NFPA®

75

Standard for the Fire Protection of Information Technology Equipment

2024

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NFPA® 75

Standard for the

Fire Protection of Information Technology Equipment

2024 Edition

This edition of NFPA 75, *Standard for the Fire Protection of Information Technology Equipment*, was prepared by the Technical Committee on Electronic Computer Systems. It was issued by the Standards Council on December 1, 2023, with an effective date of December 21, 2023, and supersedes all previous editions.

This edition of NFPA 75 was approved as an American National Standard on December 21, 2023.

Origin and Development of NFPA 75

The Committee on Electronic Computer Systems was formed by the action of the NFPA Board of Directors in January 1960, following a request for standardization of fire protection recommendations by the computer industry.

The committee first submitted the *Standard for the Protection of Electronic Computer Systems* to the 1961 NFPA Annual Meeting, and it was tentatively adopted. At the 1962 Annual Meeting, it was officially adopted as an NFPA standard. Revisions were adopted in 1963, 1964, 1968, 1972, 1976, 1981, 1987, and 1989. The document was completely rewritten for the 1992 edition. The document was revised in 1995, 1999, and again in 2003. The 2003 edition incorporated the *Manual of Style for NFPA Technical Committee Documents* revisions.

In editions of this standard prior to 2003, the terms *electronic computer/data processing equipment* and *electronic computer system* were used where the current terms *information technology equipment* and *information technology equipment system*, respectively, are used. Similarly, the terms *computer room* and *computer area* were replaced by *information technology equipment room* and *information technology equipment area*, respectively. The title was changed from *Standard for the Protection of Electronic Computer/Data Processing Equipment* to *Standard for the Protection of Information Technology Equipment*. While the title and some terminology were changed in the 2003 edition to more closely align this standard's terminology with terminology being used in other standards, such as *NFPA 70, National Electrical Code*, and UL 60950, *Safety of Information Technology Equipment*, the scope of this standard and any definitions associated with those like terms remained the same.

For the 2009 edition, Section 4.2, Telecommunications Risks, was updated; many of the UL references were updated; new requirements were added for signage to indicate that equipment will remain energized where continuous power is provided; and flame spread indexes were provided for many of the materials listed in the standard.

For the 2013 edition, the title was again changed, to *Standard for the Fire Protection of Information Technology Equipment*, to better reflect the scope of the document and to be clear that the standard is strictly for fire protection. The 2013 edition featured a new section on the emerging use of aisle containment systems for information technology equipment and how such systems must be assessed for their interaction with fire protection features. A number of definitions were extracted from *NFPA 70* to define words used in the body of the standard that previously were not defined.

The 2017 edition of the standard was revised to permit performance-based designs for specific provisions of the standard. Chapter 4 was revised to state the approaches that are permitted to be followed (prescriptive or performance-based), and a new Chapter 5 was added that details the requirements when a performance-based approach is selected. This was done to account for changes in the operation of data centers that can require more flexibility than is often provided by prescriptive approaches.

Extensive annex material that provides guidance on designing detection for high airflow environments, including detector sensitivity and spacing, was added to the standard based on Fire Protection Research Foundation reports.

For the 2020 edition of the standard, air sampling detector port location and coverage was clarified. The requirement for inside hose stream was deleted as the fire department utilizes their own hose and will most likely not use the inside hose located in the structure. New Chapter 13, Modular Data Centers, was added to specify which requirements from other chapters apply to modular data centers. The requirements for 1- and 2-hour fire barriers were clarified for structures that contain multiple occupancies. Battery requirements were extracted from Chapter 52 of NFPA 1, *Fire Code*.

For the 2024 edition, requirements for ITE immersion cooling equipment have been added in Chapter 8 to increase safety around this technology. ITE immersion cooling is becoming more prevalent, and safety standards are needed to cover equipment being used and developed for use with ITE. All requirements for lithium-ion batteries in Chapter 11 have been removed, as NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*, already covers the protection requirements for lithium-ion batteries located within energy storage systems. Off-gas detection requirements have been added to Chapter 11 for situations where those systems are installed. There were previously no requirements for these types of detection systems that are being used in the field, and it was important to address their installation from a safety standpoint. A new Annex F has been developed based on optional tests already included in NFPA 76, *Standard for the Fire Protection of Telecommunications Facilities*, because these tests are also used in data centers and contain important guidance for users of this standard.

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

Committee Scope: This Committee shall have primary responsibility for documents on the protection of electronic computer equipment, components, and associated records.

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NFPA 75

Standard for the

Fire Protection of Information Technology Equipment

2024 Edition

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

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1 Scope. This standard covers the requirements for the protection of information technology equipment (ITE) and ITE areas.

1.2* Purpose. The purpose of this standard is to set forth the minimum requirements for the protection of ITE and ITE areas from damage by fire or its associated effects — namely, smoke, corrosion, heat, and water.

1.3* Application. The application of this standard is based on the risk considerations outlined in Chapter 4.

1.3.1 A documented risk assessment shall be the basis for implementation of this standard.

1.3.2* The mere presence of ITE shall not constitute the need to invoke the requirements of this standard.

1.3.3 If applied, the requirements of this standard shall include the installation of ITE in modular data centers, fabricated containers, and other groupings.

1.4 Retroactivity.

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

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

1.5 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

Chapter 2 Referenced Publications

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

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

NFPA 1, *Fire Code,* 2024 edition.

NFPA 10, *Standard for Portable Fire Extinguishers,* 2022 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems,* 2022 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems,* 2022 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2022 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems,* 2023 edition.

NFPA 70®, National Electrical Code®, 2023 edition.

NFPA 72®, National Fire Alarm and Signaling Code®, 2022 edition.

NFPA 76, *Standard for the Fire Protection of Telecommunications Facilities,* 2024 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives,* 2022 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems,* 2024 edition.

NFPA *101®, Life Safety Code®,* 2024 edition.

NFPA 105, *Standard for Smoke Door Assemblies and Other Opening Protectives,* 2022 edition.

NFPA 220, *Standard on Types of Building Construction,* 2024 edition.

NFPA 232, *Standard for the Protection of Records,* 2022 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials,* 2023 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems,* 2023 edition.

NFPA 770, *Standard on Hybrid (Water and Inert Gas) Fire-Extinguishing Systems,* 2021 edition.

NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems,* 2023 edition.

NFPA 1225, *Standard for Emergency Services Communications,* 2022 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems,* 2022 edition.

2.3 Other Publications.

2.3.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials,* 2023.

ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C,* 2022.

ASTM E814, *Standard Test Method for Fire Tests of Penetration Firestop Systems,* 2013a, reapproved 2017.

ASTM E1354, *Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter,* 2023.

ASTM E1537, *Standard Test Method for Fire Testing of Upholstered Furniture,* 2022.

ASTM E2652, *Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-Shaped Airflow Stabilizer, at 750°C,* 2022.

ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter,* 2022a.

2.3.2 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 72, *Tests for Fire Resistance of Record Protection Equipment,* 2020.

UL 242, *Nonmetallic Containers for Waste Paper,* 2018.

UL 723, *Test for Surface Burning Characteristics of Building Materials,* 2018.

UL 900, *Air Filter Units,*2022.

UL 1315, *Containers for Waste Paper,*2022.

UL 1449, *Surge Protective Devices,* 2022.

UL 1479, *Fire Tests of Penetration Firestops,* 2021.

UL 60950, *Information Technology Equipment,* 2000, including revisions through October 30, 2007.

UL 60950-1, *Information Technology Equipment — Safety — Part 1: General Requirements,* 2019.

UL 62368-1, *Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements,* 2021.

2.3.3 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2020.

2.4 References for Extracts in Mandatory Sections.

NFPA 1, *Fire Code,* 2024 edition.

NFPA 70®, National Electrical Code®, 2023 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems,* 2024 edition.

NFPA *101®, Life Safety Code®,* 2024 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems,* 2022 edition.

NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems,* 2023 edition.

NFPA 5000®, Building Construction and Safety Code®, 2024 edition.

Chapter 3 Definitions

3.1 General.

3.1.1 The definitions contained in this chapter shall apply to the terms used in this standard.

3.1.2 Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used.

3.1.3 *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

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

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

3.2.5 Shall. Indicates a mandatory requirement.

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

3.2.7 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3 General Definitions.

3.3.1 Abandoned Cables. Installed cable that is not terminated at equipment other than a termination fitting or a connector and is not identified for future use with a tag. [**70,** 2023]

3.3.2 Air Space. The space below a raised floor or above a suspended ceiling used to circulate environmental air within the ITE room or ITE area.

3.3.3 Automated Information Storage System (AISS). An enclosed storage and retrieval system that moves recorded media between storage and ITE systems.

3.3.4 Battery Types, Stationary.

3.3.4.1 ***Lithium-Ion Battery.*** A storage battery that consists of lithium ions imbedded in a carbon graphite or nickel metal-oxide substrate. The electrolyte is a carbonate mixture or a gelled polymer. The lithium ions are the charge carriers of the battery. [**1,** 2024]

3.3.4.2 ***Nickel Cadmium (NiCad) Battery.*** An alkaline storage battery in which the positive active material is nickel oxide, the negative contains the cadmium, and the electrolyte is potassium hydroxide. [**1,** 2024]

3.3.4.3* ***Valve-Regulated Lead-Acid (VRLA).*** A lead-acid battery consisting of sealed cells furnished with a valve that opens to vent the battery whenever the internal pressure of the battery exceeds the ambient pressure by a set amount. [**1,** 2024]

3.3.4.4* ***Vented (Flooded).*** A lead-acid battery consisting of cells that have electrodes immersed in liquid electrolyte.

3.3.5 Business Interruption. The effect on business operations from the time that equipment was initially lost or damaged until it has been restored to the former level of operation.

3.3.6 Communications Circuit. A metallic, fiber, or wireless circuit that provides voice/data (and associated power) for communications-related services between communications equipment. [**70,** 2023]

3.3.7 Communications Equipment. The electronic equipment that performs the telecommunications operations for the transmission of audio, video, and data, and includes power equipment (e.g., dc converters, inverters, and batteries), technical support equipment (e.g., computers), and conductors dedicated solely to the operation of the equipment. [**70,** 2023]

3.3.8 Detector.

3.3.8.1 ***Heat Detector.*** A fire detector that detects either abnormally high temperatures or rate of temperature rise, or both.

3.3.8.2 ***Smoke Detector.*** A device that senses visible or invisible particles of combustion.

3.3.9 Electronically Interconnected. Units that must be connected by a signal channel to complete a system or perform an operation.

3.3.10* Energy Storage System (ESS). One or more devices installed as a system capable of storing energy and providing electrical energy into the premises wiring system or an electric power production and distribution network. [**70,** 2023]

3.3.11 Fire-Resistant-Rated Construction. Construction in which the structural members, including walls, partitions, columns, floors, and roof construction, have fire resistance ratings of time duration not less than that specified in this standard.

3.3.12 Fire Risk Analysis. A process to characterize the risk associated with fire that addresses the fire scenario or fire scenarios of concern, their probability, and their potential consequences.

3.3.13* Information Technology Equipment (ITE). Equipment and systems rated 1000 volts or less, normally found in offices or other business establishments and similar environments classified as ordinary locations, that are used for creation and manipulation of data, voice, video, and similar signals that are not communications equipment and do not process communications circuits. [**70,** 2023]

3.3.14 Interconnecting Cables. Signal and power cables for operation and control of a system.

3.3.15* ITE Area. An area of a building where the ITE room is located, including support rooms served by the same special air-conditioning/air-handling equipment as the ITE room.

3.3.16 ITE Immersion Cooling Liquid. An insulating liquid (dielectric) used for the purpose of cooling ITE through direct contact that is contained within the ITE system.

3.3.17 ITE Room. A room within the ITE area that contains the ITE.

3.3.18* ITE System. Any electronic digital or analog computer, along with all peripheral, support, memory, programming, or other directly associated equipment, records, storage, and activities.

3.3.19 Leak Detection System. A device or arrangement of sensors that detects the presence of liquids.

3.3.20 Material.

3.3.20.1 ***Combustible Material.*** A material that, in the form in which it is used and under the conditions anticipated, will ignite and burn; a material that does not meet the definition of noncombustible or limited-combustible.

3.3.20.2 ***Limited-Combustible Material.*** See 6.2.2.

3.3.20.3* ***Maximum Allowable Quantity (MAQ).*** The quantity of hazardous material permitted in a control area. [**1,** 2024]

3.3.20.4 ***Noncombustible Material.*** See 6.2.1.

3.3.21* Modular Data Center (MDC). Prefabricated units, rated 1000 volts or less, consisting of an outer enclosure housing multiple racks or cabinets of information technology equipment (ITE) (e.g., servers) and various support equipment, such as electrical service and distribution equipment, HVAC systems, and the like. [**70,** 2023]

3.3.22 Off-Gas. The event in which the [battery] cell case vents due to a rise in internal pressure of the cell. [**855,** 2023]

3.3.23 Optical Fiber Cable. A factory assembly or field assembly of one or more optical fibers having an overall covering. [**70,** 2023]

3.3.24 Plenum. A compartment or chamber to which one or more ducts are connected and that forms part of the air distribution system. [**90A,** 2024]

3.3.25* Raceway. An enclosed channel of metallic or nonmetallic materials designed expressly for holding wires, cables, or busbars, with additional functions as permitted in *NFPA 70.*

3.3.26* Raised Floor. A platform with removable panels where equipment is installed, with the intervening space between it and the main building floor used to house the interconnecting cables and at times is used as a means for supplying conditioned air to the ITE and the room.

3.3.27 Records.

3.3.27.1 ***Important Records.*** Records that could be reproduced only at considerable expense and labor or only after considerable delay.

3.3.27.2 ***Vital Records.*** Records that are irreplaceable, such as records of which a reproduction does not have the same value as an original; records needed to sustain the business promptly or to recover monies used to replace buildings' equipment, raw materials, finished goods, and work in progress; and records needed to avoid delay in restoration of production, sales, and service.

3.3.28 Remote Disconnect Control. An electric device and circuit that controls a disconnecting means through a relay or equivalent device. [**70,** 2023]

3.3.29 Separate Fire Division. A portion of a building cut off from all other portions of the building by fire walls, fire doors, and other approved means adequate to prevent any fire that can occur in one fire division from extending to another fire division.

3.3.30* Support Equipment. Permanently installed equipment that is essential to the operation of ITE, as well as equipment temporarily used for maintenance, installation, or deinstallation of ITE.

3.3.31 Thermal Runaway. Self-heating of an electrochemical system in an uncontrollable fashion. [**855,** 2023]

3.3.32 Uninterruptible Power Supply (UPS). A device or system that provides quality and continuity of ac power through the use of a stored-energy device as the backup power source during any period when the normal power supply is incapable of performing acceptably. [**111,** 2022]

3.3.33 Zone. A physically identifiable area (such as barriers or separation by distance) within an information technology equipment room, with dedicated power and cooling systems for the information technology equipment or systems. [**70,** 2023]

3.4 Aisle Containment.

3.4.1* Aisle. The passageway between ITE or between ITE and a wall that allows personnel access to the ITE for service or operation of the equipment.

3.4.2* Aisle Containment. An HVAC method deployed in the occupied area of an air-cooled ITE space utilizing physical separation of hot exhaust air from cooler intake air between equipment cabinets, rows of ITE, or associated power and cooling infrastructure; containment is typically above and at both ends of a hot aisle or a cold aisle, in whole or part.

3.4.3* Cold Aisle. The aisle in front of the airflow intakes on the ITE where HVAC cooling airflow is controlled.

3.4.4* Hot Air Collar. An air conveyance assembly used to direct heated exhaust air from ITE cabinet(s), enclosure(s), or rack(s) directly to a return air path.

3.4.5* Hot Aisle. The aisle at the rear of the ITE where heated exhaust air is controlled and directed into the aisle for return to the HVAC equipment.

Chapter 4 Fire Protection Approaches

4.1 Fire Protection Approach. The fire protection approach for ITE systems, ITE rooms, and ITE areas shall be permitted to be determined based on an evaluation of fire risks and hazards associated with the site and services provided and the business continuity planning and disaster restoration capabilities of the ITE specific to the site.

4.1.1 The fire protection approach shall be established with consideration given to the following factors:

(1) Exposure threat to facility occupants, the general public, emergency responders, and exposed property from a fire occurring at the facility, adjacent to or within ITE areas
(2) The importance of the continuity of the data being stored or processed by the ITE
(3) Methods and equipment employed as part of a risk management or business continuity strategy that allow data to remain viable during and after an event or to be replaced or restored
(4) The potential for a given protection strategy to result in a service or data disruption or inhibit the ability of the data provider to restore operation and access to the data in a timely manner post-event

4.1.2 The fire protection approach shall be developed in conjunction with the considerations in 4.2.3 resulting in the use of one or both of the following strategies within ITE areas:

(1) Prescriptive-based approaches in accordance with this standard
(2) A fire risk–based approach in accordance with 4.1.3 and Section 4.2

4.1.3 A fire risk–based approach shall be permitted to be used to determine the construction, fire suppression, fire detection, and utility requirements for ITE systems, ITE rooms, and ITE areas where specifically permitted by this standard that are necessary to achieve the purpose of this standard. *(See Section 1.2.)*

4.2 Fire Risk Assessment.

4.2.1* The fire risk assessment permitted by 4.1.2 shall be documented and acceptable to the authority having jurisdiction (AHJ).

4.2.2 The fire risk assessment shall include an evaluation of the risk management considerations outlined in 4.2.3.

4.2.3* The following elements shall be considered to determine the level of acceptable fire risk documented as part of the fire risk assessment *(see also Annex C)*:

(1)* Life safety aspects of the computing function
(2) Life safety of occupants of ITE areas and adjacent spaces, emergency responders, and the general public
(3) Fire threat of the installation to occupants or exposed property
(4) Continuity of service, operation, and data access
(5) Size and value of ITE areas
(6) Economic loss from loss of function or loss of records
(7) Economic loss from value of damaged equipment
(8) Loss of customer data hosted on ITE
(9) Regulatory impact
(10) Reputation impact
(11) Construction and compartmentation of ITE areas
(12) Fire suppression and detection features provided for ITE areas
(13) Response time to an alarm
(14) Local firefighting capabilities
(15) Redundant infrastructure, including off-site processing systems

4.2.4 The fire risk assessment shall cover the entire ITE area, including all adjacent exposures.

4.2.5 An approved performance-based approach, in accordance with Chapter 5, shall be permitted to be applied selectively to specifically identified areas, hazards, or equipment or to specific fire protection requirements for an entire ITE area.

4.3 Telecommunications Risks.

4.3.1 Telecommunications Risks for the Private Network.

4.3.1.1 To assess and evaluate the damage and interruption potential of the loss of ITE room operations, a risk evaluation shall be conducted on the impact of the loss of data and communications.

4.3.1.2 The provisions of this standard shall apply to those areas housing telecommunications equipment that are part of a private network or where the need for protection has been determined by the risk evaluation outlined in 4.3.1.1.

4.3.2 Telecommunications Risks for the Public Networks.

4.3.2.1 NFPA 76 shall apply to telecommunications facilities that are part of the public network as outlined in the scope of NFPA 76.

4.3.2.2 The provisions of this standard shall not apply to telecommunications facilities that are part of the public network.

Chapter 5 Performance-Based Design Approach

5.1 General.

5.1.1 The requirements of Chapter 5 shall apply to recognized performance-based practices.

5.1.2 The performance-based design approach shall include all of the following components:

(1) Goals and objectives specified in Section 5.2
(2) Performance criterion specified in Section 5.3
(3) Fire risk assessment elements specified in 4.2.3

5.2 Goals and Objectives. The performance-based design shall meet the following goals and objectives:

(1) The performance-based approach allows the alternative means to be utilized for the elements of the ITE systems, ITE rooms, and ITE areas as permitted in this standard.
(2) The risk analysis, design criteria, design brief, system performance, and testing criteria are developed in accordance with this section.
(3) The design meets the scope and purpose of the standard as detailed in Sections 1.1 and 1.2.
(4) The performance-based design provides equivalent performance to the prescriptive requirements of this standard.

5.3 Performance Criterion. ITE systems and ITE areas shall be protected from damage by fire or its associated effects, including smoke, corrosion, heat, and water.

5.4 Stakeholders. The stakeholders shall be part of the performance-based design approach and include the owner or owner's representative, a licensed design professional experienced in the design of fire and life safety systems for ITE and ITE areas, insurance representatives, the authority having jurisdiction (AHJ), and representatives of the emergency response entities.

5.5* Qualifications. The performance-based design documents shall be prepared by a licensed design professional with experience in fire protection, and be acceptable to the AHJ.

5.6* Design Brief.

5.6.1 The design of the ITE area shall include a design brief that is prepared using recognized performance-based design practices.

5.6.2 Any deviation from a prescriptive requirement shall be detailed in the design brief.

5.6.3 Design specifications and briefs used in the performance-based design shall be clearly stated and shown to be realistic and sustainable.

5.6.4 Specific inspection, testing, or maintenance requirements that are necessary to maintain reliable performance of the fire safety features of the ITE area shall be stated in the design brief.

5.7* Independent Review. The AHJ shall be permitted to require an approved, independent third party to review the proposed design brief based on the documented fire risk assessment accepted by the AHJ to provide an evaluation of the design.

5.8 Final Determination. The AHJ shall make the final determination as to whether the performance objectives have been met.

5.9 Maintenance of Design Features. The design features required for the ITE area to continue to meet the performance goals and objectives of this standard shall be maintained for the life of the building.

Chapter 6 Construction Requirements

6.1* Building Construction.

6.1.1 The ITE area shall be housed in a fully sprinklered building in accordance with NFPA 13 or housed in one of the following:

(1) A building with Type I (442 or 332) or Type II (222 or 111) construction in accordance with NFPA 220 *(for nonsprinklered buildings, see 9.1.1)*
(2) A single-story building with Type II (000) construction in accordance with NFPA 220 *(for nonsprinklered buildings, see 9.1.1.1)*

6.1.1.1 The building construction requirements in 6.1.1 shall be permitted to be modified where a risk assessment, as outlined in Chapter 4, identifies that an alternative means of construction is acceptable.

6.1.2* Protection for the building housing the ITE area shall be provided where it is subject to damage from external exposure.

6.1.3* The ITE area shall be separated from other occupancies within the building, including atria or other open-space construction, by fire-resistant-rated construction.

6.1.3.1 The ITE room shall be separated from other occupancies in the ITE area by fire-resistant-rated construction.

6.1.3.2 The fire resistance rating shall be commensurate with the exposure but not less than 1 hour for both.

6.1.3.3 The fire-resistant-rated enclosures shall extend from the structural floor to the structural floor above or to the roof.

6.1.3.4 Every opening in the fire-resistant-rated construction shall be protected to limit the spread of fire and to restrict the movement of smoke from one side of the fire-resistant-rated construction to the other. The fire resistance rating for doors shall be as follows:

(1) 2-hour fire-resistant-rated construction — 1½-hour fire-resistance-rated doors
(2) 1-hour fire-resistant-rated construction — ¾-hour fire-resistance-rated doors

6.1.3.5 The fire-resistant-rated construction shall be in accordance with NFPA *101* and applicable building and fire codes.

6.1.3.6 Under the following conditions, the fire separation requirements of 6.1.3 through 6.1.3.4 shall be permitted to be evaluated as part of the risk assessment as outlined in Chapter 4:

(1) The anticipated fire exposures are documented.
(2) Alternate forms of fire separation are provided based on the anticipated fire exposures.

6.2* Combustibility of Materials.

6.2.1 Noncombustible Material.

6.2.1.1 A material that complies with any one of the following shall be considered a noncombustible material:

(1)* The material, in the form in which it is used, and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.
(2) The material is reported as passing ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C.*
(3) The material is reported as complying with the pass/fail criteria of ASTM E136 when tested in accordance with the test method and procedure in ASTM E2652, *Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-Shaped Airflow Stabilizer, at 750°C.*

[**5000:**7.1.4.1.1]

6.2.1.2 Where the term *limited-combustible* is used in this standard, it shall also include the term *noncombustible.* [**5000:**7.1.4.1.2]

6.2.2 Limited-Combustible Material. A material shall be considered a limited-combustible material where one of the following is met:

(1) The conditions of 6.2.2.1 and 6.2.2.2, and the conditions of either 6.2.2.3 or 6.2.2.4, shall be met.
(2) The conditions of 6.2.2.5 shall be met.

[**5000:**7.1.4.2]

6.2.2.1 The material does not comply with the requirements for a noncombustible material in accordance with 6.2.1. [**5000:**7.1.4.2.1]

6.2.2.2 The material, in the form in which it is used, exhibits a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg) when tested in accordance with NFPA 259. [**5000:**7.1.4.2.2]

6.2.2.3 The material shall have a structural base of noncombustible material with a surfacing not exceeding a thickness of ⅛ in. (3.2 mm) where the surfacing exhibits a flame spread index not greater than 50 when tested in accordance with ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials,* or UL 723, *Test for Surface Burning Characteristics of Building Materials.* [**5000:**7.1.4.2.3]

6.2.2.4* The material shall be composed of materials that in the form and thickness used neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials,* or UL 723, *Test for Surface Burning Characteristics of Building Materials,* and are of such composition that all surfaces that would be exposed by cutting through the material on any plane would neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723. [**5000:**7.1.4.2.4]

6.2.2.5 Materials shall be considered limited-combustible materials where tested in accordance with ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter,* at an incident heat flux of 75 kW/m^2 for a 20-minute exposure, and both the following conditions are met:

(1) The peak heat release rate shall not exceed 150 kW/m^2 for longer than 10 seconds.
(2) The total heat released shall not exceed 8 MJ/m^2.

[**5000:**7.1.4.2.5]

6.2.2.6 Where the term *limited-combustible* is used in this standard, it shall also include the term *noncombustible.* [**5000:**7.1.4.2.6]

6.3 Location of ITE Area Within the Building.

6.3.1* The ITE area shall not be located above, below, or adjacent to areas or other structures where hazardous processes are located unless approved protective features are provided.

6.3.2* Access to the ITE area shall be restricted to authorized persons.

6.3.3* A structural floor where an ITE system is located or that supports a raised floor installation shall incorporate provisions to allow for removal of leaks from chilled water, heating water, steam condensate, domestic water, liquid coolants, or water from sprinklers or firefighting operations.

6.3.3.1* One or more of the following methods shall be used for liquid removal:

(1) Floor drain(s)
(2) Liquid containment with removal pumps
(3) Alternate methods as approved by the AHJ

6.3.3.2* Underfloor spaces shall be provided with a leak detection system where any utility liquids or computer auxiliary cooling liquids are piped into the ITE room or are capable of entering the room from adjoining areas.

6.3.4 Where an alternate solution, such as containment with leak detection, is provided, the drainage requirements in 6.3.3 shall be permitted to be evaluated as part of the performance-based risk analysis as outlined in Chapters 4 and 5.

6.4 ITE Area Interior Construction Materials.

6.4.1 All interior wall and ceiling finishes in the ITE area shall have a Class A rating in accordance with NFPA *101*.

6.4.1.1 Interior wall and ceiling finishes in fully sprinklered ITE areas shall be permitted to be Class B in accordance with NFPA *101*.

6.4.1.2 Interior floor finishes used in ITE areas shall be Class I in accordance with NFPA *101*.

6.4.1.2.1 Interior floor finishes in fully sprinklered ITE areas shall be permitted to be Class II in accordance with NFPA *101*.

6.4.1.3 Exposed cellular plastics shall not be used in ITE area construction.

6.5* Raised Floors. Where raised floors are used, they shall comply with 6.5.1 through 6.5.4.

6.5.1 Structural supporting members for raised floors shall be of noncombustible material.

6.5.2 Decking for raised floors shall be one of the following:

(1) Noncombustible
(2) Pressure-impregnated, fire-retardant-treated lumber having a flame spread index of 25 or less in accordance with ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or UL 723, *Test for Surface Burning Characteristics of Building Materials*
(3) Wood or similar core material that is encased on the top and bottom with sheet, cast, or extruded metal, with all openings or cut edges covered with metal or plastic clips or grommets so that none of the core is exposed, and that has an assembly flame spread index of 25 or less in accordance with UL 723, *Test for Surface Burning Characteristics of Building Materials*

6.5.3 Access sections or panels shall be provided in raised floors so that all the space beneath is accessible. Tools needed to provide access to the underfloor space shall be located in the room, and their location shall be well marked.

6.5.4* Electric cable openings in floors shall be made smooth or shall be otherwise protected to preclude the possibility of damage to the cables.

6.6 Penetrations and Openings in Fire-Resistant-Rated Enclosures.

6.6.1 Cable penetrations or other penetrations through required fire-rated assemblies shall be firestopped with a listed firestop system that has a rating as specified in 6.6.1.1 and 6.6.1.2 where tested with minimum positive furnace pressure differential of 2.5 Pa (0.01 in. of water) under ASTM E814, *Standard Test Method for Fire Tests of Penetration Firestop Systems*, or UL 1479, *Fire Tests of Penetration Firestops*.

6.6.1.1 F Ratings. Firestop systems and devices shall have an F rating of not less than 1 hour, and not less than the required fire resistance rating of the fire barrier penetrated. [***101***:8.3.4.2.3]

6.6.1.2 T Ratings. Penetrations in fire-resistance-rated horizontal assemblies shall have a T rating of not less than 1 hour, and not less than the fire resistance rating of the horizontal assembly. [***101***:8.3.4.2.4.1]

6.6.1.2.1 A T rating shall not be required for either of the following:

(1) Floor penetrations contained within the cavity of a wall assembly
(2) Penetrations through floors or floor assemblies where the penetration is not in direct contact with combustible material

[***101***:8.3.4.2.4.2]

6.6.2 Pass-throughs or windows located in fire-resistant-rated construction shall be equipped with an automatic fire-rated shutter, a service counter fire door, or fire-rated windows installed and maintained in accordance with NFPA 80.

6.6.2.1 The shutters, service counter door, or windows shall be operated automatically by the presence of either smoke or fire on either side of the wall.

6.6.2.2 The fire rating of the shutters, service counter door, or windows shall not be less than the fire rating of the wall in which it is located.

6.6.3 All air ducts and air transfer openings passing through fire-resistant-rated construction shall be provided with automatic fire and smoke dampers.

6.6.3.1* Fire and smoke dampers shall be installed in accordance with NFPA 90A.

6.6.3.2 Fire dampers shall be maintained in accordance with NFPA 80.

6.6.3.3 Smoke dampers and combination fire/smoke dampers shall be maintained in accordance with NFPA 105.

6.7* Aisle Containment and Hot Air Collar Systems for ITE.

6.7.1 Aisle containment and hot air collar systems shall be permitted to be one of the following:

(1) Factory-packaged and aftermarket: systems designed, provided, and installed in accordance with the manufacturer's instructions
(2) Field-constructed: systems designed and constructed using common construction materials

6.7.2 Both types of aisle containment systems shall comply with 6.7.3 through 6.7.10.1.

6.7.3 Elements of aisle containment and hot air collars shall be constructed of materials that have a maximum flame spread index of 50 and a maximum smoke development of 450 in accordance with one or more of the following:

(1) ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*
(2) UL 723, *Test for Surface Burning Characteristics of Building Materials*

6.7.4* Aisle containment systems and hot air collars shall not be considered to be plenums.

6.7.5 Aisle containment systems shall be permitted to be applied to hot aisles or cold aisles of ITE.

6.7.6* Detection and suppression components within aisle containment systems shall be rated for the intended temperatures of hot aisles when installed in those locations.

6.7.7 Where aisle containment systems are installed, the existing suppression and detection systems shall be evaluated, modified, and tested as necessary to maintain compliance with the applicable codes and standards.

6.7.8 Where automatic sprinklers are present and the application of aisle containment systems or hot air collars creates obstructions to proper operation of sprinkler systems, the sprinkler system shall be modified as necessary to comply with NFPA 13.

6.7.8.1* Sprinkler system modifications shall not be required where all of the following conditions are met:

(1)* An automatic means of smoke detection initiates the removal of the obstruction prior to operation of the suppression system.
(2) Removing the obstruction or a portion thereof does not compromise means of egress per NFPA *101*.
(3) The design and installation of removable obstruction elements does not diminish the level of protection that existed prior to the installation of the aisle containment or hot air collar.
(4)* The releasing devices are listed for the application.
(5) All removable obstructions are removed for the entire suppression zone.

6.7.9 Where gaseous suppression systems are present, they shall be designed to develop the required concentration of agent for the entire volume they serve, in accordance with NFPA 2001.

6.7.10 If the aisle containment prevents the gaseous suppression system, where present, from producing the required design concentrations, the gaseous suppression system shall be modified to produce the required concentration throughout the volume served.

6.7.10.1* Gaseous suppression system modifications shall not be required where all the following conditions are met:

(1)* An automatic means of smoke detection initiates the removal of the obstruction prior to the suppression system operation.
(2) Removing the obstruction or portion thereof does not compromise means of egress per NFPA *101*.
(3) The design and installation of removable obstruction elements does not diminish the level of protection that existed prior to the installation of the aisle containment or hot air collar.
(4)* The releasing devices are listed for the application.
(5) All removable obstructions are removed for the entire suppression zone.

Chapter 7 Materials and Equipment Permitted in the Information Technology Equipment Area

7.1 General.

7.1.1* Only ITE and support equipment shall be permitted in the ITE room.

7.1.2 Small work areas shall be permitted within the ITE room if all the following conditions are met:

(1) Areas are not occupied on a full-time basis.
(2) Case furniture, including desks, is constructed of noncombustible material (e.g., metal). The construction can include a high-pressure laminate veneer on the desktop.
(3) Space dividers and system furniture panels and chairs with upholstered assemblies exhibit a maximum rate of heat release not exceeding 80 kW (273,000 BTU/hr) and a maximum total heat release not exceeding 25 MJ (23,700 BTU) within the first 10 minutes of test where tested in accordance with ASTM E1537, *Standard Test Method for Fire Testing of Upholstered Furniture*.
(4) Paper records, manuals, drawings, and all other combustible materials are stored in fully enclosed noncombustible cabinets or cases.
(5) The quantity of records, manuals, drawings, and all other combustible materials kept in the room are limited to the absolute minimum required for essential and efficient operation.
(6) Trash receptacles, where provided, are listed, provided with tight-fitting or self-closing lids, and constructed of materials that are either noncombustible or meet a peak heat release rate not exceeding 300 kW/m^2 (95,100 BTU/hr/ft^2) where tested in accordance with ASTM E1354, *Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*, at an incident heat flux of 50 kW/m^2 (15,850 BTU/hr/ft^2) in the horizontal orientation in accordance with UL 242, *Nonmetallic Containers for Waste Paper*, or UL 1315, *Containers for Waste Paper*.

7.2 Record Storage.

7.2.1 The amount of records within the ITE room shall be kept to the absolute minimum required for essential and efficient operation.

7.2.1.1 Only records that are essential to the ITE operations shall be permitted to be kept in the ITE room.

7.2.1.2 An automated information storage system (AISS) conforming to the requirements of 9.1.4 shall be permitted in the ITE room.

7.2.2 Tape libraries and record storage rooms within the ITE area shall be protected by an extinguishing system and separated from the ITE room and other portions of the ITE area by fire-resistant-rated construction. The fire resistance rating shall be commensurate with the exposure but not less than 1 hour.

7.2.3 The records storage room shall be used only for the storage of records.

7.2.3.1 All other operations, including splicing, repairing, erasing, reproducing, cataloging, and so forth, shall be prohibited in this room.

7.2.3.2 Spare media shall be permitted to be stored in this room if they are unpacked and stored in the same manner as the media containing records.

7.3 General Storage.

7.3.1 Paper stock, inks, unused recording media, and other combustibles within the ITE room shall be restricted to the absolute minimum necessary for efficient operation. Any such materials in the ITE room shall be kept in totally enclosed metal file cases or cabinets or, if provided for in individual machine design, shall be limited to the quantity prescribed and located in the area designated by the equipment manufacturer.

7.3.2 Reserve stocks of paper, inks, unused recording media, and other combustibles shall be stored outside the ITE room.

7.3.3 The space beneath the raised floor shall not be used for storage purposes.

7.3.4 Storage in Battery Rooms. Combustible material shall not be stored in battery rooms, battery cabinets, or battery enclosures.

Chapter 8 Construction of Information Technology Equipment

8.1 ITE.

8.1.1 Equipment and replacement parts shall meet the requirements of UL 60950-1, *Information Technology Equipment — Safety — Part 1: General Requirements*, or UL 62368-1, *Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements*.

8.1.2* Each individual unit shall be constructed in such a way that by limiting combustible materials or by use of enclosures, fire is not likely to spread beyond the unit where the source of ignition is located. Automatic protection shall be provided for all units not so constructed.

8.1.3 Listed ITE shall be considered as meeting the requirements of 8.1.2.

8.1.4* Enclosures of floor-standing equipment having external surfaces of combustible materials of such size that can contribute to the spread of an external fire shall have a flame spread index of 50 or less in accordance with ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or UL 723, *Test for Surface Burning Characteristics of Building Materials*.

8.1.4.1 Equipment conforming to the requirements of UL 60950, *Information Technology Equipment*; UL 60950-1, *Information Technology Equipment — Safety — Part 1: General Requirements*; or UL 62368-1, *Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements*, shall be considered as meeting the requirements of 8.1.4.

8.2 Construction Features. If the design of the unit is such that oil or equivalent liquid is required for lubrication or hydraulic purposes, it shall have a closed-cup flash point of 149°C (300°F) or higher and a container that is of sealed construction, incorporating automatic pressure relief devices.

8.2.1* Acoustical Materials. (Reserved)

8.2.2 ITE Immersion Cooling System.

8.2.2.1 Immersion Cooling Unit Installation. Manufacturers' instructions shall be followed for installation, maintenance, and operation for all immersion cooling units.

8.2.2.2 ITE Immersion Cooling Liquid. Insulating liquids shall be noncombustible or have a closed-cup flash point of 135°C (275°F) or higher.

8.2.2.3 ITE Immersion Cooling Unit — Single-Phase. A system designed for the purpose of single-phase immersion cooling of ITE using insulating liquids shall comply with the following:

(1) Have a lid or access point
(2) Use closed piping
(3) Be listed or approved

8.2.2.4 ITE Immersion Cooling Unit — Two-Phase. (Reserved)

8.3* ITE with Integral Battery Backup.

8.3.1 Where ITE includes integral battery backup, the integral battery backup shall be included in the product listing.

8.3.2 Where ITE includes integral battery backup, the ITE shall be installed and operated in accordance with its listing and the manufacturer's instructions.

Chapter 9 Fire Protection and Detection Equipment

9.1 Automatic Fire Protection Systems.

9.1.1 ITE rooms and ITE areas located in a sprinklered building shall be provided with an automatic sprinkler system.

9.1.1.1 ITE rooms and ITE areas located in a nonsprinklered building shall be provided with one or more automatic fire suppression systems as permitted by Chapter 9.

9.1.1.2 The requirement of 9.1.1.1 shall be permitted to be evaluated as part of the fire risk assessment as outlined in Chapter 4.

9.1.1.3* An automatic fire suppression system, as permitted by Chapter 9, shall be provided for the protection of the area below a raised floor in an ITE room or ITE area where the area below the raised floor contains combustible material other than what is permitted in 9.1.1.4.

9.1.1.4 An automatic fire suppression system shall not be required for the protection of the area below a raised floor in an ITE room or ITE area where combustible material under the floor is limited to the following:

(1) Cables listed for plenum use
(2) Listed plenum communications raceways
(3) Listed equipment power cords up to 4.6 m (15 ft) each
(4) Cables installed in metallic raceways
(5) Installations in compliance with Section 300.22(C) of *NFPA 70*
(6) Listed cooling hoses

9.1.1.5 Where a gaseous fire extinguishing system is provided only under a raised floor, the gaseous system shall be either carbon dioxide or an inert gas.

9.1.1.6 Where a clean agent fire extinguishing system is provided to protect the space above the raised floor, the space under the raised floor shall be simultaneously protected by the clean agent fire extinguishing system.

9.1.2* Automatic sprinkler systems protecting ITE rooms or ITE areas shall be installed in accordance with NFPA 13.

9.1.3 Sprinkler systems protecting ITE areas shall be valved separately from other sprinkler systems.

9.1.3.1 Valves shall be in an approved location that is exterior to the room, readily accessible, and labeled as to what they control.

9.1.4* Automated information storage system (AISS) units containing combustible media with an aggregate storage capacity of more than 0.76 m^3 (27 ft^3) shall be protected within each unit by an automatic sprinkler system or a gaseous agent extinguishing system with extended discharge.

9.1.5 The requirement of 9.1.4 shall be permitted to be evaluated as part of the fire risk assessment as outlined in Chapter 4.

9.1.6 Automatic sprinkler systems protecting ITE rooms or ITE areas shall be maintained in accordance with NFPA 25.

9.2* Automatic Detection Systems.

9.2.1* Automatic detection equipment shall be installed to provide early warning of fire.

9.2.1.1 The equipment used shall be a listed smoke detection–type system installed and maintained in accordance with *NFPA 72.*

9.2.1.2 Each of the ITE areas, including aisle containment and hot air collar systems, where present, shall be evaluated to determine the hazards and ambient conditions that are present and the corresponding performance level of the detection system.

9.2.2* Automatic detection systems shall be installed to provide early warning of fire in the following locations:

(1) At the ceiling level throughout the ITE area
(2) Below the raised floor of the ITE area containing cables
(3)* In the exhaust/return air stream where aisle containment systems are used
(4) In the return air stream where the above ceiling area is used as a return air plenum

9.2.2.1 Smoke detectors or sampling ports installed on return air openings shall have a coverage area of no more than 0.4 m^2 (4 ft^2).

9.2.3* Where detection is used for the monitoring of fire in individual ITE cabinets, the following shall be met:

(1) Detectors or sampling ports shall be located in the main airflow at the exhaust vents, downstream of the airflow distribution path, or in accordance with the manufacturer's published instructions.
(2) Multiple detectors or ports shall be provided when the cabinet has multiple outlet vents.
(3) If the cabinet is compartmentalized, each compartment shall have a detector or port.
(4) Where cabinets are fitted with in-cabinet suppression systems, the detection system shall provide an alarm signal for each cabinet or group of cabinets if the suppression system is to be released into several cabinets simultaneously.

9.2.4 Where detection is used for the monitoring of fire in ITE with close-coupled cooling units, detectors or sampling ports shall be provided at the return inlets.

9.2.5 In the ITE area, where the space above the suspended ceiling or below the raised access floor is used to circulate air to other parts of the building, automatic smoke detection shall be installed in one of the following locations to operate the smoke dampers required by 6.6.3:

(1) Throughout the above ceiling space or below raised access floor space
(2) At each smoke damper
(3) At other approved locations to detect smoke entering or exiting the ITE area

9.2.6 Where interlock and shutdown devices are provided, the electrical power to the interlocks and shutdown devices shall be supervised by the fire alarm control panel.

9.2.7 Where power is required for the operation of the disconnecting means in 11.4.5, that electrical power shall be supervised by the fire alarm control panel.

9.2.8 The alarms and trouble signals of automatic detection or extinguishing systems shall be arranged to annunciate at a constantly attended location.

9.3 Portable Extinguishers.

9.3.1 Listed portable fire extinguishers of the carbon dioxide type or a halogenated agent type shall be provided for the protection of electronic equipment. The extinguishers shall be maintained in accordance with NFPA 10.

9.3.2* Listed extinguishers with a minimum rating of 2-A shall be provided for use on fires in ordinary combustible materials, such as paper and plastics. Dry chemical extinguishers shall not be permitted.

9.3.3 A sign shall be located adjacent to each portable extinguisher and shall plainly indicate the type of fire for which it is intended.

9.4 Gaseous Total Flooding Extinguishing Systems.

9.4.1* Where there is a critical need to protect data in process, reduce equipment damage, and facilitate return to service, consideration shall be given to the use of a gaseous agent inside units or total flooding systems in sprinklered or nonsprinklered ITE areas.

9.4.2 Where gaseous agent or inert gas agent total flooding systems are used, they shall be designed, installed, and maintained in accordance with the requirements of NFPA 12, NFPA 12A, or NFPA 2001. The agent selected shall not cause damage to the ITE systems and media. *(See Annex D.)*

9.4.2.1 The power to all electronic equipment shall be disconnected upon activation of a gaseous agent total flooding system, unless the risk considerations outlined in Chapter 4 indicate the need for continuous power.

9.4.3* Hot aisle or cold aisle containment systems shall not obstruct the free flow of gaseous clean agent suppression systems to the ITE or cooling system serving the contained aisle within an ITE room or zone.

9.4.4* Gaseous agent systems shall be automatically actuated by an approved method of detection meeting the requirements of *NFPA 72* and a listed releasing device compatible with the system.

9.4.5* Where operation of the air-handling system would exhaust the agent supply, it shall be interlocked to shut down when the extinguishing system is actuated.

9.4.6* Alarms shall be provided to give positive warning of a pending discharge and an actual discharge.

9.5 Warning Signs. Where continuous power is provided, signs shall be posted at each perimeter entrance to the ITE areas warning that electrical equipment will remain energized, either upon activation of the suppression system or disconnect of main electrical service.

9.6* In-Building Emergency Responder Communications Enhancement Systems. Where in-building emergency responder communications enhancement systems are required for the building, such systems shall be installed to minimize interference with ITE in accordance with NFPA 1225.

9.7 Training. Designated ITE area personnel shall be continually and thoroughly trained in the functioning of the alarm system, desired response to alarm conditions, location of all emergency equipment and tools, and use of all available extinguishing equipment. This training shall encompass both the capabilities and the limitations of each available type of extinguisher and the proper operating procedures of the extinguishing systems.

9.8 Expansion or Renovations.

9.8.1 Whenever changes are made to the ITE area — for example, size, installation of new partitions, modification of the air-handling systems, or revised ITE layout — the potential impact on existing fire detection and extinguishing systems shall be evaluated and corrective changes shall be made if necessary.

9.8.2 Modifications or alterations as outlined in 9.8.1 shall be submitted to the AHJ for approval.

9.9 Hybrid Fire-Extinguishing Systems.

9.9.1 Where provided, hybrid fire-extinguishing systems shall be installed in accordance with NFPA 770.

9.9.2 Hybrid fire-extinguishing systems shall be designed and installed for the specific hazards and protection objectives of ITE areas in accordance with the listing.

9.9.3 Detection systems used for the operation of hybrid fire-extinguishing systems shall be installed in accordance with the listing criteria.

9.10 Water Mist Fire Protection Systems.

9.10.1 Where provided, water mist fire protection systems shall be installed in accordance with the requirements of NFPA 750.

9.10.2 Water mist fire protection systems shall be designed and installed for the specific hazards and protection objectives in ITE areas in accordance with the listing.

9.10.3 Detection systems utilized for the operation of water mist fire protection systems shall be installed in accordance with the listing criteria.

Chapter 10 Records Kept or Stored in Information Technology Equipment Rooms

10.1* Protection Required for Records Within the ITE Room. Any records regularly kept or stored in the ITE room shall be provided with the following protection:

(1) Vital or important records that have not been duplicated shall be stored in listed record protection equipment with a Class 150 1-hour or better fire resistance rating as outlined in UL 72, *Tests for Fire Resistance of Record Protection Equipment.*
(2) All other records shall be stored in closed metal files or cabinets.

10.2 Records Stored Outside the ITE Room.

10.2.1* All vital and important records shall be duplicated. Duplicated records shall be stored in a remote location that would not be exposed to a fire involving the original records. Records shall be stored in fire-resistive rooms in accordance with NFPA 232.

10.2.2 The installation of portable extinguishing equipment shall be in accordance with Section 9.3.

Chapter 11 Utilities

11.1 Heating, Ventilating, and Air Conditioning (HVAC).

11.1.1 All materials and products, including the materials of construction of the HVAC system, shall comply with the requirements of NFPA 90A.

11.1.2* Any HVAC system that serves other occupancies shall also be permitted to serve the ITE area.

11.1.3 Dampers in HVAC systems serving ITE areas shall operate upon activation of smoke detectors and by operation of the disconnecting means required by 11.4.5. The automatic fire and smoke dampers required by 6.6.3 shall also operate upon activation of smoke detectors and by operation of disconnecting means required by 11.4.5.

11.1.4 Air ducts that pass through the information technology area and only serve other rooms shall be provided with fire dampers.

11.1.5 All pipe and duct insulation and linings, including vapor barriers and coatings, shall have a flame spread index of 25 or less without evidence of continued progressive combustion and a smoke developed index no higher than 50, in accordance with ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials,* or UL 723, *Test for Surface Burning Characteristics of Building Materials.*

11.1.6* Air filters for use in air-conditioning systems shall comply with the requirements of UL 900, *Air Filter Units.*

11.2* Coolant Systems. If a separate coolant system is required for operation of an ITE installation, the system shall be provided with an approved alarm to indicate loss of liquid.

11.3* Electrical Service. Equipment, power-supply wiring, equipment interconnecting wiring, and grounding of ITE and systems in an ITE room shall comply with this section.

11.3.1* Installation of all electrical equipment and wiring and all optical fiber cabling shall conform to *NFPA 70.*

11.3.2 Transformers installed in the ITE area shall be of the dry type or the type filled with a noncombustible dielectric medium. Such transformers shall be installed in accordance with the requirements of Article 450 of *NFPA 70.*

11.3.3 Service entrance transformers shall not be permitted in the electronic ITE area.

11.3.4* Protection against overvoltage shall be provided in accordance with Article 242 of *NFPA 70.*

11.3.4.1 Surge protective devices shall be listed and labeled in accordance with UL 1449, *Surge Protective Devices.*

11.3.5 Emergency lighting shall be provided in the ITE area.

11.3.6 All electrical wiring and optical fiber cabling in the air space above a suspended ceiling shall conform to the requirements in NFPA 90A for installation in a ceiling cavity plenum and to the requirements in *NFPA 70* for installation in "other spaces used for environmental air" when that air space is used for the movement of air.

11.3.7* Signal wiring and cabling, including optical fiber cables, installed in an air space below a raised floor shall be listed.

11.3.7.1 Where the air space below a raised floor is protected by an automatic fire suppression system, signal wiring and cabling listed for plenum, riser, and general-purpose use shall be permitted to be installed exposed to the airflow in the air space.

11.3.7.2 Where the air space below a raised floor is not protected by an automatic fire suppression system, only signal wiring and cabling listed for plenum use shall be permitted to be installed exposed to the airflow in the air space.

11.3.7.3 Where the air space below a raised floor is not protected by an automatic fire suppression system, signal wiring and cabling listed for plenum, riser, and general-purpose use shall be permitted to be installed in metal raceways in the air space.

11.3.8 Electrical power supply cords up to 4.6 m (15 ft) in length shall be permitted in an air space below a raised floor.

11.4 Supply Circuits and Interconnecting Cables.

11.4.1 Interconnecting Cables. Separate ITE units shall be permitted to be interconnected by means of listed cables and cable assemblies.

11.4.2 The 4.6 m (15 ft) limitation on power cords shall not apply to interconnecting cables.

11.4.3* Abandoned Cables. The accessible portion of abandoned cables shall be removed unless contained in a raceway.

11.4.4 Installed Circuits and Cables Identified for Future Use.

11.4.4.1 Circuits and cables shall be permitted to be installed in ITE areas and identified for future use if they comply with 11.4.4.2 and 11.4.4.3.

11.4.4.2 The circuits and cables shall be marked with a tag of sufficient durability to withstand the environment involved.

11.4.4.3 The tags shall have the following information:

(1) Date identified for future use
(2) Date of intended use
(3) Information relating to the intended future use

11.4.5 Disconnecting Means.

11.4.5.1* An approved means shall be provided to disconnect power to all electronic equipment in the ITE room or in designated zones within the room.

11.4.5.2* There shall be a similar approved means to disconnect the power to all dedicated HVAC systems serving the room or designated zones.

11.4.5.3 Activation of an HVAC disconnecting means shall cause all required fire/smoke dampers to close.

11.4.5.4* Disconnecting means shall be implemented by one of the methods listed in 11.4.5.4.1 through 11.4.5.4.2.

11.4.5.4.1 Remote Disconnect Controls.

11.4.5.4.1.1 Remote disconnect controls shall be located at approved locations readily accessible in case of fire to authorized personnel and emergency responders.

11.4.5.4.1.2 The remote disconnect controls for the control of electronic equipment power and HVAC systems shall be grouped and identified.

11.4.5.4.1.3 A single means to control electronic equipment power and HVAC systems shall be permitted.

11.4.5.4.1.4 Where multiple zones are created, each zone shall have an approved means to confine fire or products of combustion to within the zone.

11.4.5.4.1.5 Additional means to prevent unintentional operation of remote disconnect controls shall be permitted.

11.4.5.4.2 Alternative Disconnecting Means. Remote disconnecting controls shall not be required where all the following criteria are met:

(1) An approved procedure has been established and maintained for removing power and air movement within the room or zone.
(2) Qualified personnel are continuously available to advise emergency responders and to instruct them of disconnecting methods.

(3) A smoke-sensing fire detection system is in accordance with Chapter 9.
(4) An approved fire protection system is in accordance with Chapter 9.
(5) Cables installed under a raised floor, other than branch circuit wiring and power cords, are installed in compliance with *NFPA 70*, Sections 645.5(D)(2) or (3), or are in compliance with *NFPA 70*.

11.4.5.5* Installations qualifying under the provisions of Article 685 of *NFPA 70* shall be permitted.

11.4.6 Marking. Each unit of an information technology system supplied by a branch circuit shall be provided with a manufacturer's nameplate, which shall also include the input power requirements for voltage, frequency, and maximum rated load in amperes. [**70:**645.16]

11.5 Uninterruptible Power Supplies (UPSs).

11.5.1 UPS Systems. UPS systems installed within the information technology equipment [ITE] room, and their supply and output circuits, shall comply with 11.4.5, except for the following installations and constructions:

(1) Installations complying with Parts I and II of Article 685
(2) Power sources limited to 750 volt-amperes or less derived either from UPS equipment or from battery circuits integral to electronic equipment

[**70:**645.11]

11.5.1.1 The disconnecting means shall also disconnect the battery from its load. [**70:**645.11]

11.5.1.2 Storage battery systems in the ITE area shall comply with the requirements of Article 480 of *NFPA 70*.

11.5.2 Batteries. Batteries used in ITE UPS systems exceeding the quantities in 11.5.3.1 shall comply with this chapter.

11.5.2.1 Location and Occupancy Separation.

11.5.2.1.1 Battery systems shall be permitted in the same room as the equipment that they support.

11.5.2.1.2 Battery systems shall be housed in a noncombustible, locked cabinet or other enclosure to prevent access by unauthorized personnel unless located in an equipment room accessible only to authorized personnel.

11.5.2.1.3 Battery systems shall be located in a room separated from other portions of the building by a minimum of a 1-hour fire barrier.

11.5.2.1.4 Where the ITE is located in a structure or building housing multiple tenants or occupancies that include assembly, educational, detention, and correction facilities, health care, ambulatory care, and day care center, and residential board and care and residential occupancies, battery systems shall be located in a room separated from other portions of the building by a minimum of a 2-hour fire barrier.

11.5.2.2 Environment. The battery environment shall be controlled or analyzed to maintain temperature in a safe operating range for the specific battery technology used.

11.5.2.3 Labels. Battery cabinets shall be provided with exterior labels that identify the manufacturer and model number of the system and electrical rating (i.e., voltage and current) of the contained battery system.

11.5.2.4 Signs. Signs shall be provided within battery cabinets to indicate the relevant electrical, chemical, and fire hazard.

11.5.2.5 Seismic Protection. Battery systems shall be seismically braced in accordance with the building code.

11.5.2.6 Smoke Detection. An approved automatic smoke detection system shall be installed in rooms containing stationary battery storage systems in accordance with *NFPA 72*.

11.5.2.7 A failure modes and effects analysis shall be performed in accordance with NFPA 855 if the chemistry (i.e., type) of the batteries constituting a battery system is changed.

11.5.3 Lead-Acid and Nickel-Cadmium Batteries.

11.5.3.1 General. UPS systems having an electrolyte capacity of more than 100 gal (378.5 L) in sprinklered buildings or 50 gal (189.3 L) in unsprinklered buildings for vented lead-acid, nickel-cadmium (NiCad), and valve-regulated lead-acid (VRLA) batteries shall be in accordance with 11.5.3 and Table 11.5.3.1.

Table 11.5.3.1 Lead-Acid and Nickel-Cadmium Battery Requirements

	Nonrecombinant Batteries		Recombinant Batteries
Requirement	**Vented Lead-Acid**	**Vented Nickel-Cadmium (NiCad)**	**Valve-Regulated Lead-Acid (VRLA)**
Safety caps	Venting caps	Venting caps	Self-resealing flame-arresting caps
Thermal runaway management	Not required	Not required	Required
Spill control	Required	Required	Not required
Neutralization	Required	Required	Not required
Ventilation	Required	Required	Required
Signage	Required	Required	Required
Seismic control	Required	Required	Required
Fire detection	Required	Required	Required

11.5.3.2 Safety Features.

11.5.3.2.1 Safety Venting. Batteries shall be provided with safety venting caps per 11.5.3.2.1.1 and 11.5.3.2.1.2.

11.5.3.2.1.1 Nonrecombinant Batteries. Vented lead-acid and nickel-cadmium shall be provided with safety venting caps.

11.5.3.2.1.2 Recombinant Batteries. VRLA shall be equipped with self-resealing flame-arresting safety vents.

11.5.3.2.2 Thermal Runaway. VRLA systems shall be provided with a listed device or other approved method to preclude, detect, and control thermal runaway.

11.5.3.2.3 Spill Control.

11.5.3.2.3.1 Rooms containing free-flowing liquid electrolyte in multiple vessels having an aggregate capacity exceeding 1000 gal (3785 L) shall be provided with spill control to prevent the flow of liquids to adjoining areas.

11.5.3.2.3.2* The approved spill control method shall be capable of controlling a spill from the single largest vessel.

11.5.3.2.3.3 VRLA batteries with immobilized electrolyte shall not require spill control.

11.5.3.2.4 Neutralization.

11.5.3.2.4.1* An approved method to neutralize spilled electrolyte shall be provided.

11.5.3.2.4.2 For vented lead-acid and nickel-cadmium batteries, the method shall be capable of neutralizing a spill from the largest battery to a pH between 7.0 and 9.0.

11.5.3.2.5* Ventilation. For vented lead-acid, flooded nickel-cadmium, and VRLA batteries, ventilation shall be provided for rooms and cabinets in accordance with the mechanical code and one of the following:

(1) The ventilation system shall be designed to limit the maximum concentration of hydrogen to 1.0 percent of the total volume of the room during the worst-case event of simultaneous "boost" charging of all the batteries, in accordance with nationally recognized standards.
(2) Continuous ventilation shall be provided at a rate of not less than 1 $ft^3/min/ft^2$ (5.1 $L/sec/m^2$) of floor area of the room or cabinet.

11.5.3.2.6 Signs.

11.5.3.2.6.1 Doors or accesses into the following shall be provided with approved signs:

(1) Rooms containing stationary storage battery systems
(2) Other areas containing stationary storage battery systems

11.5.3.2.6.2 For rooms that contain VRLA batteries, the signs required by 11.5.3.2.6.1 shall state the following:

This room contains:

(1) Stationary storage battery systems

(2) Energized electrical circuits

11.5.3.2.6.3 For rooms that contain lead-acid or vented NiCad batteries, the signs required by 11.5.3.2.6.1 shall state the following:

This room contains:

(1) Stationary storage battery systems

(2) Energized electrical circuits

(3) Corrosive battery electrolyte

11.5.4* Other Battery Types. Battery types other than those addressed in 11.5.3 shall comply with Chapter 52 of NFPA 1.

11.5.4.1* Lithium-Ion Batteries. Where installed, off-gas detection systems that monitor for electrolyte vapor released prior to thermal runaway shall be listed or approved, and installed in accordance with the manufacturer's published instructions.

11.5.4.2 When lithium-ion batteries in a UPS are replaced with new batteries, replacement batteries shall be in accordance with the listing of the UPS.

Chapter 12 Emergency and Recovery Procedures

12.1* Emergency Fire Plan. There shall be a management-approved written, dated, and annually tested emergency fire plan.

12.1.1 Fire Safety of Firefighters.

12.1.1.1 Fire Department Information. Where requested by the local fire department, the following shall be provided:

(1) A general description of the ITE within the building and how it is powered
(2) An up-to-date floor plan of all ITE systems and ITE areas
(3) Actions to be taken concerning ventilation and the prevention of contamination of areas not affected by the fire

12.1.1.2* Fire Service Orientation and Information. When requested by the local fire department, orientation and information shall be provided to the fire personnel by the company management as follows:

(1) A general description of the facilities and all the ITE systems
(2) An orientation walkthrough of the facility to address all the orientation and information issues to ensure life safety and service continuity are upheld
(3) The strategy and tactics to confine, suppress, and limit an incident's impact in the ITE area

12.2* Damage Control Plan. There shall be a management-approved written, dated, and annually tested damage control plan.

12.3* Recovery Procedures Plan. There shall be a management-approved written, dated, and annually tested plan covering recovery procedures for continued operations.

Chapter 13 Modular Data Centers

13.1 General. This standard applies to modular data centers (MDCs), except as modified by Chapter 13.

13.2 Reserved.

13.3 Reserved.

13.4 Fire Protection Approaches. The construction, location, and fire protection and detection equipment for MDCs shall comply with the requirements of Chapter 4.

13.5 Reserved.

13.6 Construction Requirements. Construction requirements shall comply as required by Chapter 6.

13.7 Materials and Equipment Permitted in Modular Data Centers. Materials and equipment permitted in MDCs shall comply with the requirements of Chapter 7.

13.8 Reserved.

13.9 Fire Protection and Detection Equipment. Fire protection and detection equipment for MDCs shall comply with the requirements of Chapter 9.

13.10 Records Kept or Stored in Modular Data Centers. Records kept or stored in MDCs shall not be permitted.

13.11* Utilities.

13.11.1 Heating, ventilation, and air-conditioning and coolant systems shall comply with Sections 11.1 and 11.2.

13.11.2 Electrical service shall comply with Article 646 of *NFPA 70*.

13.12 Emergency and Recovery Procedures. Emergency and recovery procedures for MDCs shall comply with the requirements of Chapter 12.

Annex A Explanatory Material

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

A.1.2 This standard does not cover installation of ITE and ITE areas that can be made without special construction or protection. It can, however, be used as a management guide for the installation of electrically powered mechanical ITE, small tabletop or desk-type units, and ITE.

The strategic importance placed on ITE and ITE areas by the user is vitally tied to uninterrupted operation of the system. Consequently, by the partial or entire loss of this equipment, an entire operation of vital nature could be temporarily paralyzed.

Not to be overlooked are the one-of-a-kind information technology systems. These are the custom-made models that are designed to perform specific tasks. Replacement units for this type of equipment are not available, and the probability of the existence of duplicate facilities, which could be used to perform vital operations in the event that the one-of-a-kind systems are partially or totally impaired by a fire, is remote.

The prescriptive requirements of this standard are intended to provide a minimum level of fire protection for ITE systems and facilities. As technology changes, information technology facilities might have varying sizes, equipment density, equipment cooling arrangements, physical separations, different numbers of users served by a single facility, and other characteristics. The fire risk assessment required by Chapter 4 is intended to reveal any causes that justify modification of the prescriptive requirements of this standard for a specific facility.

A.1.3 See Figure A.1.3.

A.1.3.2 The requirements should apply where ITE is installed in occupiable ITE areas or rooms that contain related hazards, or in ITE areas or rooms that have strategic business importance. Typical ITE areas or rooms contain multiple servers, routers, data storage devices, and printers and usually contain associated rooms of support equipment including, but not limited to, HVAC, power, and equipment cooling.

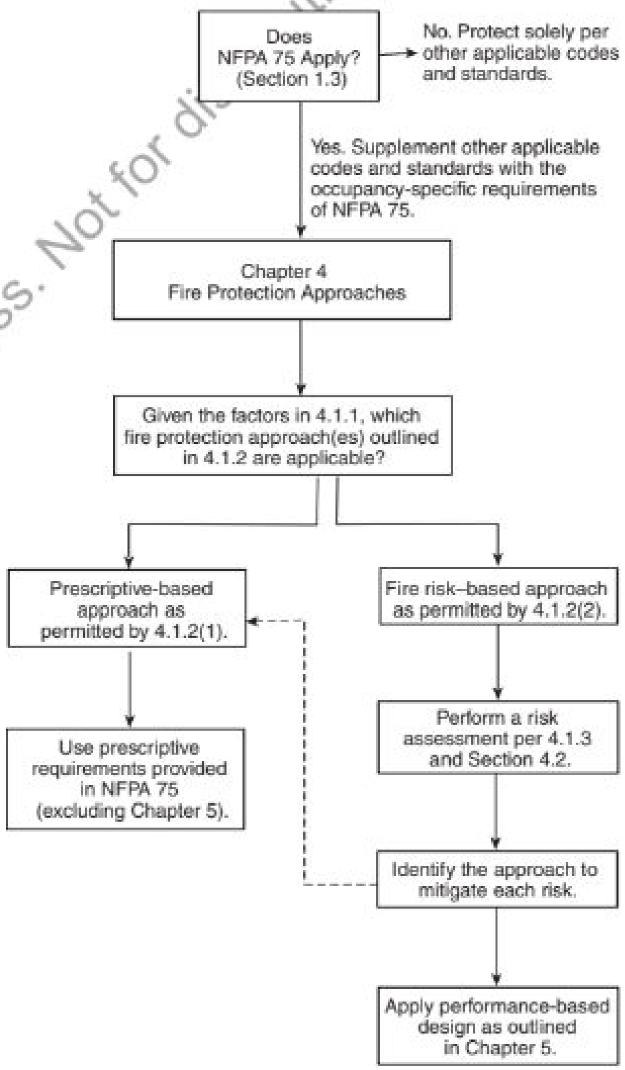


FIGURE A.1.3 Decision Tree for Application of NFPA 75.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations 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 that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

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

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.4.3 Valve-Regulated Lead-Acid (VRLA). In VRLA batteries the liquid electrolyte in the cells is immobilized in an absorptive glass mat (AGM cells or batteries) or by the addition of a gelling agent (gel cells or gelled batteries).

A.3.3.4.4 Vented (Flooded). Vented batteries have a provision for the user to add water to the cell and are equipped with a flame-arresting vent that permits the escape of hydrogen and oxygen gas from the cell in a manner such that a spark or other ignition source outside the cell will not ignite the gases inside the cell.

A.3.3.10 Energy Storage System (ESS). Energy storage systems (ESSs) differ from other storage systems [e.g., uninterruptible power supply (UPS) *(see 3.3.32)*].

A.3.3.13 Information Technology Equipment (ITE). The term ITE is widely used in the industry to designate electronic equipment such as computers, servers, and data storage devices. It designates equipment both for manipulating and transmitting the signals. It can also include close-coupled associated power and cooling systems located in, on, or on top of the lineups.

A.3.3.15 ITE Area. Areas that support ITE and the ITE room are subject to fires as well. ITE support rooms could contain primary and backup power systems; cooling, heating, and air handling equipment; wide area network connections; and network control and operation rooms. Fires in these rooms could affect the operation of the ITE; therefore, the risk in these spaces should be considered.

A.3.3.18 ITE System. Figure A.3.3.18 shows the components that comprise an ITE system.

A.3.3.20.3 Maximum Allowable Quantity (MAQ). Quantities are permitted to exceed the MAQ when they are located in an area complying with Protection Levels 1–5 in accordance with the building code. [**1,** 2024]

A.3.3.21 Modular Data Center (MDC). Equipment enclosures housing only support equipment (e.g., HVAC or power distribution equipment) that are not part of a specific modular data center are not considered a modular data center. [**70:**646.1 Informational Note No. 5]

A.3.3.25 Raceway. Raceways include, but are not limited to, rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical nonmetallic tubing,

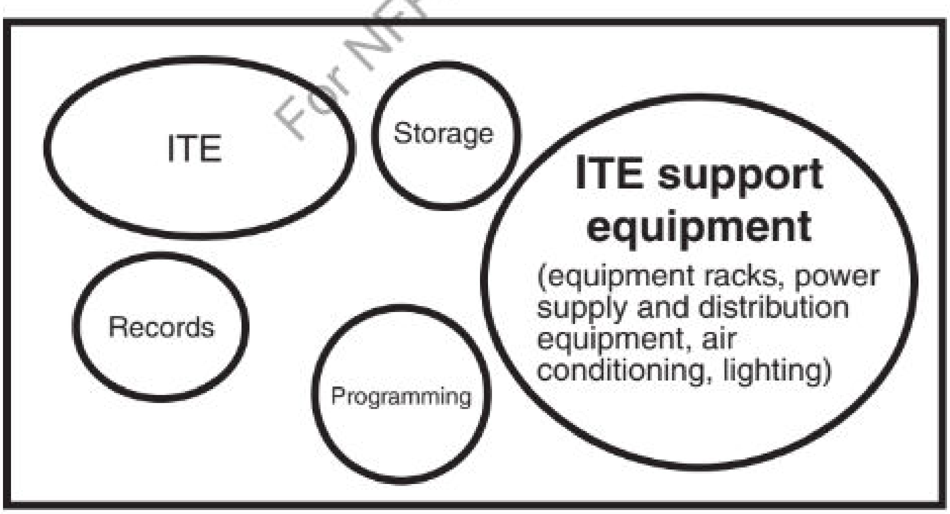


FIGURE A.3.3.18 ITE System.

electrical metallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways.

A.3.3.26 Raised Floor. Raised floors are sometimes referred to as false floors, secondary floors, or access floors.

A.3.3.30 Support Equipment. Support equipment can mean the physical infrastructure equipment necessary for the ITE, such as equipment racks, power supply and distribution equipment, air conditioning, and lighting. It can also include such things as test equipment, material-handling equipment, ladders, tools, and other equipment that might be required for installation and maintenance and that might not be permanently installed. Nonpermanent equipment should be removed from the ITE room when not needed for a particular task.

A.3.4.1 Aisle. The key elements of this definition are as follows:

(1) A passageway between equipment intended for movement of people and/or equipment
(2) Typically between opposing rows of ITE enclosures or racks but could be between two free-standing pieces or racks of ITE
(3) Intended for routine human activity such as service or operation (therefore not a plenum space)

A.3.4.2 Aisle Containment. The key elements of this definition are as follows:

(1) An occupied area (excluding areas above a ceiling or below a raised floor)
(2) Utilizing physical separation between hot and cold air (excluding construction methods such as fire-rated walls)
(3) Can be either a hot aisle or a cold aisle or a mix of both at select portions of the aisle

A.3.4.3 Cold Aisle. The key elements of this definition are as follows:

(1) Airflow controlled
(2) Intake air cold, implying an aisle normally intended for operation of the ITE
(3) Air from the output of the HVAC

A.3.4.4 Hot Air Collar. The key elements of this definition are as follows:

(1) Air conveyance assembly, sometimes referred to as a duct or a chimney
(2) Typically from specific equipment rather that from larger areas such as aisles
(3) Hot air collar not required to be physically connected to a duct or plenum

A.3.4.5 Hot Aisle. The key elements of this definition are as follows:

(1) Airflow controlled
(2) Exhaust air hot, implying an aisle normally intended for servicing of the ITE
(3) Air returns to the input of the HVAC

A.4.2.1 The fire risk analysis should be evaluated by the stakeholders. See NFPA 551 for additional guidance.

A.4.2.3 The protection for ITE systems and ITE areas should be specific to the nature and anticipated fire risks of each facility. The risk analysis should consider the risk and hazards associated with the site and services provided for a given fire safety problem. Additional considerations can include the following:

(1) Availability of alternative ITE or ITE rooms
(2) Permitted downtime of ITE
(3) Presence of additional fire protection and detection equipment proximate to the ITE room
(4) Survivability of the ITE systems and ITE room environment
(5) Number and training of emergency response personnel
(6) Building construction

NFPA 551 can be used as a reference guide for conducting and evaluating fire risk assessments.

A.4.2.3(1) Examples of life safety aspects include process controls, air traffic controls, autonomous vehicles, and drones.

A.5.5 It is essential that the design professional recognize the possibility of fire in ITE facilities. Licensed design professionals who develop performance-based design documents should be well versed in the science of fire, the effects of fire on ITE systems and operations, and options for mitigation of the risk to persons, equipment, and operations presented by fire in ITE facilities.

A.5.6 The Society of Fire Protection Engineers' *Engineering Guide to Performance-Based Fire Protection* is a recommended guide that should be used in the development of a design brief and performance-based design. The intent of the permitted deviation would be stated in the design brief or an informational annex of the design brief. The deviation can be permitted as long as the equivalent performance features are maintained.

A.5.7 The Society of Fire Protection Engineers' *Guidelines for Peer Review in the Fire Protection Design Process* provides guidance concerning the peer review process for fire protection designs.

A.6.1 The structural floor supporting the ITE area should have sufficient floor loading capacity to sustain the expected floor load.

A.6.1.2 NFPA 80A details one method of providing exposure protection.

A.6.1.3 Experience with fires affecting ITE rooms has demonstrated that the fire often starts in areas other than the ITE area and that the fire and its related products, including smoke, soot, and heat, can enter the ITE room if it is not adequately separated by sealed, rated walls. Consideration should be given to raising the rating of perimeter walls to 2 hours where adjacent walls are already rated 2 hours or greater.

The prudent facilities manager would do well to limit the exposure fire hazard by locating an ITE facility in a fully sprinklered building and install self-contained HVAC systems within the information technology area.

The rooms shown in Figure A.6.1.3 are symbolic and do not denote size, shape, or location, nor are the rooms in Figure A.6.1.3 necessarily required in the ITE area. The ITE area includes only those support rooms served by the same special air-conditioning/air-handling equipment as the ITE room. ITE rooms frequently have a raised floor.

A.6.2 The provisions of Section 6.2 do not require inherently noncombustible materials to be tested in order to be classified as noncombustible materials. [**5000:**A.7.1.4.1]

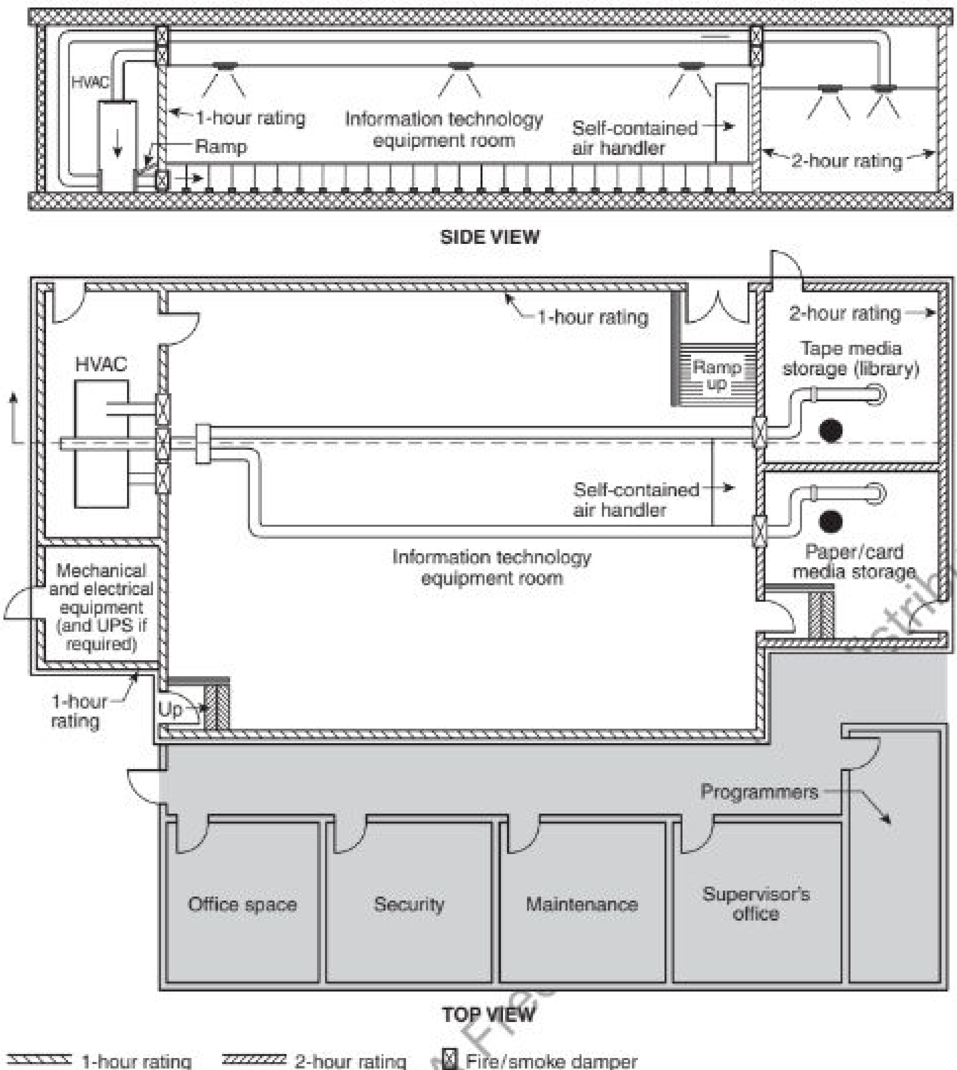


FIGURE A.6.1.3 Diagram of ITE Area.

A.6.2.1.1(1) Examples of such materials include steel, concrete, masonry, and glass. [**5000:**A.7.1.4.1.1(1)]

A.6.2.2.4 Material subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition is considered combustible. *(See NFPA 259 and NFPA 220.)* [**5000:**A.7.1.4.2]

A.6.3.1 Steam, water, or horizontal drain piping, other than for sprinkler system use, should not be in the space above the suspended ceiling and over ITE.

The ITE area should be located to minimize exposure to fire, water, corrosive fumes, heat, and smoke from adjoining areas and activities. Battery installations, if constructed and ventilated in accordance with Section 11.5, can be adjacent to or incorporated into the ITE room.

Basement areas should not be considered for the location of an ITE area. If ITE is located in a basement, precautions should be taken to facilitate smoke venting and to prevent flooding from interior and exterior sources that can occur, such as from a fire on an upper floor.

A.6.3.2 Many ITE installations have become prime targets for sabotage and arson. The location and construction should be designed to minimize the possibility of penetration by an explosive or incendiary device. It is essential that access be restricted to only those persons absolutely necessary to the operation of the equipment. A controlled-access system of admittance through positive identification should be maintained at all times. For additional guidance, see NFPA 730 and NFPA 731.

A.6.3.3 In multistoried buildings, the floor above the ITE room should be made reasonably watertight to avoid water damage to equipment. Any openings, including those for beams and pipes, should be sealed watertight. Where drainage is installed in an area containing an underfloor extinguishing system, provisions should be made for maintaining the drain piping as a closed system unless water is present. These provisions are required to ensure the integrity of a gaseous extinguishing system and allow for maintenance of the necessary concentration level. Because water will evaporate from the standard plumbing trap, mineral oil or another substitute should be considered.

A.6.3.3.1 Some liquids might not be safe to drain to the building's sewer system. The facility should plan for remediation of the spilled liquid — especially in the case of heat transfer fluids for liquid-cooled ITE.

A.6.3.3.2 The leak detection system should be capable of generating a silenceable supervisory signal upon sensor contact with water. The system should continuously supervise all sensors and interconnecting components for electrical continuity. It should also include a self-test capability.

A.6.5 The determination of the depth of the raised floor should take into consideration air movement and fire detection and extinguishing systems requirements (if installed), as well as building construction restrictions.

A.6.5.4 Openings in raised floors for electric cables or other uses should be protected to minimize the entrance of debris or other combustibles.

A.6.6.3.1 NFPA 75 requires smoke or fire dampers in locations where NFPA 90A may not.

A.6.7 The principles of Section 6.7 should be followed if an existing ITE room has aisle containment systems added after construction of the room.

A.6.7.4 Where plenums are present, the space above the raised floor and below the suspended ceiling is typically accessible to both occupants and first responders for maintenance access, firefighting activities, and so forth, and therefore does not need to be classified as a plenum. The addition of aisle containment systems installed in accordance with this standard does not change the hazards contained within those containment areas and therefore does not necessitate different construction materials as required in plenum spaces as defined elsewhere in this standard and others.

A.6.7.6 Temperatures of 38°C (100°F) are possible in hot aisles. Temporary increases in temperature above 38°C (100°F) in hot aisles can occur during normal facility operations. Some smoke detectors are listed for maximum operating temperature of 38°C (100°F). Where smoke detectors are located in hot aisles or in the airstream exhausted from hot aisles, detectors should have appropriate listing for temperatures above 38°C (100°F).

Where heat detectors are located in hot aisles, consideration of the operating temperatures within the hot aisles should be made when selecting the temperature rating of the detectors. *NFPA 72* and manufacturer's instruction should be consulted for guidance.

During startup of ITE, the rate of temperature rise within hot aisles could cause rate-of-rise detectors to activate. Detection systems should be designed to avoid unwanted alarm during ITE startup.

The normally elevated temperatures within hot aisles should be taken into account when selecting sprinklers for installation in these aisles. NFPA 13 should be consulted for guidance.

Abnormal conditions can result in even higher temperatures than described above. For example, temperatures as high as 66°C (150°F) have been observed in hot aisles upon failure of the HVAC system.

A.6.7.8.1 This paragraph addresses removable curtains and aisle containment materials, which are otherwise referred to as *removable obstructions.* Fixed obstructions are clearly addressed for suppression systems within NFPA 13. Means other than automatic smoke detection used for removing the obstructions (e.g., thermal, mechanical, and fusible links) still need further research by the industry and are not clearly demonstrating the capability of activating without impacting the timed response effective performance of suppression systems.

A.6.7.8.1(1) This action can be compared to readying the space before suppression, such as initiating the closing of fire doors, dampers, and the like.

A.6.7.8.1(4) The releasing devices can be similar to those used for initiating fire doors, dampers, and the like.

A.6.7.10.1 This paragraph addresses removable curtains and aisle containment materials, which are otherwise referred to as *removable obstructions.* Fixed obstructions are clearly addressed for suppression systems within NFPA 2001. Means other than automatic smoke detection used for removing the obstructions (e.g., thermal, mechanical, and fusible links) still need further research by the industry and are not clearly demonstrating the capability of activating without impacting the effective performance of suppression systems.

A.6.7.10.1(1) This action can be compared to readying the space before suppression, such as initiating the closing of fire doors, dampers, and the like.

A.6.7.10.1(4) The releasing devices can be similar to those used for initiating fire doors, dampers, and the like.

A.7.1.1 Support equipment, such as high-speed printers, that utilize large quantities of combustible materials should be located outside the ITE room whenever possible.

A.8.1.2 All nonelectrical parts, such as housings, frames, supporting members, and so forth, should not constitute additional fire hazards to the equipment.

A.8.1.4 See ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials,* or UL 723, *Test for Surface Burning Characteristics of Building Materials.*

A.8.2.1 All sound-deadening materials used in ITE rooms should be of such material and so arranged that the materials do not increase the potential of fire damage to equipment or the potential of fire propagation.

A.8.3 Some types of ITE use integral batteries to reduce the effects of instantaneous power shutdowns and to provide power for orderly shutdown of the server.

A.9.1.1.3 The use of carbon dioxide systems for the protection of spaces beneath raised floors is discussed in Section B.5 of NFPA 12 wherein it is pointed out that the design of such systems requires compensation for leakage and provision for a soft discharge to minimize turbulence and agent loss through perforated tiles. These same concerns exist for other inert gas clean agent systems installed in accordance with NFPA 2001. Since these spaces are usually of a very limited height, this type of fire suppression system might be easier to design and install than sprinklers.

The use of halocarbon agents for protection of the spaces under a raised floor where the room is not simultaneously protected is not recommended. However, where a room is protected by a halocarbon system, the space beneath its raised floor needs to be included in the system coverage.

A.9.1.2 In facilities that are under the supervision of an operator or other person familiar with the equipment, during all periods that equipment is energized, the normal delay between the initial outbreak of a fire and the operation of a sprinkler system will provide adequate time for operators to shut down the power by use of the electrical disconnecting means as prescribed in Section 11.4. In other instances where a fire can operate sprinkler heads before discovery by personnel, a method of automatic detection should be provided to automatically de-energize the electronic equipment as quickly as possible.

To minimize damage to electronic computer equipment located in sprinkler-protected areas, it is important that power be off prior to the application of water on the fire.

A.9.1.4 It is not intended that small automatic media loaders or AISS units be provided with protection within the unit. The decision of whether to install protection within the unit should be based on the combustible load being added to the room or area. In the absence of further information, it is reasonable to assume that units that handle in the range of 0.76 m^3 (27 ft^3) of combustible storage space or less need not be provided with protection within the unit. The 0.76 m^3 (27 ft^3) volume assumes that no single dimension is larger than 0.9 m (3 ft) [for example, 0.9 m × 0.9 m × 0.9 m (3 ft × 3 ft × 3 ft)].

A.9.2 Fire detection and extinguishing systems should be selected after a complete evaluation of the exposures. The amount of protection provided should be related to the building construction and contents, equipment construction, business interruption, exposure, and security need. For amplification of the important need of fire protection, see Chapter 4.

A.9.2.1 High-sensitivity smoke detection systems can provide earlier indication of a potential fire within an ITE area. Smoke detectors listed to UL 268, *Smoke Detectors for Fire Alarm Systems*, are optimized for general commercial applications and are designed to comply with the new cooking nuisance smoke test (normal application smoke detection). Smoke detectors designated for special applications listed to UL 268 are designed to be used in applications that require higher sensitivity and that are less likely to be exposed to cooking nuisances. Although *NFPA 72* permits aspirated smoke detector transport time of up to 120 seconds, keeping the transport time below 90 seconds for earlier warning in ITE areas should be considered.

Placing smoke detectors or air sampling ports in the path of airflow within the ITE area, including within electrical cabinets, should also be considered. Detectors outside of the return air envelope are likely to have a delayed response since the fire will have to grow to such a size that it can overcome the forces of the mechanically generated airflow.

A.9.2.2 The outline that follows provides smoke detector sensitivity and spacing guidance for protection of ITE in high airflow areas.

General. For smoke detection systems to detect products of combustion, the products must travel from the source to a spot-type smoke detector or port and arrive there in sufficient density to be detectable.

Products of combustion follow forced air streams early in the development of a fire or overheat condition where the influence of mechanical systems is greater than the buoyant forces of the fire or overheat condition. Detection system spot-type smoke detectors or ports installed in the paths of cooling air exhaust from the cooled equipment can be expected to respond to a small fire in the equipment sooner than spot-type smoke detectors or ports located outside of the ventilation air envelope. To be effective, the detection equipment installed within the ventilation air envelope should be suitable to meet the required sensitivity objectives and for the temperatures, air velocities, and other conditions present. If suitable detection equipment cannot be installed within the exhaust ventilation air envelope, a fire in the cooled equipment should be expected to grow to a size with sufficient energy to overcome the mechanical forces of the HVAC containment system.

In the presence of aisle containment systems used to enhance the effectiveness of cooling ITE, spot-type smoke detectors or ports located in hot aisles or in the above ceiling plenum are required.

Regardless, spot-type smoke detectors or ports located on the ceiling in ITE areas are a basic requirement and contribute to effective detection over a broad range of ITE area configurations.

Listed ITE has inherent fire-resistant characteristics. Failing or overheated components or connections can lead to smoldering events that produce smoke but tend to remain small. In exceptional cases, flaming fires can result.

Automatic fire and smoke detection systems installed to detect smoldering events and/or flaming fires in ITE areas are more effective in detecting flaming fires than smoldering events due to the respective release rates of combustion products and the effects of forced air flow on the products of combustion. The greater the air flow, which dilutes and channels detectable products of combustion, the less effective will be the performance of the detection system. Damage or losses that could result from smoldering events or flaming fires in ITE prior to detection are likely to be greater in the presence of greater forced air flow due to the likely decrease in detection system performance.

Smoke Detection Systems for Early Detection. Where a smoke detection system is installed for the primary purpose of summoning responsible people to the presence of a small ITE fire or electrical event that produces smoke (known as *prealarm*), the system should be arranged with high sensitivity and close spacing to achieve response to low-density products of combustion suspended in air with reasonable stability and tolerance of the environment. See Annex F for performance test procedures for early fire detection systems.

Smoke Detection Systems to Initiate Operation of HVAC Dampers or to Close Openings in Fire-Rated Walls. Where a smoke detection system is installed for the primary purpose of initiating operation of dampers, shutters, doors, or other closures in the event of a fire in an ITE area, the system should be arranged with medium sensitivity and spacing less than listed spacing to assure the integrity of fire-resistive barriers.

Smoke Detection Systems to Initiate Release of a Fire Suppression Agent. Where a smoke detection system is installed for the primary purpose of initiating the release of a fire suppression agent into an ITE area, the system should be arranged with low sensitivity and spacing less than listed spacing and should include a form of logical confirmation of the presence of products of combustion to assure that a single indication does not release the agent.

Sensitivity and Spacing Ranges. The following is guidance for sensitivity and spacing ranges for different locations in high airflow areas:

(1) Spot-type smoke detector and port spacing on ceilings in the presence of high air movement should follow the requirements of 17.7.6.3 of *NFPA 72.*
(2) Where air changes per hour (ACH) in the room served by the ventilation system exceeds 60, and where the supply air is delivered to the room through a raised floor, studies show that spot-type smoke detectors or ports under the floor might not be effective in detecting a fire originating under the floor without abnormally close spacing. Experience has shown that spot-type smoke detectors or ports under the floor can be effective in detecting a fire originating in an air-handling unit supplying air to the underfloor space, even in high airflow areas.
(3) In applying the spot-type smoke detector or port spacing, it is recommended that spot-type smoke detectors and ports be located at strategic points where smoke is likely to pass — for example, in hot air return streams and at return air registers.
(4) For spot-type smoke detectors and ports installed in the exhaust/return air stream in hot aisles or above ceiling plenums, the spacing and sensitivities listed in Table A.9.2.2 should be used. The guidance in Table A.9.2.2 comes partly from a study sponsored by the Fire Protection Research Foundation. That guidance is conservative because it is based on testing using airflow without recirculation into the volume being studied.

A.9.2.2(3) Products of combustion follow forced air streams early in the development of a fire or overheat condition when the influence of mechanical systems is greater than the buoyant forces of the fire or overheat condition. Detection system spot-type smoke detectors or ports installed in the paths of cooling air exhaust from the cooled equipment can be expected to respond to a small fire in the equipment sooner than spot-type smoke detectors or ports located outside of the cooling air exhaust stream. Where hot aisle containment systems are used, spot-type smoke detectors or ports should be installed at the hot aisle exhaust/return air opening for aisle identification. To be effective, the detection equipment installed within the cooling air exhaust stream should be suitable to meet the required sensitivity objectives and for the temperatures, air velocities, and other conditions present. If suitable detection equipment cannot be installed within the cooling air exhaust stream, a fire in the cooled equipment should be expected to grow to a size with sufficient energy to overcome the mechanical forces of the HVAC containment system.

A.9.2.3 Sampling ports or spot-type detectors should be located where smoke is more likely to migrate. For example, in an unventilated (i.e., nearly sealed) cabinet, detection should be within the top 10 percent of the cabinet, whereas in a ventilated cabinet, detection should be provided where the ventilation exits the cabinet. In a naturally vented cabinet, this will be the upper ventilation vent.

A.9.3.2 For more information, see NFPA 10.

A.9.4.1 If major concerns over potential fire loss of specific critical data or equipment or serious interruption to operations cannot be resolved or alleviated by equipment redundancy, subdivision of the ITE area, or use of leased facilities, automatic gaseous agent total flooding might be the only feasible approach to handling an incipient fire situation with an acceptable minimum amount of damage. At the same time, this sophisticated protection approach requires that all environmental design criteria — for example, damper closure, fan shutdown, and sealed openings — be carefully maintained to ensure that the needed concentration for extinguishment will be achieved.

Table A.9.2.2 Recommended Sensitivity and Spacing of Spot-Type Smoke Detectors or Ports in Exhaust/Return Air Streams in ITE Areas with High Airflow

	Low ACH — Up to 30		High ACH — Greater Than 30	
Intended Function	**Sensitivity**	**Spacing**	**Sensitivity**	**Spacing**
Early detection	≤0.2%/ft	≤200 ft²	≤0.1%/ft	≤100 ft²
Operating dampers, doors, and shutters	≤1.5%/ft	≤400 ft²	≤0.75%/ft	≤200 ft²
Suppression agent release	>2.5% ≤4%/ft	≤400 ft²	>1.5% ≤3%/ft	≤200 ft²

Notes:
(1) See Fire Protection Research Foundation reports "Validation of Modeling Tools for Detection Design in High Air Flow Environments," and "Validation of Modeling Tools for Detection Design in High Air Flow Environments — Phase II," and FM Global report "Experimental Data for Model Validation of Smoke Transport in Data Centers."
(2) It is essential that the user understand the material in A.9.2.2 prior to the application of the recommended sensitivity and spacing in this table.
(3) The sensitivity levels for early detection should be considered to be pre-alarm levels.
(4) The sensitivity levels in the table should be considered to be above the ambient obscuration level. The listed sensitivity level should be added to the recorded average peak level in the ambient environment.

A.9.4.3 Various methods of isolating the aisles between rows of equipment racks, known as hot aisle or cold aisle containment, are employed to prevent mixing of hot exhaust air or cold intake air through the ITE. In the event that a fire triggers the release of a clean agent gaseous suppression system, the gas suppressant should be able to penetrate all of the ITE In most cases of whole room total flooding systems, the flow of air through the ITE normally would be sufficient to satisfy this requirement, but the method should be evaluated on a case-by-case basis.

A.9.4.4 The gaseous extinguishing system can be actuated by the automatic fire detection system required in Section 9.2 when designed to do so.

A.9.4.5 This provision requires that all environmental design criteria — for example, damper closure, fan shutdown, and sealed openings — be carefully maintained to ensure that needed concentration for extinguishment will be achieved. It is preferable, but not essential, to de-energize ITE prior to discharge if ITE shutdown does not cause major service interruptions.

A.9.4.6 Predischarge and discharge alarms are provided to facilitate evacuation of all occupants if considered necessary.

A.9.6 Some ITE facilities are essential elements of the public safety network, providing communities with connectivity to 911 and E911 as well as processing alarms and other signals. ITE might not have been designed or tested for immunity at the power levels and frequencies commonly used in responder radios. ITE rooms are not publicly accessible and the number of incidents requiring responder access is low compared to many other occupancies. Because these facilities are unique occupancies with such an important function, close cooperation between the facility operator and the emergency response organization(s) should be encouraged to assure responder activities are not unduly impaired and the ITE remains functioning. In-building emergency responder communications enhancement systems deployed in common areas, stairwells, lobbies, and other nonequipment room locations within ITE buildings are less of a concern.

A.10.1 The protection of records storage with an extinguishing system does not reduce the need for duplicate records. In the event of a fire, some damage to the records can occur prior to operation of the extinguishing system.

The evaluation of records should be a joint effort of all parties concerned with the safeguarding of ITE operations. The amount of protection provided for any record should be directly related to its importance in terms of the mission of the ITE system and the reestablishment of operations after a fire. It is assumed that ITE capable of properly using the records will be available. *(See Chapter 12.)*

A.10.2.1 The size of record storage rooms should be determined by an engineering evaluation of the operation and the application of sound fire protection engineering principles. The evaluation should include, but not be limited to, the following:

(1) Classification of records
(2) Quantity of plastic-based records and type of container
(3) Type and capacity of fire suppression system
(4) Venting available for removal of products of combustion
(5) Type and arrangement of fire detection system
(6) Building construction materials

A.11.1.2 A dedicated HVAC system is normally used in the ITE space to regulate the higher cooling and ventilation requirements of the equipment. However, that is not always feasible. Even when there is a dedicated system, there might still be some building air in the room. For example, air economizers could be utilized for efficiency improvement. Section 11.1 is permitted to be evaluated as part of the performance-based risk analysis as outlined in Chapters 4 and 5.

A.11.1.6 Electric reheat units can collect dust over a period of time. When heat is applied after several months of nonuse and a significant amount of dust and lint has accumulated on the heating elements, energizing of the elements can cause sufficient smoke particles to actuate a sensitive smoke detector in the smoke exhaust (air discharge) area. These reheat units should be set up with a weekly timer circuit to burn off the small amounts of dust that have collected to maintain these reheat units in a clean condition.

A.11.2 For more information on immersion cooling liquids, refer to 8.28.2. For classification of compressed gas or flammable refrigerants, refer to NFPA 55.

A.11.3 The requirements in Section 11.3 apply to all power and service wiring supplying the ITE. The requirements of Section 11.3 do not apply to wiring and components within the actual equipment or to wiring connecting various units of equipment. The equipment and interconnected wiring requirements are set forth in Chapter 8.

A.11.3.1 For the installation of electrical equipment and wiring and optical fiber cabling to conform to *NFPA 70,* the applicable articles in the *NEC* need to be identified. The first step in applying the *NEC* is to review the definition of *modular data center* in 646.2. If the data center is determined to be modular, then the installation is required to conform to Article 646 and all other sections of the *NEC* that are referenced therein.

If the data center is not modular, the next step is to determine if Article 645 applies. Since Article 645 covers ITE in an ITE room, the definitions of *ITE* and *ITE room* in 645.2 should be reviewed. If the installation comprises ITE in an ITE room, Article 645 could be applicable to the installation.

Article 645 is permissive. Section 645.4 states: "This article shall be permitted to provide alternate wiring methods to the provisions of Chapter 3 and Article 708 for power wiring, Parts I and III of Article 725 for signaling wiring, and Parts I and V of Article 770 for optical fiber cabling where all of the following conditions are met."

There are six conditions. See 645.4 of the *NEC* to review the conditions.

If an installation does not meet the six conditions, then Article 645 is not permitted to be used, the provisions of Chapter 3 must be followed for power wiring, and the provisions of Article 725 and Article 770 must be followed for data wiring and optical fiber cabling. Even if a data center meets the six conditions, it is permissible to opt out of Article 645 and follow all the rules in Chapter 3, Article 725, and Article 770.

Regardless of whether Article 645 is used, installations of power wiring must comply with Chapters 1, 2, and 4 of the *NEC,* and installations of communications wiring must comply with Chapter 8 of the *NEC.*

See 250.146(D) and 406.3(E) [of *NFPA 70*] for information on isolated grounding-type receptacles. [**70:**645.15 Informational Note]

A.11.3.4 Besides providing protection against overvoltage (i.e., lightning surges) in accordance with *NFPA 70*, it is recommended that the building housing an ITE area be protected against lightning in accordance with NFPA 780.

A.11.3.7 The installation of general-purpose and riser cables exposed to the airflow in the air space below a raised floor is permitted only where the space is protected by an automatic fire suppression system. *(See 9.1.1.3.)*

A.11.4.3 Abandoned cable can interfere with airflow and extinguishing systems. Abandoned cable also adds to the fuel loading.

A.11.4.5.1 Approved means include remote disconnect controls and approved procedures. Due to the criticality of ITE to operations and life safety, a sequential shutdown might be appropriate. The strategic importance placed on ITE and ITE areas by the user is vitally tied to uninterrupted operation of the system. Consequently, the partial or total loss of the equipment could cause an entire operation of vital nature to be temporarily or permanently paralyzed. A risk analysis would factor in the criticality of the operation, including life safety, as well as the presence of the following:

(1) An approved procedure to identify shutdown procedures under identified conditions
(2) Trained and qualified personnel who can perform sequential shutdown or meet emergency responders and advise them of disconnecting methods
(3) Smoke-sensing fire detection systems installed in the ITE room
(4) Fire suppression system suitable for the application installed in the ITE room
(5) Power and signal cabling installed in accordance with *NFPA 70*

A.11.4.5.2 Cooling of ITE is critical to its operation. Information technology (IT) servers run applications that are crucial to business continuity and frequently have life safety implications. An unplanned shutdown of ITE can cause loss of control over life support systems, emergency response systems, and security systems, as well as loss of essential data. Therefore, it can be undesirable, even dangerous, to automatically shut down equipment that is not directly involved in a fire.

Modern server racks contain multiple processing units that can create a large amount of heat. Storage technology can handle many terabytes of data. If air-conditioning equipment that is used to cool the ITE is shut down, temperatures can increase by as much as 22°C (40°F) in a matter of minutes, potentially causing more damage than the heat of a small electronic fire. Therefore, it is desirable to maintain cooling airflow for as long as possible.

Thermal sensing devices are built into individual servers to immediately depower overheating components in an attempt to prevent permanent damage to entire server systems. If a single server or single server rack is shut down by thermal protective devices, other servers would generally remain available to maintain functionality. But if the room or area environmental cooling air suddenly ceased due to initiation of a fire detector under a raised floor, all equipment in the area could shut down on thermal overload. This would cause the uncontrolled loss of all functions provided by the ITE and result in potentially serious consequences.

Fire suppression systems used in IT facilities are often designed to detect and extinguish a fire in its incipient stage while cooling airflow through the facility is maintained and servers remain running. If depowering of equipment is required as part of the fire protection, such depowering is generally done in a planned, programmed sequence to minimize loss of data. When an IT facility is providing support or control related to life safety or security, the depowering sequence typically includes provision to transfer support or control functions to a backup IT facility.

Determination of when it is safe to shut off ventilation to the ITE is part of the planned depowering sequence. In IT facilities protected by automatic gaseous extinguishing systems, the activation of more than one detector is usually required to confirm existence of fire and release the fire extinguishing gas. Airflow is taken into account in locating smoke detectors.

Cessation of normal airflow upon activation of a single smoke detector can delay the activation of additional smoke detectors in the IT facility and delay the release of an automatic gaseous extinguishing agent in facilities equipped with such systems.

Airflow and its effects on fire detection in IT facilities and telecommunications facilities has been the subject of past research that indicated extinguishment might actually be aided by continuous airflow through the fire zone for the type of fire typical in IT facilities. The airflow helps maintain air pressure, cools the fire zone, and, because of the typically smoldering nature of these fires in their early stages, can reduce the amount of heat available to be carried by conduction to nearby materials.

Upon detection of smoke or fire anywhere within an IT facility, personnel will be alerted to the danger by the fire alarm system. Personnel are given the opportunity for appropriate evacuation or response to the alarm, contingent on their training and qualifications.

A.11.4.5.4 The purpose of a disconnecting means is to remove electrical energy from the source of a fire. The objectives of a well-designed disconnecting means (commonly referred to as emergency power off [EPO]) include the safety of personnel and to minimize the impact on the operation of the ITE.

A poorly designed, installed, or maintained disconnecting means can become a single point of failure that can have severe adverse effects on the operation of ITE and, by extension, life safety that depends on the proper and continued operation of the ITE.

A good design can allow the creation of zones. A zone can include everything needed to prevent the spread of a fire, including detection, suppression, and power disconnection. Zones minimize impact on the safety of personnel in the ITE area and on the number of IT devices affected.

The decision on the manner of disconnecting means is based on the risk assessment described in Chapter 4. The assessment will include, but not be limited to, considerations such as the following:

(1) What is the criticality of the operation?
(2) What would be the consequences of an unplanned shutdown on life safety and on mission performance?

(3) Can operations be transferred elsewhere in a timely manner?
(4) Is there an approved procedure for removing power and air within a room or zone?
(5) Are qualified personnel available at all hours who can manually and safely disconnect the affected equipment?
(6) Are personnel available who are trained and certified as first responders?
(7) Is fire suppression in place that can localize the impact on equipment that is not involved in the fire?
(8) Are smoke-sensing detectors in place within the room or zone (per requirements of Section 8.2)? What are their sensitivity and reliability?
(9) What is the possibility of accidental operation of the disconnecting means?
(10) Does the complexity of the system increase or decrease the probability of a false alarm shutdown?

A.11.4.5.5 Article 685 of *NFPA 70* concerns integrated electrical systems, which are systems that could include ITE that is integrated into the controls of complex industrial processes. Locating overcurrent devices and their associated disconnection means so that they are not readily accessible to unqualified personnel is one of the preventive measures used to help maintain continuity of operation and to prevent injury to personnel, severe equipment damage, or catastrophic failure.

A.11.5.3.2.3.2 Methods of achieving this protection can include, but are not limited to, the following:

(1) Absorbent mats and materials
(2) Liquidtight sloped or recessed floors
(3) Liquidtight floors in indoor locations provided with liquidtight raised or recessed sills or dikes
(4) Sumps and collection systems
(5) Other spill containment systems such as that described in A.11.5.3.2.4.1

The most likely time for severe battery damage and electrolyte spills is during installation and replacement of vented cells. During these activities, spill control is recommended even for installations below the 3785 L (1000 gal) per room threshold.

A.11.5.3.2.4.1 One method to determine compliance with the neutralization requirements of this subsection is found in UL 2436, *Outline of Investigation for Spill Containment for Stationary Acid and Alkaline Battery Systems*. UL 2436 investigates the liquid tightness, level of electrolyte absorption, pH neutralization capability, and flame spread resistance of spill containment systems.

A.11.5.3.2.5 The fixed ventilation rate of 5.1 $L/sec/m^2$ (1 $ft^3/min/ft^2$) of floor area might be excessive compared to what is actually needed for room ventilation based on worst-case hydrogen production. Detailed information on battery room ventilation can be found in IEEE 1635/ASHRAE 21, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications*.

A.11.5.4 Section 8.38.3 contains more information on ITE incorporating integral battery backup.

A.11.5.4.1 Gas detection for the purpose of detecting flammable or explosive levels of gas should not be used as a means to detect thermal runaway. Gases produced during the off-gas event that precedes thermal runaway are flammable. However, during this early off-gas stage, limited amounts of gas are produced that would not register with flammable gas sensors that are meant to prevent explosive atmospheres. During the off-gas phase, specialized detection devices are needed that can detect trace amounts of the vaporized electrolyte that can be present at the low ppm or ppb level. Additional information on explosion protection can be found in NFPA 68 and NFPA 69.

For off-gas detection, the detection devices should be placed near or on the battery rack to detect off-gas events from the rack. While airflow is not required for sensor operation, the airflow patterns should be taken into consideration when positioning the detection devices. Sampling ports in an aspirated gas sensing system should follow similar positioning guidance. Several examples of potential airflow patterns and their corresponding sensor placement are shown in Figure A.11.5.4.1. In any case, manufacturer's published instructions should be followed.

Thermal runaway can also be detected using highly sensitive particulate detection. For example, an aspirated detection system that has sensing technology to allow for the detection of particles given off during the off-gas event prior to thermal runaway.

Actions to be taken once the off-gas event has been detected will depend upon a number of factors, including the design of the battery management system, lithium-ion cell chemistry, and others.

A.12.1 A written emergency fire plan should be prepared and posted at each installation that assigns specific responsibilities to designated personnel. NFPA 1660 provides guidance on emergency planning that could be used in the creation of this fire plan. This plan should be coordinated with all responding emergency agencies. Personnel should receive continuing instructions in at least the following:

(1) The method of turning off all electrical power to the following:
    (a) The ITE under both normal and emergency conditions
    (b) The air-conditioning systems serving the area
(2) Alerting the fire department or fire brigade
(3) Evacuation of personnel and designated assembly area
(4) The operations of all fire-extinguishing and damage control equipment, including automatic detection equipment
(5) The use of extinguishers through actual operation on a practice fire
(6) Control of hazardous materials
(7) Coordination with the fire department or other emergency responders

A.12.1.1.2 Fire service orientation and information might include the review of the ITE placement, depowering issues, and how to perform depowering. Additionally, it might be in the best interest of the facility manager to initiate the fire service orientation. Figure A.12.1.1.2 is an example of a pre-fire plan drawing.

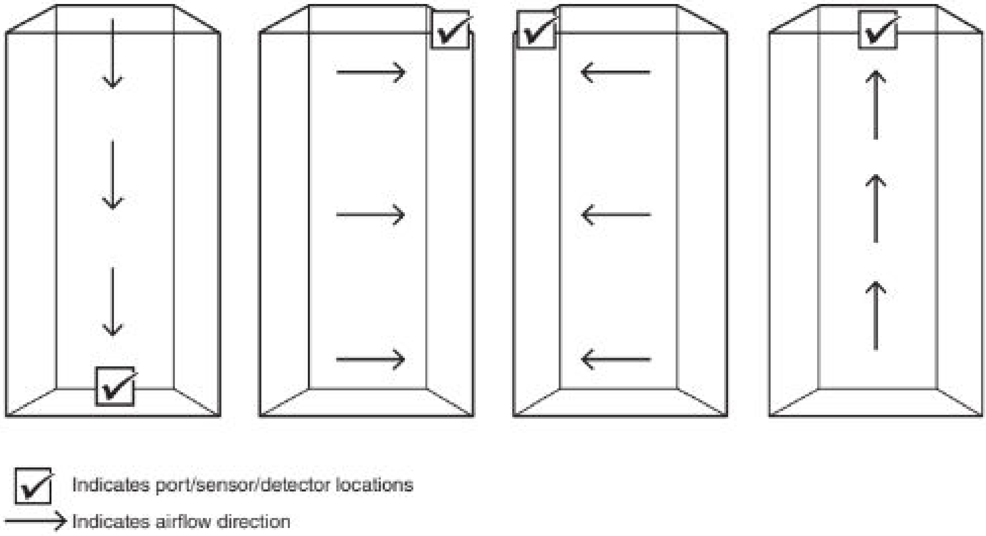


FIGURE A.11.5.4.1 Examples of Potential Airflow Patterns and Corresponding Sensor Locations.

A.12.2 A damage control plan should provide a means for at least the following:

(1) Preventing or minimizing damage to electronic equipment
(2) Preventing or minimizing damage to operations and other equipment

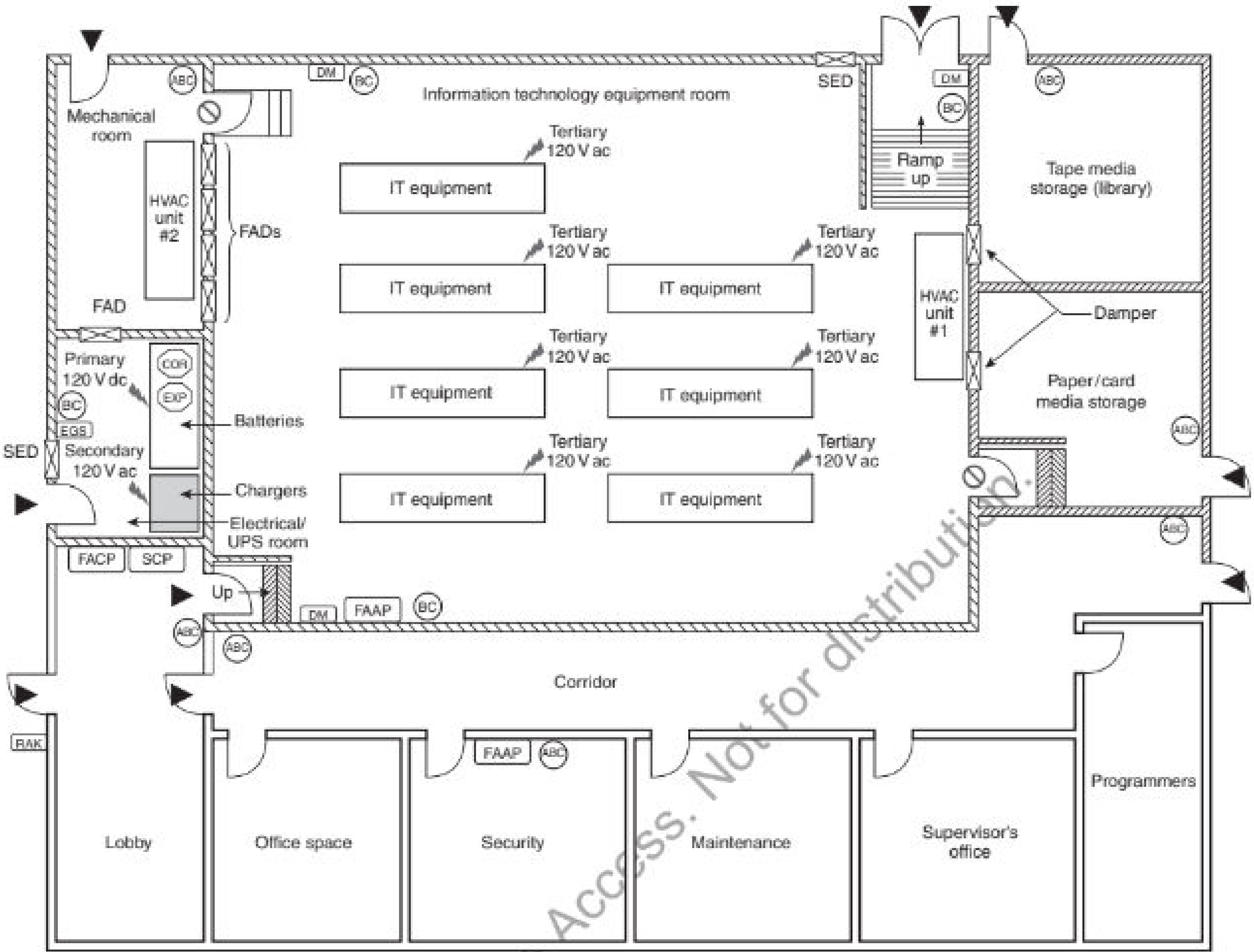
For example, whenever electronic equipment or any type of record is wet, smoke damaged, or otherwise affected by the results of a fire or other emergency, it is vital that immediate action be taken to clean and dry the electronic equipment. If water, smoke, or other contamination is permitted to remain in the equipment longer than absolutely necessary, the damage can be grossly increased.

In addition, a means should be provided for preventing water damage to electronic equipment. The proper method of doing this will vary according to the individual equipment design. The provision of waterproof covers stored in easily accessible locations should be considered. See the guidance provided in Section B.3(2).

A.12.3 Emergency procedures for the continued operation of an ITE system should include, but not be limited to, the following:

(1) A program to protect records in accordance with their importance as set forth by Chapter 10
(2) An analysis of the workload and its effect on continuity of operations
(3) A written set of requirements for the backup site, including the following:
   (a) Backup files and equipment required
   (b) Configuration of mainframe computer and peripheral units
   (c) Alternative locations for backup processing
   (d) Availability of backup system
   (e) Telecommunications required at backup site
   (f) Files, input work, special forms, and so forth, needed
   (g) Personnel staffing and transportation
   (h) Agreements and procedures for the emergency use of ITE at a contingency site

A.13.11 Since 2014, Article 646 of *NFPA 70* has addressed MDCs as special equipment. Therefore, electrical requirements for MDCs, as an alternative, can be evaluated in accordance with Article 646 of *NFPA 70* as an alternative to the extracted material from Article 645 of *NFPA 70* in Chapter 11. UL has a published UL 2755, *Outline of Investigation for Modular Data Centers*, which has been referenced in 646.4 of *NFPA 70* since the 2014 edition.



Note: Drawing is intended to convey some of the items that should be documented as part of the pre-fire plan. It is not intended to demonstrate good design practice nor compliance with any code or standard.

LEGEND

Symbol	Description	Symbol	Description
FACP	Fire alarm control panel	EGS	Emergency generator shutoff switch
FAAP	Fire alarm annunciator panel	ABC	Type ABC portable fire extinguisher
SCP	Smoke control panel	BC	Type BC portable fire extinguisher
▶	Fire fighter access	⊠	Damper
⊘	No fire fighter access—contamination hazard	⊠ SED	Smoke exhaust damper
	Power supply and voltage	⊠ FAD	Fresh air damper
COR	Corrosive material	RAK	Rapid access keyboard
EXP	Explosive gas potential		1-hour rating
	Equipment containing PCBs		2-hour rating
DM	IT and HVAC disconnecting means		

FIGURE A.12.1.1.2 Pre-Fire Plan Drawing.

Annex B What to Do in the First 24 Hours for Damaged Electronic Equipment and Magnetic Media

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

B.1 The following material is extracted from the BMS CAT publication "Electronics & Magnetic Media Recovery."

B.2 This plan attempts to detail the necessary recovery steps to be taken after a disaster has occurred to electronic equipment. The plan considers fire, heat, smoke, and water damage and is designed to limit and mitigate potential losses. The equipment under discussion includes office computers, word processors, telephone switching equipment, test equipment, audio-video equipment, and other electrical and electronic apparatus.

WARNING: It is most important that power be disconnected from all wet and smoke contaminated electronic equipment immediately. Not only is there a continuing danger from electrical shorts to the equipment, but voltage potential within the circuitry tends to plate contaminants onto printed circuit boards and backplanes.

B.3 Smoke Damage. Primary damage to electronic equipment is caused by smoke that contains corrosive chloride and sulfur combustion by-products. Smoke exposure during the fire for a relatively short period of time does little immediate damage. However, the particulate residue left after the smoke has dissipated contains the active by-product that will corrode metal contact surfaces in the presence of moisture and oxygen.

The ultimate objective in restoration is the removal of the contaminant. Since all of the equipment cannot be cleaned simultaneously, it is most important that immediate steps be taken to arrest the corrosion process.

(1) Move the exposed equipment into an air-conditioned and humidity controlled environment as soon as possible (40–50 percent relative humidity will generally prevent an acceleration of corrosive activity).
(2) If moving the equipment is not possible, make sure the equipment area is sealed off from outside elements. (Caution: do not wrap the individual pieces of equipment in any material that tends to trap moisture inside the chassis.)
(3) Spray connectors, backplanes and printed circuit board surfaces with Freon or Freon-alcohol solvents for preliminary cleanup.
(4) Follow up with any corrosion inhibiting aerosol spray to stabilize metal contact surfaces. This will leave a thin but easily removable coating helping to prevent oxygen and moisture from activating the corrosion process.

Once the corrosion process is stabilized, an analysis can be made of the contaminants, and appropriate decontamination processes can be applied.

B.4 Water Damage. It is a popular misconception that electronic equipment exposed to water and moisture is permanently damaged. Water that is sprayed, splashed, or dripped onto electronic equipment can be easily removed. Even equipment that has been totally submerged can be restored. However, in every case of water damage, immediate countermeasures are imperative. It is most important to turn off all electrical power to the equipment; i.e., DO NOT ENERGIZE ANY WET EQUIPMENT.

(1) Open cabinet doors, remove side panels and covers, and pull out chassis drawers to allow water to run out of equipment.
(2) Set up fans to move room temperature air through the equipment for general drying. Move portable equipment to dry air conditioned areas.
(3) Use compressed air at no higher than 50 psi to blow out trapped water.
(4) Use hand-held dryers on lowest setting to dry connectors, backplane wirewraps, and printed circuit cards. (Caution: Keep the dryer well away from components and wires. Overheating of electronic parts can cause permanent damage.)
(5) Use cotton-tipped swabs for hard-to-reach places. Lightly dab the surfaces to remove residual moisture. Do not use cotton tipped swabs on wirewrap terminals.
(6) Water displacement aerosol sprays containing Freon-alcohol mixtures are effective in first step drying of critical components.
(7) Follow up with professional restoration as soon as possible.

B.5 Tape/Disk Drive. The most important asset to be preserved following the loss is the corporate media (i.e., company database).

Severe damage to disk read/write heads and tape transport mechanisms is probable if an attempt is made to operate with media that is not clean. A "head-crash" caused by particulate on the surface of a disk will not only damage the drive but result in a loss of data. Dirty tapes will stick and break, causing loss of data. Emergency one-time cleaning of contaminated tapes and disks for data recovery is possible. The damaged media is then discarded after data recovery.

First step emergency procedures are as follows:

(1) Place all contaminated magnetic media in air-conditioned area to remove water and stabilize media surfaces.
(2) Remove media from wet and contaminated containers where possible. Identify all media as to type, application, and location.
(3) Wipe exterior surfaces with alcohol-based cleaning solutions to remove contamination.
(4) Data recovery from contaminated floppy disks, tapes, hard disks, and all associated drive and read/record equipment.

Annex C Risk Considerations, Business Interruption, and Temperature Considerations

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

C.1 Risk Considerations.

C.1.1 ITE is a vital and commonplace tool for business, industry, government, and research groups. The use of such equipment is a direct result of the increased complexity of modern business, industrial, governmental, and research needs. Particularly pertinent are the increasing number of variables that must be taken into consideration in everyday decisions — overlooking any one item can spell the difference between profit and loss, success and failure, and life and death. To keep track of all these variables, ITE offers practical answers.

C.1.2 ITE has become the accepted tool to research, store, and exchange information, to process large amounts of statistical, problematical, or experimental information, and to print out or display information in very short periods of time. Reliance is placed on the equipment to perform the repetitive, the experimental, and, in some cases, even the whole programming operation for business, industry, government, and research groups.

C.1.3 Risk considerations include the selection of proper equipment, preparation of areas to receive the equipment, requirements for utilities, orientation and training of personnel to operate the equipment, as well as consideration for expansion of the initial facility. One other factor should be included in this vital study, namely, protection against fires of either accidental or deliberate origin, such as sabotage and incendiary.

C.1.4 ITE and materials for data recording and storage can incur damage where exposed to sustained elevated ambient temperatures. The degree of such damage will vary depending upon the exposure, equipment design, and composition of materials for data recording and storage.

C.2 Business Interruption. Business interruption is the effect on business operations from the time that equipment was initially lost or damaged until it has been restored to the former level of operation.

C.3 Temperature Considerations. The following are guidelines concerning sustained high ambient temperatures.

(1) Damage to functioning ITE can begin at a sustained ambient temperature of 79.4°C (175°F), with the degree of damage increasing with further elevations of the ambient temperature and exposure time.
(2) Damage to magnetic tapes, flexible discs, and similar media can begin at sustained ambient temperatures above 37.8°C (100°F). Damages occurring between 37.8°C (100°F) and 48.9°C (120°F) can generally be reconditioned successfully, whereas the chance of successful reconditioning lessens rapidly with elevations of sustained ambient temperatures above 48.9°C (120°F).
(3) Damage to disc media can begin at sustained ambient temperatures above 65.6°C (150°F), with the degree of damage increasing rapidly with further elevations of sustained ambient temperatures.
(4) Damage to paper products, including punched cards, can begin at a sustained ambient temperature of 176.7°C (350°F). Paper products that have not become brittle will generally be salvageable.
(5) Damage to microfilm can begin at a sustained ambient temperature of 107.2°C (225°F) in the presence of steam or at 260°C (500°F) in the absence of steam.

Annex D General Guidance for Gaseous Agent Systems in Information Technology Equipment Spaces

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

D.1 Gaseous Agents. The use of gaseous agents provides the potential for automatic fire suppression in the incipient fire stage so that the information technology system can continue to perform its mission with little or no interruption. Where coupled with a well-designed early warning detection system, the gas can be automatically released in the early stages of a fire scenario and, being three dimensional, it will penetrate all portions of the space protected, including internal volumes of key components of the system when they are ventilated from the room. Thus an operator does not have to be present or, if present, does not have to determine if and where the fire is occurring and how to deal with it.

Gaseous agents fall into the following two general categories: inert gases and chemical agents.

D.1.1 Inert Gases. Inert gases include gases that extinguish fires by reducing the oxygen level to a point where it will not support combustion. The inert gases found in NFPA 2001 generally consist of a single gas (nitrogen or argon), blends of gases (nitrogen and argon), or blends with carbon dioxide as a secondary component. See NFPA 2001 for specific agent and system design guidance.

Carbon dioxide also falls into the category of inert gases; however, at the concentration normally used for total flooding of protected spaces, the resulting environment is hazardous to personnel. The use of carbon dioxide systems is contained in NFPA 12.

D.1.2 Chemical Agents. Chemical agents include gases that have been found to be effective in suppressing fires by chemical means or, in some cases, by a combination of chemical reaction and cooling. See NFPA 2001 for specific agent and system design guidance.

While these systems have proven to be effective and relatively trouble-free when installed as approved, it is prudent to consider the following factors in integrating such systems into a facility:

(1) Effectiveness of agent on types of fires expected
(2) Energized versus de-energized equipment
(3) Possible effect of "neat" agent discharges on the equipment and/or space that is being protected
(4) Dealing with products of combustion and/or products of decomposition created in a fire and fire suppression
(5) Potential hazard to personnel
(6) Long-term availability of agent and/or system components
(7) Compatibility of system operation with facility operation
(8) Selection of detection system

D.2 Effectiveness of Fire-Suppressing Agent. The effectiveness can vary depending on combustibles present and certain characteristics of the hazard protected. Systems are tested and listed or approved so they will afford protection of most hazards when the system is installed in accordance with the system manual. An owner should become familiar with the system design parameters as given in the manual. Certain combustibles can need higher concentrations than the standard combustibles used in the approval process. Refer to information giving recommended concentrations for specific materials.

Total flooding agents are effective when the gas envelops the protected equipment at the proper concentration, a minimum concentration is held until the ignition source is removed, and any smoldering fire that remains after flame extinguishment is controlled. This statement generally means that the enclosure to be flooded needs to be enclosed as much as possible to retain the gas discharged. Integrity of the space protected can need verification and means taken to close off openings to ensure an adequate gas concentration holding time.

The removal of an ignition source in an ITE room generally means the shutting off of power. Continued application of electrical power to ITE can result in ongoing electrical arcing or sustained high temperature "hot spots" in equipment. Such arcing can decompose halogenated agents into toxic and corrosive by-products such as hydrochloric acid, hydrofluoric acid, and possibly carbonyl halides. High temperatures such as those present in flame or glowing metal surfaces also may decompose halogenated agents into quantities of toxic and corrosive by-products. Although some decomposition of halogenated agents occurs in the process of extinguishing fire, the quantity of the toxic and corrosive by-products is limited if the following conditions exist:

(1) The system is designed in accordance with applicable NFPA standards.
(2) Continued arcing or hot spots in excess of the agent's thermal decomposition temperature are not present.

If electrical power is not to be shut down to the protected space upon discharge of a halogenated gaseous agent, operators, fire fighters, and the owner of the facility need to be aware of the possibility of increased quantities of toxic and corrosive by-products being generated by decomposition of the halogenated agent.

D.3 Agent Discharge. When the stored energy of compressed gases is released, high-velocity discharges can result. These discharges can move ceiling tiles, cause undue turbulence, and so forth. Proper system selection arrangement and design that minimizes these effects should be used.

The rapid introduction of gas can cause a pressure buildup in a confined space. This rapid pressure buildup can be a concern for well-sealed spaces, and venting might be needed. When released, some gases, especially carbon dioxide, will rapidly expand in a room or enclosure, causing significant cooling of air and small-mass material. Where significant cooling can be a problem, techniques to minimize this cooling should be employed.

Hard disk drives can be damaged by vibrations including those created by loud noise. There are a variety of sources of loud noise in an ITE area. For example, fire suppression agent discharges have damaged hard disk drives because of noise. Techniques to reduce noise or design considerations can minimize this risk. For additional information, refer to the FSSA white paper, "Effect of Sound Waves on Data Storage Devices: Fire Protection Systems Protecting Data Centers."

D.4 Products of Combustion and Products of Extinguishing Agent Breakdown. In the course of fire suppression, products of combustion are created, and products formed as chemical agents break down during the fire-extinguishing process. These products can be toxic, noxious, and corrosive, so it is imperative that their creation be minimized. Decomposition products are kept to a minimum by the detection and suppression of fires while they are small, quick extinguishment of open burning, and elimination of all ignition sources. Systems that have been approved and installed according to the NFPA standards referenced have been shown to do this. Delaying suppression by having systems manually released or by aborting and delaying discharge can significantly raise the level of these products resulting from a fire. A method to purge these products after fire extinguishment is needed.

D.5 Hazard to Personnel. In normally occupied spaces, agents or agent concentration that can cause hazards to personnel require a predischarge warning and evacuating system. In the event of a fire, all protected space should be evacuated as soon as possible.

D.6 Halon 1301 Agent and System Availability. The production of halons has stopped in the industrialized world. However, even though no new gas is being produced, recycled gas is still available. An owner who wants to use a system with halon should have a plan to ensure future gas availability in case of a system discharge and the need for refill. See NFPA 12A.

D.7 Compatibility to Facility Operation. Gaseous systems work best where the power can be turned off to eliminate all electrical faults that could serve as a continuing ignition source. If a facility is arranged so that power cannot be shut off, then Class C design concentrations from NFPA 2001 should be used and the concentration should be held long enough to allow operator intervention to isolate and eliminate the continuing ignition source.

Similarly, if a protected space does not have a dedicated air-conditioning system and ventilation of the protected space cannot be shut down, then these conditions should be considered in the system design.

Annex E Fire Detection for Information Technology Equipment Area Risks and Special Conditions

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

E.1 Introduction. For fire detection systems to be effective in ITE areas, the design and installation must respond to the special conditions and unusual risks present. The requirements of *NFPA 72* for fire detection systems might not provide effective early detection of fires in IT areas.

This standard permits equivalent solutions (*see Section 1.5*) to achieve its purpose (*see Section 1.2*). The standard recognizes the performance-based approach to determine equivalent solutions (*see Chapter 5*). The standard permits design of fire detection systems based on a fire risk assessment (*see Chapter 4*).

These fire risk assessments consider the risk of specified losses and need to consider the likelihood of fires (i.e., ignition source and fuel ignited by location in the protected space) and the likely response of the selected detector(s) in the proposed location(s). A 2013 paper by Bukowski discusses the most likely fires that might occur in data centers based on limited fire experience reported by a major, global operator as part of committee task group activities.

E.2 Risk Assessment Objective(s). The objective of a fire risk assessment is to minimize risk by mitigating the consequences of a fire or reducing its likelihood. Life safety (i.e., preventing fatalities and reducing or eliminating injuries) is generally the prime objective of a fire risk assessment, but modern data centers operate with relatively few staff located mostly in the ancillary areas. Technicians venture into the ITE areas only when necessary to install and service equipment. Life safety risk in the ancillary areas is similar to office occupancies, and the life safety risk in the equipment areas is very low — there are few occupants, and fires are rare and grow very slowly. The widespread practice of data mirroring greatly reduces the risk of data loss. Thus, the primary objective of data center fire protection is to mitigate the likelihood of loss of capacity to process, store, and retrieve data.

E.3 Design Fire Scenarios. Fire experience in data centers shows that the most common fires by far involve ancillary fuels in adjacent spaces such as meeting rooms, offices, and break rooms. The inclusion of fire and smoke barriers between these spaces and the ITE spaces, along with sprinklers and detectors as usually provided in office occupancies, will prevent fires in these spaces from affecting ITE. Additionally, strict enforcement of housekeeping rules for ITE areas so that there are no, even temporary, accumulations of combustibles (e.g., packaging materials, construction materials, papers/manuals) limits the risk of fires in ancillary areas affecting ITE.

The most common fire sources within ITE areas most frequently involve power supplies, including UPSs, because these contain some combustible materials, which can produce significant fault energies, and involve components that run hot because they are operated near rated capacity for maximum electrical efficiency. Physical separation of power supply equipment and associated power cables from digital equipment and data cables and the inclusion of overheat sensors to shut down power supplies exceeding normal operating conditions can minimize fire risk to the facility from such equipment. The next most common fire scenarios involve HVAC or other support equipment located within ITE areas. The most likely fires originating in cooling equipment involve combustible filters and overheating fan motors. Wire and cable fires are limited to power cables; these are the only cables that contain significant fault energy and can run warm enough to permit combustion of the insulation or jacket materials. Most wire and cable insulation and jacketing will not support combustion unless heated internally or externally. Physical separation or specific protection such as enclosed cable trays and linear overheat detection can result in adequate mitigation.

The least common fires are in the ITE itself, particularly where that equipment is listed to UL 60950-1, *Information Technology Equipment — Safety — Part 1: General Requirements*; UL 62368-1, *Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements*; or Telcordia GR-63-CORE, *Network Equipment Building System (NEBS)™ Requirements: Physical Protection*.

E.4 References. Bukowski, Richard W., "Risk Considerations for Data Center Fire Protection," Proc 2013 SFPE Engineering Conference and Expo, Austin, TX, October 26–30, 2013.

Annex F Performance Test Procedures for Early Fire Detection Systems

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

F.1 Introduction.

F.1.1 Scope. Performance of the tests described in this annex can result in the release of noxious fumes, the presence of localized heat, and the introduction of a fire hazard to the tested area. Precautions should be taken to protect personnel from these potential hazards. It is the responsibility of the testing personnel to conduct testing in a manner that complies with federal, state, and local health and safety regulations.

F.1.1.1 These tests are intended to simulate the small amounts of smoke that would be created in the early stages of a fire in an information technology equipment (ITE) area. If an actual fire were to produce the amounts of smoke produced by these tests, ITE companies would want to be alerted by the fire alarm system.

F.1.1.2 The tests represent a good balance between the desire to use smoke sources that are representative of the types of fires that have occurred in ITE areas and the desire to minimize the introduction of smoke that can cause damage to operating equipment in the area.

F.1.2 Objectives. These tests are also intended to meet the general objectives listed in F.1.2.1 through F.1.2.4.

F.1.2.1 The tests are intended to be repeatable such that a consistent quantity, temperature, and color of smoke is produced each time the test is performed.

F.1.2.2 The tests are intended to use test equipment that can be set up quickly in actual facilities (i.e., in situ).

F.1.2.3 The tests are intended to prevent or minimize the potential for smoke damage to the equipment in the room under test. They should create little or no corrosive products of combustion.

F.1.2.4 The tests are intended to avoid the creation of large amounts of smoke and gas that could pose a health threat to personnel in the test area.

F.2 Heated Wire Test.

F.2.1 General. This test uses an electrically overloaded polyvinyl chloride–coated (PVC-coated) wire to simulate the early stages of a fire. Although a PVC wire is used, hydrogen chloride (HCl) vapor is unlikely to be produced in quantities significant enough to be of concern, if the test procedures herein are followed, due to the relatively low temperatures reached. If the current is applied for a longer time, or if the wire sample is shorter than stated, small quantities of HCl can be generated. In either event, a clearly perceptible odor that should dissipate in short time is produced by the test.

The tests are based on the test specified in Section A.3 of BS 6266, *Fire Protection for Electronic Equipment Installations — Code of Practice*. The principal differences for some tests include the use of a regulated dc power supply and different wire, electrical load, and wire length.

Users are directed to Table F.2.1 to select the parameters for testing. The test parameters to be used should be selected based on the detection system performance levels dictated by the performance-based analysis.

F.2.2 Test Apparatus. The test apparatus consists of the items listed in F.2.2.1through F.2.2.4.

F.2.2.1 Wire. Table F.2.1 lists four options for wire selection and test parameters for the users to select. Test wire should be cut cleanly to the length specified in Table F.2.1.

F.2.2.2 Wire Mounting. The wire should be arranged by placing it on a noncombustible, nonconductive board, or by suspending it on a noncombustible, nonconductive support. The wire should be arranged so that there are no kinks or crossovers where localized higher temperature heating can occur.

Table F.2.1 Heated Wire Test Parameters

Parameter	BS 6266 Test		Modified BS 6266 Test: Two 1 m (3.3 ft) Wires in Parallel	North American Wire Test: North American Wire
	2 m (6.6 ft) Wire Test	1 m (3.3 ft) Wire Test		
Wire specifications	10 strands of 0.1 mm diameter (38 AWG) tinned copper wire insulated with PVC to a radial thickness of 0.3 mm (0.012 in.).	Total cross-sectional area of conductor is 0.078 mm^2 (28 AWG), insulated with PVC to a radial thickness of 0.3 mm (0.012 in.).	Wire is very flexible due to stranded construction and highly plasticized insulation.	A single strand of 0.65 mm diameter (22 AWG) copper wire, insulated with PVC to a diameter of 1.19 mm (0.047 in.). This wire is stiffer than the BSI wire due to the single-strand construction and the minimally plasticized PVC insulation.
Smoke characterization	Smoke is very light (barely visible). HCl vapor is unlikely to be produced due to the low temperature achieved in the wire. The primary constituent of the smoke is plasticizer.	More visible smoke than the 2 m (6.6 ft) test, but still very light smoke. Due to the higher temperature in the wire, a very small amount of HCl vapor will be produced.	More visible smoke than the 2 m (6.6 ft) test or the single wire 1 m test but still very light smoke. Due to the higher temperature in the wires, a small amount of HCl vapor will be produced.	More visible smoke than the BSI wire tests but still very light. A minor amount of HCl is produced but for a shorter duration than the BSI wire tests.
Test period	180 seconds	60 seconds	60 seconds	30 seconds
Electrical load	Constant voltage — 6.0 volts dc; current varies from 0 to 15 A during the test due to changing resistance in the wire.	Constant voltage — 6.0 volts dc; current varies from 0 to 15 A during the test due to changing resistance in the wire.	Constant voltage — 6.0 volts dc; current varies from 0 to 30 A during the test due to changing resistance in the wire.	Constant current of 28 A; voltage varies from 0 to 18 volts dc during test due to changing resistance in the wire.
Pass/fail criteria	Fire detection system should "respond" within 120 seconds of the end of the test period.		"Alert" or "pre-alarm" signal should occur within 120 seconds of the end of the test period.	

BSI: British Standards Institute.

F.2.2.3 Power Supply and Leads. A regulated dc power supply should be capable of supplying a current of 0 to 30 amperes at 0 to 18 volts dc. The lead wires between the power supply and the test wire(s) should be 10 AWG and 3.25 m (10.66 ft) long to avoid unacceptable voltage drop.

F.2.2.4 Stopwatch. A stopwatch or clock accurate to 1 second should be used.

F.2.3 Test Procedure.

F.2.3.1 Test Considerations. The test should be performed in the room in which the detection system is installed, with all normal ventilation fans (e.g., fans internal to equipment, room ventilation fans) operating. Testing should also be performed with the fans turned off to simulate the potential for fan cycling and/or a power failure. This does not preclude testing required by *NFPA 72*.

F.2.3.2 Detector Programming. The detector alarm sensitivity setting (i.e., pre-alarm or alarm) used during the test should be identical to those used during normal operation of the system. Alarm verification or time delay features should be disabled during the test to permit the detector response to be annunciated immediately upon activation.

This testing is intended to verify that the detectors sense smoke in sufficient concentrations to reach the specified alarm levels. Because the test produces a small amount of smoke for a brief period of time (i.e., a puff of smoke), the use of the alarm verification or time delay features would likely result in the detector not reaching the specified alarm levels. In a "real-world" fire, the smoke would continue to be produced as the fire grows, permitting the detector to reach alarm. If these features are disabled during the testing, they should be enabled at the conclusion of the testing before leaving the room.

F.2.3.3 Test Locations. Test locations should be selected by considering the airflow patterns in the room and choosing challenging locations for the tests (i.e., both low airflow and high airflow can be challenging). If possible, the locations and elevations of the test apparatus should be varied to simulate the range of possible fire locations in the room. Locations where the smoke would be drawn directly into the ITE cooling ports or fans should be avoided. Locations where the smoke would be entrained into the air exhausting from an equipment cabinet are acceptable.

F.2.3.4 Positioning. The test apparatus should be positioned at the test location, and the test equipment should be secured to prevent damage.

F.2.3.5 Preparation. The test wire should be prepared by carefully removing not more than 12 mm (½ in.) of the insulation from each end of the sample so that the conductor(s) is not nicked.

F.2.3.6 Mounting. The wire should be mounted on the insulating material so that there are no kinks or crossovers in the wire.

F.2.3.7 Setting. The power supply should be set to supply either a constant voltage or constant current as shown in Table F.2.3.7.

F.2.3.8 Connection. The ends of the test wire(s) should be connected to the power supply leads.

F.2.3.9 Test. When all other preparations are complete, the power supply should be switched on for the period shown in Table F.2.3.7. After the appropriate current application time, the power supply should be turned off, and the test results should be observed and recorded.

To avoid burns, the wire should not be touched during the test, or for 3 minutes after turning off the power supply. If the wire is located close to HVAC registers or equipment exhaust ports, the airflow can cool the wire and result in inadequate production of smoke. In this event, either the apparatus should be repositioned or the wire should be shielded from the airflow.

Table F.2.3.7 Heated Wire Test Electrical Specifications

Test	Voltage Setting	Current Setting	Current Application Time
2 m BSI wire test	6.0 volts dc	0 to 15 A (varies)	180 seconds
1 m BSI wire test	6.0 volts dc	0 to 15 A (varies)	60 seconds
Two BSI 6266 wires in parallel	6.0 volts dc	Current varies from 0 to 30 A during the test due to changing resistance in the wire	60 seconds
One North American wire	Voltage varies from 0 to 18 volts dc during the test due to changing resistance in the wire	0.28 A	30 seconds

BSI: British Standards Institute.

F.2.3.10 Test Sequence. The test should be repeated at least three times for each HVAC condition, with the test apparatus placed in a different location in the room each time. If possible, the elevation of the test apparatus should be varied.

F.2.3.11 Pass/Fail Criteria. The pass or fail criteria for the early detection system should be as indicated in Table F.2.1.

F.3 Lactose–Potassium Chlorate Test.

F.3.1 Description. The lactose–potassium chlorate test is one of the test methods specified in BS 6266 with modifications to the mass of mixture used for North American conditions. A mixture of 50 percent by weight of lactose and 50 percent by weight of potassium chlorate is ignited by a long-handled butane lighter to produce a small, vigorous flame and clean white smoke.

F.3.2 Test Apparatus. The test apparatus should consist of the items listed in F.3.2.1 through F.3.2.6.

F.3.2.1 Crucible or Open Cup. A noncombustible (i.e., metal, silica, or porcelain) crucible or similar cup-shaped item should be used to hold the mixture of lactose and potassium chlorate during combustion.

F.3.2.2 Support. A noncombustible surface should be used to hold the crucible upright and to insulate it from the supporting surface below.

F.3.2.3 Scale. A scale accurate to 0.1 g (0.0002 lb) should be used for weighing the required mass of lactose and potassium chlorate.

F.3.2.4 Stopwatch. A stopwatch or clock accurate to 1 second should be used.

F.3.2.5 Igniter. A long-handled butane lighter (i.e., one used to light a barbecue grill) should be used.

CAUTION

DO NOT USE AN ORDINARY CIGARETTE LIGHTER — BURNS COULD RESULT.

F.3.2.6 Ignition Mixture. A mixture composed of equal masses of lactose and potassium chlorate should be used. (This mixture is approximately 1.4 volumes of lactose to 1 volume of potassium chlorate.) For testing early detection systems, the mass of lactose/chlorate mixture should be 4.0 g (0.009 lb).

F.3.3 Procedure.

F.3.3.1 Detector Programming. The detector alarm sensitivity setting (i.e., pre-alarm or alarm) used during the test should be identical to those used during normal operation of the system. Alarm verification or time delay features should be disabled during the test to permit the detector response to be annunciated immediately upon activation.

This testing is intended to verify that the detectors sense smoke in sufficient concentrations to reach the specified alarm levels. Because the test produces a small amount of smoke for a brief period of time (i.e., a puff of smoke), the use of the alarm verification or time delay features would likely result in the detector not reaching the specified alarm levels. In a "real-world" fire, the smoke would continue to be produced as the fire grows, permitting the detector to reach alarm. If these features are disabled during the testing, they should be enabled at the conclusion of the testing before leaving the room.

F.3.3.2 Test Locations. Test locations should be selected by considering the airflow patterns in the room and choosing challenging locations for the tests (i.e., both low airflow and high airflow can be challenging). If possible, the locations and elevations of the test apparatus should be varied to simulate the range of possible fire locations in the room. Locations where the smoke would be drawn directly into the ITE cooling ports or fans should be avoided. Locations where the smoke would be entrained into the air exhausting from an equipment cabinet are acceptable.

F.3.3.3 Preparation. The required mass of lactose and potassium chlorate should be weighed into a mixing container, and mixed well by shaking or stirring to break up all lumps or clumps. The mixing container should be sealed tightly until ready to conduct the test.

F.3.3.4 Placement. The crucible should be placed on the support in the test location.

F.3.3.5 Test. When all other test preparations are complete, the required amount of mixture should be poured into the crucible, keeping it in a compact mound (i.e., without packing it down). The mixture should be ignited with the long-handled butane lighter. This mixture is essentially the formula for a match head. When ignited, it burns vigorously like a match (and smells the same). Be sure to use a long lighter to avoid being burned when the mixture ignites.

F.3.4 Test Sequence. The test should be repeated at least three times for each HVAC condition, with the test apparatus placed in a different location in the room each time. If possible, the elevation of the test apparatus should be varied.

F.3.5 Pass/Fail Criteria. The detection system should produce an "alert" or "pre-alarm" signal within 120 seconds of the cessation of ignition.

Annex G Informational References

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

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

NFPA 10, *Standard for Portable Fire Extinguishers*, 2022 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2022 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 2022 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2022 edition.

NFPA 55, *Compressed Gases and Cryogenic Fluids Code*, 2023 edition.

NFPA 68, *Standard on Explosion Protection by Deflagration Venting*, 2023 edition.

NFPA 69, *Standard on Explosion Prevention Systems*, 2023 edition.

NFPA 70®, *National Electrical Code®*, 2023 edition.

NFPA 72®, *National Fire Alarm and Signaling Code®*, 2022 edition.

NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, 2022 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 2024 edition.

NFPA 220, *Standard on Types of Building Construction*, 2024 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 2023 edition.

NFPA 551, *Guide for the Evaluation of Fire Risk Assessments*, 2022 edition.

NFPA 730, *Guide for Premises Security*, 2023 edition.

NFPA 731, *Standard for the Installation of Premises Security Systems*, 2023 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2023 edition.

NFPA 1660, *Standard for Emergency, Continuity, and Crisis Management: Preparedness, Response, and Recovery*, 2024 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 2022 edition.

Fire Protection Research Foundation (FPRF), "Validation of Modeling Tools for Detection Design in High Air Flow Environments," 2012.

Fire Protection Research Foundation (FPRF), "Validation of Modeling Tools for Detection Design in High Air Flow Environments — Phase II," 2014.

G.1.2 Other Publications.

G.1.2.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2023.

G.1.2.2 BMS CAT Publications. BMS CAT, Inc., International Headquarters, 303 Arthur Street, Fort Worth, TX 76107.

"Electronics & Magnetic Media Recovery."

G.1.2.3 BSI Publications. British Standards Institute, 12950 Worldgate Drive, Suite 800 Herndon, VA 20170.

BS 6266, *Fire Protection for Electronic Equipment Installations — Code of Practice*, 2016.

G.1.2.4 FM Publications. FM Global, 270 Central Avenue, P.O. Box 7500, Johnston, RI 02919.

Thumuluru, Sai, et al., "Experimental Data for Model Validation of Smoke Transport in Data Centers," 2014.

G.1.2.5 FSSA Publications. Fire Suppression Systems Association, 3601 East Joppa Road, Baltimore, MD 21234.

FSSA white paper, "Effect of Sound Waves on Data Storage Devices: Fire Protection Systems Protecting Data Centers," 2019.

G.1.2.6 IEEE Publications. IEEE Operations Center, 445 Hoes Lane, Piscataway, NJ 08854-4141.

IEEE 1635/ASHRAE 21, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications*, 2022.

G.1.2.7 SFPE Publications. Society of Fire Protection Engineers, 9711 Washingtonian Boulevard, Suite 380, Gaithersburg, MD 20878.

Engineering Guide to Performance-Based Fire Protection, Second Edition, 2007.

Guidelines for Peer Review in the Fire Protection Design Process, 2009.

Bukowski, Richard W., "Risk Considerations for Data Center Fire Protection," Proc 2013 SFPE Engineering Conference and Expo, Austin, TX, October 26–30, 2013.

G.1.2.8 Telcordia Publications. Telcordia Technologies, Inc., One Ericsson Drive, RRC 4A-1060, Piscataway, NJ 08854-4156.

Telcordia GR-63-CORE, *Network Equipment Building System (NEBS)™ Requirements: Physical Protection*, 2017.

G.1.2.9 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 268, *Smoke Detectors for Fire Alarm Systems*, 2021.

UL 723, *Test for Surface Burning Characteristics of Building Materials*, 2018.

UL 60950-1, *Information Technology Equipment — Safety — Part 1: General Requirements*, 2019.

UL 62368-1, *Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements*, 2021.

UL 2755, *Outline of Investigation for Modular Data Centers*, 2018.

UL 2436, *Outline of Investigation for Spill Containment for Stationary Acid and Alkaline Battery Systems*, 2020.

G.2 Informational References. (Reserved)

G.3 References for Extracts in Informational Sections. NFPA 1, *Fire Code*, 2024 edition.

NFPA 70®, *National Electrical Code®*, 2023 edition.

NFPA *101®*, *Life Safety Code®*, 2024 edition.

NFPA 5000®, *Building Construction and Safety Code®*, 2024 edition.

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Sequence of Events for the Standards Development Process

Once the current edition is published, a Standard is opened for Public Input.

Step 1 – Input Stage

- Input accepted from the public or other committees for consideration to develop the First Draft
- Technical Committee holds First Draft Meeting to revise Standard (23 weeks); Technical Committee(s) with Correlating Committee (10 weeks)
- Technical Committee ballots on First Draft (12 weeks); Technical Committee(s) with Correlating Committee (11 weeks)
- Correlating Committee First Draft Meeting (9 weeks)
- Correlating Committee ballots on First Draft (5 weeks)
- First Draft Report posted on the document information page

Step 2 – Comment Stage

- Public Comments accepted on First Draft (10 weeks) following posting of First Draft Report
- If Standard does not receive Public Comments and the Technical Committee chooses not to hold a Second Draft meeting, the Standard becomes a Consent Standard and is sent directly to the Standards Council for issuance (see Step 4) or
- Technical Committee holds Second Draft Meeting (21 weeks); Technical Committee(s) with Correlating Committee (7 weeks)
- Technical Committee ballots on Second Draft (11 weeks); Technical Committee(s) with Correlating Committee (10 weeks)
- Correlating Committee Second Draft Meeting (9 weeks)
- Correlating Committee ballots on Second Draft (8 weeks)
- Second Draft Report posted on the document information page

Step 3 – NFPA Technical Meeting

- Notice of Intent to Make a Motion (NITMAM) accepted (5 weeks) following the posting of Second Draft Report
- NITMAMs are reviewed and valid motions are certified by the Motions Committee for presentation at the NFPA Technical Meeting
- NFPA membership meets each June at the NFPA Technical Meeting to act on Standards with "Certified Amending Motions" (certified NITMAMs)
- Committee(s) vote on any successful amendments to the Technical Committee Reports made by the NFPA membership at the NFPA Technical Meeting

Step 4 – Council Appeals and Issuance of Standard

- Notification of intent to file an appeal to the Standards Council on Technical Meeting action must be filed within 20 days of the NFPA Technical Meeting
- Standards Council decides, based on all evidence, whether to issue the standard or to take other action

Notes:

1. Time periods are approximate; refer to published schedules for actual dates.
2. Annual revision cycle documents with certified amending motions take approximately 101 weeks to complete.
3. Fall revision cycle documents receiving certified amending motions take approximately 141 weeks to complete.

Committee Membership Classifications[1,2,3,4]

The following classifications apply to Committee members and represent their principal interest in the activity of the Committee.

1. M *Manufacturer:* A representative of a maker or marketer of a product, assembly, or system, or portion thereof, that is affected by the standard.
2. U *User:* A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.
3. IM *Installer/Maintainer:* A representative of an entity that is in the business of installing or maintaining a product, assembly, or system affected by the standard.
4. L *Labor:* A labor representative or employee concerned with safety in the workplace.
5. RT *Applied Research/Testing Laboratory:* A representative of an independent testing laboratory or independent applied research organization that promulgates and/or enforces standards.
6. E *Enforcing Authority:* A representative of an agency or an organization that promulgates and/or enforces standards.
7. I *Insurance:* A representative of an insurance company, broker, agent, bureau, or inspection agency.
8. C *Consumer:* A person who is or represents the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in (2).
9. SE *Special Expert:* A person not representing (1) through (8) and who has special expertise in the scope of the standard or portion thereof.

NOTE 1: "Standard" connotes code, standard, recommended practice, or guide.

NOTE 2: A representative includes an employee.

NOTE 3: While these classifications will be used by the Standards Council to achieve a balance for Technical Committees, the Standards Council may determine that new classifications of member or unique interests need representation in order to foster the best possible Committee deliberations on any project. In this connection, the Standards Council may make such appointments as it deems appropriate in the public interest, such as the classification of "Utilities" in the National Electrical Code Committee.

NOTE 4: Representatives of subsidiaries of any group are generally considered to have the same classification as the parent organization.

Submitting Public Input / Public Comment Through the Online Submission System

Following publication of the current edition of an NFPA standard, the development of the next edition begins and the standard is open for Public Input.

Submit a Public Input

NFPA accepts Public Input on documents through our online submission system at www.nfpa.org. To use the online submission system:

- Choose a document from the List of NFPA codes & standards or filter by Development Stage for "codes accepting public input."
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- Choose the link "The next edition of this standard is now open for Public Input." You will be asked to sign in or create a free online account with NFPA before using this system.
- Follow the online instructions to submit your Public Input (see www.nfpa.org/publicinput for detailed instructions).
- Once a Public Input is saved or submitted in the system, it can be located on the "My Profile" page by selecting the "My Public Inputs/Comments/NITMAMs" section.

Submit a Public Comment

Once the First Draft Report becomes available there is a Public Comment period. Any objections or further related changes to the content of the First Draft must be submitted at the Comment Stage. To submit a Public Comment follow the same steps as previously explained for the submission of Public Input.

Other Resources Available on the Document Information Pages

Header: View document title and scope, access to our codes and standards or NFCSS subscription, and sign up to receive email alerts.

Current & Prior Editions	Research current and previous edition information.
Next Edition	Follow the committee's progress in the processing of a standard in its next revision cycle.
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News	Provides links to available articles and research and statistical reports related to our standards.
Purchase Products & Training	Discover and purchase the latest products and training.
Related Products	View related publications, training, and other resources available for purchase.

Information on the NFPA Standards Development Process

I. Applicable Regulations. The primary rules governing the processing of NFPA standards (codes, standards, recommended practices, and guides) are the NFPA *Regulations Governing the Development of NFPA Standards (Regs)*. Other applicable rules include NFPA *Bylaws*, NFPA *Technical Meeting Convention Rules*, NFPA *Guide for the Conduct of Participants in the NFPA Standards Development Process*, and the NFPA *Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council*. Most of these rules and regulations are contained in the *NFPA Standards Directory*. For copies of the *Directory*, contact Codes and Standards Administration at NFPA headquarters; all these documents are also available on the NFPA website at "www.nfpa.org/regs."

The following is general information on the NFPA process. All participants, however, should refer to the actual rules and regulations for a full understanding of this process and for the criteria that govern participation.

II. Technical Committee Report. The Technical Committee Report is defined as "the Report of the responsible Committee(s), in accordance with the Regulations, in preparation of a new or revised NFPA Standard." The Technical Committee Report is in two parts and consists of the First Draft Report and the Second Draft Report. (See *Regs* at Section 1.4.)

III. Step 1: First Draft Report. The First Draft Report is defined as "Part one of the Technical Committee Report, which documents the Input Stage." The First Draft Report consists of the First Draft, Public Input, Committee Input, Committee and Correlating Committee Statements, Correlating Notes, and Ballot Statements. (See *Regs* at 4.2.5.2 and Section 4.3.) Any objection to an action in the First Draft Report must be raised through the filing of an appropriate Comment for consideration in the Second Draft Report or the objection will be considered resolved. [See *Regs* at 4.3.1(b).]

IV. Step 2: Second Draft Report. The Second Draft Report is defined as "Part two of the Technical Committee Report, which documents the Comment Stage." The Second Draft Report consists of the Second Draft, Public Comments with corresponding Committee Actions and Committee Statements, Correlating Notes and their respective Committee Statements, Committee Comments, Correlating Revisions, and Ballot Statements. (See *Regs* at 4.2.5.2 and Section 4.4.) The First Draft Report and the Second Draft Report together constitute the Technical Committee Report. Any outstanding objection following the Second Draft Report must be raised through an appropriate Amending Motion at the NFPA Technical Meeting or the objection will be considered resolved. [See *Regs* at 4.4.1(b).]

V. Step 3a: Action at NFPA Technical Meeting. Following the publication of the Second Draft Report, there is a period during which those wishing to make proper Amending Motions on the Technical Committee Reports must signal their intention by submitting a Notice of Intent to Make a Motion (NITMAM). (See *Regs* at 4.5.2.) Standards that receive notice of proper Amending Motions (Certified Amending Motions) will be presented for action at the annual June NFPA Technical Meeting. At the meeting, the NFPA membership can consider and act on these Certified Amending Motions as well as Follow-up Amending Motions, that is, motions that become necessary as a result of a previous successful Amending Motion. (See 4.5.3.2 through 4.5.3.6 and Table 1, Columns 1-3 of *Regs* for a summary of the available Amending Motions and who may make them.) Any outstanding objection following action at an NFPA Technical Meeting (and any further Technical Committee consideration following successful Amending Motions, see *Regs* at 4.5.3.7 through 4.6.5) must be raised through an appeal to the Standards Council or it will be considered to be resolved.

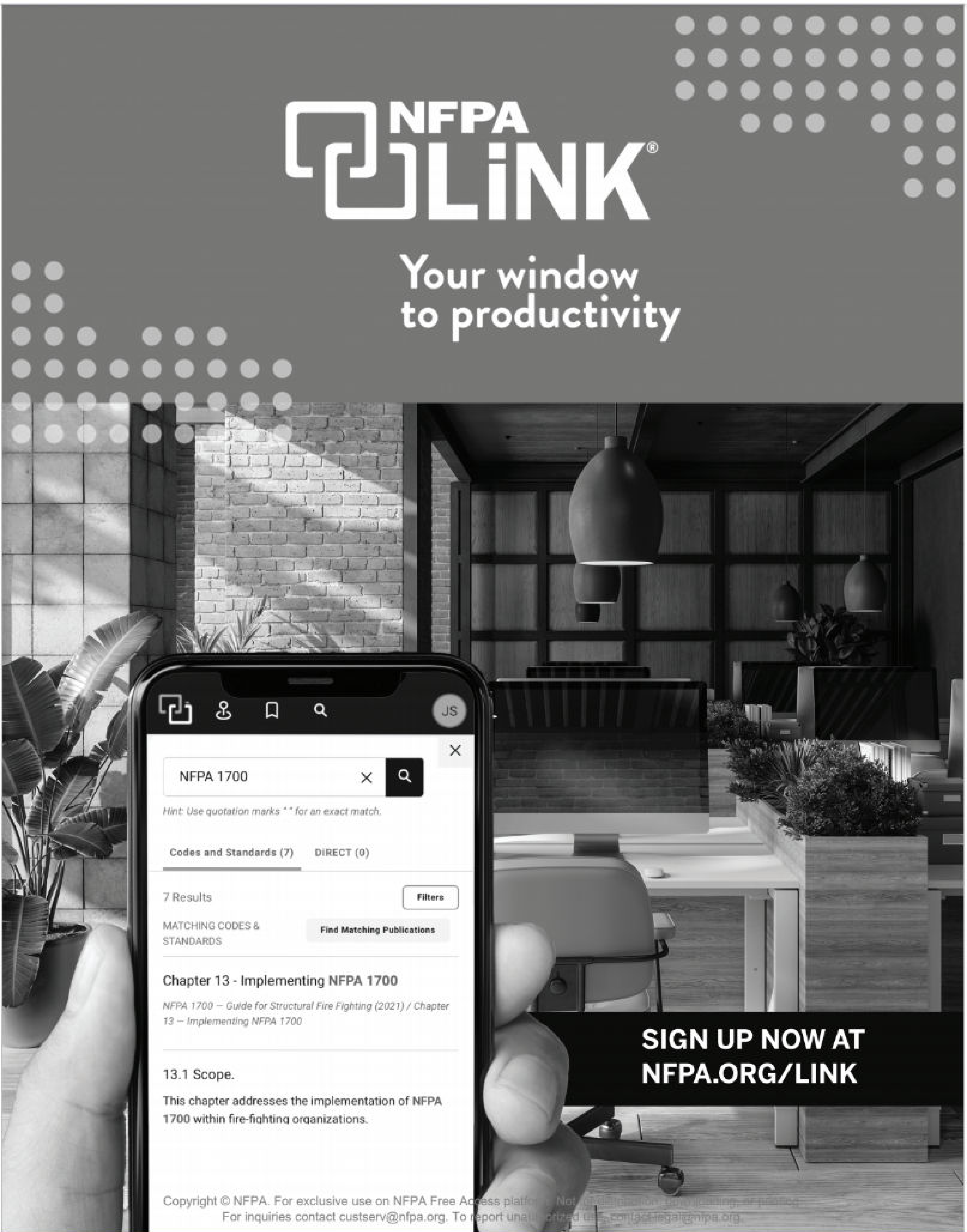
VI. Step 3b: Documents Forwarded Directly to the Council. Where no NITMAM is received and certified in accordance with the *Technical Meeting Convention Rules*, the standard is forwarded directly to the Standards Council for action on issuance. Objections are deemed to be resolved for these documents. (See *Regs* at 4.5.2.5.)

VII. Step 4a: Council Appeals. Anyone can appeal to the Standards Council concerning procedural or substantive matters related to the development, content, or issuance of any document of the NFPA or on matters within the purview of the authority of the Council, as established by the *Bylaws* and as determined by the Board of Directors. Such appeals must be in written form and filed with the Secretary of the Standards Council (see *Regs* at Section 1.6). Time constraints for filing an appeal must be in accordance with 1.6.2 of the *Regs*. Objections are deemed to be resolved if not pursued at this level.

VIII. Step 4b: Document Issuance. The Standards Council is the issuer of all documents (see Article 8 of *Bylaws*). The Council acts on the issuance of a document presented for action at an NFPA Technical Meeting within 75 days from the date of the recommendation from the NFPA Technical Meeting, unless this period is extended by the Council (see *Regs* at 4.7.2). For documents forwarded directly to the Standards Council, the Council acts on the issuance of the document at its next scheduled meeting, or at such other meeting as the Council may determine (see *Regs* at 4.5.2.5 and 4.7.4).

IX. Petitions to the Board of Directors. The Standards Council has been delegated the responsibility for the administration of the codes and standards development process and the issuance of documents. However, where extraordinary circumstances requiring the intervention of the Board of Directors exist, the Board of Directors may take any action necessary to fulfill its obligations to preserve the integrity of the codes and standards development process and to protect the interests of the NFPA. The rules for petitioning the Board of Directors can be found in the *Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council* and in Section 1.7 of the *Regs*.

X. For More Information. The program for the NFPA Technical Meeting (as well as the NFPA website as information becomes available) should be consulted for the date on which each report scheduled for consideration at the meeting will be presented. To view the First Draft Report and Second Draft Report as well as information on NFPA rules and for up-to-date information on schedules and deadlines for processing NFPA documents, check the NFPA website (www.nfpa.org/docinfo) or contact NFPA Codes & Standards Administration at (617) 984-7246.



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13.1 Scope.
This chapter addresses the implementation of NFPA 1700 within fire-fighting organizations.
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