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NFPA 17 Dry Chemical Extinguishing Systems 1990 Edition

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Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

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NFPA 17

Standard for

Dry Chemical Extinguishing Systems

1990 Edition

This edition of NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, was prepared by the Technical Committee on Dry and Wet Chemical Extinguishing Systems, and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 13-15, 1989 in Seattle, WA. It was issued by the Standards Council on January 12, 1990, with an effective date of February 5, 1990, and supersedes all previous editions.

The 1990 edition of this document has been approved by the American National Standards Institute.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

Origin and Development of NFPA 17

The Dry Chemical Extinguishing Systems Committee was activated in 1952. At that time there was no dry chemical extinguishing system tested and listed by a testing laboratory, but by late 1954 a system was tested and listed by Underwriters Laboratories Inc. At its meeting in January 1955 the Committee prepared an outline of a standard on Dry Chemical Extinguishing Systems, and in the following year prepared the standard that was tentatively adopted by the National Fire Protection Association on June 7, 1956. Changes to the tentative standard led to approval of the first official NFPA Standard on Dry Chemical Extinguishing Systems in 1957. Further amendments were made in 1958, 1968, 1969, 1972, 1973, 1975, and 1980. The 1985 edition is a complete revision of the standard. The 1990 edition is a partial revision.

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

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NOTE: An asterisk (*) following the number or letter designating a subdivision indicates explanatory material on that subdivision in Appendix A.

Information on referenced publications can be found in Chapter 7 and Appendix B.

Chapter 1 Administration

1-1* Scope. This standard includes minimum requirements for dry chemical fire extinguishing systems that discharge dry chemical from fixed nozzles or hand hose lines by means of expellant gas. It contains only the essentials and suggestions to make the standard workable in the hands of those skilled in this field. Portable dry chemical equipment is covered in NFPA 10, *Standard for Portable Fire Extinguishers.*

1-2 Purpose. This standard is prepared for the use and guidance of those charged with the purchasing, designing, installing, testing, inspecting, approving, listing, operating, or maintaining of dry chemical fire extinguishing systems, in order that such equipment will function as intended throughout its life. Nothing in this standard is intended to prevent the use of new methods or devices, provided sufficient technical data are submitted to the authority having jurisdiction to demonstrate that the new method or devices are equivalent in quality, effectiveness, durability, and safety to that prescribed by this standard.

1-2.1 Only those skilled in this field are competent to design and install this equipment. It may be necessary for many of those charged with the purchasing, inspecting, testing, approving, operating, and maintaining this equipment to consult an experienced fire protection engineer, competent in this field, in order to effectively discharge their respective duties.

1-2.2 Arrangement. This standard is arranged as follows:

Chapter 1 – Administration.

Chapter 2 – General Information and Requirements.

Chapter 3 – Total Flooding Systems.

Chapter 4 – Local Application Systems.

Chapter 5 – Hand Hose Line Systems.

Chapter 6 – Pre-Engineered Systems.

Chapter 7 – Referenced Publications.

Appendix A – Explanatory.

Appendix B – Referenced Publications.

1-3 Definitions. For the purpose of clarification, the following general terms used with special technical meanings in this standard are defined.

Approved. Acceptable to the "authority having jurisdiction."

NOTE: 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 or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

Authority Having Jurisdiction. The "authority having jurisdiction" is the organization, office, or individual responsible for "approving" equipment, an installation, or a procedure.

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner since jurisdictions and "approval" agencies vary as do their responsibilities. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local, or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, 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 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."

Auxiliary Equipment. Listed equipment used in conjunction with the dry chemical systems, i.e., to shut down power, fuel, or ventilation to the hazard being protected, or to initiate signaling devices.

Branch Duct. The duct work that contains the exhaust air from a single hood or hazard area.

Caking. A phenomenon that occurs when moisture chemically reacts with a dry chemical fire extinguishing agent. This reaction results in materials that, being hydrated by moisture, stick together to form a large agglomerate, or what is more commonly referred to as lumps. For the purpose of this standard, lumps are defined as those that do not crumble into particles when dropped from a height of 4 in. (101 mm) onto a hard surface.

Calculation and Design. The process of computing, with the use of equations, graphs, or tables, the system characteristics such as flow rate, pipe size, area, or volume protected by each nozzle, nozzle pressure, and pressure drop. This information is not required for listed pre-engineered systems since these systems must be installed in accordance with their pretested limitations described in the manufacturer's installation manual.

Common Duct. The duct work containing the exhaust air from two or more branch ducts.

CTC. The Canadian Transport Commission, which has jurisdiction over compressed gas cylinders and cartridges.

DOT. The U.S. Department of Transportation, which has jurisdiction over compressed gas cylinders and cartridges.

Dry Chemical. A powder composed of very small particles, usually of sodium bicarbonate, potassium bicarbonate, urea-potassium based bicarbonate, potassium chloride, or monoammonium phosphate with added particulate material supplemented by special treatment to provide resistance to packing, resistance to moisture absorption (caking), and the proper flow capabilities.

Dry Chemical System. A supply of dry chemical that can be automatically or manually activated to discharge through a distribution system onto or into the protected hazard. The system also may include auxiliary equipment.

Engineered Systems. Those requiring individual calculation and design to determine the flow rates, nozzle pressures, pipe size, area, or volume protected by each nozzle, quantities of dry chemical, and the number and types of nozzles and their placement in a specific system.

Inspection. Inspection is a "quick check" to give reasonable assurance that the extinguishing system is fully charged and operable. This is done by seeing that the system is in place, that it has not been activated or tampered with, and that there is no obvious physical damage or condition to prevent operation.

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

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

Maintenance. Maintenance is a "thorough check" to give maximum assurance that the extinguishing system will operate as intended. It includes a thorough examination and any necessary repair or replacement of system components.

Mobile Equipment. Any equipment in use without its own motive power train and normally moved by self-propelled equipment.

Multipurpose Dry Chemical. Usually ammonium phosphate-based. Effective on fires involving both ordinary combustibles, such as wood or paper, and fires in flammable liquids.

Pre-Engineered Systems. Those having predetermined flow rates, nozzle pressures, and quantities of dry chemical. These systems have the specific pipe size, maximum and minimum pipe lengths, flexible hose specifications, number of fittings, and number and types of nozzles prescribed by a testing laboratory. The hazards protected by these systems are specifically limited as to type and size by a testing laboratory based upon actual fire tests. Limitations on hazards that can be protected by these systems are contained in the manufacturer's installation manual, which is referenced as part of the listing.

Self-Propelled Equipment. Any unit that contains a motive power train as an integral part of the unit and is not rail mounted.

Shall. Indicates a mandatory requirement.

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

Suitable. That which has qualities or qualifications to meet a given purpose, occasion, condition, function, or circumstance.

Testing. A functional test of all components to verify operation of the system, design, and installation.

1-4 Units. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). (*See ASTM E380, Standard for Metric Practice.*)

1-4.1 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 may be approximate.

1-4.2 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 General Information and Requirements

2-1* Dry Chemical. The type of dry chemical used in the system shall not be changed unless proved to be changeable by a testing laboratory, recommended by the manufacturer of the equipment, and approved by the authority having jurisdiction. Systems are designed on the basis of the flow and extinguishing characteristics of a specific make and type of dry chemical.

CAUTION: Types of dry chemical shall not be mixed. Mixtures of certain dry chemicals will generate dangerous pressures and will form lumps.

2-2 Use and Limitations.

2-2.1* Use. Types of hazards and equipment that can be protected using dry chemical extinguishing systems include the following:

(a) Caution.

CAUTION: Extinguishment of flowing flammable liquid fires, especially Class I Liquids, may result in a reflash unless all sources of ignition have been removed. Flammable gases

present a potential explosion hazard if the flow of gas is not stopped before or during extinguishment.

(b) Combustible solids having burning characteristics similar to naphthalene and pitch, which melt when involved in fire.

(c) Electrical hazards such as transformers or oil circuit breakers.

(d) Textile operations subject to flash surface fires. Where bicarbonate-based dry chemical is used, water shall be provided to extinguish possible smoldering or deep-seated fires.

(e) Ordinary combustibles such as wood, paper, or cloth using multipurpose dry chemical when it can reach all surfaces involved in combustion.

(f) Restaurant and commercial hoods, ducts, and associated cooking appliance hazards such as deep fat fryers. [*See also Section 4-4 and A-2-1(3).*] For other specific details, see NFPA 96, *Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.*

(g) Some plastics, depending upon the type of material and its configuration of hazard. For more specific information, consult the manufacturer of the equipment.

2-2.2 Limitations. Dry chemical extinguishing systems shall not be considered satisfactory protection for the following:

(a) Chemicals containing their own oxygen supply, such as cellulose nitrate.

(b) Combustible metals such as sodium, potassium, magnesium, titanium, and zirconium.

(c) Deep-seated or burrowing fires in ordinary combustibles where the dry chemical cannot reach the point of combustion.

2-2.2.1 Before dry chemical extinguishing equipment is considered for use to protect electronic equipment or delicate electrical relays, the effect of residual deposits of dry chemical on the performance of this equipment shall be evaluated.

2-2.2.2 Multipurpose dry chemical shall not be considered satisfactory for use on machinery such as carding equipment in textile operations and delicate electrical equipment because, upon exposure to temperatures in excess of 250°F (121°C) or relative humidity in excess of 50 percent, deposits will be formed that may be corrosive, conductive, and difficult to remove.

2-2.2.3* Dry chemical, when discharged, will drift from the immediate discharge area and settle on surrounding surfaces. Prompt cleanup will minimize possible staining or corrosion of certain materials that may take place in the presence of moisture.

2-3 Systems Protecting One or More Hazards.

2-3.1 Where, in the opinion of the authority having jurisdiction, two or more hazards may be simultaneously involved in fire by reason of their proximity, the hazards shall be protected by individual systems installed to operate simultaneously, or by a single system designed to protect all hazards that may be simultaneously involved. Any hazard that will allow fire propagation from one area to another shall constitute a single fire hazard.

Exception: See Chapter 6 for pre-engineered systems.

2-3.2 Where hand hose lines may be used on a hazard that is also protected by a fixed system, separate dry chemical supplies shall be provided.

Exception: If a single dry chemical supply is used for both a hand hose line system and a fixed nozzle system, the hazards protected by the two systems shall be separated so that the hand hose lines cannot be simultaneously used on the hazard protected by the fixed nozzle system.

2-4* Personnel Safety.

2-4.1 Safety Requirements. In total flooding and local application systems where there is a possibility that personnel may be exposed to a dry chemical discharge, suitable safeguards shall be provided to ensure prompt evacuation of such locations, and also to provide means for prompt rescue of any trapped personnel. Safety items to be considered shall include, but not be limited to, personnel training, warning signs, discharge alarms, predischarge alarms, and respiratory protection.

CAUTION: Hazards to Personnel. The discharge of large amounts of dry chemical may create hazards to personnel such as reduced visibility and temporary breathing difficulty.

2-4.1.1 When dry chemical pressure containers are not attached to piping or hand hose lines, the discharge outlet shall be provided with a protective diffusing safety cap to protect personnel from recoil and high flow discharge in case of accidental actuation. Such protective caps shall also be used on empty pressure containers to protect threads. These caps shall be provided by the manufacturer of the equipment.

2-4.2 Electrical Clearances. All system components shall be so located as to maintain minimum clearances from live parts as shown in Table 2-4.2.

As used in this standard, "clearance" is the air distance between water spray equipment, including piping and nozzles, and unenclosed or uninsulated live electrical components at other than ground potential. The minimum clearances listed in Table 2-4.2 are for the purpose of electrical clearance under normal conditions; they are not intended for use as "safe" distances during fixed water spray system operation.

The clearances given are for altitudes of 3,300 ft (1000 m) or less. At altitudes in excess of 3,300 ft (1000 m) the clearance shall be increased at the rate of 1 percent for each 330-ft (100-m) increase in altitude above 3,300 ft (1000 m).

The clearances are based upon minimum general practices related to design Basic Insulation Level (BIL) values. To coordinate the required clearance with the electrical design, the design BIL of the equipment being protected shall be used as a basis, although this is not material at nominal line voltages of 161 kv or less.

Up to electrical system voltages of 161 kv, the design BIL kv and corresponding minimum clearances, phase to ground, have been established through long usage.

At voltages higher than 161 kv, uniformity in the relationship between design BIL kv and the various electrical system voltages has not been established in practice. For these

higher system voltages it has become common practice to use BIL levels dependent on the degree of protection that is to be obtained. For example, in 230 kv systems, BILs of 1050, 900, 825, 750, and 650 kv have been utilized.

Required clearance to ground also may be affected by switching surge duty, a power system design factor that along with BIL must correlate with selected minimum clearances. Electrical design engineers may be able to furnish clearances dictated by switching surge duty. Table 2-4.2 deals only with clearances required by design BIL. The selected clearance to ground shall satisfy the greater of switching surge or BIL duty, rather than being based upon nominal voltage.

Table 2-4.2
Clearance from Dry Chemical Equipment to Live Uninsulated Electrical Components

Nominal System Voltage (kv)	Maximum System Voltage (kv)	Design BIL (kv)	Minimum* Clearance (in.)	(mm)
To 13.8	14.5	110	7	178
23	24.3	150	10	254
34.5	36.5	200	13	330
46	48.3	250	17	432
69	72.5	350	25	635
115	121	550	42	1067
138	145	650	50	1270
161	169	750	58	1473
230	242	900	76	1930
		1050	84	2134
345	362	1050	84	2134
		1300	104	2642
500	550	1500	124	3150
		1800	144	3658
765	800	2050	167	4242

*For voltages up to 161 kv the clearances are taken from NFPA 70, *National Electrical Code©. For voltages 230 kv and above, the clearances are taken from Table 124 of ANSI C-2, National Electrical Safety Code.*

NOTE: BIL values are expressed as kilovolts (kv), the number being the crest value of the full wave impulse test that the electrical equipment is designed to withstand. For BIL values that are not listed in the table, clearances may be found by interpolation.

Possible design variations in the clearance required at higher voltages are evident in the table, where a range of BIL values is indicated opposite the various voltages in the high voltage portion of the table. However, the clearance between uninsulated energized parts of the electrical system equipment and any portion of the dry chemical system shall not be less than the minimum clearance provided elsewhere for electrical system insulations on any individual component.

2-4.2.1 When the design BIL is not available, and when nominal voltage is used for the design criteria, the highest minimum clearance listed for this group shall be used.

2-5 Specifications, Plans, and Approvals.

2-5.1 Specifications. Specifications for dry chemical fire extinguishing systems shall be drawn up with care under supervision of a competent person and with the advice of the authority having jurisdiction. To ensure a satisfactory system, the following items shall be included in the specifications.

2-5.1.1 The specifications shall designate the authority having jurisdiction and indicate whether plans are required for pre-engineered systems. Plans shall be required for all engineered systems.

2-5.1.2 The specifications shall state that the installation shall conform to this standard and meet the approval of the authority having jurisdiction.

2-5.1.2.1 The specification shall indicate that only equipment that is specifically listed and compatible for use with the extinguishing system shall be used.

Exception: Special auxiliary devices acceptable to the manufacturer and the authority having jurisdiction may be used.

2-5.1.3 The specifications shall include the specific tests that may be required, if any, to meet the approval of the authority having jurisdiction.

2-5.1.4 These specifications shall indicate the hazard to be protected and shall include such information as physical dimensions, combustibles, air handling equipment, heat sources, etc.

2-5.2 Plans. Where plans are required, the responsibility for their preparation shall be entrusted only to competent persons.

2-5.2.1 These plans shall be drawn to an indicated scale or be suitably dimensioned, and shall be made so that they can be reproduced easily.

2-5.2.2 These plans shall contain sufficient detail to enable the authority having jurisdiction to evaluate the hazard or hazards, and to evaluate the effectiveness of the system. The details on the hazards shall include materials involved, the location and arrangement, and the exposure to the hazard.

2-5.2.3 The details on the system shall include sufficient information and calculations on the amount of dry chemical; the size, length, and arrangement of connected piping, or piping and hose; and description and location of nozzles so that the adequacy of the system can be determined. Flow rates of nozzles used shall be provided for engineered systems. Information shall be submitted pertaining to the location and function of detection devices, operating devices, auxiliary equipment, and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used.

2-5.3 Approval of Plans. Where plans are required, they shall be submitted to the authority having jurisdiction for approval before work starts.

2-5.3.1 Where field conditions necessitate any substantial change from the approved plan, the corrected as-installed plans shall be submitted to the authority having jurisdiction for approval.

2-5.4 Approval of Installations. The completed system shall be tested by qualified personnel as required by the authority having jurisdiction. These tests shall determine that the system has been properly installed and will function as intended. Only listed equipment and devices shall be used in these systems.

2-5.4.1 The installer shall certify to the authority having jurisdiction that the installation has been made in accordance with the approved plans and the listing of a testing laboratory.

2-5.4.2 The approval tests shall include a discharge of dry chemical in sufficient amounts to verify that the system is properly installed and functional. The method of verification shall be acceptable to the authority having jurisdiction. Piping shall not be hydrostatically tested. Where pressure testing is required, it shall be by means of a dry gas. The labeling of devices with proper designations and instructions shall be checked.

Exception: The specific use of dry chemical for the approval test may be waived by the authority having jurisdiction.

2-5.4.3 After any discharge of dry chemical, care shall be taken to see that all piping and nozzles have been blown clean, using compressed dry air or nitrogen if necessary. Care also shall be taken to see that the system is properly charged and placed in the normal "set" condition.

2-6* Operation and Control of Systems.

2-6.1 Methods of Actuation. Systems shall be classified as automatic or manual in accordance with the following methods of actuation:

(a) *Automatic Operation.* Operation that does not require any human action.

(b) *Normal Manual Operation.* Operation of a system requiring human action where the device used to cause the operation is located near the hazard so as to be easily accessible at all times (*see 2-6.3.4*). Operation of one control shall be all that is required to bring about the full operation of the system.

(c) *Emergency Manual Operation.* Operation of the system by human means where the device used to cause operation is fully mechanical in nature and is located on the device being controlled or on its mounting assembly. "Fully mechanical" may incorporate use of the system pressure to complete operation of the device.

2-6.2 Detection of Fires. Fires or conditions likely to produce fire shall be detected by visual (human senses) or by automatic means.

2-6.2.1 Reliance on visual detection shall be permitted only with permission of the authority having jurisdiction where fires or conditions likely to produce fires can be readily detected visually.

2-6.2.2 Automatic detection shall be by a listed or approved device that is capable of detecting and indicating heat, flame, smoke, combustible vapors, or an abnormal condition in the hazard, such as process trouble, that is likely to produce fire.

2-6.3 Operating Devices. Operating devices shall mean expellant gas releasing mechanisms, dry chemical discharge controls, and shutdown equipment.

2-6.3.1 Operation shall be by listed mechanical, electrical, or pneumatic means.

2-6.3.2 All operating devices shall be designed for the service they will encounter and shall not be readily rendered inoperative or susceptible to accidental operation. Devices shall be normally designed to function properly from −40°F to +150°F (−40°C to +65.6°C), or marked to indicate temperature limitations.

2-6.3.3 All devices shall be designed, located, installed, or protected so that they are not subject to mechanical, environmental, or other conditions that would render them inoperative or cause inadvertent operation of the system.

2-6.3.4* At least one manual control for actuation shall be located no more than 5 ft (1.5 m) above the floor and be convenient and easily accessible at all times including the time of fire.

Exception: Automatic systems protecting common exhaust ducts only do not require a remote manual actuator.

2-6.3.5 All valves controlling the release and distribution of dry chemical shall be provided with an emergency manual control.

Exception No. 1: This does not apply to slave cylinders.

Exception No. 2: It is possible for the normal manual control to qualify as emergency manual control if provisions of Section 2-6 are satisfied.

2-6.3.6 Manual controls shall not require a pull of more than 40 lb (178 newtons) (force) nor a movement of more than 14 in. (356 mm) to secure operation.

2-6.3.7 Means shall be provided for checking the amount of expellant gas to assure that it is sufficient for the proper operation of the system.

2-6.3.8 All shutdown devices shall be considered integral parts of the system and shall function with the system operation. If the expellant gas is used to pneumatically operate these devices, then the gas must be taken prior to its entry into the dry chemical tank.

2-6.3.9 All remote manual operating devices shall be identified as to the hazard they protect.

2-6.4 Supervision. Supervision of electric or pneumatic operated automatic systems shall be provided unless specifically waived by the authority having jurisdiction.

Exception: Pneumatic actuation piping, hose, and tubing between remote actuators expellant gas supply and dry chemical storage containers that are not normally pressurized do not require supervision.

2-6.5* Alarms and Indicators. An alarm or indicator shall be provided to show the system has operated, that personnel response may be needed, and that the system is in need of recharge. The extinguishing system shall be connected to the alarm system, if provided, in accordance with the requirements of the appropriate signaling system standard (NFPA 71, 72A, 72B, 72C, or 72D) so that actuation of the dry chemical system will sound the fire alarm as well as provide the function of the extinguishing system.

Two sources of electrical power shall be provided. These shall consist of a primary (main) supply and a secondary (standby) supply. The primary (main) power supply shall have a high degree of reliability, adequate capacity for the intended service, and shall consist of one of the following:

(a) Light and power service,

(b) Engine-driven generator or equivalent.

Secondary (Standby) Power Supply Capacity and Sources. The secondary (standby) supply shall be provided to supply the energy to the system under the maximum normal load for 24 hours and then be capable of receiving one fire alarm signal persisting for five minutes in the event of a total power failure or low voltage condition (less than 85 percent of the nameplate voltages) of the primary (main) power supply. The secondary (standby) power supply shall transfer automatically to operate the system within 30 seconds of the loss of the primary (main) power supply. The secondary (standby) power supply shall consist of one of the following:

(a) A storage battery with 24-hours capacity.

(b) An engine-driven generator.

(c) Multiple automatic-starting engine-driven generators capable of supplying the energy required with the largest generator out of service.

Exception: When acceptable to the authority having jurisdiction, secondary (standby) power shall not be required to operate the evacuation alarm-indicating appliances or other supplemental functions not essential to the receipt of signals at the main control unit.

These systems shall be electrically supervised so the occurrence of a single open or single ground fault condition of its installation wiring that prevents the normal operation of the system or failure of the primary electric power supply will be indicated by a distinctive trouble signal.

2-6.5.1 Alarms indicating failure of supervised devices or equipment shall give prompt and positive indication of any failure and shall be distinctive from alarms indicating operation or hazardous conditions.

2-7 Dry Chemical and Expellant Gas Supply.

2-7.1 Quantity. The amount of dry chemical in the system shall be at least sufficient for the largest single hazard protected, or for the group of hazards that are to be protected simultaneously.

2-7.2 Quality. The dry chemical used in the system shall be supplied by the manufacturer of the equipment. The characteristics of the system are dependent upon the composition of the dry chemical and the type of expellant gas, as well as upon other factors, and, therefore, it is imperative to use the dry chemical provided by the manufacturer of the system and the type of expellant gas specified by the manufacturer of the system.

2-7.2.1 Where carbon dioxide or nitrogen is used as the expellant gas, it shall be of good commercial grade, free of water and other contaminants that might cause container corrosion.

2-7.2.2 Carbon dioxide used as an expellant gas shall meet the following specifications:

(a) The vapor phase shall be not less than 99.5 percent carbon dioxide.

(b) The water content of the liquid phase shall not be more than 0.01 percent by weight [–30°F (–34.4°C) dew point].

(c) Oil content shall not be more than 10 ppm by weight.

2-7.2.3 Nitrogen used as an expellant gas shall be only standard industrial grade with a dew point of –60°F (–52.2°C) or lower.

2-7.3* Reserve Supply. Where a dry chemical system protects multiple hazards by means of selector valves, sufficient dry chemical and expellant gas shall be kept on hand for one complete recharge of the system. For single hazard systems, a similar supply shall be kept on hand if the importance of the hazard is such that it cannot be shut down until recharges can be procured.

2-7.4 Storage. Storage of charging supplies of dry chemical shall be in a constantly dry area, and the dry chemical shall be contained in metal drums or other containers that will prevent the entrance of moisture even in small quantities. Prior to charging the dry chemical chamber, the dry chemical shall be checked carefully to determine that it is in a flowing condition.

2-8 Container. The dry chemical container and expellant gas assemblies shall be located near the hazard or hazards protected, but not where they will be exposed to a fire or explosion in these hazards.

2-8.1 The dry chemical container and expellant gas assemblies shall be located so as not to be subjected to severe weather conditions, or to mechanical, chemical, or other damage. When excessive climatic or mechanical exposures are expected, suitable enclosures or guards shall be provided.

2-8.2* The dry chemical container and expellant gas assemblies utilizing nitrogen shall be located where the ambient temperature is normally between –40°F and 120°F (–40°C and 48.9°C). Assemblies utilizing carbon dioxide shall be located where the ambient temperature is normally between 32°F and 120°F (0°C and 48.9°C). If temperatures are outside these limits, the equipment shall be listed for such temperatures, or methods shall be provided for maintaining the temperatures within the ambient ranges given.

2-8.3 The dry chemical container and expellant gas assemblies shall be located where they will be accessible to inspect, maintain, and service.

2-9 Distribution System.

2-9.1 Pipe and Fittings. Piping and fittings shall be of noncombustible material having physical and chemical characteristics such that its integrity under stress can be predicted with reliability. Pipe shall be galvanized steel, stainless steel, copper, or brass. Fittings shall be galvanized steel, stainless steel, copper, brass, galvanized malleable or ductile iron. The pressure rating of the pipe, fittings, and connection joints shall withstand the maximum expected pressure in the piping system. Black steel pipe and fittings may be used in relatively noncorrosive atmospheres. Special corrosion-resistant materials shall be used for corrosive atmospheres. When steel pipe incorporating welded joints or rolled groove fittings is used, a minimum wall thickness of 0.188 in. (5 mm) is permitted for pressures up to 300 psi (20.7 bar) in sizes 4 in. (101 mm) and larger. For pipe sizes less than 4 in. (101 mm) in welded or rolled groove pipe systems, a minimum wall thickness equivalent to Schedule 10 pipe is permitted for pressures up to 300 psi. When steel pipe is joined by threaded fittings or by cut groove couplings, the minimum pipe thickness shall be in accordance with Schedule 40 for pressures up to 300 psi. Brass and copper pipe shall be not less than the approximate Schedule 40 wall thickness (regular pipe) for pipe sizes of 6 in. (152 mm) or less. Pipe fittings shall be compatible with the piping materials and connection method.

2-9.1.1 Cast-iron pipe and fittings shall not be used.

2-9.1.2* Flexible piping (hose) shall be used only in accordance with the listings of a testing laboratory as they are stated for specific dry chemical fire extinguishing systems.

2-9.1.3 Piping for systems to be installed for protection of cryogenic liquid spill fires shall be protected from submergence in the liquid, localized liquid impingement, and the simultaneous exposure to cryogenic liquid and flame temperatures. Where the dry chemical supply lines are installed underground within the potential spill area, the individual branch lines shall be brought up through insulated sleeves. The insulated sleeves shall be extended above the maximum anticipated cryogenic liquid accumulation depth. Any subbranching above grade shall also be protected against localized impingement by the cryogenic liquid.

2-9.1.4 Other types of pipe or tubing that have been investigated and listed for this service may be used. The use of such pipe or tubing shall involve careful consideration of the following factors:

(a) Pressure rating

(b) Corrosion (chemical and electrolytic)

(c) Methods of joining

(d) Availability of fittings

(e) Resistance to fire exposure and rapid temperature changes

(f) Flow characteristics.

2-9.2* Arrangement and Installation of Pipe and Fittings. Piping shall be installed in accordance with good commercial practices.

2-9.2.1 All piping shall be laid out to produce the desired dry chemical flow rate at the nozzles, and care shall be taken to avoid possible restrictions due to foreign matter, faulty fabrication, or improper installation.

2-9.2.2 The piping system shall be securely supported and shall not be subject to mechanical, chemical, or other damage. Where explosions are possible, the piping system shall be hung from supports that are least likely to be displaced.

2-9.2.3 Pipe shall be reamed and cleaned before assembly, and after assembly the entire piping system shall be blown out with dry gas before nozzles or discharge devices are installed. Pipe-thread compound or tape shall not be used.

Exception: Pipe thread tape shall be permitted when installed in accordance with the manufacturer's listed installation manual.

2-9.3 Valves. All valves shall be listed for the intended use, particularly in regard to flow capacity and operation. Selector valves shall be of the quick-opening type, allowing essential free passage of the dry chemical without restriction.

2-9.3.1 Valves shall not be easily subject to mechanical, chemical, or other damage.

2-9.4 Discharge Nozzles. Discharge nozzles shall be listed for the use intended, in accordance with subsequent chapters.

2-9.4.1 Discharge nozzles shall be of adequate strength for use with the expected working pressures.

2-9.4.2 Discharge nozzles shall be of brass, stainless steel, or other corrosion-resistant materials, or be protected inside and out against corrosion. They shall be made of noncombustible materials and shall withstand the expected fire exposure without deformation.

2-9.4.3 All nozzles shall be designed and subsequently located, installed, or protected so that they are not subject to mechanical, environmental, or other conditions that would render them inoperative.

2-9.4.4 Discharge nozzles shall be so connected and supported that they may not be readily put out of alignment. Where nozzles are connected directly to flexible hoses, they shall be provided with mounting brackets or fixtures to assure that they can be aligned properly and that the alignment will be maintained.

2-9.4.5 Discharge nozzles shall be clearly marked for identification of type and size.

2-9.4.6 Discharge nozzles shall be provided with blow-off caps or other suitable devices or materials to prevent the entrance of moisture or other environmental materials into the piping. The protective device shall blow-off, open, or blow-out upon agent discharge.

2-9.5 Pipe Size and Nozzle Determination. Pipe sizes and nozzles shall be selected on the basis of calculations to deliver the required dry chemical flow rate at each nozzle or, for preengineered systems, in accordance with limitations set by a testing laboratory.

2-9.5.1 Equations, or graphs derived therefrom, shall be used to determine the pressure drop in the pipe line in engineered systems. This design information shall be based on tests performed by the manufacturer and confirmed by a testing laboratory. It is not required in pre-engineered systems.

2-10 Electrical Wiring and Equipment.

2-10.1* Installation. Electrical wiring and equipment shall be installed in accordance with NFPA 70, *National Electrical Code*.

2-11 Inspection, Maintenance, and Recharging.

2-11.1 General. The procedure for inspection, maintenance, and recharging of dry chemical extinguishing systems varies considerably. Minimal knowledge is necessary to perform a monthly "quick check" or monthly inspection in order to follow the inspection procedure as outlined in 2-11.2.

A trained person who has undergone the instructions necessary to reliably perform the maintenance and recharge service and has the manufacturer's service manual shall service the dry chemical fire extinguishing system at intervals not more than 6 months apart as outlined in 2-11.3.

2-11.1.1 System access for inspection and service that requires opening panels in fire chases and/or ducts shall not be permitted while any appliance(s) or equipment protected by that system are in operation.

2-11.2 Inspection.

2-11.2.1 On a monthly basis, inspection shall be conducted in accordance with the manufacturer's manual. As a minimum, this "quick check" or inspection shall include the following:

(a) The extinguishing system is in its proper location.

(b) Manual actuators are unobstructed.

(c) Tamper indicators and seals are intact.

(d) Maintenance tag or certificate is in place.

(e) No obvious physical damage or condition exists that may prevent operation.

(f) Pressure gage(s), if provided, are in operable range.

2-11.2.2 If any deficiencies are found, appropriate corrective action shall be taken immediately.

2-11.2.3 Personnel making inspections shall keep records for those extinguishing systems that were found to require corrective actions.

2-11.2.4 At least monthly the date the inspection was performed and the initials of the person performing the inspection shall be recorded.

2-11.3 Maintenance.

2-11.3.1 At least semiannually, maintenance shall be conducted in accordance with the manufacturer's maintenance manual. As a minimum, such maintenance shall consist of the following:

(a) Check to see that the hazard has not changed.

(b) Examine all detectors, expellant gas container(s), agent container(s), releasing devices, piping, hose assemblies, nozzles, alarms, and all auxiliary equipment.

(c)* Verify that the agent distribution piping is not obstructed.

(d) Examine the dry chemical. If there is evidence of caking, the dry chemical shall be discarded and the system shall be recharged in accordance with the manufacturer's instructions.

Exception: The dry chemical in stored pressure systems does not require semiannual examination, but shall be examined at least every 6 years.

(e) When semiannual maintenance of any dry chemical containers or system components reveals conditions such as but not limited to corrosion or pitting in excess of manufacturer's limits, structural damage or fire damage, repairs by soldering, welding, or brazing, the affected part(s) shall be replaced or hydrostatically tested in accordance with the recommendations of the manufacturer or the original certifying agency or both. The hydrostatic testing of dry chemical containers shall follow the applicable procedures outlined in Section 2-12.

(f) All dry chemical systems shall be tested, which shall include a check of the detection system, alarms, and releasing devices, including manual stations and other associated equipment. A discharge of the dry chemical normally is not part of this test.

(g) When the maintenance of the system(s) reveals defective parts that could cause an impairment or failure of proper operation of the system(s), the affected parts shall be replaced or repaired in accordance with the manufacturer's recommendations.

(h) The maintenance report, with recommendations, if any, shall be filed with the owner or with the designated party responsible for the system.

2-11.3.2 Fixed temperature sensing elements of the fusible metal alloy type shall be replaced at least annually or more frequently if necessary to assure proper operation of the system.

2-11.4 Recharging.

2-11.4.1 All extinguishing systems shall be recharged after use or as indicated by an inspection or when performing maintenance.

2-11.4.2 Systems shall be recharged in accordance with the manufacturer's instructions.

2-12 Hydrostatic testing. The following parts of dry chemical extinguishing systems shall be subjected to a hydrostatic pressure test at intervals not exceeding 12 years:

(a) dry chemical containers;

(b) auxiliary pressure containers; and

(c) hose assemblies.

Exception No. 1: Dry chemical containers from extinguishing systems having an agent capacity exceeding 150 lbs.

Exception No. 2: Auxiliary pressure containers not exceeding 2 in. outside diameter and less than 2 ft in length.

Exception No. 3: Auxiliary pressure containers bearing the DOT "3E" marking.

NOTE: DOT or CTC marked cylinders may require more frequent test intervals.

2-12.1 Dry chemical containers, auxiliary pressure containers, and hose assemblies shall be subjected to a hydrostatic test pressure equal to the marked factory test pressure or the test pressure specified by the manufacturer. No leakage, rupture, or movement of hose couplings is permitted. The test procedures shall be in accordance with the manufacturer's detailed written hydrostatic test instructions.

Exception: Containers bearing DOT or CTC marking shall be tested or replaced in accordance with the appropriate DOT or CTC requirements.

2-12.2 Dry chemical agent removed from the containers prior to hydrostatic testing shall be discarded.

2-12.3 Care shall be taken to ensure that all tested equipment is thoroughly dried prior to reuse.

2-12.4 To protect the hazard during hydrostatic testing, if there is no connected reserve, alternate protection acceptable to the authority having jurisdiction shall be provided.

Chapter 3 Total Flooding Systems

3-1 General Information.

3-1.1 Definition. A total flooding system means a supply of dry chemical permanently connected to fixed piping, with fixed nozzles arranged to discharge dry chemical into an enclosed space or enclosure about the hazard.

3-1.2 Uses. This type of system shall be used only where there is a permanent enclosure about the hazard that is adequate to enable the required concentration to be built up. The total area of unclosable openings shall not exceed 15 percent of the total area of the sides, top, and bottom of the enclosure.

3-1.2.1 Consideration shall be given to the elimination of probable sources of reignition because the extinguishing action of a dry chemical flooding system is transient.

3-1.2.2 Deep-seated fires involving solids subject to smoldering shall be protected by multipurpose dry chemical systems where the dry chemical can reach all surfaces involved in combustion. Bicarbonate-based dry chemicals shall not be used for protection against this type of fire.

3-1.3 General Requirements. Total flooding systems shall be designed, installed, tested, and maintained in accordance with the applicable rules in Chapter 2 and with the additional rules set forth in this chapter.

3-2 Hazard Specifications.

3-2.1 Enclosure. In the design of total flooding systems the characteristics of the enclosure shall be considered as follows:

3-2.1.1 The total area of unclosable openings for which no compensation is provided shall not exceed 1 percent of the total area of the sides, top, and bottom of the enclosure. Unclosable openings having an area in excess of 1 percent and not exceeding 5 percent shall be compensated for by the provision of additional dry chemical. Unclosable openings having an area in excess of 5 percent of the total enclosure area and not exceeding 15 percent shall be screened by local application of additional dry chemical. (*See 3-3.4.1.*)

3-2.2 Leakage and Ventilation. The leakage of dry chemical from the protected space shall be minimized since the effectiveness of the flooding system depends upon obtaining an extinguishing concentration of dry chemical.

3-2.2.1 Where possible, openings such as doorways, windows, etc., shall be arranged to close before, or simultaneously with, the start of the dry chemical discharge, or 3-3.4.1 shall be followed.

3-2.2.2 Where forced-air ventilating systems are involved, they shall either be shut down and/or closed before, or simultaneously with, the start of the dry chemical discharge, or 3-3.4.2 shall be followed.

3-3 Dry Chemical Requirements and Distribution.

3-3.1* General. The following factors shall be considered in the total flooding of enclosed spaces with dry chemical:

(a) Minimum quantity of dry chemical required

(b) Minimum rate of flow of dry chemical

(c) Spacing limitations of the nozzles.

Exception: In the case of pre-engineered systems, the rate of flow need not be considered, since it is governed by the piping and nozzle limitations verified by a testing laboratory. See Chapter 6.

3-3.1.1 The quantity of dry chemical and the flow rate shall be sufficient to create a fire extinguishing concentration in all parts of the enclosure.

3-3.1.2 The nozzles shall be placed so as to provide not less than the minimum design concentration of dry chemical in all parts of the enclosure. For fires in ordinary combustibles where multipurpose dry chemical shall be used for protection, additional dry chemical applied by local application may be required in order to protect adequately all exposed surfaces.

3-3.1.3 The nozzles shall be located so that the discharge will not be obstructed.

3-3.2 Volume Allowances. In calculating the net volume to be protected, allowance shall be permitted for permanently located structures that materially reduce the volume.

3-3.3 Rate of Application. In engineered systems the minimum design rate of application shall be based on the quantity of dry chemical and the maximum time to obtain the design concentration.

Exception: In pre-engineered systems, these factors are established for specific volume and other conditions given in the listing of such systems by testing laboratories. (See Chapter 6 and A-3-3.1.)

3-3.3.1 In engineered systems, the rate of application shall be such that the design concentration in all parts of the enclosure shall be obtained within 30 seconds.

3-3.4 Compensation for Special Conditions. Additional quantities of dry chemical and additional nozzles, if necessary, shall be provided to compensate for any special condition that may adversely affect the extinguishing effectiveness of the system.

3-3.4.1 Unclosable openings having areas in excess of 1 percent of the total area of the sides, top, and bottom of the enclosure, and not exceeding 5 percent, shall be compensated for by the use of supplemental dry chemical in the proportions of not less than 0.5 lb per sq ft (2.44 kg/m^2) of unenclosed opening, applied through the regular distribution system. When the unclosable openings have areas exceeding 5 percent of the total of the sides, top, and bottom of the enclosure, and not exceeding 15 percent, compensation shall be furnished by additional dry chemical in the proportion of not less than 1 lb per sq ft (4.88 kg/m^2) of unclosed opening, applied simultaneously by location application over the openings. A system that is listed by a testing laboratory for or including protection of unclosable openings may be used in lieu of the above.

3-3.4.2 For ventilating systems that will not be shut down, supplementary dry chemical shall be added to the protected volume through the regular distribution system. The supplementary dry chemical shall be added at the point or points of air inlet and shall be in proportion to the volume of air removal during the period of dry chemical discharge, calculating as if it were additional volume to be protected.

Exception: Pre-engineered systems listed for restaurant hood and duct protection are suitable for use with or without shutdown of the ventilation system or closure of dampers. See Chapter 6.

Chapter 4 Local Application Systems

4-1 General Information.

4-1.1 Definition. A local application system means a supply of dry chemical permanently connected to a system of fixed piping with nozzles arranged to discharge directly onto the fire.

4-1.2* Uses. Local application systems shall be used for the extinguishment of fires in flammable or combustible liquids, gases, and shallow solids, such as paint deposits, where the hazard is not enclosed or where the enclosure does not conform to the requirements for total flooding. Application of dry chemical shall be from nozzles mounted on the tank side or overhead.

4-1.3 General Requirements. Local application systems shall be designed, installed, tested, and maintained in accordance with the applicable requirements in Chapter 2 and with the additional requirements set forth in this chapter.

4-2 Hazard Specifications.

4-2.1 Extent of Hazard. The hazard shall be so isolated from other hazards or combustibles that fire will not spread outside the protected area. The entire hazard shall be protected. The hazard shall include all areas that are or may become coated by combustible or flammable liquids or shallow solid coatings, such as areas subject to spillage, leakage, dripping, splashing, or condensation, and all associated materials or equipment, such as freshly coated stock, drainboards, hoods, ducts, etc., that might extend fire outside or lead fire into the protected area.

Exception: Protection of the entire hazard may require the combined use of local application and total flooding systems, such as in a restaurant kitchen where surface cooking appliances can be protected by a local application system and the space above the grease filters in the hood can be protected by a combination local application-total flooding system. See Chapter 6.

4-2.2 Location. The design of the system shall consider the location of the hazard, which may be indoors, partly sheltered, or completely outdoors, so as to provide a discharge that will not be affected by winds or other stray air currents.

4-3 Dry Chemical Requirements and Distribution.

4-3.1 General. The following factors shall be considered in the design of local application systems:

(a) Minimum quantity of dry chemical

(b) Minimum flow rate

(c) Nozzle distribution patterns

(d) Nozzle placement limitations with respect to flammable liquid surfaces

(e) Possible obstruction to nozzle distribution pattern.

Exception: In the case of the pre-engineered systems, the rate of flow need not be considered since it is governed by the pipe and nozzle limitations verified by a testing laboratory (see Chapter 6 and A-3-3.1).

4-3.2 Draft Conditions. The quantity of dry chemical, the dry chemical flow rate, and the number of nozzles shall be sufficient to extinguish fires under the most severe wind or the most severe draft conditions expected in the hazard area.

4-3.2.1 The maximum allowable draft condition shall be that specified by a testing laboratory.

4-3.3 Nozzle Placement. The nozzles shall be placed so as to provide an extinguishing concentration of dry chemical over the entire hazard area during discharge.

4-3.3.1 The nozzles shall be placed about (tankside) or above (overhead), or a combination of about (tankside) and above (overhead) the flammable liquid surface within the limits of the listing in order to prevent splashing during discharge.

4-3.4 Coated Surfaces. Although it is recognized that fires on coated surfaces are less severe than fires in deep layer flammable liquids, such areas shall be treated as if they were deep layer flammable liquid areas because no distinction has been made in this standard.

4-3.5 Duration of Discharge. The minimum effective discharge time shall be determined by the required minimum quantity of dry chemical and the minimum application rate.

Exception: In the case of pre-engineered systems, these factors need not be considered since they are governed by the piping and nozzle limitations gathered by a testing laboratory. See Chapter 6.

4-3.5.1* In the case of engineered systems, the minimum discharge time shall be increased to compensate for any hazard condition that would require a longer discharge period to assure complete extinguishment.

Exception: Hot saponifiable fats do not require an extended discharge period when sodium bicarbonate-based dry chemical is the extinguishing agent.

4-4 Special Considerations. Where systems protect hazards that are normally heated, such as deep fat fryers, charbroilers, upright broilers, griddles, and ranges in kitchens, or wax tanks, the power or fuel supply to heaters shall be shut off automatically upon actuation of the extinguishing systems.

All shutdown devices shall be considered integral parts of the system and shall function with the system operation. This equipment shall be of the type that requires manual resetting prior to fuel or power being restored.

Chapter 5 Hand Hose Line Systems

5-1 General Information.

5-1.1 Definition. Hand hose line systems means a hose and nozzle assembly connected, by fixed piping or directly, to a supply of dry chemical.

5-1.2 Supply. A separate dry chemical supply may be provided for hand hose line use, or dry chemical may be piped from a central storage unit that may be supplying several hose lines or fixed manually or automatically operated systems (*see 2-3.2 and 2-3.3*).

5-1.3 Uses. Hand hose line systems shall be acceptable to supplement fixed nozzle fire protection systems or to supplement portable fire extinguishers for the protection of specific hazards for which dry chemical is a suitable extinguishing agent. These systems shall not be used as a substitute for dry chemical fire extinguishing systems equipped with fixed nozzles except where the hazard cannot be adequately or economically provided with fixed nozzle protection. The decision as to whether hose lines are applicable to the particular hazard shall rest with the authority having jurisdiction.

5-1.4 General Requirements. Hand hose line systems shall be installed and maintained in accordance with the applicable provisions of Chapters 2, 3, and 4, except as outlined below.

5-2 Hazard Specifications. Hand hose line systems shall be considered suitable for combatting fires in all hazards covered under Chapter 2 except those that are inaccessible and beyond the scope of manual fire fighting.

5-3 Location and Spacing.

5-3.1 Location. Hand hose line stations shall be placed so that they are easily accessible and have hose lines long enough to reach the most distant hazard that they are expected to protect. In general they shall be located so that they are not exposed to the hazard.

5-3.2 Spacing. If multiple hose stations are used, they shall be spaced so that any area within the hazard may be covered by one or more hose lines.

5-3.3 Actuation. Manual actuation of the dry chemical system shall be possible at each hose line station.

5-4 Dry Chemical Requirements.

5-4.1* Rate and Duration of Discharge. The rate and duration of discharge, and consequently the amount of dry chemical, shall be determined by the type and potential size of the hazard. A hand hose line shall have a sufficient quantity of dry chemical to permit its effective use for a minimum of 30 seconds. The minimum flow rate also shall be sufficient to prevent surging and interrupted discharge. These values for minimum flow rate shall be confirmed by a testing laboratory.

5-4.2 Provision for Use by Inexperienced Personnel. The possibility of these hose lines being used by inexperienced personnel shall be considered and adequate provision made so that there will be a sufficient supply of dry chemical to enable them to effect extinguishment of fires in the hazards that they are likely to encounter.

5-4.3 Simultaneous Use of Hose Lines. Where simultaneous use of two or more hose lines is possible, a sufficient quantity of dry chemical shall be available to supply the maximum number of nozzles that are likely to be used at any one time for at least 30 seconds and at the appropriate flow rates.

5-5 Equipment Specifications.

5-5.1 Hose. Hose lines on systems shall incorporate hose listed for this use. Normally, identifying marking on the hose will indicate the acceptability of the hose for this purpose.

5-5.2 Nozzle Assemblies. Nozzles shall be so designed that they can be handled by one person and shall incorporate a quick-opening shutoff arrangement to control the flow of dry chemical.

5-5.3 Hose Line Storage. The hose shall be coiled on a hose reel or rack so that it will be ready for immediate use without the necessity of coupling and may be uncoiled with a minimum of delay. If installed outdoors, it shall be protected against the weather.

5-5.4* Operation of Hose Lines.

5-5.4.1 The pressurizing valve shall remain in the open position during the entire fire fighting operation.

5-5.4.2 The hose lines shall be cleared of dry chemical immediately after use.

5-6 Training. All personnel who are likely to use this equipment shall be kept properly trained in its operation and in the fire fighting techniques applicable to this equipment.

Chapter 6 Pre-Engineered Systems

6-1 General Information.

6-1.1 Pre-engineered systems consist of components designed to be installed according to pretested limitations as listed.

6-1.2 Uses. Pre-engineered systems shall be installed to protect hazards within the limitations that have been established by the listing organization.

6-1.3 General Requirements. Pre-engineered systems may have special limitations, flow rates, and methods of application that differ from the requirements specified in Chapters 1-5 of this standard. Therefore, these systems shall be installed in accordance with the manufacturer's installation manual, which is referenced as part of the listing. Only system components referenced in the manufacturer's installation manual shall be used.

6-1.4 Inspection, Maintenance, Recharge. All pre-engineered dry chemical systems shall be periodically serviced in accordance with the provisions outlined in Sections 2-11 and 2-12.

6-2 Types of Systems.

6-2.1 Pre-engineered dry chemical systems may be of the following types:

(a) Local application

(b) Total flooding

(c) Hand hose line

(d) Combination of local application and total flooding.

6-3 Restaurant Hood, Duct, and Cooking Appliance Systems.

6-3.1 Each protected cooking appliance(s), individual hood(s), and branch exhaust duct(s) directly connected to the hood shall be protected by a system or systems designed for simultaneous operation.

6-3.2 All cooking appliances protected by a pre-engineered automatic dry chemical extinguishing system shall be provided with an automatic means to ensure the shutdown of fuel or power to the protected appliances upon system actuation (*see Section 4-4*).

NOTE: Exhaust fans do not need to be shut down or dampers closed upon system actuation since the systems have been tested under both zero and high velocity flow conditions.

6-3.3 Systems protecting two or more common hoods, or plenums, or both shall be installed to ensure the simultaneous operation of all systems protecting the hoods, plenums, or both, or associated cooking appliances located below the hoods.

6-3.4* Automatic protection shall be provided for all portions of a common exhaust duct. This shall be accomplished by one of the following methods:

(a) Simultaneous operation of all systems on protecting the common exhaust duct. See Figure A-6-3.4(a).

(b) A system or multiple systems operating simultaneously for the protection of the common duct only. See Figure A-6-3.4(b).

(c) Multiple systems operating individually to protect a portion of the common duct only. See Figure A-6-3.4(c).

(d) One or more nozzles from a single hood and duct system protecting the entire common duct. See Figure A-6-3.4(d).

(e) One or more nozzles from multiple hood and duct systems each protecting a portion of the common duct so that the entire common duct is protected. See Figure A-6-3.4(e).

(f) Multiple systems operating independently, each protecting a portion of the common duct and/or a hood or restaurant.

6-3.4.1 A fusible link or heat detector shall be located at each branch duct to common duct connection. Actuation of any branch duct to common exhaust duct fusible link or heat detector shall actuate the system, protecting that portion of the common duct, and shut off fuel or power to all protected hazards connected to that portion of the common exhaust duct.

6-3.4.2 The building owner(s) shall be responsible for the protection of the common exhaust duct(s) used by more than one tenant.

The tenant shall be responsible for the protection of common exhaust duct(s) serving hoods located within the tenant's space and up to the point of connection to the building owner's common exhaust duct. The tenant's common duct shall be considered a branch duct to the building owner's common duct.

6-3.5 Fusible metal alloy type links shall be replaced at least annually (*see 2-11.3.2*).

6-3.6 A fusible link or heat detector shall be provided above each cooking appliance or group of appliances protected by a single nozzle.

Exception: A fusible link or heat detector is not required above cooking appliances located directly below the exhaust duct, provided a fusible link or heat detector is installed at or within 12 in. (305 mm) of the entrance to the duct.

6-3.7 Discharge nozzles shall be provided with blow-off caps or other suitable devices or materials to prevent the entrance of moisture or other environmental materials into the piping. The protective device shall blow-off, open, or blow-out upon agent discharge.

6-3.8 The owner of the restaurant shall be provided with a copy of the manufacturer's installation and maintenance manual or owner's manual, which describes system operation, required maintenance, and recharging.

6-4 Vehicle Fueling Service Station Systems.

6-4.1 All vehicle fueling areas protected by two or more systems shall be connected for simultaneous operation.

6-4.2 Protected area shall include the area within the arc scribed by the nozzle end of the hose on each vehicle fuel dispenser.

CAUTIONARY NOTE: The manufacturer of the system shall be consulted to determine the need for additional coverage under adverse wind conditions.

6-4.3 Suitable means shall be provided to contain the fuel spill within the protected area. (*See NFPA 30, Flammable and Combustible Liquids Code.*)

6-4.4 Equipment shall be provided to simultaneously shut down all vehicle fuel dispensers upon system actuation. In the event of a system discharge, the hazard being protected shall not be returned to service until such time as the system is recharged and operational.

6-4.5 Automatic detection and actuation of the extinguishing system shall be provided. The manufacturer's installation manual shall be consulted regarding the type and location of the detectors.

6-4.6 A remote manual system actuator shall be provided in a conspicuous and accessible location away from the vehicle fuel dispensers and protected area.

6-4.7 All manual actuators shall be provided with operating instructions. These instructions may include the use of pictographs and shall have lettering at least 1/4 in. (6.35 mm) in height. (*See 2-6.3.4.*)

6-4.8 Discharge nozzles shall be provided with blow-off caps or other suitable devices or materials to prevent the entrance of moisture or other environmental materials into the piping. The protective device shall blow-off, open, or blow-out upon agent discharge.

6-4.9 All discharge nozzles shall be located so as to minimize the likelihood of damage or misalignment and within the limitations and constraints of the manufacturer's installation manual.

6-5 Systems for the Protection of Mobile/Self-Propelled Equipment.

6-5.1 Only pre-engineered dry chemical systems, including detection systems that have been listed for such use, shall be installed on mobile/self-propelled equipment. For information on mobile surface mining equipment, see NFPA 121, *Fire Protection for Self-Propelled and Mobile Surface Mining Equipment.*

6-5.2 Compartments or areas that could be subject to fire shall be protected in accordance with the manufacturer's installation manual.

6-5.3 Each protected compartment or area shall be provided with a listed fire detection device specified in the manufacturer's installation manual to automatically actuate the extinguishing system.

Exception: Mechanical operation only may be provided if acceptable to the authority having jurisdiction.

6-5.4 Only the flexible hose and hose fittings specified in the manufacturer's installation manual shall be used.

6-5.5 All discharge nozzles shall be provided with caps or other suitable device to prevent the entrance of moisture or foreign materials into the piping.

6-5.6 All discharge nozzles shall be located to minimize the likelihood of damage or misalignment and within the limitations and constraints of the manufacturer's installation manual.

6-5.7 Fusible metal alloy type links used on mobile/self-propelled equipment shall be replaced at least annually (*see 2-11.3.2*).

6-5.8 Location of agent containers, expellant gas cartridges or cylinders, and manual actuator station(s) shall be appropriate to each application, protected against physical damage, and accessible.

6-5.9 At least one easily accessible manual system actuator shall be provided for use by the equipment operator.

6-5.10 An additional manual system actuator shall be located so that it is in the path of egress and operable from ground level.

6-5.11 If the system is provided with a discharge delay device, both audible and visual alarms shall be provided to warn of the impending system discharge.

6-5.12 In the event of system discharge, the vehicle being protected shall not be returned to service until such time as the system is recharged and operational.

6-6 Hand Hose Line Systems.

6-6.1 Pre-engineered dry chemical hand hose line systems may be provided with turrets, skid-mounted hose reels, remote hose reels, or combinations of the above.

6-6.2 The length and size of piping, of hose, and type of nozzles shall be within the limitations stated in the manufacturer's installation manual.

6-6.3 Differences in elevation between the dry chemical storage tank and each turret or hose reel shall be within the limitations of the manufacturer's installation manual.

6-6.4 If multiple cylinders are used to pressurize the dry chemical agent containers, each cylinder shall be provided with a pressure gauge and manual means of operation.

Exception: Slave cylinders without manual actuators are permitted if at least two master cylinders with manual actuators are provided.

6-6.5 Discharge nozzles shall be provided with blow-off caps or other suitable devices or materials to prevent the entrance of moisture or other environmental materials into the piping. The protective device shall blow-off, open, or blow-out upon agent discharge.

Exception: Only one manual actuator needs to be provided for self-contained skid-mounted systems.

6-6.6 Each turret and hose reel shall be provided with a shutoff nozzle or flow control valve.

6-6.7 An integral method shall be provided to blow out all system piping and hose reels after any use.

6-6.8 Turret nozzles shall be provided with caps or other suitable devices to prevent moisture or foreign materials from entering the turret or piping.

Chapter 7 Referenced Publications

7-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

7-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 70-1990, *National Electrical Code*

NFPA 71-1989, *Standard for the Installation, Maintenance and Use of Signaling Systems for Central Station Service*

NFPA 72A-1987, *Standard for the Installation, Maintenance and Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm and Supervisory Service*

NFPA 72B-1986, *Standard for the Installation, Maintenance and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service*

NFPA 72C-1986, *Standard for the Installation, Maintenance and Use of Remote Station Protective Signaling Systems*

NFPA 72D-1986, *Standard for the Installation, Maintenance and Use of Proprietary Protective Signaling Systems*

7-1.2 Other Publication. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E380-1986, *Standard for Metric Practice*

Appendix A

This Appendix is not a part of the requirements of this NFPA standard, but is included for information purposes only.

A-1-1 Scope. The dry chemical systems described in this standard are designed to discharge dry chemical from fixed nozzles and piping or from hose lines by means of an expellant gas. The intent of the standard is to present the design considerations applicable to these systems.

Because the flow of dry chemical (solid particles suspended in a gaseous medium) does not follow general hydraulic theories, most of the flow principles have been determined experimentally. The dry chemicals produced by various manufacturers usually are not identical in all characteristics, and each manufacturer designs equipment for use with a specific dry chemical. Therefore, system design principles applicable to the products of one manufacturer are not applicable to the products of another manufacturer. As a result, it is not practical to include system design details as a part of this standard.

It is now generally accepted that the flame extinguishing properties of dry chemicals are due to the interaction of the particles to stop the chain reaction that takes place in flame combustion. Dry chemicals vary in their flame extinguishing effectiveness. Multipurpose dry chemical owes its effectiveness in extinguishing fires in ordinary combustibles, such as wood and paper, to the formation of a glow-retarding coating over the combustible material. For additional information on dry chemicals and their extinguishing characteristics, see A-2-1.

A-2-1 Agent Characteristics. A dry chemical extinguishing agent is a finely divided powdered material that has been specially treated to be water repellent and capable of being fluidized and free-flowing so that it may be discharged through hose lines and piping when under expellent gas pressure. Dry chemicals currently in use may be described briefly as follows:

1. Sodium Bicarbonate-($NaHCO_3$-) Based Dry Chemical.

This agent consists primarily of sodium bicarbonate and is suitable for use on all types of flammable liquid and gas fires (Class B) and also for fires involving energized electrical equipment (Class C).

Its effect on fires in common cooking oils and fats is particularly good, as in combination with these materials the sodium bicarbonate-based agent reacts to form a type of soap (saponification), which floats on the liquid surface, such as in deep fat fryers, and effectively prevents reignition of the grease.

Sodium bicarbonate-based dry chemical is not generally recommended for the extinguishment of fires in ordinary combustibles (Class A), although it may have a transitory effect in extinguishing surface flaming of such materials.

2. Dry Chemicals Based on the Salts of Potassium.

Commercially available agents are essentially potassium bicarbonate ($KHCO_3$), potassium chloride (KCL), and urea-based potassium bicarbonate ($KC_2N_2H_3O_3$). All three agents are suitable for use on all types of flammable liquid and gas fires (Class B) and also for fires involving energized electrical equipment (Class C).

It is generally recognized that salts of potassium are more effective in terms of chemical extinguishment mechanisms than sodium salts in extinguishing Class B type fires, except those in deep fat fryers and other cooking equipment.

Dry chemicals based on the salts of potassium are not generally recommended for the extinguishment of fires in ordinary combustibles (Class A), although they may have a transitory effect in extinguishing surface flaming of such materials.

3. Multipurpose Dry Chemicals.

This agent has as its base monoammonium phosphate ($NH_4H_2PO_4$) and is similar in its effect on Class B and Class C fires to the other dry chemicals. However, it does not possess a saponification characteristic and should therefore not be used on deep fat fryers. Unlike the other dry chemicals, it does have a considerable extinguishing effect on Class A materials. The agent, when heated, decomposes to form a molten residue that will adhere to heated surfaces. On combustible solid surfaces (Class A) this characteristic excludes the oxygen necessary for propagation of the fire.

4. Foam-Compatible Dry Chemicals.

When or where foam dry chemical systems are used or proposed for the protection of a hazard, the manufacturer should be consulted as to the compatibility of the agents.

Extinguishing Mechanisms. The detailed mechanisms by which dry chemical agents extinguish fires have not been completely determined. However, it is generally accepted that the primary extinguishing mechanisms include interruption of the chain reaction sequence by chemical reactions, reduction of liquid fuel evaporation rates by reduction in flame radiation at the liquid surface, and inerting effects due to reduction of oxygen concentration within the active fire zone. Secondary extinguishing mechanisms may include heat absorption effects (particularly at high dry chemical concentrations), additional cooling effects due to the formation of water vapor by the pyrolysis processes, additional inerting effects due to the formation of carbon dioxide by the pyrolysis of the dry chemical, and fire retardant effects due to surface coatings.

The effectiveness of the chemical reaction mechanisms differs with the currently used dry chemical agents and is believed to be the primary reason for the differences in overall effectiveness of the different agents at critical extinguishing flow rates. The physical mechanisms, such as reduction of the flame feedback radiation and reduction of oxygen concentrations, are significantly influenced by dry chemical concentrations in the flame zone as well as the dry chemical agent physical properties. The more important extinguishing mechanisms are discussed in greater detail in the following paragraph.

The flame chain reaction sequence is a detailed set of chemical reactions in an oxidative combustion process. The rates at which the various reactions occur determine the extent of pyrolysis. The reactions are best illustrated in terms of a simple hydrocarbon such as methane, CH_4, where the probable reactions are as follows:[1]

$2CH_4 + 2O_2 \; 2CH_3 + OH + 3O + H$	Chain Initiation
$CH_3 + O_2 \; H_2CO + OH$	
$2O_2 + 2H \; 2OH + 2O$	
$CH_4 + OH \; CH_3 + H_2O$	
$H_2CO + O \; HCO + OH$	Chain Initiation
$HCO \; H + CO$	
$CO + OH \; CO_2 + H$	
$HOH \; 2H_2O + O$	
$CO + O \; CO_2$	
$CO + 2OH \; CO_2 + H_2O$	Chain Initiation

The basic scheme involves initiation of the chain reaction, in this case the generation of CH_3, OH, O and H radicals. These radicals react with fuel materials and oxygen, resulting in the generation of species that in turn react to produce more radicals. In this way, the chain reaction propagates itself. Normal termination of the chain reaction occurs when the radicals necessary to propagate the chain reaction are destroyed through recombination or by chemical reaction.

It is widely accepted that two basic mechanisms are involved in the chemical extinguishing action of a dry chemical and that their contribution to the overall extinguishing effectiveness differs with each type of dry chemical agent. However, both mechanisms are based upon the ability of the agent to cause termination in the chain reaction of the fuel oxidizer combination.

One chemical mechanism involves the increase in the extinguishing effectiveness that is observed with decreasing median particle size. This is most generally discussed in terms of the total surface area of all the particles, or specific surface area, rather than median particle size. In general, the higher the specific surface area, the more effective the agent within the constraints imposed by hardware considerations. The argument advanced is that decreasing the median particle size (increasing the specific surface area) affords more active surface for radicals generated in the flame to recombine on, thus accelerating the termination of the chain reaction occurring within the flame. The other chemical mechanism involves the formation of chemical species capable of reacting with chain-propagating radicals.[2] It is believed that finely divided salts containing Na or K, because of a high surface area, exhibit good heat transfer characteristics resulting in vaporization of the highly reactive metal, or metal hydroxide, that can efficiently scavenge H or OH radicals in the chain reaction propagation in the flame, resulting in chain termination. In general, the chemical extinguishing reactions become more energetically favorable as the atomic weight of the metal ion increases within the metals of Group IA of the Periodic Table.

The level of effectiveness of agents based upon monoammonium phosphate, $NH_4H_2PO_4$, which has been found to be slightly less than that of agents based on potassium salts, cannot readily be explained by the foregoing theories. The reaction of this material with flame radicals is energetically less probable. It is more likely that a complex reaction sequence, involving a complex form of the anion (H_2PO_4)-, occurs. This material can undergo extensive endothermic (energy-absorbing) reactions that tend to cool the flame and affect the chain reaction sequence by removing energy from the system. An increase in effectiveness with increasing specific surface is also observed with this material.

[1]Westenburg, A. A. and Fristrom, R. M., J. Phys., Chem. 65 591 (1961).

[2]Friedman, R. and Levy, J. B., Combustion and Flame, 7 195 (1963).

In addition to the interruption of the flame process by chemical chain breaking and formation of chemical compounds, dry chemicals also utilize mechanical disturbance to aid in extinguishing flames. This characteristic can be readily observed in Class B fires when the dry chemical particles come between the fuel source and the burning vapors. A noticeable heat shielding effect is also apparent since the dry chemical particles prevent some reradiation of the flames to the fuel source, thus reducing the rate at which combustible vapors are produced. The softening and adhesive characteristics of monoammonium phosphate dry chemical, when heated, serve as an added mechanical disturbance to the Class A type fire by coating burning materials with an impervious layer.

A-2-2.1 Gas fires normally should not be extinguished unless the source of burning gas can be shut off because an explosive mixture may be formed with air that, if ignited, may cause greater damage than the original fire.

Factors that determine if the gas fire should be extinguished prior to shutting off the gas supply are:

(a) *Accessibility of gas shutoff valves.* Where water hose streams are not available, it may be necessary to extinguish the fire in order to reach the shutoff valves.

(b) *The proximity of other flammable or combustible materials.* If ignition of these materials could result in a more hazardous condition, the fire may have to be extinguished prior to gas shutoff.

(c) *Personnel rescue.* Dry chemical should be applied at flow rates and discharge patterns that will be effective. Gas line flange, line rupture, or impinging fires may require special flow rates and discharge patterns.

A-2-2.2.3 Monoammonium phosphate and potassium chloride are slightly acidic and in the presence of moisture can corrode metals such as steel, cast iron, and aluminum.

Potassium bicarbonate, sodium bicarbonate, and urea-based potassium bicarbonate are slightly basic and in the presence of moisture can corrode metals such as aluminum, aluminum brass, aluminum bronze, and titanium.

Such corrosion will vary from a dull or tarnished finish to mild surface corrosion. Corrosion need not be of concern when accompanied by prompt cleanup. For the most part, these dry chemical agents can be readily cleaned up by wiping, vacuuming, or washing the exposed materials. Monoammonium phosphate-based agent will require some scraping and washing if exposed surfaces were hot when the agent was applied.

A-2-4 Hazards to Personnel. Dry chemical fire extinguishing agents are considered nontoxic from a physiological point of view. However, as with any finely divided material, they may produce mild irritation effects, especially when used in an enclosed area. In general, these effects are neither serious nor permanent.

For more specific guidance on individual dry chemical extinguishing agent components and their hazards to personnel (Threshold Limit Values), consult the dry chemical manufacturer.

A-2-6 See: NFPA 71, *Standard for the Installation, Maintenance and Use of Central Station Signaling Systems*; NFPA 72A, *Standard for the Installation, Maintenance and Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm and Supervisory Service*; NFPA 72B, *Standard for the Installation, Maintenance and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service*; NFPA 72C, *Standard for the Installation, Maintenance and Use of Remote Station Protective Signaling Systems*; NFPA 72D, *Standard for the Installation, Maintenance and Use of Proprietary Protective Signaling Systems*; and NFPA 72E, *Standard on Automatic Fire Detectors*, as applicable to detection, alarm and control functions for dry chemical extinguishing systems.

A-2-6.3.4 Common exhaust ducts normally are located in concealed areas such that the need for manual discharge of the system may not be readily apparent. It is recommended that the number and location of remote controls, if any, be given careful consideration.

A-2-6.5 If only local alarms are provided, consideration should be given to transmitting this alarm to a constantly attended location.

A-2-7.3 Reserve Supply. A fully charged reserve unit permanently connected to the system is desirable and may be required by the authority having jurisdiction.

A-2-8.2 Listed systems for use at higher temperatures up to 210°F (99°C) or lower temperatures down to –65°F (–54°C) are available from most system manufacturers, or special systems can be specially designed for extreme temperature(s) conditions.

A-2-9.1.2 The piping for a dry chemical system embodies distinctive features necessitated by the characteristics of the agent. The use of flexible piping or hoses in a dry chemical system introduces a number of things to be considered that do not normally affect rigid piping. The most important of these is the nature of any changes of direction. The minimum radius of curvature for any flexible hose to be used in a dry chemical system is usually shown in the listing information for a particular system. Other areas of concern that are evaluated in the test for listing are resistance to the effects of vibration, flexure, tension, torsion, temperature, flame, compression, and bending. It is also necessary for the hose to have the strength to contain the dry chemical during discharge and be made of materials that will be resistant to atmospheric corrosion.

A-2-9.2 Dry Chemical Piping. The following material enumerates some of the necessary considerations that must be incorporated when piping a mixture of dry chemical and expellant gas. The flow of the mixture of dry chemical and gas does not strictly follow general hydraulic principles because it is two-phase flow. The flow characteristics are dependent upon the composition and physical characteristics of the type and make of the dry chemical being used, the type of expellant gas being used, and the design of the equipment being used.

Pre-engineered systems do not need calculations for flow rate, pressure drop, and nozzle pressure since they have been tested for fire extinguishment with minimum and maximum piping limitations, including length of pipe and number and type of elbows, and minimum and maximum temperature limitations. These limitations have been verified by testing laboratories and are published in the manufacturer's installation manual.

Engineered systems are calculated to show that the proper flow rate and nozzle pressure are obtained with the pressure drop occurring in the piping layout. The necessary charts, graphs, and nozzle pattern information must be obtained from the equipment manufacturer and are verified by testing laboratories.

The pipe, fittings, valves, etc., used to distribute the dry chemical should be as specified in 2-9.1 and 2-9.2 of this standard.

Changes in direction of flow causes separation of expellant gas and dry chemical. To provide proper distribution of dry chemical upon splitting the stream, special attention must be given to the method in which an approach is made to a tee after a change in direction. Certain acceptable methods are shown in Figures A-2-9.2(a) and A-2-9.2(b). Other methods and equipment may be recognized by a testing laboratory in its listings.

A-2-10.1 Regular service contracts with the manufacturer or his authorized installing or maintenance company are recommended.

A-2-11.3.1(c) The following methods that may be used for verifying that the piping is not obstructed:

(a) dissassemble all piping

(b) purge piping with nitrogen or dry air

(c) conduct full or partial discharge test

(d) other methods recommended by the manufacturer.

A-3-3.1 The limiting specifications for a dry chemical system are a function of the flow characteristics of the particular dry chemical and equipment used by the manufacturer of the system. Therefore, it is not possible to specify in this standard the exact values for the quantity required, rate of flow required, or nozzle distribution. The above considerations are carried in this standard to point out the important features that should be made available to the purchaser, inspector, or other authorities charged with the examination and evaluation of this system. These data should be established by investigation and tests confirmed by a testing laboratory.

A-4-1.2 Examples of hazards that may be successfully protected by local application systems include dip tanks, quenching oil tanks, spray booths, oil-filled electrical transformers, vapor vents, deep fat fryers, etc.

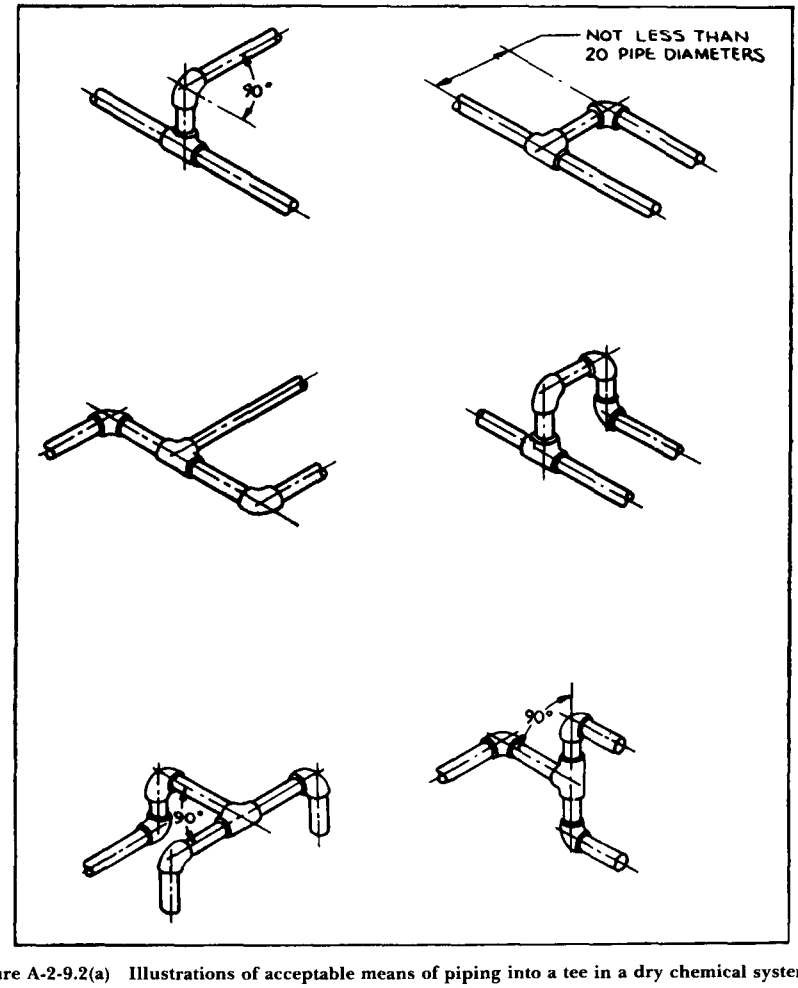

Figure A-2-9.2(a) Illustrations of acceptable means of piping into a tee in a dry chemical system.

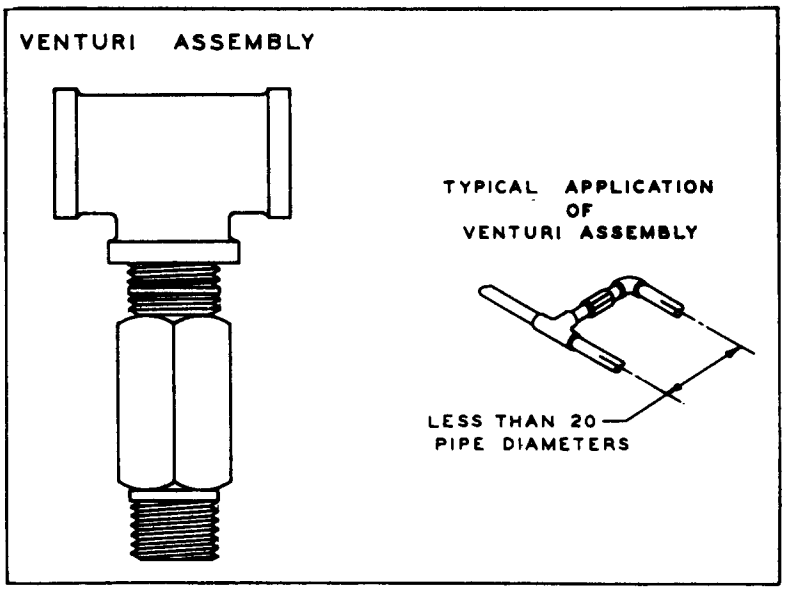

Figure A-2-9.2(b).

A-4-3.5.1 Sodium bicarbonate is decomposed by heat to form carbon dioxide, water vapor, and sodium carbonate. The latter reacts with saponifiable fats to form soap and simultaneously releases additional carbon dioxide. The resulting soap-foam forms a lasting blanket over the hot fat and prevents both flame ignition and autoignition.

A-5-4.1 An unusually low flow rate will cause the dry chemical to separate from the expellant gas while within the pipe and/or hose, resulting in uneven flow from the nozzle.

A-5-5.4 Operation of hand hose line systems depends on manual actuation and manipulation of a discharge nozzle. Speed and simplicity of operation are essential.

A-6-3.4 One example of each acceptable method is presented below. These figures are not intended to be all inclusive.

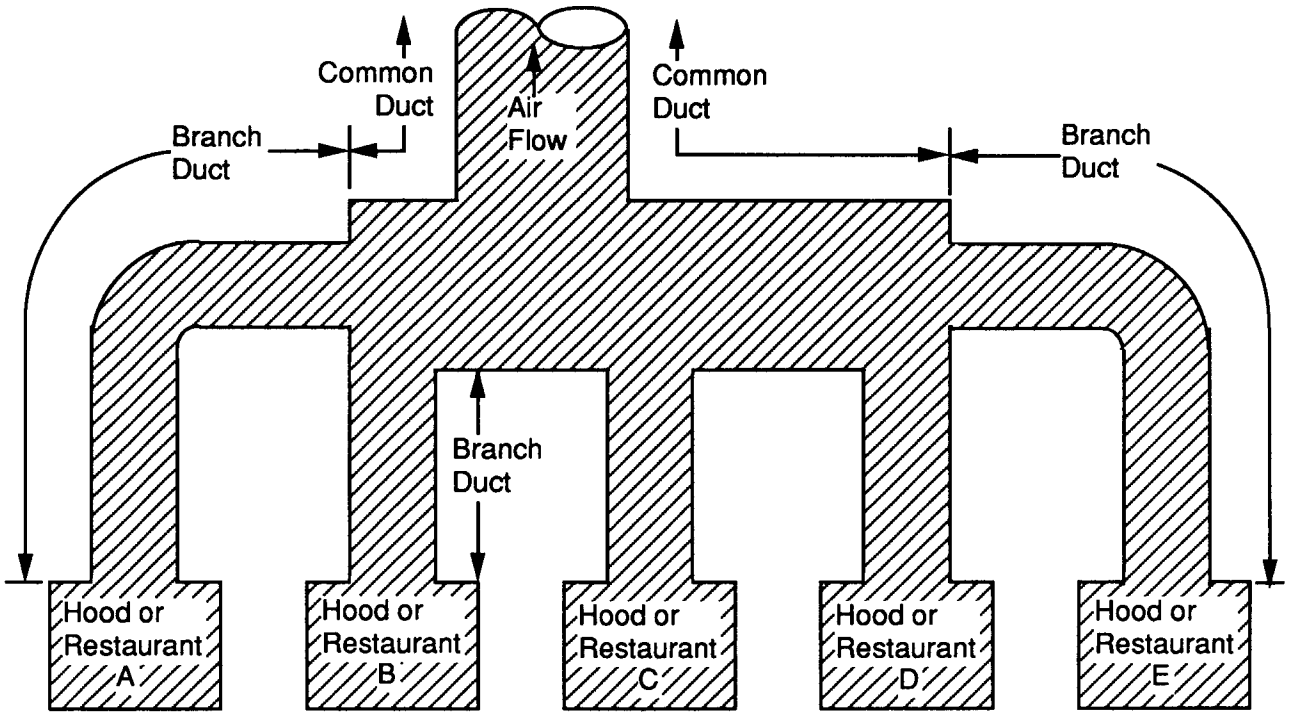

Figure A-6-3.4(a).

Simultaneous operation of all systems.

Separate extinguishing systems in all hoods or restaurants that are interconnected and operate simultaneously if a fire occurs in any hood or restaurant.

SCENARIO:

A fire originates in hood or Restaurant "A." The system protecting appliances of hood or Restaurant "A" is actuated. Simultaneously, the systems protecting appliances of hoods or Restaurants B, C, D, and E are also actuated. All fuel or power to all protected appliances is shut down in conjunction with the simultaneous discharges.

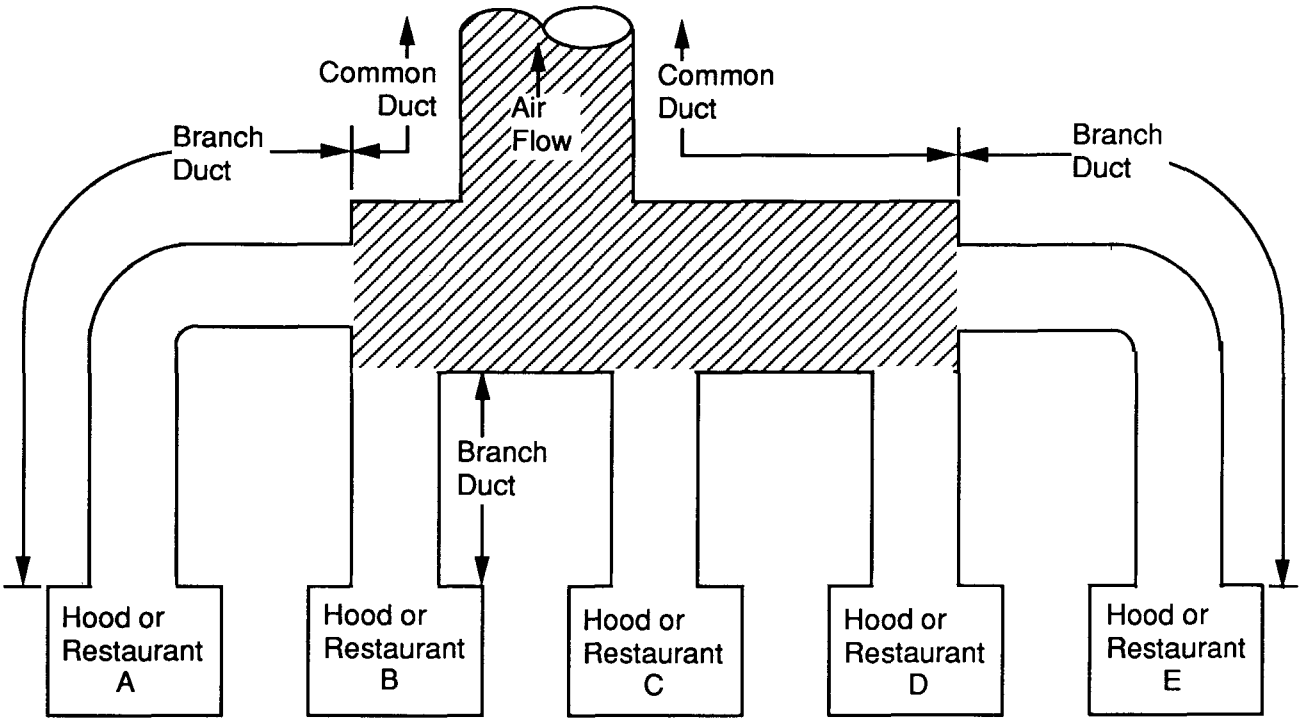

Figure A-6-3.4(b).

A single system or multiple systems operating simultaneously for the protection of the common duct only.

A single common duct extinguishing system that, when actuated, extinguishes the fire in the common duct and shuts down fuel and power to all protected appliances in hoods or restaurants connected to the common duct.

SCENARIO:

A fire originates in hood or restaurant "B" and spreads to the common duct. The system(s) protecting the common duct automatically detects the fire and discharges the agent into the common duct. At the same time, all fuel or power to all protected appliances in all hoods or restaurants served by the common duct is to be shut down.

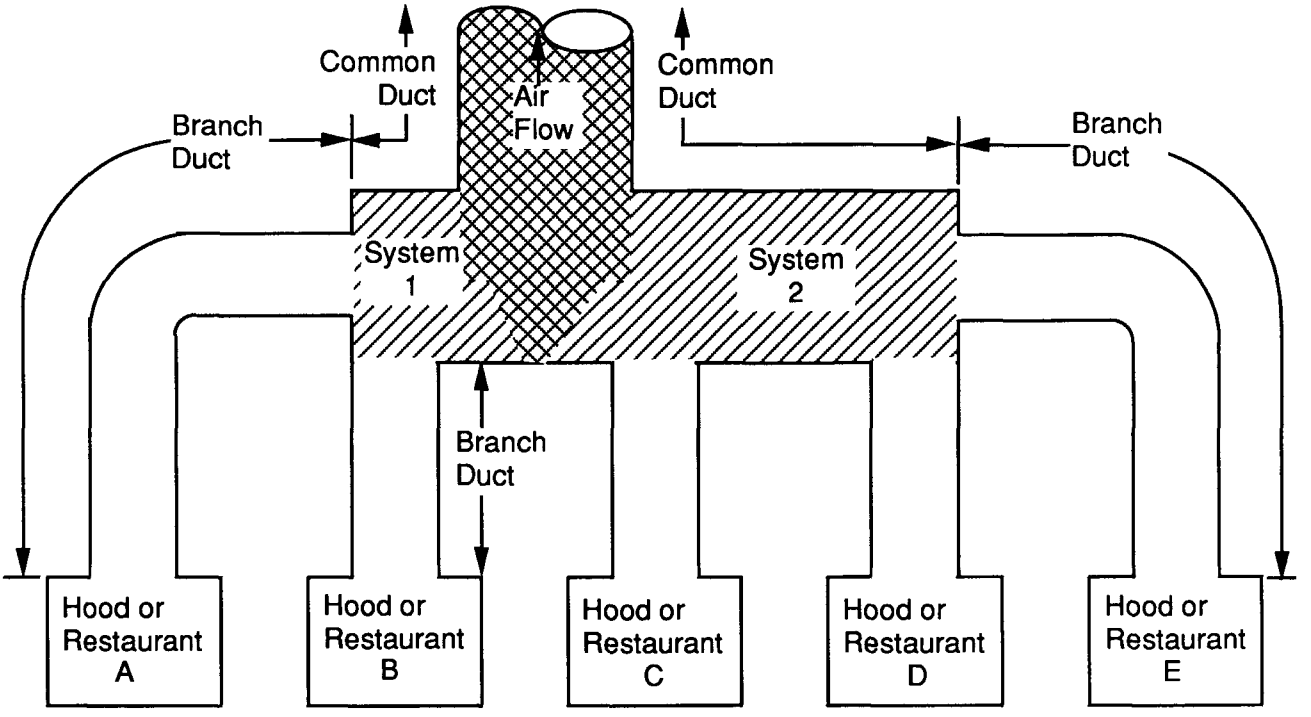

Figure A-6-3.4(c).

Multiple systems operating independently for the protection of portions of the common duct only so that the entire common duct is protected.

A separate common duct extinguishing system that, when activated, discharges agent into its segment of the common duct and shuts down fuel and power to all protected appliances in hoods or restaurants connected to that protected segment of the common duct.

SCENARIO:

A fire originates in hood or Restaurant "A" and spreads to the common duct. Common duct system #1 automatically detects the fire and discharges the agent into the common duct. At the same time, all fuel or power to all protected appliances in both hoods or restaurants A and B is to be shut down. Hoods or Restaurants C, D, and E may remain in operation unless system #2 also detects the fire and is actuated.

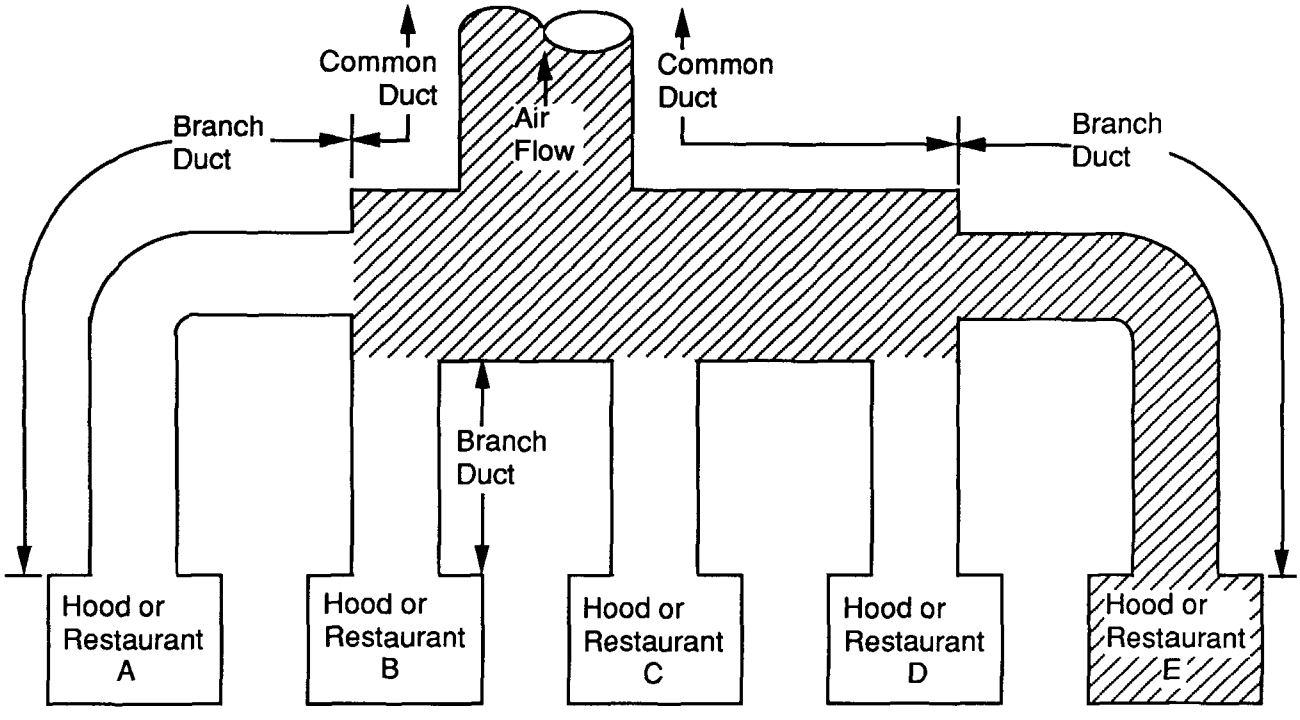

Figure A-6-3.4(d).

One or more nozzles from a single hood and duct system protecting the entire common duct.

An extinguishing system that protects a single hood or restaurant and the common duct. A fire in the common duct actuates the extinguishing system and shuts down fuel and power to all hoods or restaurants connected to the common duct.

SCENARIO #1:

A fire originates in hood or restaurant "E". The system automatically detects the fire and discharges agent both on the protected appliances and hood or restaurant "E" and throughout the common duct. At the same time, all fuel and power to all protected appliances serviced by the common duct shall be shut down.

SCENARIO #2:

A fire originates in hood or restaurant "B" and spreads to the common duct. The system protecting the common duct (from hood or restaurant "E") automatically detects the fire and discharges agent both into the common duct and on the appliances and hood or restaurant "E". At the same time, all fuel or power to all protected appliances is shut down.

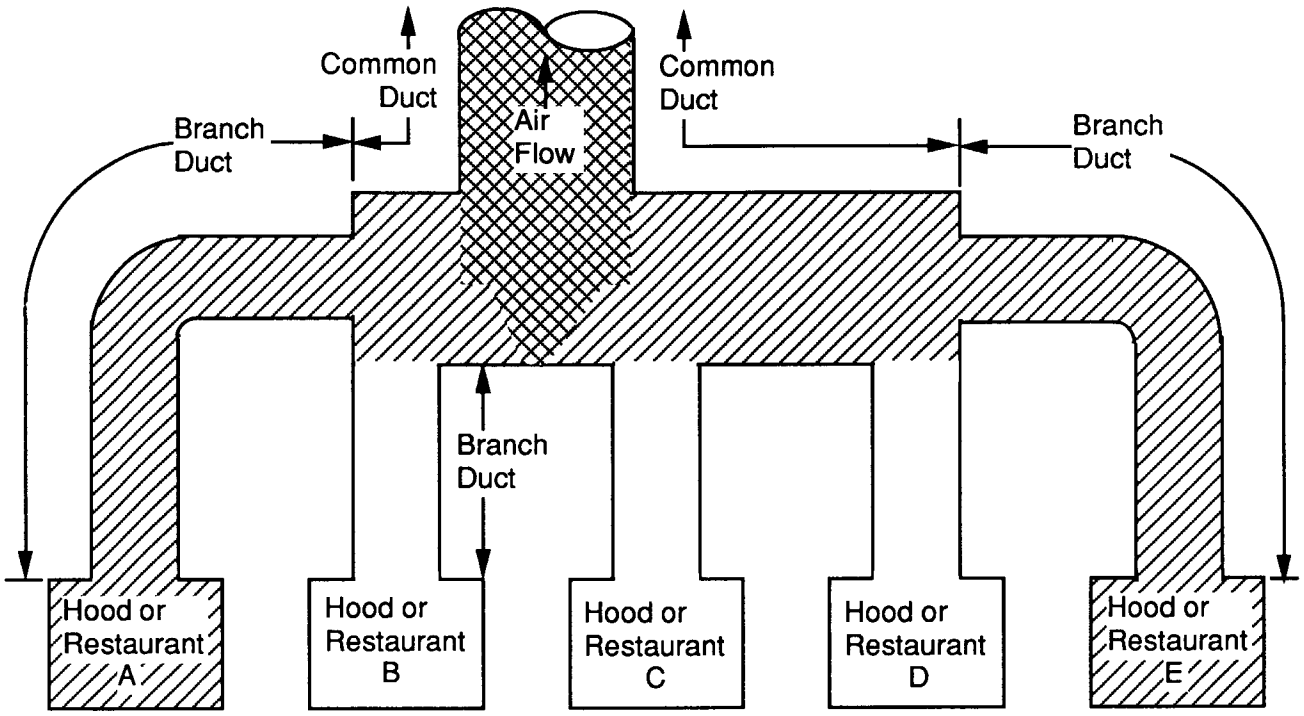

Figure A-6-3.4(e).

One or more nozzles from multiple hood and duct systems not necessarily operating simultaneously, each protecting a portion of the common duct so that the entire common duct is protected.

An extinguishing system that protects a single hood or restaurant and a portion of the common duct. A fire in the hood or restaurant or the protected portion of the common duct actuates the system in the hood or restaurant and shuts down fuel and power only to protected appliances in those hoods or restaurants connected to the protected portion of the common exhaust duct.

SCENARIO #1:

A fire originates in hood or restaurant "B" and spreads to the common duct. The common duct system (from hood or restaurant "A") automatically detects the fire and discharges agent both in the common duct and on the protected appliances in hood or restaurant "A". At the same time, all fuel or power to protected appliances in hoods or restaurants A and B is shut down. Hoods or Restaurants C, D, and E may remain in operation unless the system protecting their portion of the common duct also detects the fire and is acuated, at which time agent will be discharged into hood or restaurant "E" and the fuel or power shut down to protected appliances in hoods or restaurants C, D and E.

SCENARIO #2:

A fire originates in hood or restaurant "E". The system detects the fire and is actuated. At the same time, all fuel or power to protected appliances in hoods or restaurants C and D is to be shut down. Hoods or Restaurants A and B may continue in operation unless the system protecting their portion of the common duct detects the fire and is actuated, at which time agent will be discharged into hood or restaurant "A" and all fuel or power to protected appliances in hoods or restaurants A and B will be shut down.

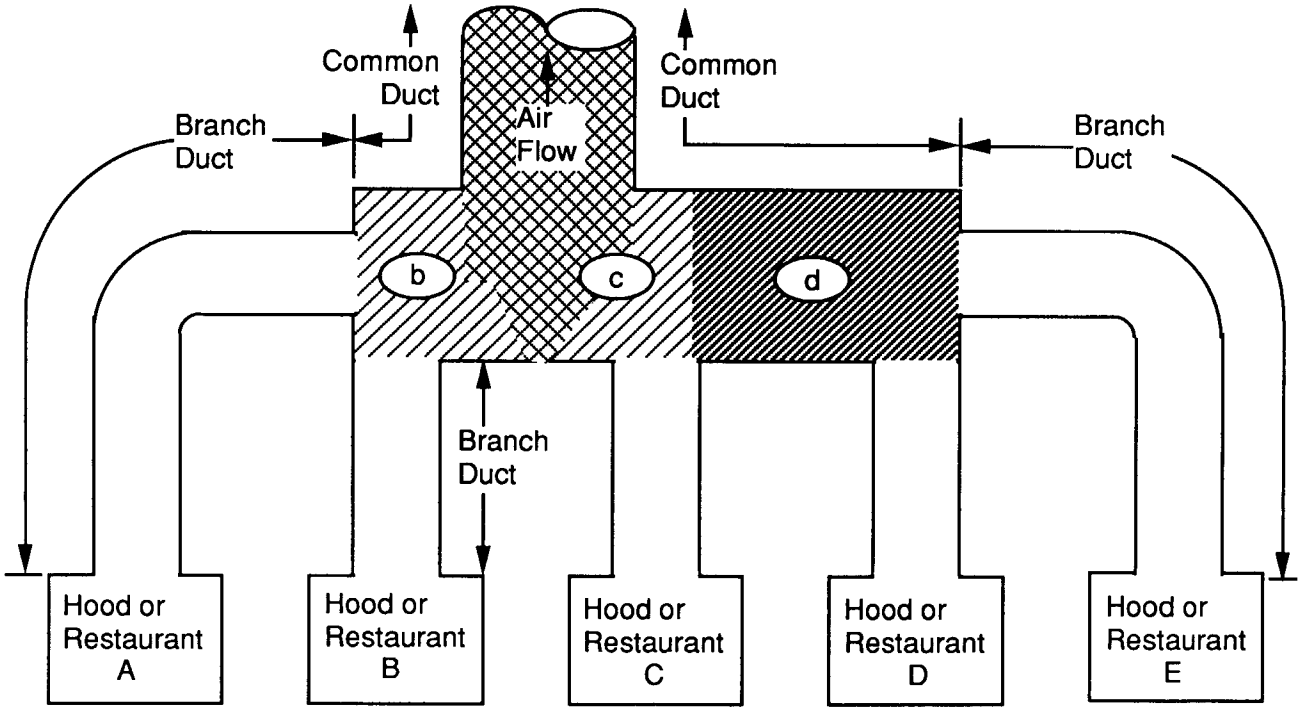

Figure A-6-3.4(f).

Multiple systems operating independently, each protecting a portion of the common duct and/or a hood or restaurant.

Multiple systems each separately protecting the portion of the common duct at each hood or restaurant connection. These systems, designated by lower case letters, may be part of the hood or restaurant system, or they may be separate independent systems.

In the above figure, common duct system "b" is part of hood or restaurant system "B." Common duct systems "c" and "d" are separate independent systems from hood or restaurant systems "C" and "D."

Scenario #1:

A fire originates in hood or restaurant "B," activating system "B" and "b." All fuel and power to protected appliances located in hood or restaurant "B" are shut down. All other hoods or restaurants continue to operate.

Scenario #2:

A fire in the common duct actuates system "d," which discharges and shuts off fuel and power to all protected appliances in hood or restaurant "D." System "D" does not actuate unless a fire occurs in hood or restaurant "D." All other hoods or restaurants continue to operate.