order to keep them in an absorbent condition. At temperatures below 32°F (0°C), the cartridges act as a filter; above 32°F (0°C), they absorb moisture directly. Various telltale compositions are available that, by means of color, indicate the degree of absorptivity still available in the gel.
(2) An extra operation is required to minimize the water within the converter. This operation consists of blowing off a short burst of liquid carbon dioxide from the bottom of the converter in order to blow off free water. This operation can only be performed above 32°F (0°C). With the converter contents colder than 32°F (0°C), blowing off is ineffectual.

The preferred source of carbon dioxide for recharging fire extinguishers is from a low-pressure [300 psi at 0°F (2068 kPa at –17.8°C)] supply, supplied either directly or via dry cylinders used as an intermediary means.

A.6.4.4.1 If it becomes necessary to replace a pressure gauge on a fire extinguisher, in addition to knowing the charging pressure, it is important to know the type of extinguishing agent for which the gauge is suitable, as well as the valve body with which the gauge is compatible. This information could be available in the form of markings on the dial face. Where the marking is provided, the extinguishing agent is indicated by references such as "Use Dry Chemicals Only," while the valve body compatibility is indicated as follows.

(1) Gauges intended for use with aluminum or plastic valve bodies are marked with a line above the gauge manufacturer's code letter.
(2) Gauges intended for use with brass or plastic valve bodies are marked with a line below the manufacturer's code letter.
(3) Universal gauges that can be used with aluminum, brass, or plastic valve bodies are marked with lines above and below the manufacturer's code letter or by the absence of any line above or below the manufacturer's code letter.

Using the proper replacement gauge as to pressure range, extinguishing agent, and valve body compatibility is recommended to avoid or to reduce gauge-related problems.

A.6.4.4.3 The compressor/dryer module shall be a fully enclosed, factory-assembled, and factory-tested package of a vertical design (compressor above motor). It shall incorporate the compressor driver, purification system, controls, interconnecting piping, and wiring. The scope of supply shall include the following:

(1) *Compressor.* The compressor block shall be multistage, air cooled, oil lubricated, and rated for continuous duty at 5000 psi (34,475 kPa) with a charging rate of [_____ cfm]. The crankcase shall be fully enclosed with oversized ball bearings on each end. The connecting rods shall utilize needle bearings on both ends. Pistons shall be aluminum or cast iron and shall incorporate piston rings on all stages. Cylinders shall be of cast iron. Relief valves and individually mounted intercoolers shall be utilized after each stage of compression. The aftercooler shall be designed to deliver final air at a temperature not to exceed 20°F (–6.67°C) above ambient. The compressor flywheel shall incorporate a high-velocity cooling fan for maximum heat dissipation. An automatic condensate drain system shall be supplied as standard equipment on all systems.
(2) *Dryer System.* The system shall be of a multichamber arrangement, each constructed of aluminum alloy with a tensile strength of 83,000 psi (572,285 kPa) and designed for 5000 psi (34,475 kPa) working pressure with a 4 to 1 safety factor. The first chamber shall be a mechanical separator to eliminate oil and water. Subsequent chambers shall utilize replacement cartridges to further remove moisture and oil vapor. The dryer system shall process [_____ cf] before cartridge replacement. The air delivered shall have a –60°F (–51.1°C) dew point or lower.
(3) *Controls/Instrumentation.* The compressor module shall incorporate a gauge panel to include the following: interstage and final discharge pressure gauges, lube oil pressure gauge (where applicable), hour meter, and power-on light. All pressure gauges shall be liquid filled. The control system shall consist of all devices to monitor the operation of the compressor, including motor starter with overload detectors and switches to shut the compressor down in the event that high temperature or low oil pressure (on pressure-lubricated compressors) occurs. An air pressure switch shall be supplied to automatically start and stop the compressor to maintain adequate system pressure. [The unit shall come complete with a cartridge monitoring system that combines both moisture monitoring and timed shutdown. The moisture monitor checks air quality continuously and is calibrated to indicate when a dew point of –60°F (–51.1°C) has been reached. When moisture is detected, a yellow light comes on and the digital timer comes into operation. At the conclusion of a 1-hour to 2-hour timing period, shutdown occurs and a red light comes on.]

A.6.4.4.3.2 Some Class D fire extinguishers are required to be pressurized with argon.

A.7.1.4 A condemned cylinder or fire extinguisher can only be destroyed by its owner or at the owner's direction. It is strongly recommended that a record be kept of cylinders or fire extinguishers that are recommended to be destroyed.

A.7.1.4(1) For welding or brazing on mild steel shells, consult the manufacturer of the fire extinguisher.

A.7.1.6 Structural integrity of aluminum shells or cylinders is reduced when they are exposed to temperatures in excess of 350°F (177°C). These temperatures can occur under fire exposure without any visual evidence or during repainting operations where oven drying is utilized.

A.7.6.1 The permanent record should include, as a minimum, the date of test, cylinder serial number or extinguisher serial number, model number, cylinder size, test pressure, visual inspection result, cylinder disposition, and initials of person performing the test. Refer to CGA C-1, *Methods of Hydrostatic Testing of Compressed Gas Cylinders,* for a sample form for recording test results.

A.7.6.4 Figure A.7.6.4 provides a guide to the design of a hydrostatic test label.

All print should be black on a silver background.

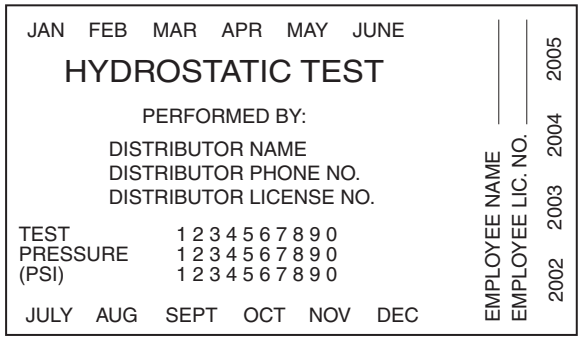
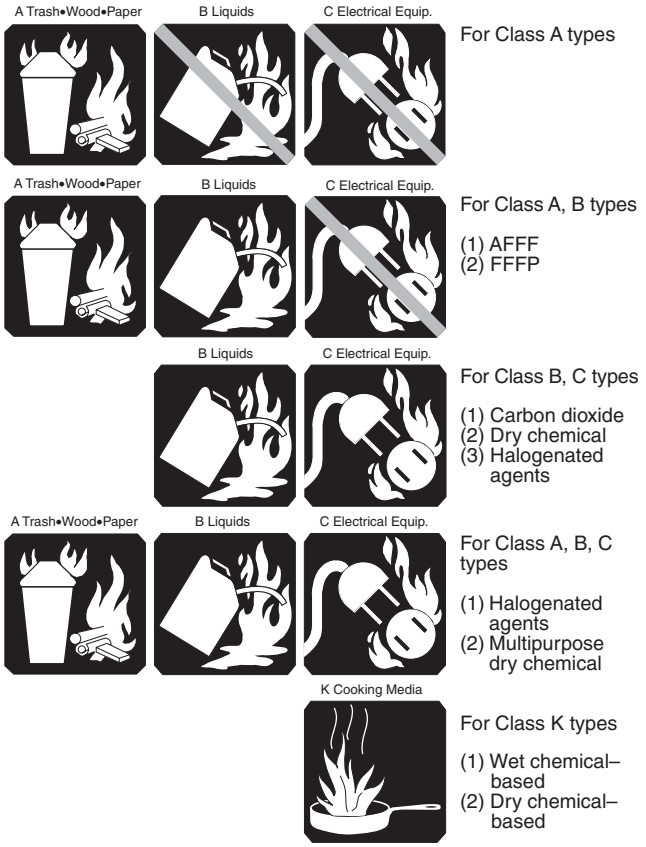


FIGURE A.7.6.4 Design of a Hydrostatic Test Label.



Note: Recommended colors, per PMS (Pantone Matching System) include the following:

BLUE — 299
RED — Warm Red

FIGURE B.1.1 Recommended Marking System.

Annex B Recommended Markings to Indicate Extinguisher Suitability According to Class of Fire

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

B.1 General.

B.1.1 Markings should be applied by decals that are durable and resistant to color fading. The color separation identification for the markings is as follows:

(1) Picture symbol objects are white.
(2) Background borders are white.
(3) Background for "YES" symbols is blue.
(4) Background for symbols with slash mark ("NO") is black.
(5) Class of fire letters and wording are black.
(6) Slash mark for black background symbols are red. (*See Figure B.1.1.*)

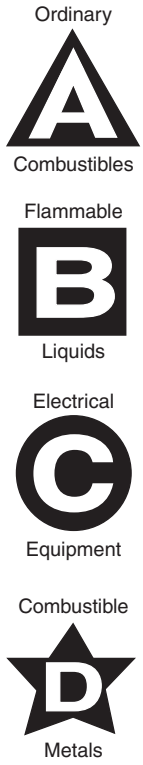
B.1.2 Markings should be located on the front of the fire extinguisher shell. Size and form should permit easy legibility at a distance of 3 ft (1 m). The labels shown in Figure B.1.1 are consistent with fire extinguishers that have been tested and listed in accordance with fire test standards. *(See 1.4.3.)*

B.1.3 Where markings are applied to wall panels, and so forth, in the vicinity of fire extinguishers, they should permit easy legibility at a distance of 15 ft (4.6 m).

B.2 Recommended Marking System.

B.2.1 The recommended marking system is a pictorial concept that combines the uses and nonuses of fire extinguishers on a single label. *(See Figure B.1.1.)*

B.2.2 Letter-shaped symbol markings, as previously recommended, are shown in Figure B.2.2. Note that fire extinguishers suitable for more than one class of fire should be identified by multiple symbols placed in a horizontal sequence.



Extinguishers suitable for Class A fires should be identified by a triangle containing the letter "A." If colored, the triangle is colored green.*

Extinguishers suitable for Class B fires should be identified by a square containing the letter "B." If colored, the square is colored red.*

Extinguishers suitable for Class C fires should be identified by a circle containing the letter "C." If colored, the circle is colored blue.*

Extinguishers suitable for fires involving metals should be identified by a five-pointed star containing the letter "D." If colored, the star is colored yellow.*

* Recommended colors, per PMS (Pantone Matching System) include the following:

GREEN — Basic Green
RED — 192 Red
BLUE — Process Blue
YELLOW — Basic Yellow

FIGURE B.2.2 Letter-shaped Symbol Markings.

Annex C Fire Extinguisher Selection

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

C.1 Principles of Selecting Fire Extinguishers.

C.1.1 Selection of the best portable fire extinguisher for a given situation depends on the following factors:

(1) Nature of the combustibles or flammables that might be ignited
(2) Potential severity (size, intensity, and speed of travel) of any resulting fire
(3) Effectiveness of the fire extinguisher on that hazard
(4) Ease of use of the fire extinguisher
(5) Personnel available to operate the fire extinguisher and their physical abilities and emotional reactions as influenced by their training
(6) Ambient temperature conditions and other special atmospheric considerations (wind, draft, presence of fumes)
(7) Suitability of the fire extinguisher for its environment
(8) Any anticipated adverse chemical reactions between the extinguishing agent and the burning materials
(9) Any health and operational safety concerns (exposure of operators during the fire control efforts)
(10) Upkeep and maintenance requirements for the fire extinguisher

C.1.2 Portable fire extinguishers are designed to cope with fires of limited size, and are necessary and desirable even though the property could be equipped with automatic sprinkler protection, standpipe and hose systems, or other fixed fire-protective equipment.

C.1.3 A fire creates conditions of stress and intense excitement. Under these conditions, the choice of a correct fire extinguisher needs to be made quickly. The protection planner can help to ensure selection of the correct fire extinguisher by using the following procedures:

(1) Locating the fire extinguisher near fire hazards for which they are suitable
(2) Using fire extinguishers suitable for more than one class of fire
(3) Marking clearly the intended use *(See Annex B.)*
(4) Training employees in the use of proper fire extinguishers.

The use of conspicuous markings to readily identify a fire extinguisher's suitability is particularly important where fire extinguishers are grouped or where multiple fire hazards are present in an area.

C.2 Matching Fire Extinguishers to the Hazard.

C.2.1 The first step in evaluating the selection of a fire extinguisher for the protection of a property is to determine the nature of the materials that might be ignited. Some fire extinguishers are suitable for only one class of fire, others for two, and still others for three. For example, a plain water fire extinguisher is suitable for Class A fires only.

C.2.2 The successful use of a Class A fire extinguisher on an incipient fire is directly related to the quantity of combustible material (contents and interior finish or both) involved. The amount of combustibles is sometimes referred to as the *fire loading* of a building, figured as the average pounds of combustibles per square foot of area. The larger the amount of combustibles, the greater the fire loading and the greater the potential fire hazard that the fire extinguisher could be called upon to combat. Based on this concept, Class A fire extinguishers are allocated according to the average fire loading that could be encountered in the occupancy to be protected.

C.2.3 Virtually every structure, even if of fire-resistive or noncombustible construction, has some combustible building components in the form of interior finish, partitions, and so forth. Thus, for building protection, fire extinguishers suitable for Class A fires are standard. Likewise, in virtually every situation, whether it be a building, a vehicle, or an outdoor exposure, ordinary combustible materials are found.

C.2.4 It is also true that, where ordinary combustibles are present, there could be the need for fire extinguishers suitable for use on Class B and Class C fires (e.g., in the dining areas of a restaurant, the principal combustibles present are wood, paper, and fabrics, which are Class A materials; however, in the kitchen area, the essential hazard involves combustible cooking oils, and a Class K fire extinguisher should be installed).

C.2.5 As another example, although in hospitals there is a general need for Class A fire extinguishers to cover spaces such as the patients' rooms, corridors, offices, and so forth, Class B:C fire extinguishers should be available in the laboratories, areas where flammable anesthetics are stored or handled, or in electrical switchgear or generator rooms. Each area should be surveyed for its actual fire extinguisher requirements, keeping in mind the variety of conditions that exist in

that particular area. Class K fire extinguishers should be installed in kitchen areas where cooking oils and fats are used.

C.2.6 In connection with Class B (flammable liquid) fires, four basic conditions could exist as follows:

(1) Flammable liquid fires of appreciable depth [i.e., ¼ in. (6.3 mm) or more], such as those occurring in dip tanks and quench tanks in industrial plants
(2) Spill fires or running fires where the depth of the liquid does not accumulate appreciably
(3) Pressurized flammable liquid or gas fires from damaged vessels or product lines
(4) Cooking grease fires of appreciable depth, such as those occurring in deep fat fryers

Each of these four conditions presents significantly different problems in extinguishment that can also be further complicated by variations between indoor and outdoor conditions.

C.2.7 The Class B ratings given by testing laboratories are based on flammable liquid fires of appreciable depth. The number thus derived is an approximate indication of the relative fire-extinguishing potential of the fire extinguisher.

C.2.8 The selection of Class B fire extinguishers to be used on pressurized flammable liquids and pressurized gas fires requires special consideration. Fires of this nature are considered to be a special hazard and only dry chemical types of fire extinguishers should be employed. Other types of Class B–rated fire extinguishers are relatively ineffective on these hazards. It has been determined that special dry chemical nozzle designs and rates of application are required to cope with such hazards.

CAUTION: It is undesirable to attempt to extinguish this type of fire unless there is reasonable assurance that the source of fuel can be shut off promptly.

C.2.9 The size and type of the Class C fire extinguisher selected should be based on the following:

(1) Construction features of the electrical equipment
(2) Degree of agent contamination that can be tolerated
(3) Size and extent of Class A and Class B components, or both, that are a part of the equipment
(4) Nature and amount of combustible materials in the immediate vicinity (e.g., large motors and power panels will contain a considerable amount of Class A insulating materials as compared to the Class B material in an oil-filled transformer)

C.2.10 Once an analysis is made of the nature of the combustibles present and their potential fire severity, a study is made of the various candidate fire extinguishers that might be provided to meet fire protection needs.

C.3 Selecting the Right Fire Extinguisher.

C.3.1 Selecting the right fire extinguisher for the class of hazard depends on a careful analysis of the advantages and disadvantages (under various conditions) of the various types available. The following paragraphs review some of the points that should be considered.

C.3.2 Water-Type Fire Extinguishers.

C.3.2.1 The most popular type is the 2½ gal (9.46 L) stored-pressure water fire extinguisher. These fire extinguishers are being used to replace inverting types of water fire extinguishers (soda acid and cartridge-operated water) that are no longer manufactured. An important advantage of the stored-pressure water type, as opposed to inverting types, is its ability to be discharged intermittently. Some models are suitable for use at freezing conditions when charged as specified on the nameplate.

C.3.2.2 Since the pump tank fire extinguisher (hand-carry type) cannot be operated while being carried, it is considered somewhat more difficult to use. However, it does possess some advantages over stored-pressure types under certain applications. It is an excellent choice for use as a standby fire extinguisher on welding or cutting operations, protecting buildings in remote locations, and for use by the construction industry. It can easily be filled from any convenient, relatively clean water supply, can be used without the need for pressurization, and can be easily maintained. For freezing conditions, chemical additives containing corrosion inhibitors can be used; however, copper and nonmetallic tank models are recommended because they will not corrode easily. The backpack style of pump tank, which can be carried and operated at the same time, is ideally suited for use in combating brush fires.

C.3.3 AFFF and FFFP Fire Extinguishers. AFFF (aqueous film-forming foam) and FFFP (film-forming fluoroprotein)-type fire extinguishers are rated for use on both Class A and Class B fires. They are not suitable for use in freezing temperatures. An advantage of this type of extinguisher when used on Class B flammable liquid fires of appreciable depth is the ability of the agent to float on and secure the liquid surface, which helps to prevent reignition.

C.3.4 Carbon Dioxide Fire Extinguishers. The principal advantage of CO_2 (carbon dioxide) fire extinguishers is that the agent does not leave a residue after use. This can be a significant factor where protection is needed for delicate and costly electronic equipment. Other typical applications are food preparation areas, laboratories, and printing or duplicating areas. Carbon dioxide extinguishers are listed for use on a Class B and Class C fire. Since the agent is discharged in the form of a gas/snow cloud, it has a relatively short range of 3 ft to 8 ft (1 m to 2.4 m). This type of fire extinguisher is not recommended for outdoor use where windy conditions prevail, or for indoor use in locations that are subject to strong air currents, because the agent can rapidly dissipate and prevent extinguishment. The concentration needed for fire extinguishment reduces the amount of oxygen (air) needed for life safety when the discharge is in a confined area (space).

C.3.5 Halogenated Agent Extinguishers.

C.3.5.1 The bromochlorodifluoromethane (Halon 1211) fire extinguisher has an agent that is similar to carbon dioxide in that it is suitable for cold weather installation and leaves no residue. Some larger models of Halon 1211 fire extinguishers are listed for use on Class A as well as Class B and Class C fires. Compared to carbon dioxide on a weight-of-agent basis, bromochlorodifluoromethane (Halon 1211) is at least twice as effective. When discharged, the agent is in the combined form of a gas/mist with about twice the range of carbon dioxide. To some extent, windy conditions or strong air currents could make extinguishment difficult by causing the rapid dispersal of the agent.

C.3.5.2 In general, bromotrifluoromethane (Halon 1301) fire extinguishers have features and characteristics similar to

carbon dioxide fire extinguishers in that they are suitable for cold weather installation and leave no residue. Halon 1301 fire extinguishers are listed for Class B and Class C fires. Compared to carbon dioxide on a weight-of-agent basis, bromotrifluoromethane (Halon 1301) is at least as effective. When discharged, the agent is in the combined form of a gas/mist. To some extent, windy conditions or strong air currents could make extinguishment difficult by causing the rapid dispersal of the agent.

C.3.5.3 Fire extinguishers containing a mixture of Halon 1211 and Halon 1301 share properties of the other halogenated agent–type fire extinguishers, such as leaving no residue after use and minimizing thermal shock. The mixture of halogenated agents will discharge in the form of a gas/mist, with the ratio of gas to mist increasing with higher ratios of Halon 1301 to Halon 1211. The discharge range will likewise be affected by the ratio of Halon 1301 to Halon 1211, with the range decreasing as the proportion of Halon 1301 increases. To some extent, windy conditions or strong air currents could make extinguishments difficult by causing the rapid dispersal of the agent.

C.3.5.4 Halocarbon agents are similar to halon agents in that they are nonconductive, noncorrosive, and evaporate after use, leaving no residue. Larger models of halocarbon fire extinguishers are listed for Class A as well as Class B and Class C fires, which makes them quite suitable for use on fires in electronic equipment. Compared to carbon dioxide on a weight-of-agent basis, halocarbon agents are at least twice as effective. When discharged, the agent is in a combined form of a gas/mist with about twice the range of carbon dioxide. To some extent, windy conditions or strong air currents could make extinguishing difficult by causing a rapid dispersal of agent.

C.3.6 Dry Chemical Extinguishers.

C.3.6.1 Due to the different designs and the various types of dry chemical agents, choosing the most suitable dry chemical fire extinguisher requires careful evaluation. Hand portable models have a discharge stream that ranges from 10 ft to 30 ft (3 m to 9 m), depending on fire extinguisher size. Compared with carbon dioxide or halogenated agent fire extinguishers, they will also perform better under windy conditions.

C.3.6.2 Dry chemical fire extinguishers are available in two basic styles: stored-pressure and cartridge-operated. The stored-pressure (rechargeable) type is the most widely used and is best suited where infrequent use is anticipated and where skilled personnel with professional recharge equipment are available. The cartridge-operated type has the advantage of being quickly refilled in remote locations without the need for special equipment. Some dry chemical models can be equipped with long-range (high-velocity) nozzles or applicators that are beneficial in applying the agent under certain special fire-fighting conditions.

C.3.6.3 There are five available types of dry chemical agent, and each has certain advantages and disadvantages. These advantages and disadvantages should be reviewed by potential users.

C.3.6.4 The potassium and urea-potassium base bicarbonate agents are selected in preference to sodium bicarbonate, principally because of their greater fire-extinguishing capabilities. If corrosion is not a factor, potassium chloride can also be included in this group. However, the potassium chloride base agent is corrosive and does not have any specific extinguishing characteristics that are superior to the potassium bicarbonate base agents.

C.3.6.5 The ammonium phosphate base agent (multipurpose) is the only dry chemical agent that is suitable for Class A protection. In addition to Class B and Class C protection, the residues of multipurpose dry chemical, when left in contact with metal surfaces, can cause corrosion.

C.3.6.6 Where dry chemical fire extinguishers are utilized for Class C protection, it is important to consider that the residue of potassium chloride is more corrosive than other dry chemicals and that a multipurpose base agent will be more difficult to remove because it first softens when in contact with hot surfaces and then hardens when it cools. Any of the other dry chemical agents, depending on protection requirements, could prove to be a more practical choice for Class C protection.

C.3.7 Wheeled Fire Extinguishers.

C.3.7.1 The selection of any type of wheeled fire extinguisher is generally associated with a recognized need to provide additional protection for special hazards or large, extra-hazard areas. Where wheeled fire extinguishers are to be installed, consideration should be given to mobility within the area in which they will be used.

C.3.7.2 For outdoor locations, models with rubber tires or wide-rim wheels will be easier to transport. For indoor locations, doorways, aisles, and corridors need to be wide enough to permit the ready passage of the fire extinguisher. Because of the magnitude of the fire it will generally be used on, this type of fire extinguisher should be reserved for use by operators who have actually used the equipment, who have received special instructions on the use of the equipment, or who have used the equipment in live fire training. *[See Figure C.3.7.2(a) and Figure C.3.7.2(b).]*

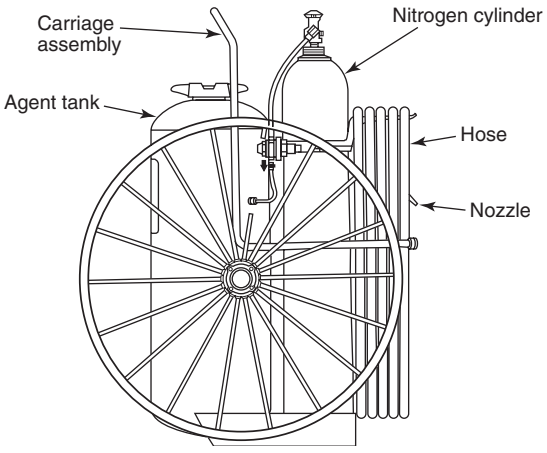


FIGURE C.3.7.2(a) Cylinder-operated Dry Chemical–type.

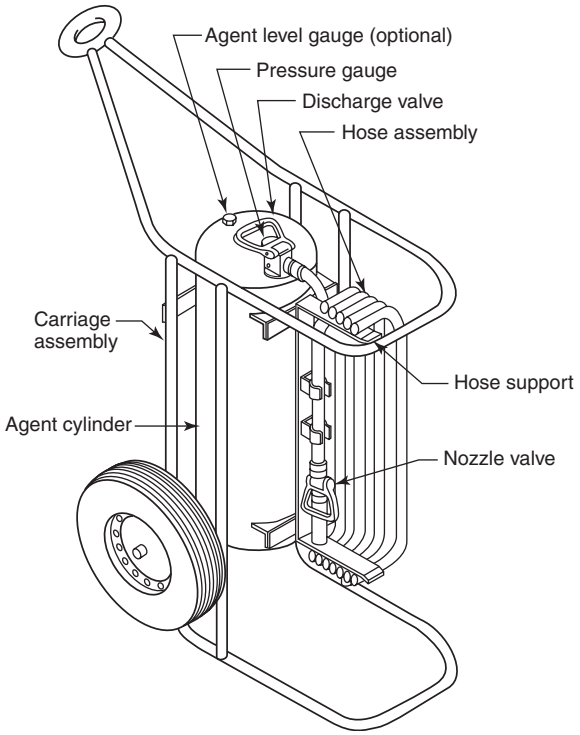


FIGURE C.3.7.2(b) Stored-pressure Halogenated Agent–type.

Annex D Operation and Use

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

D.1 General.

D.1.1 Persons who are expected to use a fire extinguisher should be made familiar with all information contained in the manufacturer's nameplate(s) and the instruction manual. Proper operation of a fire extinguisher requires the operator to execute several basic steps in a certain sequence. The fire extinguisher designer, the approval agencies, the installer, and the protection planner can influence significantly the ease and likelihood of these steps being accomplished properly.

D.1.1.1 Fire extinguishers will be used by one or more of the following groups of people, listed in descending order of their probable skill:

(1) Trained fire departments (municipal or industrial)
(2) Trained or untrained employees (business or industrial)
(3) Untrained private owners (home, car, boat, etc.)
(4) Untrained general public

D.1.1.2 Where employees have not been trained, operation of fire extinguishers could be seriously delayed, the extinguishing material could be wasted due to poor application techniques, and more fire extinguishers could have to be used, or the fire could possibly not be extinguished.

D.1.1.3 It is not enough for the protection planner to determine the hazard of a location or area within a building and then select a proper type and size of fire extinguisher to fit the hazard. He or she needs to take into account any problems of getting the fire extinguisher into action, and the difficulty of properly applying the extinguishing agent. The planner should also consider who is the most likely to use the fire extinguisher and should estimate the degree of skill or training that person should have.

D.1.2 Methods of Fire Extinguisher Operation.

D.1.2.1 The methods of operation of fire extinguishers are most conveniently arranged by grouping fire extinguishers according to their expelling means. Five methods are in common use.

(1) *Self-Expelling.* The agents have sufficient vapor pressure at normal operating temperatures to expel themselves.
(2) *Gas Cartridge or Cylinder.* Expellant gas is confined in a separate pressure vessel until an operator releases it to pressurize the fire extinguisher shell.
(3) *Stored-Pressure.* The extinguishing material and expellant are kept in a single container.
(4) *Mechanically Pumped.* The operator provides expelling energy by means of a pump, and the vessel containing the agent is not pressurized.
(5) *Hand-Propelled.* The material is applied with a scoop, pail, or bucket.

D.1.2.2 Several different extinguishing materials are handled by each of these expelling means. Table D.1.2.2 lists the agent and expelling means combinations that are or have been in use.

D.2 Basic Steps to Operate Extinguishers.

D.2.1 The following are the basic steps necessary to put a fire extinguisher into operation:

(1) Recognition as a fire extinguisher
(2) Selection and suitability of a fire extinguisher
(3) Transport of a fire extinguisher to the fire
(4) Actuation of the fire extinguisher
(5) Application of the extinguishing agent to the fire

D.2.2 Recognition as an Extinguisher. The following will help a person to recognize a fire extinguisher.

D.2.2.1 Approval agencies require permanent marking on the front of fire extinguishers indicating their purpose, content, and usage.

D.2.2.2 Additional markings, not a part of the device, could be needed to indicate the location of a fire extinguisher. These preferably should be standardized throughout the property so that all fire extinguishers are easily "spotted." These markings could be in the form of electric lights, placards, mounting boards, overhead signs, color panels or stripes, or cabinets. They could be distinctively colored by painting or reflective taping.

D.2.2.3 If fire extinguishers are located along the normal exit paths from an area, personnel are more inclined to take them and return to the site of a fire.

D.2.3 Transport of a Fire Extinguisher to the Fire.

D.2.3.1 A fire extinguisher should be mounted and located so it can be easily removed in a fire emergency and brought to the site of the fire as quickly as possible. It should be readily accessible without need for moving or climbing over stock, materials, or equipment.

Table D.1.2.2 Extinguisher Operation and Methods of Expelling

Extinguishing Materials	Expelling Methods				
	Self-Expelling	Gas Cartridge or Cylinder	Stored-Pressure	Mechanically Pumped	Hand-Propelled
Water and antifreeze			x	x	x
Wetting agent			x		
AFFF and FFFP		x	x		
Loaded stream		x	x		
Multipurpose dry chemical		x	x		
Carbon dioxide	x				x
Dry chemical		x	x		
Halogenated agents	x		x		
Dry powder (metal fires)		x	x		x
Wet chemical			x		

D.2.3.2 Portability is affected by the following factors:

(1) Weight of the fire extinguisher
(2) Travel distance to a possible fire
(3) Need for carrying the unit up or down stairs or ladders
(4) Need for using gloves
(5) Overall congestion of the premises
(6) Physical ability of the operators

D.2.3.3 In the case of wheeled fire extinguishers, the width of aisles and doorways and the nature of the flooring and outside grounds over which the fire extinguisher needs to be moved should be taken into account.

D.2.4 Actuation of the Fire Extinguisher.

D.2.4.1 Once the fire extinguisher has been transported to the fire site, it should be placed into operation without delay. Employees should be familiar with any steps needed to actuate any fire extinguisher. Here is where previous training is most valuable, since there is little time to stop and read operating instructions on the nameplate.

D.2.4.2 To actuate a fire extinguisher, one or more of the following steps are required:

(1) *Position for Operation.* The intended position for operation is usually marked on the fire extinguisher. When the position of operation is obvious (such as when one hand holds the fire extinguisher and the other hand holds the nozzle), this information can be omitted.
(2) *Removal of Restraining or Locking Devices.* Many fire extinguishers have an operation safeguard or locking device that prevents accidental actuation. The most common device is a lock pin or ring pin that needs to be withdrawn before operation. Other forms of such devices are clips, cams, levers, or hose or nozzle restrainers. Most tamper indicators (such as wire and lead seals) will break with removal of the restraining device. On some fire extinguishers, the restraining device is arranged to disengage when the unit is normally handled. No separate motion is required. This type of restraining device is especially suited for use by private owners and the general public since prior instruction is seldom possible.
(3) *Start of Discharge.* This requires one or more of several actions such as turning or squeezing a valve handle or lever, pushing a lever, or pumping. These can cause a gas to be generated, release a gas from a separate container, open a normally closed valve, or create a pressure within the container.
(4) *Agent Application.* This act involves direction of the stream of extinguishing agent onto the fire. Nameplate information has advisory notes regarding the application of the agent to different types of fires. Specific application techniques are described in Section D.3.

D.2.5 Expellant Gas/Pressure.

D.2.5.1 Many of the fire extinguishers described in this annex are of the stored-pressure or cartridge-operated type. Since the operating characteristics of these two types are similar, regardless of agent used, they are described generally in the following paragraphs.

D.2.5.2 In stored-pressure models, the expellant gas and extinguishing agent are stored in a single chamber, and the discharge is controlled by a shutoff valve or nozzle.

D.2.5.3 In cartridge-operated models, the expellant gas is stored in a separate cartridge or could be stored in an expellant-gas cylinder (wheeled models), located within or adjacent to the shell containing the extinguishing agent. These fire extinguishers are actuated by releasing the expellant gas that expels the agent. In most models, the discharge could subsequently be controlled by a shutoff valve or nozzle.

D.3 Application Techniques.

D.3.1 General.

D.3.1.1 Many fire extinguishers deliver their entire quantity of extinguishing material in 8 to 10 seconds (although some take 30 seconds or longer to discharge). The agent needs to be applied correctly at the outset since there is seldom time for experimentation. In many fire extinguishers, the discharge can be started or stopped by a valve. When using some fire extinguishers on flammable liquid fires, the fire could flare up momentarily when the agent is initially applied.

D.3.1.2 The best technique of applying the fire extinguisher discharge on a fire varies with the type of extinguishing material.

D.4 Fire Extinguisher Characteristics.

D.4.1 Water Types. This includes water, antifreeze, wetting agent, and loaded stream fire extinguishers. These fire extinguishers are intended primarily for use on Class A fires. The stream initially should be directed at the base of the flames.

After extinguishment of flames, it should be directed generally at smoldering or glowing surfaces. Application should begin as close as possible to the fire. Deep-seated fires should be thoroughly soaked and might need to be "broken apart" to effect complete extinguishment.

D.4.1.1 Stored-Pressure Water. Hand fire extinguishers of this type are usually available in 2½ gal (9.46 L) capacity with a fire extinguishment rating of 2-A. Since the agent used is fresh water, this fire extinguisher cannot be installed in areas subjected to temperatures below 40°F (4°C). This same type of fire extinguisher is also manufactured in an antifreeze model charged with an approved solution that will afford protection to temperatures as low as –40°F (–40°C). The fire extinguisher weighs about 30 lb (14 kg) and has a solid stream range of approximately 35 ft to 40 ft (10.7 m to 12.2 m) horizontally. This fire extinguisher can be operated intermittently but, under continuous use, it has a discharge time of about 55 seconds. The operating lever is held in a locked position to prevent accidental discharge while being carried. Most manufacturers use a ring pin that needs to be pulled out before the operating lever can be depressed. To do this, it is best to set the fire extinguisher on the ground and, while loosely holding the combination handle in one hand, pull out the ring pin (or release a small latch) with the other hand. Then, grasp the hose and nozzle in one hand and squeeze the discharge lever with the other. *(See Figure D.4.1.1.)*

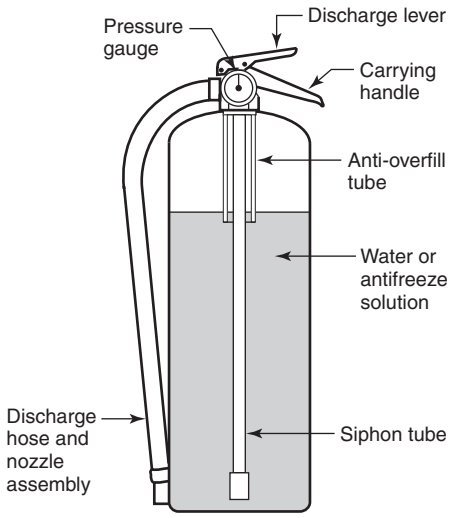


FIGURE D.4.1.1 Stored-pressure Water Extinguisher.

D.4.1.2 Loaded Stream. Hand fire extinguishers of this type have been made with liquid capacities from 1 gal to 2½ gal (3.8 L to 9.46 L) having fire-extinguishing ratings of 1-A:1-B to 3-A:1-B. Due to limited effectiveness, these fire extinguishers are no longer recognized (listed) for use on Class B fires. Wheeled fire extinguishers have been made having liquid capacities of 17 gal and 33 gal (64 L and 125 L) [trade designations 20 gal and 40 gal (76 L and 151 L)] having fire extinguishment ratings of 10-A to 20-A. The chemical used is a solution of an alkali metal salt that will not freeze at temperatures as low as –40°F (–40°C).

D.4.1.3 Pump Tank. Fire extinguishers of this type have been made in 1½ gal to 5 gal (5.7 L to 19 L) capacities with fire extinguishment ratings of 1-A to 4-A. The most common type is 2½ gal (9.46 L), rated at 2-A. These fire extinguishers have cylindrical metal containers and carrying handles. In some models, the carrying handle is combined with the pump handle, and in others it is attached to the container. A built-in, hand-operated vertical piston pump, to which a short rubber hose and nozzle are attached, provides the means for discharging the water onto the fire. The pump is of the double-acting type, which discharges a stream of water on both the up and down strokes. When brought to a fire, the pump tank is placed on the ground and, to steady the unit, the operator puts one foot on a small extension bracket attached to the base. To force the water through the hose, the operator then pumps the handle up and down. To work around the fire, or to move closer to the fire as the flames subside, the operator needs to stop pumping and carry the fire extinguisher to a new location. The force, range, and duration of the stream are dependent, to a degree, on the operator.

They can be filled with either plain water or antifreeze charges recommended by the fire extinguisher manufacturer. Common salt or other freezing depressants could corrode the fire extinguisher, damage the pump assembly, or affect the fire-extinguishing capability. Copper shell and nonmetallic models do not corrode as easily as steel and are recommended for use in conjunction with antifreeze agents. *(See Figure D.4.1.3.)*

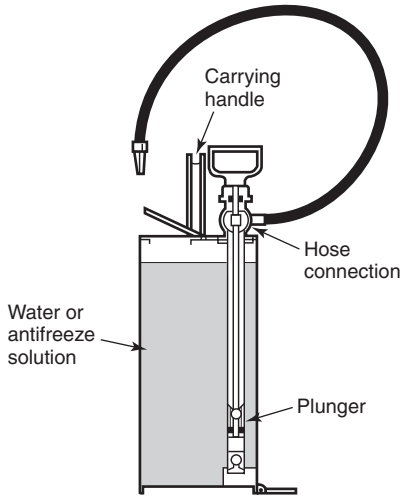


FIGURE D.4.1.3 Pump Tank Fire Extinguisher.

D.4.1.4 Backpack. This type of pump fire extinguisher is used primarily for fighting outdoor fires in brush and wildlands. The tank has a capacity of 5 gal (19 L) and weighs approximately 50 lb (23 kg) when full. Although it is listed by UL, it does not have a designated rating. Generally, plain water is used as the extinguishant. However, antifreeze agents, wetting agents, or other special water-base agents can be used. The tank can be constructed of fiberglass, stainless steel, galvanized steel, or brass. As its name implies, it is designed to be carried on the operator's back. The backpack fire extinguisher has a large opening for fast refilling as well as a tight-fitting filter to prevent foreign material from entering and clogging the pump. This design permits convenient refilling from nearby water sources such as ponds, lakes, or streams. The most commonly used model has a trombone-type,

double-acting piston pump connected to the tank by a short length of rubber hose. Discharge occurs when the operator, holding the pump in both hands, moves the piston section back and forth. Models have also been manufactured with compression pumps mounted on the right side of the tank. Expellant pressure is built up with about 10 strokes of the handle, and then maintained by continual slow, easy pumping strokes. Discharge is controlled with the left hand by means of a lever-operated shutoff nozzle attached to the end of the hose. *(See Figure D.4.1.4.)*

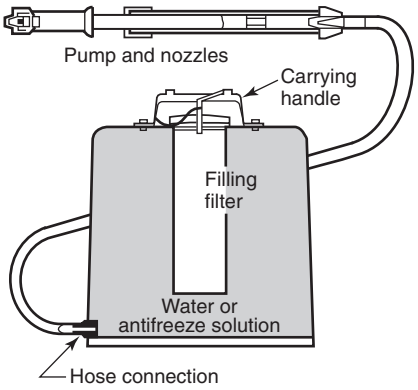


FIGURE D.4.1.4 Pump Tank Backpack Fire Extinguisher.

D.4.1.5 Wetting Agent. Extinguishers of this type are usually available in hand portable models of 1½ gal (5.7 L) capacities and in wheeled models having liquid capacities of 45 gal and 60 gal (170 L and 228 L). These extinguishers have ratings of 2-A, 30-A, and 40-A, respectively. The extinguishing agent used is a surface-active material added to water in proper quantities to materially reduce the surface tension of the water and thus increase penetrating and spreading characteristics *(see NFPA 18, Standard on Wetting Agents)*. Hand portable models are of the stored-pressure design and are operated essentially the same as other stored-pressure types. Wheeled extinguishers are operated by a separate carbon dioxide cartridge containing the expellant gas which, when released, expels the agent through the hose nozzle. These extinguishers need to be protected from exposure to temperatures below 40°F (4°C).

D.4.1.6 Fire Pails, Drums with Pails, and Bucket Tanks.

D.4.1.6.1 Small water supplies applied with fire pails are of limited fire-extinguishing value. The following combinations are considered as possessing two units of extinguishing potential (2-A) for Class A fires:

(1) Five 12 qt (11 L) water-filled standard fire pails
(2) Six 10 qt (9 L) water-filled standard fire pails
(3) Drum, cask, or barrel of approximately 55 gal (208 L) capacity, with at least three standard fire pails attached
(4) Bucket tanks of 25 gal to 55 gal (95 L to 208 L) capacity, with standard fire pails [either (1) or (2) above] immersed therein

D.4.1.6.2 Standard fire pails are made of galvanized steel of at least No. 24 USS gauge, with rounded bottoms welded in place or otherwise suitably reinforced, furnished with stamped ears welded in place, and with strong wire bail and loose-fitting metal covers to exclude debris and retard evaporation.

D.4.1.6.3 Casks, drums, or barrels should preferably be of metal of No. 24 USS gauge thickness or better, and should have covers. Fire pails can be hung on sides of the containers or immersed therein. Pails, casks, drums, or bucket tanks should be painted bright red with the word "FIRE" stenciled in large letters on their outside with black or other contrasting colored paint. If antifreezing solution is used, the surfaces of pails, drums, or bucket tanks should be coated with red lead or oil, followed by a coat of asphalt-base paint. Casks should be heavily coated with pitch.

D.4.1.6.4 When located where continued temperatures below 40°F (4°C) could be encountered, containers should be filled with an antifreeze solution consisting of 75 percent to 80 percent calcium chloride (free from magnesium chloride) dissolved in water. Table D.4.1.6.4 shows the approximate temperature at which the solutions will freeze.

Table D.4.1.6.4 To Make 10 Gallons Antifreeze Solutions

Approx. Freezing Temp.		Water		Calcium Chloride		Specific Gravity	Degrees Baume
°F	°C	gal	L	lb	kg		
10	–12	9	34	20	9.1	1.139	17.7
0	–18	8½	32	25	11.3	1.175	21.6
–10	–23	8	30	29½	13.4	1.205	24.7
–20	–29	8	30	33½	15.2	1.228	26.9
–30	–34	8	30	36½	16.6	1.246	28.6
–40	–40	8	30	40	18.1	1.263	30.2

Note: This solution should not be used in extinguishers. Only solutions supplied by the manufacturers should be used in stored-pressure and cartridge-operated water extinguishers and in pump tank extinguishers where an antifreeze solution is desired.

D.4.2 Film-Forming Foam Agents. These fire extinguishers are intended for use on Class A and Class B fires. On flammable liquid fires of appreciable depth, best results are obtained when the discharge from the fire extinguisher is played against the inside of the back wall of the vat or tank just above the burning surface to permit the natural spread of the agent back over the burning liquid. If this cannot be done, the operator should stand far enough away from the fire to allow the agent to fall lightly upon the burning surface — the stream should not be directed into the burning liquid. Where possible, the operator should walk around the fire while directing the stream to get maximum coverage during the discharge period. For fires in ordinary combustible materials, the agent can be used to coat the burning surface directly. For flammable-liquid spill fires, the agent could be flowed over a burning surface by bouncing it off the floor just in front of the burning area. Film-forming foam agents are not effective on flammable liquids and gases escaping under pressure or cooking-grease fires.

D.4.2.1 AFFF and FFFP. Fire extinguishers of these types are usually available in hand portable models of 1.6 gal (6 L) and 2½ gal (9.46 L) and in wheeled models having a liquid capacity of 33 gal (125 L). These fire extinguishers have ratings of 2-A:10-B, 3-A:20-B, and 20-A:160-B, respectively. The extinguishing agent is a solution of film-forming surfactant in water that forms mechanical foam when discharged through an

aspirating nozzle. On Class A fires, the agent acts as both a coolant and penetrant to reduce temperatures to below the ignition level. On Class B fires, the agent acts as a barrier to exclude air or oxygen from the fuel surface.

Grades of these agents are also suitable for the protection of water-soluble flammable liquids (polar solvents) such as alcohols, acetone, esters, ketones, and so forth. The suitability of these fire extinguishers for polar solvent fires should be referenced specifically on the nameplate. These agents are not suitable for use on pressurized fuel fires or cooking-grease fires.

Specific information on the properties and limitations of AFFF and FFFP are contained in NFPA 11, *Standard for Low-Expansion Foam*.

The hand portable models closely resemble stored-pressure water fire extinguishers except for the special types of nozzles *[see Figure D.4.2.1]*. Wheeled types are operated by a separate nitrogen cylinder containing the expellent gas which, when released, pressurizes the agent container. The discharge is controlled by a special aspirating shutoff type of nozzle at the end of the hose assembly. These types of fire extinguishers can be used only in locations not subject to freezing conditions, unless special measures recommended by the manufacturer are provided to prevent the agent from freezing.

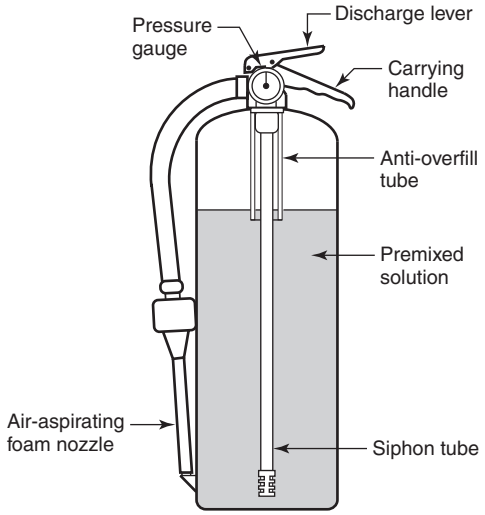


FIGURE D.4.2.1 Stored-pressure AFFF or FFFP Liquid Extinguisher.

D.4.3 Carbon Dioxide Type. This type of fire extinguisher is primarily intended for use on Class B and Class C fires. Carbon dioxide fire extinguishers have a limited range and are affected by draft and wind; thus, initial application needs to start reasonably close to the fire. On all fires, the discharge should be directed at the base of the flames. The discharge should be applied to the burning surface even after the flames are extinguished to allow added time for cooling and to prevent possible reflash. The most commonly used method of agent application on contained flammable liquid fires is to start at the near edge and direct the discharge in a slow, side-to-side sweeping motion, gradually progressing toward the back of the fire. The other method is called overhead application. The discharge horn is directed in a dagger or downward position (at an angle of about 45 degrees) toward the center of the burning area. Generally, the horn is not moved, as in the other method, because the discharge stream enters the fire from above and spreads out in all directions over the burning surface. For spill fires, the side-to-side sweeping motion could give better results.

On fires involving electrical equipment, discharge should be directed at the source of the flames. It is important to de-energize the equipment as soon as possible to eliminate the potential of reignition. These agents are not suitable for use on pressurized fuel fires or cooking-grease fires.

The carbon dioxide agent extinguishes by diluting the surrounding atmosphere with an inert gas so that oxygen levels are kept below the percentage required for combustion. When this type of fire extinguisher is used in an unventilated space, such as a small room, closet, or other confined area, prolonged occupancy of that space can result in the loss of consciousness due to oxygen deficiency.

Hand fire extinguishers of this type are usually available at capacities from 2½ lb to 20 lb (1.1 kg to 9.1 kg), having fire extinguishment ratings from 1-B:C to 10-B:C. Carbon dioxide fire extinguishers might have a limited effect on deep-seated fires in electrical enclosures. Wheeled carbon dioxide fire extinguishers are usually available in capacities from 50 lb to 100 lb (23 kg to 45 kg), having fire extinguishment ratings from 10-B:C to 20-B:C. The carbon dioxide is retained under its own pressure in a fluid condition at room temperature. The agent is self-expelling and is discharged by operation of a valve that causes the carbon dioxide to be expelled through a horn in its vapor and solid phase. To be operated, the fire extinguisher is held in an upright position, the locking ring pin is pulled, and the operating lever is squeezed. On the smaller 2 lb to 5 lb (0.91 kg to 2.3 kg) models, the discharge horn is attached to the valve assembly by a metal tube/swing joint connector. The smaller models are designed to be operated with one hand. On the larger hand portables, the discharge horn is attached to several feet of flexible hose. These fire extinguishers require a "two-hand" operation. The minimum discharge time for hand portables varies from 8 seconds to 30 seconds, depending upon size. The maximum range of the discharge stream is from 3 ft to 8 ft (1 m to 2.4 m). *[See Figure D.4.3(a) and Figure D.4.3(b).]*

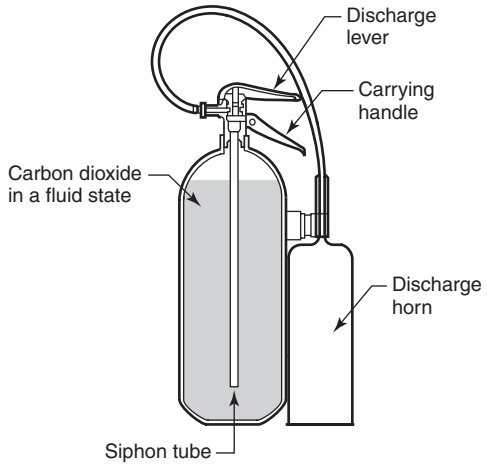


FIGURE D.4.3(a) Carbon Dioxide Extinguisher.

FIGURE D.4.3(b) Carbon Dioxide Extinguisher.

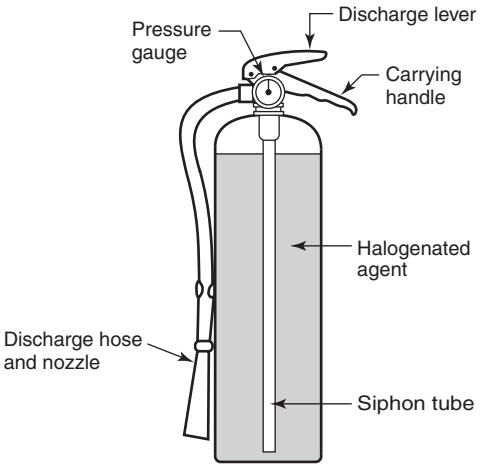


FIGURE D.4.4.1 Halogenated Agent–type Stored-pressure Fire Extinguisher.

D.4.4 Halogenated Agent Types. Halogenated agent fire extinguishers, which include both halon and halocarbon types, are rated for use on Class B and Class C fires. Larger models are also rated for Class A fires. On flammable liquid fires, best results are obtained when the discharge from the fire extinguisher is employed to sweep the flame off the burning surface, applying the discharge first at the near edge of the fire and gradually progressing toward the back of the fire by moving the discharge nozzle slowly from side to side. In using fire extinguishers of this type in unventilated places, such as small rooms, closets, or confined spaces, operators and other persons should avoid breathing the extinguishing agent or the gases produced by thermal decomposition. These agents are not suitable for use on pressurized fuel fires or cooking-grease fires.

D.4.4.1 Bromochlorodifluoromethane — Halon 1211. Stored-pressure fire extinguishers of this type are available in capacities from 2 lb to 22 lb (0.91 kg to 10 kg), having fire extinguishment ratings from 2-B:C to 4-A:80-B:C, and wheeled models with a capacity of 150 lb (68 kg) and a fire extinguishment rating of 30-A:160-B:C. Although the agent is retained under pressure in a liquid state and is self-expelling, a booster charge of nitrogen is added to ensure proper operation. Upon actuation, the vapor pressure causes the agent to expand so that the discharge stream consists of a mixture of liquid droplets and vapor. The smaller sizes have a horizontal stream range of 9 ft to 15 ft (2.7 m to 4.6 m) that is not affected by wind as much as carbon dioxide or Halon 1301. Deep-seated Class A fires could need to be broken apart to effect complete extinguishment. On Class B fires, the discharge is applied in a side-to-side motion, gradually progressing toward the back of the fire. The fire extinguisher should be discharged initially from not closer than 8 ft (2.4 m) to prevent splashing when applied to depths of flammable liquid. *(See Figure D.4.4.1.)*

D.4.4.2 Bromochlorodifluoromethane/Bromotrifluoromethane Mixtures — Halon 1211 and Halon 1301. Fire extinguishers of this type are available in capacities from 1.0 lb to 20 lb (0.45 kg to 9 kg), having fire extinguishment ratings from 1-B:C to 4-A:80-B:C. The halogenated agent mixture is retained under pressure in a liquid state and is self-expelling. Some of these fire extinguishers are superpressurized with nitrogen. Upon actuation, the vapor pressure causes the agent to expand so that the discharge stream is in the form of a gas/mist. These extinguishers have a horizontal stream range of 3 ft to 18 ft (0.9 m to 5.5 m) that is not affected by wind as much as carbon dioxide or Halon 1301. Deep-seated Class A fires could need to be broken apart to effect complete extinguishment. On Class B fires, the discharge is applied in a side-to-side motion, progressing toward the back of the fire. *(See Figure D.4.4.2.)*

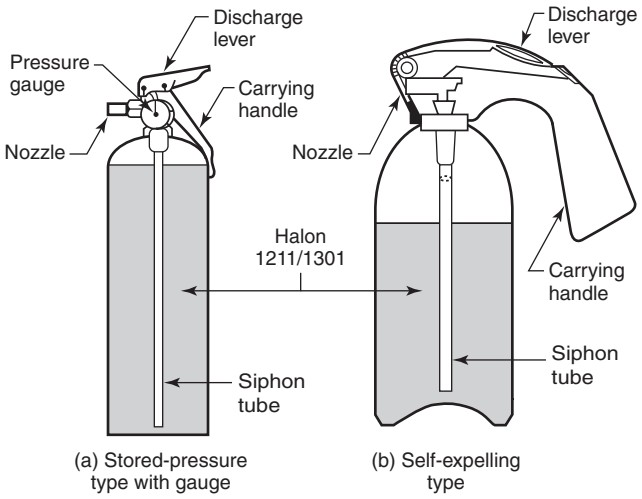


FIGURE D.4.4.2 Halon 1211/1301 Extinguishers.

D.4.5 Dry Chemical Types. Dry chemical fire extinguishers (sodium bicarbonate, potassium bicarbonate, potassium bicarbonate urea base, bicarbonate urea base, or potassium chloride base) are intended primarily for use on Class B and Class C fires. Dry chemical fire extinguishers (multipurpose ammonium phosphate base) are intended for use on Class A, Class B, and Class C fires. There are two methods whereby a dry chemical agent can be discharged from a fire extinguisher shell, depending on the basic design of the fire extinguisher. They are the cartridge/cylinder-operated method and the stored-pressure method. Regardless of fire extinguisher design, the method of agent application is basically the same.

Stored-pressure fire extinguishers are available in capacities from 1 lb to 30 lb (0.5 kg to 14 kg) for hand fire extinguishers and 125 kg to 250 lb (57 kg to 113.5 kg) for wheeled fire extinguishers. Cartridge/cylinder-operated fire extinguishers are available in capacities from 4 lb to 30 lb (1.8 kg to 14 kg) for hand fire extinguishers and 45 lb to 350 lb (20 kg to 159 kg) for wheeled fire extinguishers.

Dry chemical fire extinguishers are also available in nonrechargeable, nonrefillable types that contain the agent and expellant gas in a single, nonreusable, factory-filled container. Most dry chemical fire extinguishers having ratings of 20-B and less will discharge their contents in 8 seconds to 20 seconds. Fire extinguishers with higher ratings could take as long as 30 seconds. Therefore, since there is little time for experimentation, it is important that the operator be prepared to apply the agent correctly at the outset. All dry chemical fire extinguishers can be carried and operated simultaneously and can be discharged intermittently. The discharge stream has a horizontal range of 5 ft to 30 ft (1.5 m to 9.2 m), depending on fire extinguisher size. When used on outdoor fires, maximum effectiveness can be achieved when the direction of the wind is on the back of the operator. *[See Figure D.4.5(a) and Figure D.4.5(b).]*

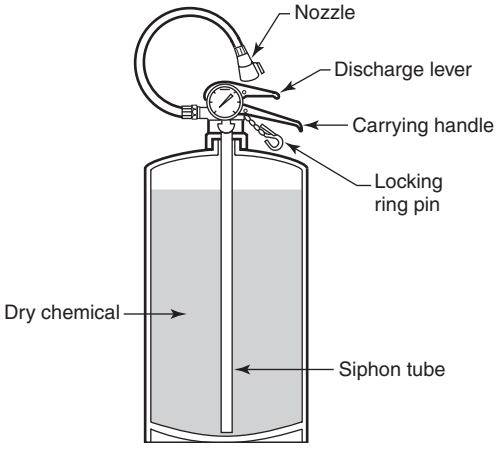


FIGURE D.4.5(a) Stored-pressure Dry Chemical Extinguisher.

Special long-range nozzles are available where potential fire-fighting conditions could require greater distance. These nozzles are also useful on pressurized gas or liquid fires, or where strong winds prevail. All dry chemical agents can be used at the same time that water (straight stream or fog) is being applied. The use of dry chemical fire extinguishers on wet energized electrical equipment (such as rain-soaked utility poles, high-voltage switch gear, and transformers) can aggravate electrical leakage problems. The dry chemical, in combination with moisture, provides an electrical path that can reduce the effectiveness of insulation protection. The removal of all traces of dry chemical from such equipment after extinguishment is recommended. *[See Figure D.4.5(c).]*

Fire extinguishers with a Class B rating can extinguish a fire involving combustible cooking media (vegetable or animal oils and fats). Only fire extinguishers having a Class K rating are recommended for use on cooking-grease fires.

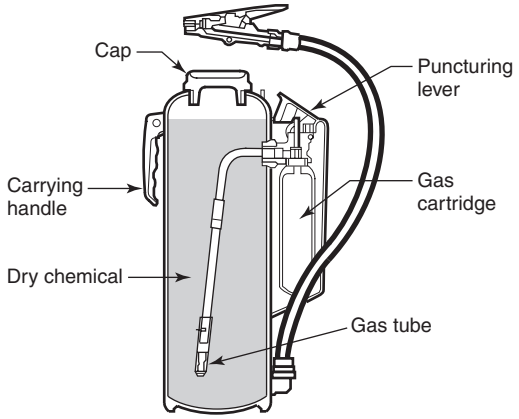


FIGURE D.4.5(b) Cartridge-operated Dry Chemical Extinguisher.

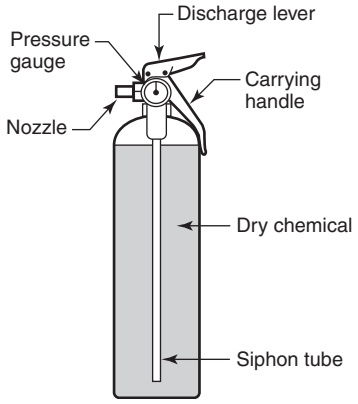


FIGURE D.4.5(c) Stored-pressure Dry Chemical with Fixed Nozzle.

D.4.5.1 Ordinary Dry Chemical Extinguishers (Class B and Class C Fires). Hand fire extinguishers of this type are available with fire-extinguishing ratings of 1-B:C to 160-B:C and wheeled models having fire extinguishment ratings from 80-B:C to 640-B:C. The fire extinguishing agent used is a specially treated material in a finely divided form. Types of agents available include sodium bicarbonate base, potassium bicarbonate base, potassium chloride base, or potassium bicarbonate urea base. Some formulations of these agents are specially treated to be relatively compatible for use with air foam (mechanical foam). For use on flammable liquid fires, the stream should be directed at the base of the flame. Best results are generally obtained by attacking the near edge of the fire and progressing toward the back of the fire by moving the nozzle rapidly with a side-to-side sweeping motion. Care should also be taken not to direct the initial discharge directly at the burning surface at close range [less than 5 ft to 8 ft (1.5 m to 2.4 m)] because the high velocity of the stream can cause splashing or scattering of the burning material, or both. Although not listed for use on Class A fires, ordinary dry chemical can be used to rapidly knock down the flames. Once the flames are extinguished, the operator can kick or poke apart the fire debris. This will assist and hasten the natural cooling of the burning embers. Hot spots or small areas that reignite can be con-

trolled with short intermittent bursts of agent. Water should then be applied to extinguish burning embers or deep-seated hot spots. It is recommended that this method of extinguishment be attempted only if the operator has had training and previous experience in this technique.

Fire extinguishers with a Class B rating can extinguish a fire involving combustible cooking media (vegetable or animal oils and fats). Only fire extinguishers having a Class K rating are recommended for use on cooking-grease fires.

D.4.5.2 Multipurpose Dry Chemical Extinguishers (Class A, Class B, and Class C Fires). Fire extinguishers of this type contain an ammonium phosphate base agent. Hand fire extinguishers are available with fire extinguishment ratings of 1-A to 20-A and 10-B:C to 120-B:C and wheeled models with fire extinguishment ratings of 20-A to 40-A and 60-B:C to 320-B:C. Multipurpose agents are used in exactly the same manner as ordinary dry chemical agents on Class B fires. For use on Class A fires, the multipurpose agent has the additional characteristic of softening and sticking when in contact with hot surfaces. In this way, it can adhere to burning materials and form a coating that will smother and isolate the fuel from air. When applying the agent, it is important to try to coat all burning areas in order to eliminate or minimize the number of small embers that could be a potential source of reignition. The agent itself has little cooling effect and, because of its surface coating characteristic, it cannot penetrate below the burning surface. For this reason, extinguishment of deep-seated fires could possibly not be accomplished unless the agent is discharged below the surface or the material is broken apart and spread out.

Fire extinguishers with a Class B rating can extinguish a fire involving combustible cooking media (vegetable or animal oils and fats). Only fire extinguishers having a Class K rating are recommended for use on cooking-grease fires.

D.4.6 Dry Powder Types. These fire extinguishers and agents are intended for use on Class D fires and specific metals, following special techniques and manufacturer's recommendations for use. The extinguishing agent can be applied from a fire extinguisher or by scoop and shovel. The technique of applying the agent to the fire could vary with the type and form of the agent and combustible metal. The application of the agent should be of sufficient depth to cover the fire area adequately and provide a smothering blanket. Additional applications can be necessary to cover any hot spots that could develop. The material should be left undisturbed until the mass has cooled before disposal is attempted. Care should be taken to avoid scattering the burning metal. Fires in finely divided combustible metal or combustible metal-alloy scrap that is moist, wet with water or water-soluble machine lubricants, or on water-wetted surfaces, is likely to burn rapidly and violently. They can even be of an explosive nature. They can develop so much heat that they cannot be approached closely enough to permit proper application of the extinguishing medium. Where the burning metal is on a combustible surface, the fire should be covered with dry powder, then a 1 in. or 2 in. (25.4 mm or 51 mm) layer of powder should be spread out nearby and the burning metal shoveled into this layer, with more dry powder added as needed.

D.4.6.1 Dry Powder Extinguisher. Dry powder fire extinguishers are available in a hand portable, 30 lb (14 kg) cartridge-operated model and 150 lb (68 kg) and 350 lb (159 kg) cylinder-operated wheeled models. Stored-pressure dry powder fire extinguishers with an extension wand applicator are available in a 30 lb (14 kg) model. The extinguishing agent is composed of sodium chloride, with additives to render it free flowing in order to cause it to form a crust over the fire. A thermoplastic material is added to bind the sodium chloride particles into a solid mass when applied on burning metals. Other specialized dry powder agents are available for use in fighting specific types of metal fires. With the nozzle fully opened, the hand portable models have a range of 6 ft to 8 ft (1.8 m to 2.4 m). The method of agent application depends on the type of metal, the quantity that is burning, and its physical form. In the case of a very hot fire, initial discharge should be started at maximum range with the nozzle fully opened. Once control is established, the nozzle valve should be partially closed to produce a soft, heavy flow so that complete coverage can be accomplished safely at close range. The nozzle is designed so that the operator can throttle or reduce the rate and force of the agent discharge. Since combustible metal fires can produce complex and difficult fire-fighting conditions, it is advisable to get specific details on equipment use from the manufacturer. *[See Figure D.4.6.1(a) and Figure D.4.6.1(b).]*

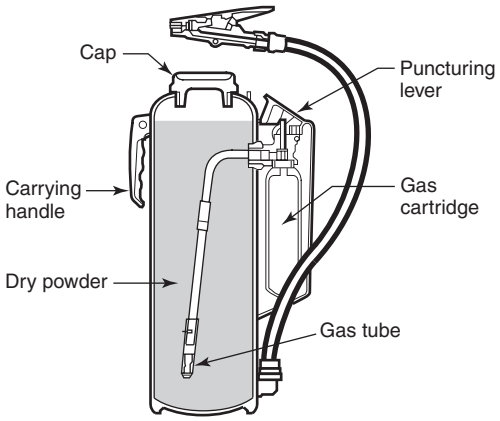


FIGURE D.4.6.1(a) Cartridge-operated Dry Powder Extinguisher.

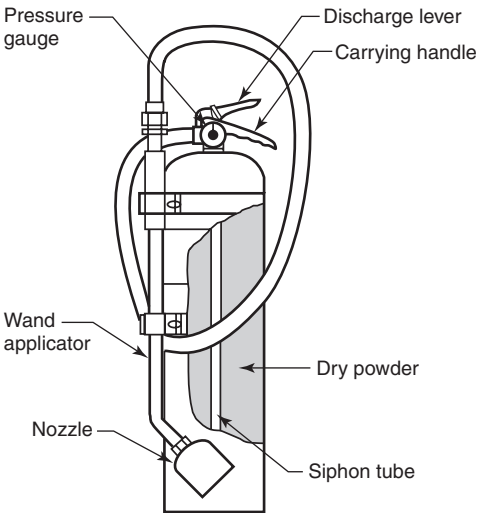


FIGURE D.4.6.1(b) Stored-pressure Dry Powder Extinguisher with Wand Applicator.

D.4.6.2 Bulk Dry Powder Agent. In bulk form, dry powder extinguishing agents are available in 40 lb and 50 lb (18 kg and 23 kg) pails and 350 lb (159 kg) drums. In addition to the sodium chloride base agent, a dry powder material called G-1 is also available. This material consists of graded, granular graphite to which compounds containing phosphorus are added, improving its fire-extinguishing effectiveness. Whereas the sodium chloride can be used in a dry powder fire extinguisher or applied by shovel or hand scoop, the G-1 agent needs to be applied to the fire by hand. When G-1 is applied to a metal fire, the heat of the fire causes the phosphorus compounds to generate vapors that blanket the fire and prevent air from reaching the burning metal. The graphite, being a good conductor of heat, cools the metal to below the ignition point. Each extinguishing agent is listed for use on the specific combustible metal fires for which it has been found acceptable, as determined by individual investigations. Such information, together with the recommended method of application limitations, is given on the agent container. It is important to note that dry powder extinguishing agents should not be confused with dry chemical extinguishing agents. *(See D.4.5.)*

D.4.7 Wet Chemical Extinguisher. Fire extinguishers of this type are available in hand portable models of 1.5 gal (6 L) and 2½ gal (9.46 L). The extinguishing agent can be comprised of, but is not limited to, solutions of water and potassium acetate, potassium carbonate, potassium citrate, or a combination of the aforementioned chemicals (which are conductors of electricity). The liquid agent typically has a pH of 9.0 or less. On Class A fires, the agent works as a coolant. On Class K fires (cooking-oil fires), the agent forms a foam blanket to prevent reignition. The water content of the agent aids in cooling and reducing the temperature of the hot oils and fats below their autoignition point. The agent, when discharged as a fine spray directly at cooking appliances, reduces the possibility of splashing hot grease and does not present a shock hazard to the operator.

In recent years, the development of high-efficiency cooking equipment with high-energy input rates and the widespread use of vegetable oils with high autoignition temperatures has highlighted the need for a new Class K fire extinguisher. The wet chemical extinguisher was the first extinguisher to qualify to the new Class K requirements.

In addition to offering rapid fire extinguishment, a thick foam blanket is formed to prevent reignition while cooling both the appliance and the hot cooking oil. Wet chemical extinguishers also offer improved visibility during fire fighting as well as minimizing clean-up afterwards. *(See Figure D.4.7(a) and Figure D.4.7(b).)*

D.4.8 Water Mist Extinguisher. Fire extinguishers of this type are available in 2.5 gal (9.5 L) and 1.75 gal (6.6 L) sizes. They have ratings of 2A:C. The agent is limited to distilled water, which is discharged as a fine spray. In addition to being used as a regular water extinguisher, water mist extinguishers are used where contaminants in unregulated water sources can cause excessive damage to personnel or equipment. Typical applications include operating rooms, museums, and book collections. *(See Figure D.4.8)*

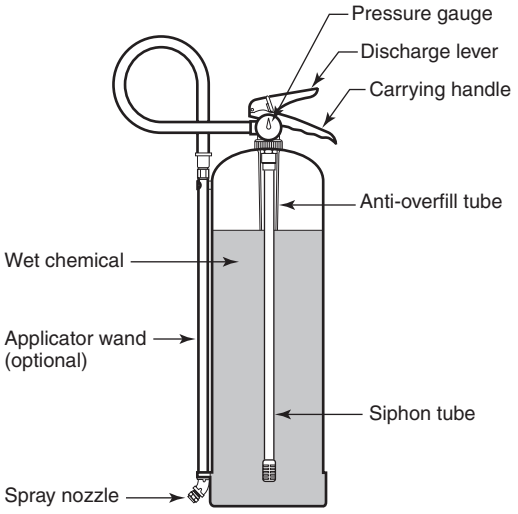


FIGURE D.4.7(a) Wet Chemical Extinguisher with Wand.

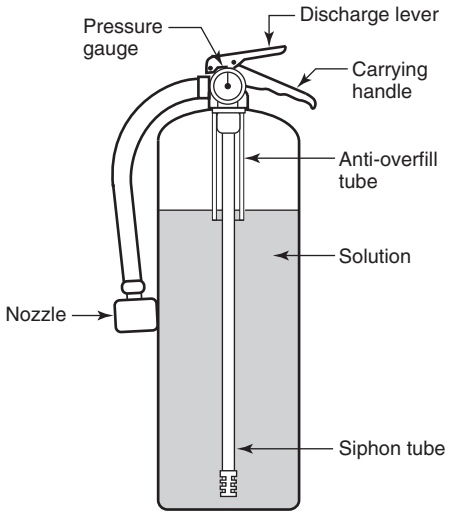


FIGURE D.4.7(b) Wet Chemical Extinguisher.

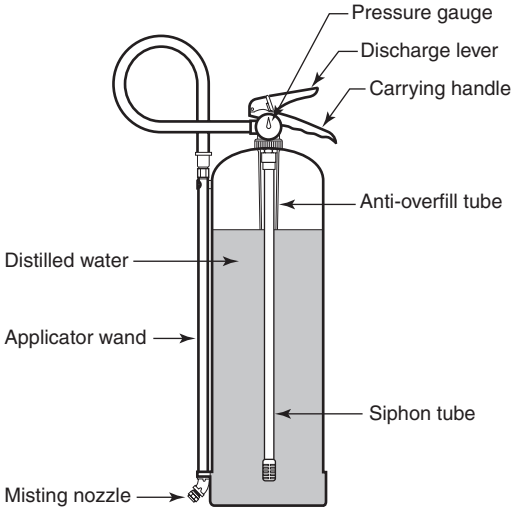


FIGURE D.4.8 Water Mist Extinguisher.

Annex E Distribution

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

E.1 Distribution of Fire Extinguishers.

E.1.1 Portable fire extinguishers are most effectively utilized when they are readily available in sufficient number and with adequate extinguishing capacity for use by persons familiar with their operation.

E.1.2 In fire emergencies where fire extinguishers are relied upon, someone usually has to travel from the fire in order to obtain the device, and then return to the fire before beginning extinguishing operations. This takes time, with the number of seconds or minutes governed mainly by the travel distance involved in securing the fire extinguisher and placing it in operation.

E.1.3 Sometimes fire extinguishers are purposely kept nearby (as in welding operations); however, since a fire outbreak usually cannot be prejudged as to location, fire extinguishers are more often strategically positioned throughout areas.

E.1.4 Travel distance is not merely a simple circle radius matter, but is the actual distance the user of the fire extinguisher will need to walk. Consequently, travel distance will be affected by partitions, location of doorways, aisles, piles of stored materials, machinery, and so forth.

E.2 Arrangement in a Building. The actual placement of fire extinguishers can best be accomplished through a physical survey of the area to be protected. In general, selected locations should have the following characteristics:

(1) Provide uniform distribution
(2) Provide easy accessibility
(3) Be relatively free from blocking by storage and equipment, or both
(4) Be near normal paths of travel
(5) Be near entrance and exit doors
(6) Be free from the potential of physical damage
(7) Be readily visible
(8) Be installed on a floor-by-floor basis

E.3 Class A Fire Extinguisher Distribution.

E.3.1 Table 5.2.1 is a guideline for determining the minimum number and rating of fire extinguishers for Class A fire protection needs in accordance with the occupancy hazard. In certain instances, through a fire protection analysis of specific areas, process hazards, or building configurations, fire extinguishers with higher ratings can be required. This does not mean, however, that the recommended maximum travel distances can be exceeded.

E.3.2 Where the floor area of a building is less than 3000 ft^2 (279 m^2), at least one fire extinguisher of the minimum size recommended should be provided.

The first step in calculating Class A fire extinguisher needs is to determine the proper class of occupancy (light, ordinary, or extra hazard). Depending on the rating of the fire extinguisher (1-A to 40-A), the maximum area that it will protect can be determined. For example, each 2½ gal (9.46 L) stored-pressure water fire extinguisher (rated 2-A) will protect an area of 3000 ft^2 (279 m^2) in an ordinary hazard occupancy. The requirements in Table 5.2.1 also specify that the travel distance (actual walking distance) from any point to the nearest fire extinguisher shall not exceed 75 ft (22.7 m). It is necessary to select fire extinguishers that fulfill both the distribution and travel distance requirements for a particular occupancy classification.

E.3.3 If a building floor area were unobstructed and circular in shape with a radius of 75 ft (22.7 m), it would be possible to place one fire extinguisher at the center without exceeding the 75 ft (22.7 m) travel distance. In that case, an area of 17,700 ft^2 (1644 m^2) could be assigned to one fire extinguisher of adequate A rating; for example, light hazard, 6-A; ordinary hazard, 20-A (no 12-A fire extinguisher ratings); extra hazard, 20-A (no 18-A fire extinguisher ratings). However, as buildings are usually rectangular in shape, the largest square area that can be formed with no point more than 75 ft (22.7 m) from the center is 11,250 ft^2 (1045 m^2), which is the area of a square [106 ft × 106 ft (32 m × 32 m)] inscribed within a 75 ft (22.7 m) radius circle. *(See Figure E.3.3.)*

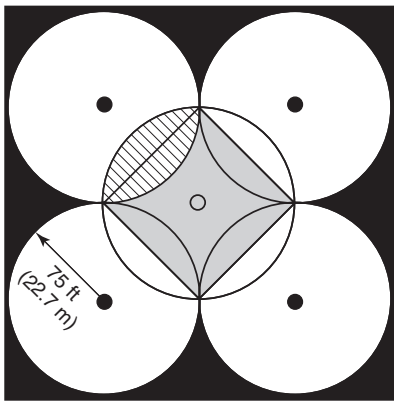


FIGURE E.3.3 Maximum Area [11,250 ft^2 (1045 m^2)] That an Extinguisher Can Protect within the Limits of the 75 ft (22.7 m) Radius (shown by gray shading).

E.3.4 The following examples of distribution illustrate the number and placement of fire extinguishers according to occupancy type and rating. The sample building is 150 ft × 450 ft (46 m × 137 m), giving a floor area of 67,500 ft^2 (6271 m^2). Although several different ways of placing fire extinguishers are given, a number of other locations could have been used with comparable results.

The area that can be protected by one fire extinguisher with a given A rating is shown in Table E.3.4. These values are determined by multiplying the maximum floor area per unit of A shown in Table 5.2.1 by the various A ratings, until a value of 11,250 ft^2(1045 m^2) is exceeded.

E.3.5 The first example demonstrates placement at the maximum protection area limits [11,250 ft^2 (1045 m^2)] allowed in Table 5.2.1 for each class of occupancy. Installing fire extinguishers with higher ratings will not affect distribution or placement.

Example 1:

$$\frac{67{,}500\ ft^2}{11{,}250\ ft^2} = 6 \begin{cases} \text{4-A extinguishers for light hazard occupancy} \\ \text{10-A extinguishers for ordinary hazard occupancy} \\ \text{20-A extinguishers for extra hazard occupancy} \end{cases}$$

Table E.3.4 Maximum Area to Be Protected per Extinguisher in Square Feet

Class A Rating Shown on Extinguisher	Light (Low) Hazard Occupancy	Ordinary (Moderate) Hazard Occupancy	Extra (High) Hazard Occupancy
1A	—	—	—
2A	6,000	3,000	—
3A	9,000	4,500	—
4A	11,250	6,000	4,000
6A	11,250	9,000	6,000
10A	11,250	11,250	10,000
20A	11,250	11,250	11,250
30A	11,250	11,250	11,250
40A	11,250	11,250	11,250

For SI unit: 1 ft^2 = 0.0929 m^2
Note: 11,250 ft^2 is considered a practical limit.

E.3.6 This placement, along outside walls, would not be acceptable because the travel distance rule is clearly violated. In Figure E.3.6, relocation or additional fire extinguishers, or both, are needed. The shaded areas indicate "voids" that are farther than 75 ft (227 m) to the nearest extinguisher. The dots represent extinguishers.

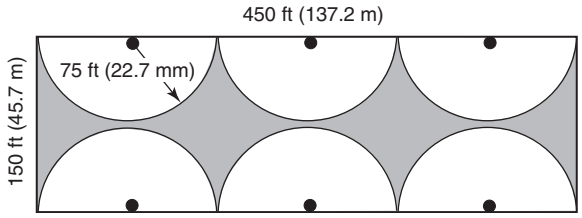


FIGURE E.3.6 A Diagrammatic Representation of Extinguishers Located along the Outside Walls of a 450 ft × 150 ft (137 m × 46 m) Building.

E.3.7 Example 2 is for fire extinguishers having ratings that correspond to protection areas of 6000 ft^2 (557 m^2). Example 3 is for extinguishers having the minimum ratings permitted by Table 5.2.1 with corresponding minimum protection areas. As the number of lower-rated extinguishers increases, meeting the travel distance requirement generally becomes less of a problem.

Example 2:

$$\frac{67{,}500\ ft^2}{6000\ ft^2} = 12 \begin{cases} \text{2-A extinguishers for light hazard occupancy} \\ \text{4-A extinguishers for ordinary hazard occupancy} \\ \text{6-A extinguishers for extra hazard occupancy} \end{cases}$$

E.3.8 Fire extinguishers could be mounted on exterior walls or, as shown in Figure E.3.8, on building columns or interior walls, and conform to both distribution and travel distance rules.

E.3.9 This arrangement, illustrated in Figure E.3.9, shows fire extinguishers grouped together on building columns or interior walls in a manner that still conforms to distribution and travel distance rules.

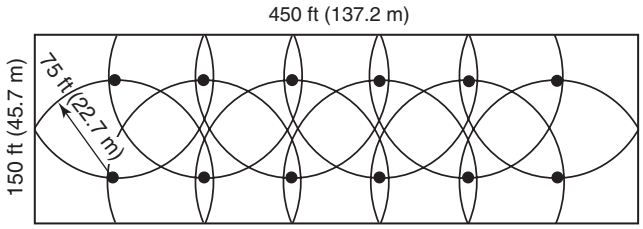


FIGURE E.3.8 Configuration Representing 12 Fire Extinguishers Mounted on Building Columns or Interior Walls, in Which Requirements for Both Travel Distance and Fire Extinguisher Distribution Are Met.

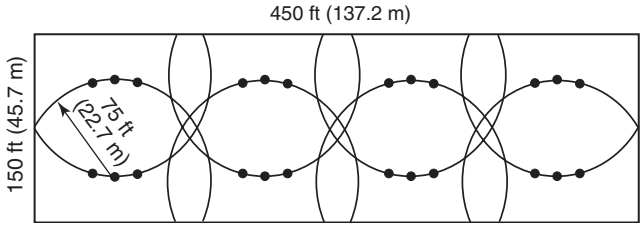


FIGURE E.3.9 Fire Extinguishers Grouped Together.

Example 3:

$$\frac{67{,}500\ ft^2}{6000\ ft^2} = 12 \text{ 2-A extinguishers for ordinary hazard occupancy}$$

$$\frac{67{,}500\ ft^2}{3000\ ft^2} = 23 \text{ 2-A extinguishers for ordinary hazard occupancy}$$

$$\frac{67{,}500\ ft^2}{4000\ ft^2} = 17 \text{ 4-A extinguishers for extra hazard occupancy}$$

E.4 Class B Fire Extinguisher Distribution.

E.4.1 Normal Class B fire hazards fall into two quite different general categories regarding requirements for fire extinguishers. One condition is where the fire does not involve flammable liquids in appreciable depth, such as spilled fuel on an open surface, a fire involving vapors issuing from a container or piping system, or a running fire from a broken container.

E.4.2 The other condition is where the fire involves flammable liquids in appreciable depth [defined as a depth of liquid greater than ¼ in. (6.3 mm)], such as fires involving open tanks of flammable liquids commonly found in industrial plants (dip tanks used for coating, finishing, treating, or similar processes).

E.4.3 In situations where flammable liquids are not in appreciable depth, fire extinguishers should be provided according to Table 5.3.1. Once the type of hazard is determined, the selected Class B fire extinguisher should have a rating equal to or greater than that specified, and be so located that the maximum travel distance is not exceeded.

E.4.4 The reason the basic maximum travel distance to Class B fire extinguishers is 50 ft (15.25 m), as opposed to 75 ft (22.7 m) for Class A fire extinguishers, is that flammable liquid fires reach their maximum intensity almost immediately. It is imperative that the fire extinguisher be brought to the fire in a much shorter period of time than allowed for a slower developing Class A fire.

E.4.5 Even though Table 5.3.1 specifies maximum travel distances for Class B fire extinguisher placement, judgment should be exercised in actually establishing them. The fire extinguisher can be placed closer to the hazard it is protecting, up to a point where the fire extinguisher itself might be involved in the fire or access to it made difficult because of flame, heat, or smoke.

E.4.6 Where an entire room or area is judged to be a Class B hazard (such as an automobile repair garage), fire extinguishers should be placed at regular intervals so that the maximum walking distance from any point to the nearest fire extinguisher does not exceed the travel distances specified in Table 5.3.1.

For fires in flammable liquids of appreciable depth, a Class B fire extinguisher is provided on the basis of two numerical units of Class B extinguishing potential per 1 ft^2 (0.0929 m^2) of flammable liquid surface for the largest tank within the area. The travel distance requirements in Table 5.3.1 should also be used to locate fire extinguishers for spot hazard protection; however, the type of hazard and the availability of the fire extinguisher should be carefully evaluated.

E.4.7 One fire extinguisher can be installed to provide protection against several hazards, provided travel distances are not exceeded. Where hazards are scattered or widely separated and travel distances are exceeded, then individual protection should be installed according to the square foot rule.

E.4.8 When fixed Class B extinguishing systems are installed, the provision of portable fire extinguishers can be waived for that one hazard, but not for the structure, other special hazards, or the rest of the contents. Sometimes a burning tank can result in burning liquid spills outside the range of the fixed equipment, or the fire could originate adjacent to the tank rather than in its liquid content. Therefore, having portable fire extinguishers available is desirable, even though hazards of this type are protected with fixed extinguishing systems.

E.4.9 The selection of the proper type and size of Class B fire extinguishers for fires in pressurized fuels is made on the basis of the recommendations of the manufacturers of this specialized equipment available for that type of hazard. Special nozzle design and rates of agent application are necessary in order to be able to cope with hazards of this magnitude. Also, it is generally undesirable to attempt to extinguish pressurized fuel fires unless there is reasonable assurance that the source of fuel can be shut off promptly, thus avoiding a possible explosion. The travel distances for hand portable fire extinguishers should not exceed those specified in Table 5.3.1.

E.4.10 Only Class K fire extinguishers are recommended for cooking-grease fires. Maximum travel distance is 30 ft (9.1 m) as defined in 5.7.2.

E.5 Class C Fire Extinguisher Distribution.

E.5.1 To protect fire extinguisher operators in situations where live electrical equipment could be encountered, fire extinguishers with Class C ratings are required.

E.5.2 When the power to a piece of electrical equipment is cut off, the fire changes character to that of a Class A, Class B, or a combined Class A and B fire, depending on the nature of the burning electrical components and any material burning in the immediate vicinity.

E.5.3 De-energizing electrical equipment eliminates the possibility of shock hazards to the fire extinguisher operator if the operator accidentally comes into physical contact with the equipment, or if the operator brings any conductive part of a fire extinguisher within arcing distance. De-energizing also eliminates fault currents from prolonging the fire or from being a source of reignition. Switches or circuit breakers that cut electric power to specific equipment can prevent hazardous side effects (e.g., plunging an entire multistory building into darkness or shutting down the essential electric power that supplies life support equipment). Often, fires involving an electrical component are relatively minor and, by a short application of a Class C extinguishant, can be effectively extinguished without disturbing electrical continuity.

E.5.4 The capacity of the fire extinguishers supplied for each major Class C hazard situation should be individually judged according to the following factors:

(1) Size of the electrical equipment
(2) Configuration of the electrical equipment (particularly the enclosures of units) that influences agent distribution
(3) Effective range of the fire extinguisher stream
(4) Amount of Class A and B material involved

Each of these factors influences the amount and type of agent needed, the desired rate of agent discharge, the associated duration of application, and the potential wastage factors.

E.5.5 For large installations of electrical apparatus where the power continuity is critical, fixed fire protection is desirable. At locations where such fixed systems are installed, it is practical to also provide Class C portable fire extinguisher units to handle quickly discovered fires: obviously, the number and size of these units can be reduced under such conditions.

E.6 Class D Fire Extinguisher Distribution.

E.6.1 For Class D hazards, the availability of special portable fire extinguishers (or equivalent equipment to contain or extinguish any fire developing in a combustible metal) is particularly important. Extinguishing equipment for such fires should be located no more than 75 ft (22.7 m) from the hazard.

E.6.2 Use of the wrong fire extinguisher can instantly increase or spread the fire. Quantitatively, the amount of agent needed is normally measured by the surface area of combustible metals that might become involved, plus the potential severity of the fire as influenced by the shape and form of the metal. Because fires in magnesium fines are more difficult to extinguish than fires involving magnesium scrap, the amount of agent needed to handle fires in magnesium fines is correspondingly greater. Fire extinguishers labeled for Class D fires are not necessarily equally effective on all combustible metal fires. Often, fire extinguishers so labeled might be hazardous when used on some metal fires. Unless the effect of the extinguishing agent is known for the metal being considered, tests should be made with representative material.

E.7 Sample Problem. A light-occupancy office building is to be protected by portable fire extinguishers. The floor area is 11,100 ft^2 (1031 m^2) and of unusual design. *(See Figure E.7.)*

The most common fire extinguisher selections would be 2½ gal (9.46 L) stored-pressure water models rated 2-A. According to Table 5.2.1 and Table E.3.4, two fire extinguishers are needed (11,100 ÷ 6000 = 2). Travel distance requirements are 75 ft (22.7 m) maximum.

The two units are placed at points 1 and 2, and a check is made on the travel distance requirement. Because of the area's

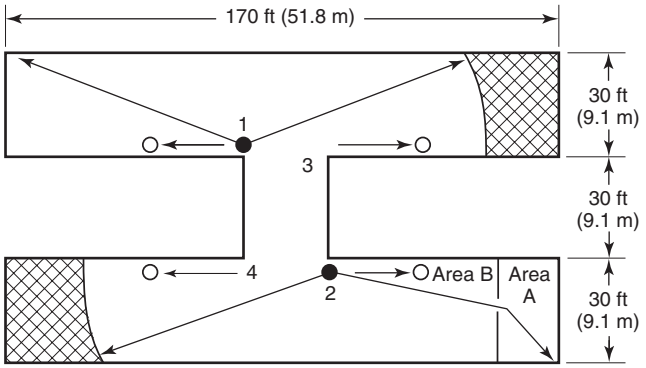


FIGURE E.7 Floor Plan.

unusual shape, it is found that the shaded areas exceed the 75 ft (22.7 m) distance. Two additional fire extinguishers (at points 3 and 4) are needed. The additional fire extinguishers afford more flexibility in placement, and alternate locations are indicated. It is important to consider any partitions, walls, or other obstructions in determining the travel distance.

As an additional item, consider that Area A contains a small printing and duplicating department that uses flammable liquids. This area is judged to be an ordinary Class B hazard. A 10-B:C or 20-B:C fire extinguisher should be specified to protect this area.

There are now two alternatives to be considered. First, a fifth fire extinguisher, either carbon dioxide or ordinary dry chemical, with a rating of 10-B:C or 20-B:C could be specified. Second, the water fire extinguisher at point 2 could be replaced with a multipurpose dry chemical fire extinguisher that has a rating of at least 2-A:10-B:C. It should be located near point B, keeping in mind the 75 ft (22.7 m) travel distance for the 2-A protection and the 30 ft or 50 ft (9.25 m or 15.25 m) travel distance required for the Class B protection that this fire extinguisher provides.

Annex F Selection of Home Fire-Extinguishing Equipment

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

F.1 The provisions of this annex section apply to the selection, installation, and maintenance of fire-extinguishing equipment for one- and two-family dwellings and living units within multifamily structures. The fire-extinguishing equipment is intended as a first line of defense to cope with fires of limited size. This equipment is needed even though the dwelling or living unit is protected by an automatic sprinkler system; fire or smoke alarm systems, or both; single station smoke detectors; or other fixed fire suppression or detection systems. The recommendations given herein are minimum. Depending upon the conditions existing in each living unit, additional extinguishers or extinguishers of larger capacity might be advisable.

For more information on automatic sprinkler systems for the home, see NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, and NFPA 13R, *Standard for Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height*. For more information about fire or smoke alarm systems, or both, and single station smoke detectors, see *NFPA 72®*, *National Fire Alarm Code®*.

The purpose of this annex is to provide guidance for the owners and occupants of one- and two-family dwellings and living units within multifamily structures in selection, use, installation, and maintenance of fire-extinguishing equipment.

F.2 General Recommendations. Selection of a fire extinguisher for home use should be made with the understanding of an extinguisher's capacity (or its rating) along with the potential fire hazards in the home. Depending on the conditions existing in each living unit, additional extinguishers or extinguishers of larger capacity might be advisable.

The following are minimum recommendations per floor level:

(1) A single extinguisher rated 2-A:10-B:C or higher
(2) One extinguisher rated 2-A or higher, and a second extinguisher rated 10-B:C or higher

F.2.1 Extinguishers installed in the home should meet the requirements of Section 1.4.

F.2.2 Attached Garages. One extinguisher rated 2-A:10-B:C or higher should be provided to protect an attached garage that is under the home or connected to the home by a common wall.

F.2.3 Detached Garages. Where provided, extinguishers for detached garages should have a rating of 2-A:10-B:C or higher.

F.2.4 Due to the volume of flammable liquids normally present in garages (those liquids associated with automobiles, lawn mowers, snow blowers, workshops, etc.), a larger extinguisher than that meeting the minimum recommendations should be specifically installed for protection.

F.3 Fire Extinguisher Types.

F.3.1 The following types of fire extinguishers are recommended for installation and use in family dwellings and living units:

(1) Dry chemical
(2) Water, AFFF, FFFP, antifreeze, wetting agent
(3) Halogenated agent
(4) Carbon dioxide

F.3.2 The following types of extinguishers are considered obsolete and should be removed from service and replaced:

(1) Soda acid types
(2) Chemical foam (excluding film-forming agents)
(3) Vaporizing liquid
(4) Cartridge-operated water
(5) Cartridge-operated loaded stream
(6) Copper or brass shell fire extinguishers (excluding pump tanks) joined by soft solder or rivets
(7) Extinguishers rated prior to 1955 and marked B-1,C-1 on the nameplate
(8) Fire extinguishers not listed or labeled

F.4 Application for Specific Hazards.

F.4.1 Combustible Cooking Media Fires. Combustible cooking media fires require the use of extinguishers that will extinguish the fire from a safe distance, without causing splashing of the burning grease or permitting reignition of the fire. This can be achieved by a special purpose home fire extinguisher listed for residential grease fires or an automatic fire extinguisher unit listed for residential range top protection. An

ABC dry chemical extinguisher is not the extinguisher of choice because of the possibility of reignition. Other agents can have limited effectiveness. Water, AFFF, or FFFP can cause dangerous splashing of burning grease and can cause fire to spread.

WARNING: Do not attempt to pick up a pot or pan containing burning grease! To avoid personal injury and to avoid spreading the fire, fight the fire in place. Shut off the heat source as soon as it is safe to do so to avoid fire reflash.

F.4.2 Electronic Equipment Fires. Where provided, extinguishers for the protection of delicate electronic equipment, such as TVs, computers, and stereos, should have a 1-B:C rating or higher and should be of the carbon dioxide or halogenated agent types.

F.4.3 An automatic residential fire extinguisher unit is designed and listed for the protection of a specific hazard. It should only be utilized in accordance with the manufacturer's specifications.

F.4.4 Due to the volume of flammable liquids normally present in garages (those liquids associated with automobiles, lawn mowers, snow blowers, workshops, etc.), a larger extinguisher than those meeting the minimum recommendations should be specifically installed for protection.

F.5 Extinguishing Equipment Guidelines.

F.5.1 Minimum Placement. A minimum of one portable fire extinguisher, meeting the general recommendations of Section F.1, should be provided per floor level of a living unit, with a maximum of 40 ft (12 m) of travel distance to the equipment.

F.5.2 Installation. Before installing any fire-extinguishing equipment, read and understand the installation and use instructions, including the limitations, cautions, and warnings contained on the equipment and in the owner's manual.

F.5.2.1 Portable fire extinguishers should be installed as follows:

(1) In an accessible spot, free from blocking by storage and equipment, and near room exits that provide an escape route
(2) So that the top of the extinguisher is not more than 5 ft (1.5 m) above the floor and not less than 4 in. (101.6 mm) above the floor; the extinguisher should be easy to reach and remove and should be placed where it will not be damaged
(3) On hangers or in the brackets supplied by the manufacturer, mounted in cabinets, or placed on shelves
(4) Placed so that the operating instructions on the extinguisher face outward

F.5.3 Safety Precautions. For personal safety, observe the following precautions for locating and using a fire extinguisher:

(1) Most fires produce toxic decomposition products of combustion, and some materials can produce highly toxic gases. Fires can also consume available oxygen or produce dangerously high exposure to convected or radiated heat. All of these can affect the degree to which a fire can be safely approached with extinguishing equipment.
(2) Discharging portable fire extinguishers from too close a distance on cooking grease fires can cause splashing of the burning grease or oil and spread the fire. The recommended distance for operating portable fire extinguishers is shown on the label. *(See F.4.1.)*
(3) Portable fire extinguishers should not be installed adjacent to the location of a potential fire hazard but should be accessible to the hazard.
(4) Halogenated agent extinguisher labels contain information such as the minimum volume of room that can be properly and safely protected. When using these extinguishers, avoid breathing the discharged agent or the gases produced by the thermal decomposition of the agent. Evacuate and ventilate the area immediately after use.
(5) The use of a carbon dioxide extinguisher(s) in an unventilated space can dilute the oxygen supply. Prolonged occupancy of such spaces can result in loss of consciousness due to oxygen deficiency.
(6) Extinguishers not classified for Class C hazards present a shock hazard if used on fires involving energized electrical equipment.
(7) Dry chemical extinguishers, when used in a small unventilated area, can reduce visibility for a period of up to several minutes.

If similar flammable liquids are kept in partially open carports, an extinguisher of this type should also be provided.

F.5.4 Procedures Following the Use of Fire Extinguishers. For personal safety and proper operation, it is essential that the instructions on the extinguisher label and contained in the manual be followed. It is also essential that once the extinguisher is used, it be refilled or replaced promptly. Even if only a short burst of agent is released, the extinguisher can lose the rest of its pressure.

F.6 Inspection, Maintenance, and Servicing of Home Fire-Extinguishing Equipment.

F.6.1 General.

F.6.1.1 This section is concerned with the inspection, maintenance, and servicing of fire extinguishers.

F.6.1.2 The homeowner or occupant is responsible for ensuring that inspection, maintenance, and servicing of fire extinguishers is performed in a timely manner by competent individuals.

F.6.2 Inspections.

F.6.2.1 Inspections should be performed when the fire extinguisher is initially placed in service and thereafter at approximately 30-day intervals. Inspections should be performed in accordance with the owner's manual supplied with the fire extinguisher.

F.6.2.2 Inspection procedures should include a check of at least the following:

(1) The equipment is in its designated place, and its operating instructions face outward.
(2) Access to the fire extinguisher is not obstructed.
(3) Operating instructions are legible.
(4) Any seals or tamper indicators are not broken, missing, or in need of replacement.
(5) Pressure gauge or indicating devices, if provided, are in the operable range or position.
(6) There is no evidence of corrosion or physical damage.

F.6.2.3 If the inspection of the fire extinguisher reveals any deficiency under F.6.2.2(1) and (2), immediate corrective action should be taken by the homeowner or occupant. Deficiencies related to F.6.2.2(3) through (6) indicate the need for immediate maintenance and servicing.

F.6.3 Maintenance and Servicing.

F.6.3.1 Maintenance and servicing of fire extinguishers should be performed by fire extinguisher servicing companies that have the proper tools, recharge materials, lubricants, manufacturer's servicing instructions, and replacement parts.

F.6.3.2 Manufacturer's instructions specify servicing of rechargeable fire extinguishers after any use. The frequency of internal maintenance and hydrostatic testing is specified in the owner's manual and in Table F.6.3.2.

Table F.6.3.2 Frequency of Internal Maintenance and Hydrostatic Testing of Fire Extinguishers in Years

Type of Extinguisher	Internal Maintenance Interval	Hydrostatic Testing Interval
Dry chemical*	6	12
Water, AFFF, FFFP, antifreeze	5	5
Halogenated agent†	6	12
Carbon dioxide	5	5

*Nonrechargeable dry chemical extinguishers do not require a 6-year internal inspection but should be removed from service 12 years after the date of manufacture.

†Nonrechargeable halogenated agent extinguishers do not require an internal inspection but should be removed from service 12 years from the date of manufacture. The extinguishers should be returned to the manufacturer or the manufacturer's designated agent for reclaiming of the halogenated agent.

F.7 General Recommendations.

F.7.1 Fire Extinguishers.

F.7.1.1 Fire extinguishers should be maintained in a fully charged and operable condition and kept in their designated places at all times when they are not being used.

F.7.1.2 Inverting-type fire extinguishers are not recommended and should be removed from service.

F.7.2 Owner's Manual. An owner's manual is provided by the manufacturer of listed equipment, giving instructions and cautions necessary to the installation, operation, inspection, maintenance, and disposal or recharging of the fire extinguisher(s). The manual refers to this standard, as appropriate, as a source of detailed instructions. The manual should be read carefully and kept in a convenient place for future reference.

F.7.3 Principles of Fire Extinguishment. Many fires are small at origin and can be extinguished by the use of fire extinguishers or small hose streams. The fire department should be notified as soon as a fire is discovered. This alarm should not be delayed by awaiting the results of application of residential fire-extinguishing equipment.

Portable fire-extinguishing equipment can represent an important segment of a residential fire protection program. If a fire starts in your residence, get people out of the house and call the fire department; then use a fire extinguisher. These rules should be followed when fighting a residential fire:

(1) Keep near a door that can be used as an escape route.
(2) Stay low. Avoid breathing the heated smoke, vapors, or fumes as much as possible, as well as the extinguishing agents.
(3) If you feel confident in attacking the fire, use the appropriate fire-fighting equipment. If the fire is not extinguished quickly, get out of the building, closing door(s) behind you, and do not re-enter.

F.7.4 Responsibility. The homeowner/occupant has an obligation for the care and use of the fire-extinguishing equipment at all times. The nameplate(s) and instruction manual should be read and thoroughly understood by all persons who are expected to use the equipment. The instruction manual should be kept in a safe place and periodically reviewed.

The presence of an extinguisher in a residence is not worthwhile unless the homeowner is willing to do the following:

(1) Understand how to use the device properly.
(2) Instruct family members who might have to use it.
(3) Maintain and recharge it according to the manufacturer's instructions. The owner/occupant should see that everyone understands how to call the fire department and stress that they should do so for every fire, no matter how small it is.

Homeowners/occupants should recognize fire hazards on their properties and plan in advance exactly how, and with what, a fire will be fought. It is important for homeowners to understand that extinguishers of the sizes discussed have a discharge time of only 8 seconds to 60 seconds; in actual use, no time can be wasted determining the best way to use the device. Instruction on fire extinguisher use can also be obtained from local fire department personnel.

Annex G Extinguisher Classification and Rating System

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

G.1 Portable fire extinguishers are classified for use on certain classes of fires and rated for relative extinguishing effectiveness at a temperature of 70°F (21°C) by testing laboratories. This is based on the classification of fires and the fire-extinguishment potentials as determined by fire tests.

G.2 The classification and rating system described in this standard is that of Underwriters Laboratories Inc. and Underwriters Laboratories of Canada, and is based on extinguishing preplanned fires of determined size and description as follows:

(1) *Class A Rating.* Wood
(2) *Class B Rating.* Two in. (5.1 cm) depth n-heptane fires in square pans
(3) *Class C Rating.* No fire test. Agent must be a nonconductor of electricity
(4) *Class D Rating.* Special tests on specific combustible metal fires
(5) *Class K Rating.* Special tests on cooking appliances using combustible cooking media (vegetable or animal oils and fats)

G.3 The classification and rating are found on the label affixed to the fire extinguisher.

Example:
A fire extinguisher is rated and classified 4-A:20-B:C. This imparts the following information:

(1) It should extinguish approximately twice as much Class A fire as a 2-A [2½ gal (9.46 L) water] rated fire extinguisher.

(2) It should extinguish approximately 20 times as much Class B fire as a 1-B rated fire extinguisher.
(3) It is suitable for use on energized electrical equipment.

Currently, laboratories classify fire extinguishers for use on Class A fires with the following ratings: 1-A, 2-A, 3-A, 4-A, 6-A, 10-A, 20-A, 30-A, and 40-A. Effective June 1, 1969, fire extinguishers classified for use on Class B fires have the following ratings: 1-B, 2-B, 5-B, 10-B, 20-B, 30-B, 40-B, 60-B, 80-B, 120-B, 160-B, 240-B, 320-B, 480-B, and 640-B. Ratings from 1-A to 20-A and 1-B to 20-B, inclusive, are based on indoor fire tests; ratings at or above 30-A and 30-B are based on outdoor fire tests.

Ratings of 4-B, 6-B, 8-B, 12-B, and 16-B, which were previously used to classify individual fire extinguishers for use on Class B fires, were not used for new fire extinguishers after June 1, 1969. Existing fire extinguishers having these ratings are acceptable if they have been properly inspected and maintained in accordance with this standard.

For Class B fires, it should be recognized that the amount of fire that can be extinguished by a particular fire extinguisher is related to the degree of training and experience of the operator.

For fire extinguishers classified for use on Class C fires, no number is used, since Class C fires are essentially either Class A or Class B fires involving energized electrical wiring and equipment. Other than when being discharged from an extinguisher, water-based agents are conductive, and agent pooling after discharge might present additional hazard concerns. The size of the different suitable fire extinguishers installed should be commensurate with the size and extent of the Class A or Class B components, or both, of the electrical hazard being protected.

For fire extinguishers classified for use on Class D fires, no number is used. The relative effectiveness of these fire extinguishers for use on specific combustible metal fires is detailed on the fire extinguisher nameplate.

Fire extinguishers that are effective on more than one class of fire have multiple letter and number-letter classifications and ratings.

The equivalency for Class A extinguishers rated under the rating classification system used prior to 1955 is in accordance with Table G.3(a).

Table G.3(a) Class A Rating Equivalencies

All Water Types and Loaded Stream Types of Extinguishers (gal)	Pre-1955 Rating	Equivalency
1¼ to 1¾	A-2	1-A
2½	A-1	2-A
4	A-1	3-A
5	A-1	4-A
17	A	10-A
33	A	20-A

For SI unit: 1 gal = 3.785 L

The equivalency for Class B extinguishers rated under the rating classification system used prior to 1955 is in accordance with Table G.3(b).

For extinguishers classified under the system used prior to 1955, the pre-1955 classifications of C, C-1, and C-2 are equivalent to the current C classification.

Table G.3(b) Class B Rating Equivalencies

Extinguisher Type and Capacity	Pre-1955 Rating	Equivalency
Foam (gal)		
2½	B-1	2-B
5	B-1	5-B
17	B	10-B
33	B	20-B
Carbon Dioxide (lb)		
Under 7	B-2	1-B
7	B-2	2-B
10 to 12	B-2	2-B
15 to 20	B-1	2-B
25 to 26	B-1	5-B
50	B-1	10-B
75	B-1	10-B
100	B	10-B
Dry Chemical (lb)		
4 to 6¼	B-2	2-B
7½	B-2	5-B
10 to 15	B-1	5-B
20	B-1	10-B
30	B-1	20-B
75 and up	B	40-B

For SI units: 1 gal = 3.785 L; 1 lb = 0.454 kg

Carbon dioxide extinguishers with metal horns do not carry any C classification.

Annex H Conditions of Selection

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

H.1 Physical Conditions That Affect Selection. When a fire extinguisher is being selected, the following physical conditions should be considered:

(1) *Gross Weight.* In the selection of a fire extinguisher, the physical ability of the user should be contemplated. When the hazard exceeds the capability of a hand portable fire extinguisher, wheeled fire extinguishers or fixed systems *(see Section 1.1)* should be considered.
(2) *Corrosion.* In some fire extinguisher installations, there exists a possibility of exposing the fire extinguisher to a corrosive atmosphere. Where this is the case, consideration should be given to providing the fire extinguishers so exposed with proper protection or providing fire extinguishers that have been found suitable for use in these conditions.
(3) *Agent Reaction.* The possibility of adverse reactions, contamination, or other effects of an extinguishing agent on either manufacturing processes or on equipment, or both, should be considered in the selection of a fire extinguisher.
(4) *Wheeled Units.* Where wheeled fire extinguishers are used, consideration should be given to the mobility of the fire extinguisher within the area in which it will be used. For outdoor locations, the use of proper rubber-tired or wide-rimmed wheel designs should be considered according to terrain. For indoor locations, the size of doorways and

passages should be large enough to permit ready passage of the fire extinguisher.

(5) *Wind and Draft.* If the hazard is subject to winds or draft, the use of fire extinguishers and agents having sufficient range to overcome these conditions should be considered.

(6) *Availability of Personnel.* Consideration should be given to the number of persons available to operate the fire extinguishers, the degree of training provided, and the physical capability of the operators.

H.2 Health and Safety Conditions That Affect Selection. When a fire extinguisher is being selected, consideration should be given to the health and safety hazards involved in its maintenance and use, as described in items (1) through (8):

(1) For confined spaces, prominent caution labels on the fire extinguisher, warning signs at entry points, provision for remote application, extra-long-range fire extinguisher nozzles, special ventilation, provision of breathing apparatus and other personal protective equipment, and adequate training of personnel are among the measures that should be considered.

(2) Halogenated agent–type fire extinguishers contain agents whose vapor has a low toxicity. However, their decomposition products can be hazardous. When using these fire extinguishers in unventilated places, such as small rooms, closets, motor vehicles, or other confined spaces, operators and others should avoid breathing the gases produced by thermal decomposition of the agent.

(3) Carbon dioxide fire extinguishers contain an extinguishing agent that will not support life when used in sufficient concentration to extinguish a fire. The use of this type of fire extinguisher in an unventilated space can dilute the oxygen supply. Prolonged occupancy of such spaces can result in loss of consciousness due to oxygen deficiency.

(4) Fire extinguishers not rated for Class C hazards (e.g., water, antifreeze, soda acid, loaded stream, AFFF, FFFP, wetting agent, foam, and carbon dioxide with metal horns) present a shock hazard if used on fires involving energized electrical equipment.

(5) Dry chemical fire extinguishers, when used in a small unventilated area, can reduce visibility for a period of up to several minutes. Dry chemical, discharged in an area, can also clog filters in air-cleaning systems.

(6) A dry chemical fire extinguisher containing ammonium compounds should not be used on oxidizers that contain chlorine. The reaction between the oxidizer and the ammonium salts can produce an explosive compound (NCL_3).

(7) Halon extinguishers should not be used on fires involving oxidizers, since they can react with the oxidizer.

(8) Most fires produce toxic decomposition products of combustion, and some materials, upon burning, can produce highly toxic gases. Fires can also consume available oxygen or produce dangerously high exposure to convected or radiated heat. All of these can affect the degree to which a fire can be safely approached with fire extinguishers. *(See Bulletin of Research No. 53, "Survey of Available Information on the Toxicity of Combustion and Thermal Decomposition Products of Certain Building Materials under Fire Conditions.")*

Table H.2 summarizes the characteristics of fire extinguishers and can be used as an aid in selecting fire extinguishers in accordance with Chapter 4. The ratings given are those that were in effect at the time this standard was prepared. Current listings should be consulted for up-to-date ratings.

Table H.2 Characteristics of Extinguishers

Extinguishing Agent	Method of Operation	Capacity	Horizontal Range of Stream	Approximate Time of Discharge	Protection Required below 40°F (4°C)	UL or ULC Classifications[a]
Water	Stored pressure	6 L	30 to 40 ft	40 sec	Yes	1-A
	Stored-pressure or pump	2½ gal	30 to 40 ft	1 min	Yes	2-A
	Pump	4 gal	30 to 40 ft	2 min	Yes	3-A
	Pump	5 gal	30 to 40 ft	2 to 3 min	Yes	4-A
Water (wetting agent)	Stored-pressure	1½ gal	20 ft	30 sec	Yes	2-A
		25 gal (wheeled)	35 ft	1½ min	Yes	10-A
		45 gal (wheeled)	35 ft	2 min	Yes	30-A
		60 gal (wheeled)	35 ft	2½ min	Yes	40-A
Loaded stream	Stored-pressure	2½ gal	30 to 40 ft	1 min	No	2A
		33 gal (wheeled)	50 ft	3 min	No	
AFFF, FFFP	Stored-pressure	2½ gal	20 to 25 ft	50 sec	Yes	3-A:20 to 40-B
	Stored-pressure	6L	20 to 25 ft	50 sec	Yes	2A:10B
	Nitrogen cylinder	33 gal	30 ft	1 min	Yes	20-A:160-B
Carbon dioxide[b]	Self-expelling	2½ to 5 lb	3 to 8 ft	8 to 30 sec	No	1 to 5-B:C
	Self-expelling	10 to 15 lb	3 to 8 ft	8 to 30 sec	No	2 to 10-B:C
	Self-expelling	20 lb	3 to 8 ft	10 to 30 sec	No	10-B:C

Table H.2 *Continued*

Extinguishing Agent	Method of Operation	Capacity	Horizontal Range of Stream	Approximate Time of Discharge	Protection Required below 40°F (4°C)	UL or ULC Classifications[a]
	Self-expelling	50 to 100 lb (wheeled)	3 to 10 ft	10 to 30 sec	No	10 to 20-B:C
Regular dry chemical (sodium bicarbonate)	Stored-pressure	1 to 2½ lb	5 to 8 ft	8 to 12 sec	No	2 to 10-B:C
	Cartridge or stored-pressure	2¾ to 5 lb	5 to 20 ft	8 to 25 sec	No	5 to 20-B:C
	Cartridge or stored-pressure	6 to 30 lb	5 to 20 ft	10 to 25 sec	No	10 to 160-B:C
	Stored-pressure	50 lb (wheeled)	20 ft	35 sec	No	160-B:C
	Nitrogen cylinder or stored-pressure	75 to 350 lb (wheeled)	15 to 45 ft	20 to 105 sec	No	40 to 320-B:C
Purple K dry chemical (potassium bicarbonate)	Cartridge or stored-pressure	2 to 5 lb	5 to 12 ft	8 to 10 sec	No	5 to 30-B:C
	Cartridge or stored-pressure	5½ to 10 lb	5 to 20 ft	8 to 20 sec	No	10 to 80-B:C
	Cartridge or stored-pressure	16 to 30 lb	10 to 20 ft	8 to 25 sec	No	40 to 120-B:C
	Cartridge or stored-pressure	48 to 50 lb (wheeled)	20 ft	30 to 35 sec	No	120 to 160-B:C
	Nitrogen cylinder or stored-pressure	125 to 315 lb (wheeled)	15 to 45 ft	30 to 80 sec	No	80 to 640-B:C
Super K dry chemical (potassium chloride)	Cartridge or stored-pressure	2 to 5 lb	5 to 8 ft	8 to 10 sec	No	5 to 10-B:C
	Cartridge or stored-pressure	5 to 9 lb	8 to 12 ft	10 to 15 sec	No	20 to 40-B:C
	Cartridge or stored-pressure	9½ to 20 lb	10 to 15 ft	15 to 20 sec	No	40 to 60-B:C
	Cartridge or stored-pressure	19½ to 30 lb	5 to 20 ft	10 to 25 sec	No	60 to 80-B:C
	Cartridge or stored-pressure	125 to 200 lb (wheeled)	15 to 45 ft	30 to 40 sec	No	160-B:C
Multipurpose/ABC dry chemical (ammonium phosphate)	Stored-pressure	1 to 5 lb	5 to 12 ft	8 to 10 sec	No	1 to 3-A[c] and 2 to 10-B:C
	Stored-pressure or cartridge	2½ to 9 lb	5 to 12 ft	8 to 15 sec	No	1 to 4-A and 10 to 40-B:C
	Stored-pressure or cartridge	9 to 17 lb	5 to 20 ft	10 to 25 sec	No	2 to 20-A and 10 to 80-B:C
	Stored-pressure or cartridge	17 to 30 lb	5 to 20 ft	10 to 25 sec	No	3 to 20-A and 30 to 120-B:C
	Stored-pressure or cartridge	45 to 50 lb (wheeled)	20 ft	25 to 35 sec	No	20 to 30-A and 80 to 160-B:C
	Nitrogen cylinder or stored-pressure	110 to 315 lb (wheeled)	15 to 45 ft	30 to 60 sec	No	20 to 40-A and 60 to 320-B:C
Dry chemical (foam compatible)	Cartridge or stored-pressure	4¾ to 9 lb	5 to 20 ft	8 to 10 sec	No	10 to 20-B:C
	Cartridge or stored-pressure	9 to 27 lb	5 to 20 ft	10 to 25 sec	No	20 to 30-B:C
	Cartridge or stored-pressure	18 to 30 lb	5 to 20 ft	10 to 25 sec	No	40 to 60-B:C
	Nitrogen cylinder or stored-pressure	150 to 350 lb (wheeled)	15 to 45 ft	20 to 150 sec	No	80 to 240-B:C

Table H.2 *Continued*

Extinguishing Agent	Method of Operation	Capacity	Horizontal Range of Stream	Approximate Time of Discharge	Protection Required below 40°F (4°C)	UL or ULC Classifications[a]
Dry chemical	Stored-pressure	5 to 11 lb	11 to 22 ft	18 sec	No	40 to 80-B:C
(potassium bicarbonate urea based)	Stored-pressure	9 to 23 lb	15 to 30 ft	17 to 33 sec	No	60 to 160-B:C
		175 lb (wheeled)	70 ft	62 sec	No	480-B:C
		3 L	8 to 12 ft	30 sec	No	K
Wet chemical	Stored-pressure	6 L (2½ gal)	8 to 12 ft	35 to 45 sec	No	2A:1-B:C:K
			8 to 12 ft	75 to 85 sec	No	2-A:1-B:C:K
Halon 1211 (bromochlorodi-fluoromethane)	Stored-pressure	0.9 to 2 lb	6 to 10 ft	8 to 10 sec	No	1 to 2-B:C
		2 to 3 lb	6 to 10 ft	8 to 10 sec	No	5-B:C
		5½ to 9 lb	9 to 15 ft	8 to 15 sec	No	1-A:10-B:C
		13 to 22 lb	14 to 16 ft	10 to 18 sec	No	2 to 4-A and 20 to 80-B:C
		50 lb	35 ft	30 sec	No	10-A:120-B:C
		150 lb (wheeled)	20 to 35 ft	30 to 44 sec	No	30-A:160 to 240-B:C
Halon 1211/1301 (bromochloro-difluoro-methane	Stored-pressure or self-expelling	0.9 to 5 lb	3 to 12 ft	8 to 10 sec	No	1 to 10-B:C
bromotrifluoro-methane) mixtures	Stored-pressure	9 to 20 lb	10 to 18 ft	10 to 22 sec	No	1-A:10-B:C to 4-A:80-B:C
Halocarbon type	Stored-pressure	1.4 to 150 lb	6 to 35 ft	9 to 23 sec	No	1B:C to 10A:80B:C

Note: Halon should be used only where its unique properties are deemed necessary.

[a]UL and ULC ratings checked as of July 24, 1987. Readers concerned with subsequent ratings should review the pertinent lists and supplements issued by these laboratories: Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062, or Underwriters Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario, Canada M1R 3A9.

[b]Carbon dioxide extinguishers with metal horns do not carry a C classification.

[c]Some small extinguishers containing ammonium phosphate–based dry chemical do not carry an A classification.

Annex I Maintenance Procedures

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

I.1 For convenience, the following checklists are organized into two parts. The first, Table I.1(a), is arranged by mechanical parts (components and containers) common to most fire extinguishers. The second, Table I.1(b), is arranged by extinguishing material and expelling means and involves a description of the problems peculiar to each agent.

Table I.1(a) Mechanical Parts Maintenance Checklist

Shell	Corrective Action
1. Hydrostatic test date or date of manufacture*	1. Retest, if needed
2. Corrosion*	2. Conduct hydrostatic test and refinish, or discard
3. Mechanical damage (denting or abrasion)*	3. Conduct hydrostatic test and refinish, or discard
4. Paint condition	4. Refinish
5. Presence of repairs (welding, soldering, brazing, etc.)	5. Discard or consult manufacturer
6. Damaged threads (corroded, crossthreaded, or worn)	6. Discard or consult manufacturer
7. Broken hanger attachment, carrying handle lug	7. Discard or consult manufacturer
8. Sealing surface damage (nicks or corrosion)*	8. Clean, repair, and leak test, or discard
Nameplate	**Corrective Action**
1. Illegible wording	1. Clean or replace
2. Corrosion or loose plate	2. Inspect shell under plate (see shell check points) and reattach plate

Table I.1(a) *Continued*

	Nozzle or Horn	Corrective Action
1.	Deformed, damaged, or cracked	1. Replace
2.	Blocked openings	2. Clean
3.	Damaged threads (corroded, crossthreaded, or worn)	3. Replace
4.	Aged (brittle)	4. Replace

	Hose Assembly	Corrective Action
1.	Damaged (cut, cracked, or worn)	1. Replace
2.	Damaged couplings or swivel joint (cracked or corroded)	2. Replace
3.	Damaged threads (corroded, crossthreaded, or worn)	3. Replace
4.	Inner tube cut at couplings	4. Repair or replace
5.	Electrically nonconductive between couplings (CO_2 hose only)	5. Replace
6.	Hose obstruction	6. Remove obstruction or replace

	Valve Locking Device	Corrective Action
1.	Damaged (bent, corroded, or binding)	1. Repair and lubricate, or replace
2.	Missing	2. Replace

	Gauge or Pressure-Indicating Device	Corrective Action
1.	Immovable, jammed, or missing pointer (pressure test)*	1. Depressurize and replace gauge
2.	Missing, deformed, or broken crystal*	2. Depressurize and replace gauge
3.	Illegible or faded dial*	3. Depressurize and replace gauge
4.	Corrosion*	4. Depressurize and check calibration, clean and refinish, or replace gauge
5.	Dented case or crystal retainer*	5. Depressurize and check calibration, or replace gauge
6.	Immovable or corroded pressure-indicating stem (nongauge type)*	6. Replace head assembly, depressurize, and replace shell or complete extinguisher

	Shell or Cylinder Valve	Corrective Action
1.	Corroded, damaged or jammed lever, handle, spring, stem, or fastener joint*	1. Depressurize, check freedom of movement, and repair or replace
2.	Damaged outlet threads (corroded, crossthreaded, or worn)*	2. Depressurize and replace

	Nozzle Shutoff Valve	Corrective Action
1.	Corroded, damaged, jammed or binding lever, spring, stem, or fastener joint	1. Repair and lubricate, or replace
2.	Plugged, deformed, or corroded nozzle tip or discharge passage	2. Clean or replace

	Puncture Mechanism	Corrective Action
1.	Damaged, jammed, or binding puncture lever, stem, or fastener joint	1. Replace
2.	Dull or damaged cutting or puncture pin	2. Replace
3.	Damaged threads (corroded, crossthreaded, or worn)	3. Replace

	Gas Cartridge	Corrective Action
1.	Corrosion	1. Replace cartridge
2.	Damaged seal disc (injured, cut, or corroded)	2. Replace cartridge
3.	Damaged threads (corroded, crossthreaded, or worn)	3. Replace cartridge
4.	Illegible weight markings	4. Replace cartridge

	Gas Cylinders	Corrective Action
1.	Hydrostatic test date or date of manufacture	1. Retest if needed
2.	Corrosion	2. Conduct hydrostatic test and refinish, or discard
3.	Paint condition	3. Refinish
4.	Presence of repairs (welding, soldering, brazing, etc.)	4. Discard or consult manufacturer
5.	Damaged threads (corroded, crossthreaded, or worn)	5. Discard or consult manufacturer

Table I.1(a) *Continued*

	Wheel Cap or Fill Cap		Corrective Action
1.	Corroded, cracked, or broken	1.	Replace
2.	Damaged threads (corroded, crossthreaded, or worn)	2.	Replace
3.	Sealing surface damage (nicked, deformed, or corroded)	3.	Clean, repair, and leak test, or replace
4.	Blocked vent hole or slot	4.	Clean
	Nonrechargeable Shell		**Corrective Action**
1.	Corrosion*	1.	Discard shell
2.	Damaged seal disc (injured, cut, or corroded)*	2.	Discard shell
3.	Damaged threads (corroded, crossthreaded, or worn)	3.	Discard shell
4.	Illegible weight markings*	4.	Discard shell
	Carriage and Wheels		**Corrective Action**
1.	Corroded, bent, or broken carriage	1.	Repair or replace
2.	Damaged wheel (buckled or broken spoke, bent rim or axle, loose tire, low pressure, jammed bearing)	2.	Clean, repair, and lubricate, or replace
	Carrying Handle		**Corrective Action**
1.	Broken handle lug	1.	Discard shell or valve, or consult manufacturer
2.	Broken handle	2.	Replace
3.	Corroded, jammed, or worn fastener joint	3.	Clean or replace
	Seals or Tamper Indicator		**Corrective Action**
1.	Broken or missing	1.	Check under agent and expelling means [Table I.1(b)] for specific action
	Hand Pump		**Corrective Action**
1.	Corroded, jammed, or damaged pump	1.	Repair and lubricate, or replace
2.	Improper adjustment of packing nut	2.	Adjust
	Pressurizing Valve		**Corrective Action**
1.	Leaking seals	1.	Depressurize and replace valve or core
	Gasket "O" Ring and Seals		**Corrective Action**
1.	Damaged (cut, cracked, or worn)*	1.	Replace and lubricate
2.	Missing*	2.	Replace and lubricate
3.	Aged or weathered (compression set, brittle, cracked)*	3.	Replace and lubricate
	Brackets		**Corrective Action**
1.	Corroded, worn, or bent	1.	Repair and refinish, or replace
2.	Loose or binding fit	2.	Adjust fit or replace
3.	Worn, loose, corroded, or missing screw or bolt	3.	Tighten or replace
4.	Worn bumper, webbing, or grommet	4.	Replace
	Gas Tube and Siphon or Pickup Tube		**Corrective Action**
1.	Corroded, dented, cracked, or broken	1.	Replace
2.	Blocked tube or openings in tube	2.	Clean or replace
	Safety Relief Device		**Corrective Action**
1.	Corroded or damaged*	1.	Depressurize and replace or consult manufacturer
2.	Broken, operated, or plugged*	2.	Depressurize and replace or repair
	Pressure Regulators		**Corrective Action**
1.	External condition (a) Damage (b) Corrosion	1.	 (a) Replace regulator (b) Clean regulator or replace
2.	Pressure relief (corroded, plugged, dented, leaking, broken, or missing)	2.	Disconnect regulator from pressure source, replace pressure relief
3.	Protective bonnet relief hole (tape missing or seal wire broken or missing)	3.	Check regulator in accordance with manufacturer's regulator test procedures
4.	Adjusting screw (lock pin missing)	4.	Check regulator in accordance with manufacturer's regulator test procedures

Table I.1(a) *Continued*

Pressure Regulators	Corrective Action
5. Gauges	5.
(a) Immovable, jammed, or missing pointer	(a) Disconnect regulator from pressure source, replace gauge
(b) Missing or broken crystal	(b) Replace crystal
(c) Illegible or faded dial	(c) Replace gauge
(d) Corrosion	(d) Check calibration, clean and refinish, or replace gauge
(e) Dented case or crystal retainer	(e) Check calibration or replace gauge
6. Regulator hose	6.
(a) Cut, cracked, abraded, or deformed exterior	(a) Conduct hydrostatic test or replace hose
(b) Corroded or cracked coupling	(b) Replace hose
(c) Corroded, crossthreaded, or worn coupling threads	(c) Replace hose

*For disposable-type extinguishers, those items indicated with a dagger cannot be inspected and serviced. If the corrective action requires the depressurization of the extinguisher, disposable halogenated agent fire extinguishers shall not be depressurized but returned to the manufacturer or service agency for proper disposal and reclaiming of the extinguishing agent.

Table I.1(b) Agent and Expelling Means Maintenance Checklist

Foam	Corrective Action
1. Recharging date due	1. Empty, clean, and recharge
2. Improper fill levels in inner container and shell	2. Empty, clean, and recharge
3. Agent condition (check for sediment)	3. Empty, clean, and recharge
Self-Expelling	
Carbon Dioxide	**Corrective Action**
1. Improper weight	1. Recharge to proper weight
2. Broken or missing tamper indicator	2. Leak test and weigh, recharge or replace indicator
Halon 1301 Bromotrifluoromethane	**Corrective Action**
1. Punctured cylinder seal disc	1. Replace shell
2. Improper weight	2. Replace shell or return to manufacturer for refilling
3. Broken or missing tamper indicator	3. Examine cylinder seal disc, replace indicator
Combination Halon 1211/1301	**Corrective Action**
1. Improper weight	1. Return to manufacturer *(see 6.2.3.3)*
2. Broken or missing tamper indicator	2. Return to manufacturer *(see 6.2.3.3)*
Mechanical Pump	
Water and Antifreeze	**Corrective Action**
1. Improper fill level	1. Refill
2. Defective pump	2. Clean, repair, and lubricate, or replace
Dry Powder	**Corrective Action**
1. Improper fill level	1. Refill
2. Agent condition (contamination or caking)	2. Discard and replace
3. Missing scoop	3. Replace
Gas Cartridge or Cylinder	
Dry Chemical and Dry Powder Types	**Corrective Action**
1. Improper weight or charge level	1. Refill to correct weight
2. Agent condition (contamination, caking, or wrong agent)	2. Empty and refill
3. For cartridge	3.
(a) Punctured seal disc	(a) Replace cartridge
(b) Improper weight	(b) Replace cartridge
(c) Broken or missing tamper indicator	(c) Examine seal disc, replace indicator