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## CODE CORNER

### ABOUT CODE CORNER

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## SECTION 904 ALTERNATIVE FIRE EXTINGUISHING SYSTEMS – PART 1

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### 904.1 General.

Automatic fire-extinguishing systems, other than *automatic sprinkler systems*, shall be designed, installed, inspected, tested and maintained in accordance with the provisions of this section and the applicable referenced standards.

▫ *Section 904 covers alternative fire-extinguishing systems that use extinguishing agents other than water. Alternative automatic fire-extinguishing systems include wet-chemical, dry-chemical, foam, carbon dioxide, halon and clean-agent suppression systems. In addition to the provisions of Section 904, the indicated referenced standards include specific installation, maintenance and testing requirements for all systems.*

**904.1.1 Certification of service personnel for fire-extinguishing equipment.** Service personnel providing or conducting maintenance on automatic fire-extinguishing systems, other than *automatic sprinkler*

*systems*, shall possess a valid certificate issued by an approved governmental agency, or other approved organization for the type of system and work performed.

▫ *Maintenance of fire protection systems and devices are minimum Chapter 9 requirements. Fire protection systems, like other technologies, have advanced new designs which require a clear understanding of their construction and maintenance. To ensure that systems and devices are properly maintained, the code now requires individuals performing these activities be certified. Certification must be issued by an approved organization or governmental agency.*

*These provisions align the code with NFPA standards governing the design, construction, inspection and maintenance of alternative automatic fire-extinguishing systems and portable fire extinguishers. The personnel qualification requirements specified by the applicable NFPA standards for the various alternative automatic fire-extinguishing systems are summarized in Figure 904.1.1.*

Several organizations offer certifications that will confirm to code officials that individuals are qualified to perform maintenance on alternative automatic fire extinguishing systems and portable fire extinguishers. The International Code Council (ICC), in conjunction with the National Association of Fire Equipment Distributors, offers certifications to individuals who service and inspect portable fire extinguishers and pre-engineered alternative fire-extinguishing systems protecting commercial kitchen hoods or industrial equipment such as spray booths. The National Institute for Certification in Engineering Technologies (NICET) offers four progressive levels of certification for individuals who design, erect and inspect special hazard suppression systems. Special hazard suppression systems include all of the various systems recognized in Section 904 and Figure 904.1.1. Finally, most manufacturers of these systems offer corporate certifications to individuals who will design, install and inspect them. Such certifications are beneficial to code officials because they confirm the individuals are qualified to install or maintain fire protection equipment produced by a specific manufacturer.

**904.2 Where required.** Automatic fire-extinguishing systems installed as an alternative to the required automatic sprinkler systems of Section 903 shall be approved by the fire code official. Automatic fire-extinguishing systems shall not be considered alternatives for the purposes of exceptions or reductions allowed by other requirements of this code.

□ One of the main considerations in selecting an extinguishing agent should be the compatibility of the agent with the hazard. The fire code official is responsible for approving an alternative extinguishing agent. The approval should be based on the compatibility of the agent with the hazard and the potential effectiveness of the agent to suppress a fire involving the hazards present.

The code places limitations on alternative systems in that they may not be credited toward a building being equipped throughout with an automatic sprinkler system where the sprinkler system is an alternative to a code requirement.

**904.2.1 Commercial hood and duct systems.** Each required commercial kitchen exhaust hood and duct sys-

tem required by Section 609 to have a Type I hood shall be protected with an approved automatic fire-extinguishing system installed in accordance with this code.

□ This section requires an effective suppression system to combat fire on the cooking surfaces of grease-producing appliances and within the hood and exhaust system of a commercial kitchen installation. Type I hoods, including the duct system, must be protected with an approved automatic fire-extinguishing system because they are used for handling grease-laden vapors or smoke, whereas Type II hoods handle fumes, steam, heat and odors. Type I hoods are typically required for commercial food heat-processing equipment, such as deep fryers, griddles, charbroilers, broilers and open burner stoves and ranges. For additional guidance on the requirements for Type I and II hoods, see the commentary to Section 507 of the IMC.

**904.3 Installation.** Automatic fire-extinguishing systems shall be installed in accordance with this section.

□ The installation of automatic fire-extinguishing systems must comply with the requirements of Sections 904.3.1 through 904.3.5 in addition to the installation criteria contained in the referenced standard for the proposed type of alternative extinguishing system.

**904.3.1 Electrical wiring.** Electrical wiring shall be in accordance with NFPA 70.

□ NFPA 70 regulates the design and installation of electrical systems and equipment. All electrical work must also be in compliance with any specific electrical classifications and conditions contained in the referenced standards for each type of system.

Section 605 of the code and Chapter 27 of the IBC contain provisions that also reference NFPA 70. Those sections also contain additional information that must be applied when addressing electrical issues.

**904.3.2 Actuation.** Automatic fire-extinguishing systems shall be automatically actuated and provided with a manual means of actuation in accordance with Section 904.11.1. Where more than one hazard could be simultaneously involved in fire due to their proximity, all hazards shall be protected by a single system designed to

NFPA STANDARD NUMBER & EDITION	SUBJECT	SECTION	PERSONNEL QUALIFICATION REQUIREMENT
12, 2008 ed.	Carbon dioxide	4.4.1.1	Specifications for carbon dioxide fire-extinguishing systems shall be prepared under the supervision of a person fully experienced and qualified in the design of carbon dioxide extinguishing systems and with the advice of the authority having jurisdiction.
12A, 2009 ed.	Halon 1301	5.1.2.1	Plans and calculations shall be submitted for approval to the authority having jurisdiction before installation begins. Their preparation shall be entrusted only to persons fully experienced and qualified in the design of Halon 1301 extinguishing systems.
17, 2009 ed.	Dry chemical	1.6	Only persons properly trained shall be considered competent to design, install and service dry-chemical systems.
17A, 2009	Wet chemical	1.7	Only persons properly trained shall be considered competent to design, install, and service pre-engineered wet chemical systems.
2001, 2008 ed.	Clean agent	7.6.1	All persons who could be expected to inspect, test, maintain, or operate fire-extinguishing systems shall be thoroughly trained and kept thoroughly trained in the functions the persons are expected to perform.

**Figure 904.1.1**  
**PERSONNEL QUALIFICATION REQUIREMENTS BY TYPE OF FIRE-EXTINGUISHING AGENT**

protect all hazards that could become involved.

**Exception:** Multiple systems shall be permitted to be installed if they are designed to operate simultaneously.

□ Section 904.3.2 requires alternative fire-extinguishing systems to be designed for automatic activation. Activation commonly occurs when a heat-, fire- or smoke detection system operates. In Type I commercial kitchen hoods, Section 904.11 requires a manual and automatic means of activating the fire-extinguishing system. Designing a fire-extinguishing system to only operate upon manual actuation is prohibited by the IBC and many of the NFPA fire protection system standards.

The requirements for fire-extinguishing system actuation correlate with the requirements of NFPA 17 and NFPA 17A. The requirement prescribes that when a hazard is protected by two or more fire-extinguishing systems, all of the systems must be designed to operate simultaneously. The reason for the revision is that a typical alternative automatic fire extinguishing system has a limited amount of fire extinguishing agent. The amount of agent that is available is based on the area or volume of the hazard and the fire behavior of

*the fuel. Because the amount of agent is limited, the simultaneous operation of all the fire-extinguishing systems ensures that enough agent is applied to extinguish the fire and prevent its spread from the area of origin.*

*It is fairly common for a single hazard to be protected by two or more alternative automatic fire-extinguishing systems. For example, protection of a spray booth used for the application of flammable finishes using dry chemical commonly requires two or three alternative automatic fire-extinguishing systems. The reason is that many dry-chemical and all wet-chemical systems are pre-engineered systems. Utilizing listed nozzles, pre-engineered systems are designed and constructed based on the manufacturer's installation requirements. Because these systems are assembled using listed nozzles and extinguishing agents, one system may not be able to protect the spraying space and exhaust plenum. As a result, two or more systems may be required as a provision of an extinguishing system's listing to protect certain hazards.*

*Another example is commercial kitchen cooking operations. Consider a flat grill broiler and a deep-fat fryer located beneath the same Type I hood. It is quite common for each of these commercial cooking appliances*

to be protected by separate automatic fire-extinguishing systems. Based on the revision to Section 904.3.2, both extinguishing systems must simultaneously operate in the event a fire involves either of the example appliances (see commentary, Section 904.11.1).

**904.3.3 System interlocking.** Automatic equipment interlocks with fuel shutoffs, ventilation controls, door closers, window shutters, conveyor openings, smoke and heat vents, and other features necessary for proper operation of the fire extinguishing system shall be provided as required by the design and installation standard utilized for the hazard.

▫ *Shutting off fuel supplies will eliminate potential ignition sources in the protected area. Automatic door and window closers and dampers for forced-air ventilation systems are intended to maintain the desired concentration level of the extinguishing agent in the protected area. See the commentary for Section 904.11.2 for information on system interconnections in commercial cooking fire-extinguishing systems.*

**904.3.4 Alarms and warning signs.** Where alarms are required to indicate the operation of automatic fire-extinguishing systems, distinctive audible, visible alarms and warning signs shall be provided to warn of pending agent discharge. Where exposure to automatic-extinguishing agents poses a hazard to persons and a delay is required to ensure the evacuation of occupants before agent discharge, a separate warning signal shall be provided to alert occupants once agent discharge has begun. Audible signals shall be in accordance with Section 907.5.2.

▫ *Safeguards are necessary to prevent injury or death to personnel in areas where the atmosphere will be made hazardous by oxygen depletion due to agent discharge in a confined space. The “where alarms are required” phrase is referring to requirements that will be found in the referenced installation standards indicated in Sections 904.5 through 904.19, as applicable. Predischarge alarms that will operate on fire detection system activation must be installed within and at entrances to the affected areas.*

*Where required by the appropriate installation standard( s), an extinguishing agent discharge delay fea-*

*ture shall also be provided to allow evacuation of personnel prior to agent discharge. Warning and instructional signs are also to be posted, preferably at the entrances to and within the protected area. See Section 4.5.6.1 of NFPA 12 for additional information on carbon dioxide system alarms, Section 4.3.5 of NFPA 12A for additional information on Halon system alarms and Section 4.3.5 of NFPA 2001 for additional information on clean agent system alarms.*

**904.3.5 Monitoring.** Where a building fire alarm system is installed, automatic fire-extinguishing systems shall be monitored by the building fire alarm system in accordance with NFPA 72.

▫ *Automatic fire-extinguishing systems need not be electrically supervised unless the building is equipped with a fire alarm system. This section recognizes the fact that a fire alarm system is not required in all buildings. However, because most alternative fire extinguishing systems require the space to be evacuated before the system is discharged, they are equipped with evacuation alarms. Interconnection of the fire-extinguishing system evacuation alarm with the building evacuation alarm results in an increased level of hazard notification for the occupants in addition to the electrical supervision of the fire-extinguishing system.*

**904.4 Inspection and testing.** Automatic fire-extinguishing systems shall be inspected and tested in accordance with the provisions of this section prior to acceptance.

▫ *The completed installation must be tested and inspected to determine that the system has been installed in compliance with the code and will function as required. Full-scale acceptance tests must be conducted as required by the applicable referenced standard.*

**904.4.1 Inspection.** Prior to conducting final acceptance tests, the following items shall be inspected:

1. Hazard specification for consistency with design hazard.
2. Type, location and spacing of automatic- and manual initiating devices.

3. Size, placement and position of nozzles or discharge orifices.

4. Location and identification of audible and visible alarm devices.

5. Identification of devices with proper designations.

6. Operating instructions.

▫ *This section identifies those items that need to be verified or visually inspected prior to the final acceptance tests. All equipment should be listed, approved and installed in accordance with the manufacturer's recommendations*

**904.4.2 Alarm testing.** Notification appliances, connections to fire alarm systems, and connections to approved supervising stations shall be tested in accordance with this section and Section 907 to verify proper operation.

▫ *Components of fire-extinguishing systems related to alarm devices and their supervision must be tested before the system is approved. Alarm devices must be tested to satisfy the requirements of NFPA 72.*

**904.4.2.1 Audible and visible signals.** The audibility and visibility of notification appliances signaling agent discharge or system operation, where required, shall be verified.

▫ *This section requires verification upon completion of the system installation of the audibility and visibility of notification appliances in the area affected by the extinguishing agent discharge of the alternative automatic fire-extinguishing system.*

**904.4.3 Monitor testing.** Connections to protected premises and supervising station fire alarm systems shall be tested to verify proper identification and retransmission of alarms from automatic fire-extinguishing systems.

▫ *Where monitoring of fire-extinguishing systems is required, such as by Section 904.3.5, all connections related to the supervision of the system must be tested to verify they are in proper working order.*

**904.5 Wet-chemical systems.** Wet-chemical extinguish-

ing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 17A and their listing.

▫ *NFPA 17A contains minimum requirements for the design, installation, operation, testing and maintenance of wet-chemical pre-engineered extinguishing systems. Equipment that is typically protected with wet-chemical extinguishing systems includes restaurant, commercial and institutional hoods; plenums; ducts and associated cooking equipment. Strict compliance with the manufacturer's installation instructions is vital for a viable installation.*

*Wet-chemical solutions used in extinguishing systems are relatively harmless and there is usually no lasting significant effect on a person's skin, respiratory system or clothing. These solutions may produce a mild, temporary irritation but the symptoms will usually disappear when contact is eliminated.*

**904.5.1 System test.** Systems shall be inspected and tested for proper operation at six-month intervals. Tests shall include a check of the detection system, alarms and releasing devices, including manual stations and other associated equipment. Extinguishing system units shall be weighed and the required amount of agent verified. Stored pressure-type units shall be checked for the required pressure. The cartridge of cartridge-operated units shall be weighed and replaced at intervals indicated by the manufacturer.

▫ *This section specifies the frequency for inspection and testing of wet-chemical extinguishing systems. The system and its essential components must be inspected and checked every six months to determine that the system is in full operating condition.*

**904.5.2 Fusible link maintenance.** Fixed temperature-sensing elements shall be maintained to ensure proper operation of the system.

▫ *Wet-chemical extinguishing systems are commonly used to protect commercial cooking equipment. The fusible metal alloy sensing elements are subject to the accumulation of grease or other contaminants that could affect the operation of the fusible link. The sensing elements must be inspected routinely and replaced as needed.*

**904.6 Dry-chemical systems.** Dry-chemical extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 17 and their listing.

- *NFPA 17 contains the minimum requirements for the design, installation, testing, inspection, approval, operation and maintenance of dry-chemical extinguishing systems.*

*The fire code official has the authority to approve the type of dry-chemical extinguishing system to be used. NFPA 17 identifies three types of dry-chemical extinguishing systems: total flooding, local application and hand hose-line systems. Only total flooding and local application systems are considered automatic extinguishing systems.*

*The types of hazards and equipment that can be protected with dry-chemical extinguishing systems include: flammable and combustible liquids and combustible gases; combustible solids, which melt when involved in a fire; electrical hazards, such as transformers or oil circuit breakers; textile operations subject to flash surface fires; ordinary combustibles such as wood, paper or cloth and restaurant and commercial hoods, ducts and associated cooking appliance hazards, such as deep fat fryers and some plastics, depending on the type of material and configuration.*

*Total flooding dry-chemical extinguishing systems are 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 must not exceed 15 percent of the total area of the sides, top and bottom of the enclosure. Consideration must be given to eliminating the probable sources of re-ignition within the enclosure because the extinguishing action of dry-chemical systems is transient.*

*Local application of dry-chemical extinguishing systems is to be used for extinguishing fires where the hazard is not enclosed or where the enclosure does not conform to the requirements for total flooding systems. Local application systems have successfully protected hazards involving flammable or combustible liquids, gases and shallow solids, such as paint deposits.*

*NFPA 17 also discusses pre-engineered dry-chemical systems consisting of components designed to be installed in accordance with pretested limitations as tested and labeled by a testing agency. Pre engineered systems must be installed within the limitations that have been established by the testing agency and may include total flooding, local application or a combination of both types of systems.*

*The type of dry chemical used in the extinguishing system is a function of the hazard to be protected. The type of dry chemical used in a system should not be changed unless it has been proven changeable by a testing laboratory, is recommended by the manufacturer of the equipment and is acceptable to the fire code official for the hazard being protected. Additional guidance on the use of various dry-chemical agents can be found in NFPA 17.*

**904.6.1 System test.** Systems shall be inspected and tested for proper operation at six-month intervals. Tests shall include a check of the detection system, alarms and releasing devices, including manual stations and other associated equipment. Extinguishing system units shall be weighed, and the required amount of agent verified. Stored pressure-type units shall be checked for the required pressure. The cartridge of cartridge-operated units shall be weighed and replaced at intervals indicated by the manufacturer.

- *This section specifies the frequency for inspection and testing of dry-chemical extinguishing systems. The system and its essential components must be inspected and checked every six months to determine that the system is in full operating condition.*

**904.6.2 Fusible link maintenance.** Fixed temperature-sensing elements shall be maintained to ensure proper operation of the system.

- *Dry-chemical extinguishing systems are commonly used to protect commercial cooking systems and other hazardous use conditions. In these applications the fusible metal alloy sensing elements are subject to the accumulation of grease or other contaminants that could affect the operation of the fusible link. The sensing elements must be inspected routinely and replaced as needed.*

**904.7 Foam systems.** Foam-extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 11 and NFPA 16 and their listing.

□ *NFPA 11 covers the characteristics of foam-producing materials used for fire protection and the requirements for design, installation, operation, testing and maintenance of equipment and systems, including those used in combination with other fire-extinguishing agents. The minimum requirements are covered for flammable and combustible liquid hazards in local areas within buildings, storage tanks and indoor and outdoor processing areas.*

*Low-expansion foam is defined as an aggregation of air-filled bubbles resulting from the mechanical expansion of a foam solution by air with a foam-to-solution volume ratio of less than 20:1. It is most often used to protect flammable and combustible liquid hazards. Also, low-expansion foam may be used for heat radiation protection. Combined-agent systems involve the application of low-expansion foam to a hazard simultaneously or sequentially with dry-chemical powder.*

*NFPA 11 gives minimum requirements for the installation, design, operation, testing and maintenance of medium- and high-expansion foam systems. Medium-expansion foam is defined as an aggregation of air-filled bubbles resulting from the mechanical expansion of a foam solution by air or other gases with a foam-to-solution volume ratio of 20:1 to 200:1. High-expansion foam has a foam-to-solution volume ratio of 200:1 to approximately 1,000:1.*

*Medium-expansion foam may be used on solid fuel and liquid fuel fires where some degree of in-depth coverage is necessary (for example, for the total flooding of small, enclosed or partially enclosed volumes, such as engine test cells, transformer rooms, etc.). High-expansion foam is most suitable for filling volumes in which fires exit at various levels. For example, high-expansion foam can be used effectively against high-rack storage fires in enclosures such as in underground passages, where it may be dangerous to send personnel to control fires involving liquefied natural gas (LNG) and liquefied petroleum gas (LP-gas), and to provide vapor dispersion control for LNG and ammonia*

*spills. High-expansion foam is particularly suited for indoor fires in confined spaces, since it is highly susceptible to wind and lack-of-confinement effects.*

*NFPA 16 contains the minimum requirements for open-head deluge-type foam-water sprinkler systems and foam-water spray systems. The systems are especially applicable to the protection of most flammable liquid hazards and have been used successfully to protect aircraft hangars and truck loading racks.*

**904.7.1 System test.** Foam-extinguishing systems shall be inspected and tested at intervals in accordance with NFPA 25.

□ *Although Section 904.7.1 references NFPA 25 as the standard for the inspection and testing of foam-extinguishing systems, NFPA 25 is limited to water-based extinguishing systems. NFPA 25 technically addresses only foam-water sprinkler systems as specified in NFPA 16. NFPA 11 should be consulted for inspection and testing intervals for low-, medium and high-expansion foam systems.*

*As with other alternative fire-extinguishing systems, the inspection and testing of foam systems is necessary to determine that the system is fully operational. In addition to general maintenance of equipment, the condition of the foam concentrate and its storage tanks or containers should be inspected at least once a year to verify adequate quality. The desired concentration of the foam concentrate in a stagnant storage situation may deteriorate over time.*

**904.8 Carbon dioxide systems.** Carbon dioxide extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 12 and their listing.

□ *NFPA 12 provides minimum requirements for the design, installation, testing, inspection, approval, operation and maintenance of carbon dioxide extinguishing systems.*

*Carbon dioxide extinguishing systems are useful in extinguishing fires in specific hazards or equipment in occupancies where an inert electrically nonconductive medium is essential or desirable and where cleanup of other extinguishing agents, such as dry chemical resi-*

due, presents a problem. Carbon dioxide systems have satisfactorily protected the following: flammable liquids; electrical hazards, such as transformers, oil switches, rotating equipment and electronic equipment; engines using gasoline and other flammable liquid fuels; ordinary combustibles, such as paper, wood and textiles and hazardous solids.

The fire code official has the authority to approve the type of carbon dioxide system to be installed. NFPA 12 defines four types of carbon dioxide systems: total flooding, local application, hand hose lines and stand-pipe and mobile supply systems. Only total flooding and local application systems are automatic suppression systems.

Total-flooding systems may be used where there is a permanent enclosure around the hazard that is adequate to allow the required concentration to be built up and maintained for the required period of time, which varies for different hazards. Examples of hazards that have been successfully protected by total flooding systems include rooms, vaults, enclosed machines, ducts, ovens and containers and their contents.

Local application systems may be used for extinguishing surface fires in flammable liquids, gases and shallow solids where the hazard is not enclosed or the enclosure does not conform to the requirements for a total-flooding system. Examples of hazards that have been successfully protected by local application systems include dip tanks, quench tanks, spray booths, oil-filled electric transformers and vapor vents.

**904.8.1 System test.** Systems shall be inspected and tested for proper operation at 12-month intervals.

- To determine adequate operation, carbon dioxide systems must be inspected and tested at least once a year.

**904.8.2 High-pressure cylinders.** High-pressure cylinders shall be weighed and the date of the last hydrostatic test shall be verified at six-month intervals. Where a container shows a loss in original content of more than 10 percent, the cylinder shall be refilled or replaced.

- Because of the potential of unobserved leaking high pressure cylinders, they need to be weighed semiannually to verify the concentration level is always within at least 10 percent of the original content.

**904.8.3 Low-pressure containers.** The liquid-level gauges of low-pressure containers shall be observed at one-week intervals. Where a container shows a content loss of more than 10 percent, the container shall be refilled to maintain the minimum gas requirements.

- A weekly visual observation of the liquid level gauges of low-pressure containers is required to verify that there has been no significant leakage.

**904.8.4 System hoses.** System hoses shall be examined at 12-month intervals for damage. Damaged hoses shall be replaced or tested. At five-year intervals, all hoses shall be tested.

- The maintenance of system hoses is essential to ensuring the reliability of their use in an emergency. Although system hoses need to be visually checked on an annual basis only, a complete pressure test as indicated in Section 904.8.4.1 must be performed every five years.

**904.8.4.1 Test procedure.** Hoses shall be tested at not less than 2,500 pounds per square inch (psi) (17 238 kPa) for high-pressure systems and at not less than 900 psi (6206 kPa) for low-pressure systems.

- Every five years, system hoses for both high-pressure/ low-pressure systems must be pressure tested to verify they are still in proper operating condition. The test typically involves filling the hose with water. The hose is then pressurized at the desired test pressure for at least 1 minute to observe any potential distortions or leakage in the hose. All hose assemblies that do not pass the test should be marked, destroyed and replaced with new hose assemblies. Hose assemblies that pass the test should be marked, dated and returned to service.

**904.8.5 Auxiliary equipment.** Auxiliary and supplementary components, such as switches, door and window releases, interconnected valves, damper releases and supplementary alarms, shall be manually operated at 12-month intervals to ensure that such components are in

proper operating condition.

- *The effectiveness of the carbon dioxide extinguishing system is also dependent upon the operation of its auxiliary components. These components must also be manually operated at least once a year.*

**904.9 Halon systems.** Halogenated extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 12A and their listing.

- *NFPA 12A contains minimum requirements for the design, installation, testing, inspection, approval, operation and maintenance of Halon 1301 extinguishing systems. Halon 1301 fire-extinguishing systems are useful in specific hazards, equipment or occupancies where an electrically nonconductive medium is essential or desirable and where cleanup of other extinguishing agents presents a problem.*

*Halon 1301 systems have satisfactorily protected gaseous and liquid flammable materials; electrical hazards, such as transformers, oil switches and rotating equipment; engines using gasoline and other flammable fuels; ordinary combustibles, such as paper, wood and textiles and hazardous solids. Halon 1301 systems have also satisfactorily protected electronic computers, data processing equipment and control rooms.*

*The fire code official has the authority to approve the type of halogenated extinguishing system to be installed. NFPA 12A defines two types of halogenated extinguishing systems: total flooding and local application. Total-flooding systems may be used where there is a fixed enclosure around the hazard that is adequate to enable the required halon concentration to be built up and maintained for the required period of time to enable the effective extinguishing of the fire. Total-flooding systems may provide fire protection for rooms, vaults, enclosed machines, ovens, containers, storage tanks and bins.*

*Local application systems are used where there is not a fixed enclosure around the hazard or where the fixed enclosure around the hazard is not adequate to enable an extinguishing concentration to be built up and maintained in the space. Hazards that may be successfully protected by local application systems*

*include dip tanks, quench tanks, spray booths, oil filled electric transformers and vapor vents.*

*Two other considerations in selecting the proper extinguishing system are ambient temperature and the personnel hazards associated with the agent. The ambient temperature of the enclosure for a total flooding system must be above 70°F (21°C) for halon 1301 systems. Special consideration must also be given to the use of halon systems when the temperatures are in excess of 900°F (482°C) because halon will readily decompose at such temperatures and the products of decomposition can be extremely irritating if inhaled, even in small amounts.*

*Halon 1301 total-flooding systems must not be used in concentrations greater than 10 percent in normally occupied areas. Where personnel cannot vacate the area within 1 minute, Halon 1301 total flooding systems must not be used in normally occupied areas with concentrations greater than 7 percent. Halon 1301 total-flooding systems may be used with concentrations of up to 15 percent if the area is not normally occupied and the area can be evacuated within 30 seconds.*

*Therefore, the supply of halon is limited and new supplies of halogenated extinguishing agents will not be available in the future. Existing supplies of halon can, however, continue to be used in existing, undischarged systems or to recharge discharged systems. This new-found need for halon supplies has given rise to new industries geared to the ranking, recycling and reclamation of existing halon supplies. Alternative “clean agent” extinguishing agents have been developed to replace halogenated agents (see Section 904.10).*

**904.9.1 System test.** Systems shall be inspected and tested for proper operation at 12-month intervals.

- *To determine proper operation, Halon systems must be inspected and tested at least once a year.*

**904.9.2 Containers.** The extinguishing agent quantity and pressure of containers shall be checked at six-month intervals. Where a container shows a loss in original weight of more than 5 percent or a loss in original pressure (adjusted for temperature) of more than 10 percent, the container shall be refilled or replaced. The weight and pressure of the container shall be recorded on a tag

attached to the container.

□ *Because of the potential for unobserved leakage of the Halon containers, they must be checked at least semi-annually to verify the original weight and pressure are within the designated tolerances. When necessary, containers must be refilled or replaced when the desired levels are not maintained. The containers should also be checked for evidence of corrosion or mechanical damage.*

**904.9.3 System hoses.** System hoses shall be examined at 12-month intervals for damage. Damaged hoses shall be replaced or tested. At five-year intervals, all hoses shall be tested.

□ *Maintenance of system hoses is essential to ensuring the reliability of their use in an emergency. System hoses need to be visually checked annually. A complete pressure test as indicated in Section 904.9.3.1 must be performed every five years.*

**904.9.3.1 Test procedure.** For Halon 1301 systems, hoses shall be tested at not less than 1,500 psi (10 343 kPa) for 600 psi (4137 kPa) charging pressure systems and not less than 900 psi (6206 kPa) for 360 psi (2482 kPa) charging pressure systems. For Halon 1211 hand-hose line systems, hoses shall be tested at 2,500 psi (17 238 kPa) for high-pressure systems and 900 psi (6206 kPa) for low-pressure systems.

□ *Every five years, system hoses must be pressure tested to verify they are still in proper operating condition. This section specifies the test pressure for the various types of Halon systems. The pressure test is intended to check for any potential distortion or leaking in the hose (see commentary, Section 904.8.4.1).*

**904.9.4 Auxiliary equipment.** Auxiliary and supplementary components, such as switches, door and window releases, interconnected valves, damper releases and supplementary alarms, shall be manually operated at 12-month intervals to ensure such components are in proper operating condition.

□ *The effectiveness of halogenated extinguishing systems is also dependent upon the operation of its auxiliary components. These components must be manually operated at least once a year.*

**904.10 Clean-agent systems.** Clean-agent fire-extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 2001 and their listing.

□ *NFPA 2001 contains minimum requirements for the design, installation, testing, inspection and operation of clean-agent fire-extinguishing systems. A clean agent is an electrically nonconducting suppression agent that is volatile or gaseous at discharge and does not leave a residue on evaporation. Cleanagent fire-extinguishing systems are installed in locations that are enclosed and have openings in the protected area that can be sealed on activation of the alarm to provide effective clean-agent concentrations. A clean-agent fire-extinguishing system should not be installed in locations that cannot be sealed unless testing has shown that adequate concentrations can be developed and maintained.*

*The two categories of clean agents are halocarbon compounds and inert gas agents. Halocarbon compounds include bromine, carbon, chlorine, fluorine, hydrogen and iodine. Halocarbon compounds suppress fire by a combination of breaking the chemical chain reaction of the fire, reducing the oxygen supporting the fire and reducing the ambient temperature of the fire origin to reduce the propagation of the fire. Inert gas agents contain primary components consisting of helium, neon, argon or a combination of these. Inert gases work by reducing the oxygen concentration around the fire origin to a level that does not support combustion.*

*Clean-agent fire-extinguishing systems were developed in response to the demise of halon as an acceptable fire-extinguishing agent because of its harmful effect on the environment. Although the original hope for a halon substitute was that these new clean agents could be directly and proportionally substituted for halon agents in existing systems (drop in replacements), research has shown that clean agents are less efficient in extinguishing fires than are the halons they were intended to replace and require approximately 60 percent more agent by weight and volume in storage to do the same job. Additionally, the physical and chemical characteristics of clean agents differ sufficiently from halon to require different nozzles in addition to the need for larger storage vessels. Existing piping systems*

should be salvaged for use with clean agents only if they are carefully evaluated and determined to be hydraulically compatible with the flow characteristics of the new agent.

This section also relies on strict adherence to the system manufacturer's design and installation instructions for code compliance. As with many of the alternative fire suppression systems covered in this chapter, clean-agent systems are, for the most part, subjected by their manufacturers to a testing and listing program conducted by an approved testing agency. In such testing and listing programs, the clean agent is listed for use with specific equipment and equipment is listed for use with specific clean agents. The resultant listings include reference to the manufacturer's installation manuals, thereby giving the fire code official another valuable resource for reviewing and approving clean-agent systems.

Although clean agents have found a limited market for local application uses, such as a replacement for Halon 1211 in portable fire extinguishers, their primary application is in total-flooding systems and they are available in both engineered and pre-engineered configurations.

Engineered clean-agent systems are specifically designed for protection of a particular hazard, whereas pre-engineered systems are designed to operate within predetermined limitations up to the noted maximums, thus allowing broader applicability to a variety of hazard applications.

Total flooding systems are used where there is a fixed enclosure around the hazard that is adequate to enable the required clean-agent concentration to build up and be maintained within the space long enough to extinguish the fire. Such applications can include vaults, ovens, containers, tanks, computer rooms, paint lockers or enclosed machinery. In selecting the clean agent to be used in a given application, careful consideration must be given to whether the protected area is a normally occupied space, because different agents have different levels of concentration at which they may be a health hazard to occupants of the area.

The fire code official has the authority to approve the type of clean-agent system to be installed and should

become familiar with the unique characteristics and hazards of clean-agent extinguishing systems using all available resources on the subject.

**904.10.1 System test.** Systems shall be inspected and tested for proper operation at 12-month intervals.

- To determine proper operation, all clean-agent systems must be inspected and tested at least once a year.

**904.10.2 Containers.** The extinguishing agent quantity and pressure of the containers shall be checked at six-month intervals. Where a container shows a loss in original weight of more than 5 percent or a loss in original pressure, adjusted for temperature, of more than 10 percent, the container shall be refilled or replaced. The weight and pressure of the container shall be recorded on a tag attached to the container.

- Because of the potential for unobserved leakage of the clean-agent containers, they must be checked at least semi-annually to verify the original weight and pressure are within the designated tolerances. When necessary, containers must be refilled or replaced when the desired levels are not maintained.

**904.10.3 System hoses.** System hoses shall be examined at 12-month intervals for damage. Damaged hoses shall be replaced or tested. All hoses shall be tested at five-year intervals.

- The maintenance of system hoses is essential to ensuring their reliability in an emergency. System hoses must be visually checked annually. A complete pressure test must be performed every five years.

Next Month: **904.11 Commercial cooking systems.**