NFPA 232

Standard for the Protection of Records

2007 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA 232

Standard for the

Protection of Records

2007 Edition

This edition of NFPA 232, *Standard for the Protection of Records*, was prepared by the Technical Committee on Record Protection and acted on by NFPA at its June Association Technical Meeting held June 4–8, 2006, in Orlando, FL. It was issued by the Standards Council on July 28, 2006, with an effective date of August 17, 2006, and supersedes all previous editions.

This edition of NFPA 232 was approved as an American National Standard on August 17, 2006.

Origin and Development of NFPA 232

The destructive fire in the general offices of the Chicago, Burlington, and Quincy Railway in Chicago on March 25, 1922, was clear proof that valuable and often irreplaceable business records, unless properly protected, can be destroyed even in so-called "fire-resistive" buildings. Following this destructive fire, the Committee on Record Protection was organized. Reports were submitted annually from 1923 through 1936 and again in 1939. In 1947, a standard was developed from the officially adopted committee reports of 1942 to 1946. In 1960, the standard underwent major editorial revision and was revised again in 1963, 1967, and 1970. In 1975, it was reconfirmed. The 1980 edition reformatted the standard to conform to the NFPA *Manual of Style* and revised the detail specifications to performance-oriented requirements. The 1986 edition was a reconfirmation of the 1980 edition.

Changes to the 1991 edition included a reclassification of certain types of records. New provisions were added for the construction, arrangement, and protection of file rooms. These changes further increased the chance that vital documents would be spared during most fire events.

The 1995 edition incorporated several editorial changes and the inclusion of a retroactivity clause, and further addressed the protection requirements for non-paper records media.

The 2000 edition incorporated NFPA 232A, and, where appropriate, the information that had been contained in NFPA 232A was included as enforceable language. The documents were combined because both contained similar information. Requirements for housekeeping and emergency planning were included to provide guidance during emergency conditions and recovery operations.

In addition to reformatting in accordance with the *Manual of Style for NFPA Technical Committee Documents*, the 2007 edition of NFPA 232 has been reorganized to clearly provide requirements for each storage environment and to consolidate general requirements. Considerable effort was made to provide requirements for compartmented records centers.

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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 books, papers, plans, and other records from loss incident to fire.

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A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex F. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1* Scope.

1.1.1 This standard provides requirements for records protection equipment and facilities and records-handling techniques that provide protection of records in a variety of media forms from the hazards of fire.

1.1.2 This standard does not consider forcible entry.

1.1.3 This standard covers the following categories of records storage environments in ascending order of risk tolerance:

(1) Vaults
(2) Archives
(3) File rooms
(4) Compartmented records centers
(5) Records centers

1.1.4 This standard also covers the application of records protection equipment.

1.1.5* This standard does not cover the storage and handling of cellulose nitrate film records.

1.1.6 This standard does not cover the storage and handling of useful records.

1.1.7 The responsible party (or owner of the records) shall determine from this standard the level of protection afforded the records.

1.1.8 The various levels of protection shall be clearly defined to ensure the responsible party understands their risk exposure.

1.1.9 The responsible party shall determine which records justify the application of this standard.

1.2 Purpose.

1.2.1 This standard is prepared for the use and guidance of those charged with purchasing, designing, constructing, installing, inspecting, approving, listing, operating, or maintaining equipment and facilities that protect records against fire and its associated effects.

1.2.2* This standard also is intended for the use and guidance of those charged with planning, surveying, classifying, retaining, and otherwise handling of records.

1.3 Retroactivity. 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.

1.3.1 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.

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

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

1.4 Planning. It could be necessary for many of those charged with planning, inspecting, approving, operating, and maintaining records facilities, equipment, and techniques to consult with an experienced and competent fire protection engineer or records protection consultant.

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.

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

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

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 10, *Standard for Portable Fire Extinguishers,* 2007 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems,* 2004 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2007 edition.

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NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2007 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems,* 2002 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment,* 2006 edition.

NFPA 40, *Standard for the Storage and Handling of Cellulose Nitrate Film,* 2007 edition.

NFPA 54, *National Fuel Gas Code,* 2006 edition.

NFPA 58, *Liquefied Petroleum Gas Code,* 2004 edition.

NFPA 70, *National Electrical Code®,* 2005 edition.

NFPA 72®, National Fire Alarm Code®, 2007 edition.

NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures,* 2007 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems,* 2002 edition.

NFPA *101®, Life Safety Code®,* 2006 edition.

NFPA 220, *Standard on Types of Building Construction,* 2006 edition.

NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls,* 2006 edition.

NFPA 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials,* 2006 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems,* 2006 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems,* 2004 edition.

NFPA 1600, *Standard on Disaster/Emergency Management and Business Continuity Programs,* 2004 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems,* 2004 edition.

2.3 Other Publications.

2.3.1 ANSI/ARMA Publications. ARMA International, 13725 W. 109th Street, Suite 101, Lenexa, KS 66215.

ANSI/ARMA 5, *Vital Records Programs: Identifying, Managing, & Recovering Business-Critical,* 2003.

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

ANSI/UL 72, *Standard for Tests for Fire Resistance of Record Protection Equipment*, 2001.

ANSI/UL 155, *Standard for Tests for Fire Resistance of Vault and File Room Doors,* 2000.

2.3.3 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 909, *Code for the Protection of Cultural Resource Properties — Museums, Libraries, and Places of Worship,* 2005 edition.

NFPA 1250, *Recommended Practice in Emergency Service Organization Risk Management,* 2004 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

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

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

3.2.5 Shall. Indicates a mandatory requirement.

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

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

3.3 General Definitions.

3.3.1 Archive. An independent facility or area within a records center, designed for the protection of archival materials and records, typically designed to be fire resistive.

3.3.2 Building.

3.3.2.1* *Fire-Resistive Building.* A building of Type I or Type II (222) construction in which the structural members, including walls, partitions, columns, floors, and roofs are of noncombustible or limited-combustible materials.

3.3.2.2 *Non-Fire-Resistive Building.* A building of that type of construction in which the structural members, including walls, partitions, columns, floors, and roofs, do not qualify as fire-resistive as defined herein.

3.3.3* Compartment. The subdivision of a building by fire-resistant construction methods to create defensible areas.

3.3.4 Door.

3.3.4.1 *File Room Door.* A listed assembly that protects paper records against fire for the duration of the door's rated exposure.

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3.3.4.2 ***Vault Door.*** A listed and labeled assembly that provides a specific degree of fire protection to the opening for the duration of the door's rated exposure.

3.3.5 File Room. A fire-resistive enclosure that provides less fire protection than a vault and is used for the storage of records.

3.3.6 Mobile Shelving. A system of records storage, usually a type of open-shelf file equipment, also known as track files, compaction files, or movable files, in which sections or rows of shelves are manually or electrically moved on tracks to provide access aisles.

3.3.7 Open-Shelf File Equipment. Any shelving that does not enclose file compartments on six sides.

3.3.8* Processing Area. An area used for preparing records for storage.

3.3.9 Record.

3.3.9.1 ***Active Record.*** A record that is needed to perform current operations.

3.3.9.2 ***Archival Material/Record.*** A record that was created or received and accumulated by a person or organization in the course of the conduct of affairs and that has been preserved because of its historical or continuing value.

3.3.9.3 ***Important Record.*** A record for which a reproduction, although acceptable as a substitute for the original, could be obtained only at considerable expense and labor or only after considerable delay.

3.3.9.4 ***Inactive Record.*** A record that does not have to be readily available for current business operations or use.

3.3.9.5* ***Permanent Record.*** A record that has been determined by the responsible party to have sufficient value to warrant its permanent retention and preservation.

3.3.9.6 ***Unscheduled Record.*** A record in which the final disposition has not been approved by the responsible party.

3.3.9.7* ***Useful Record.*** A temporary record that is normally accumulated in operations and is kept for a time period established by the responsible party.

3.3.9.8 ***Vital Record.*** A record that is irreplaceable or that contains information for which temporary unavailability could constitute a serious legal or business impairment.

3.3.10 Records Center. A building or enclosure having a minimum storage volume of records exceeding 50,000 ft^3 (1416 m^3) used for the retention of records.

3.3.11 Records Protection Equipment. Self-contained movable devices of varying configurations, including insulated bodies with insulated doors or drawers or lids, nonrated multidrawer devices housing individually rated drawer bodies, and other similar constructions.

3.3.12 Responsible Party. An organization, office, or individual charged with the classification, retention scheduling, and disposition of records.

3.3.13 Risk Management. The process of planning, organizing, directing, and controlling the resources and activities of an organization in order to minimize detrimental effects on that organization. [**1250,** 2004]

3.3.14 Slab. A poured concrete floor–ceiling assembly.

3.3.15 Vault.

3.3.15.1 ***Ground-Supported Vault.*** A vault that is supported from the ground up and that is structurally independent of the building in which it is located.

3.3.15.2 ***Standard Records Vault.*** A completely fire-resistive enclosure used exclusively for records storage.

3.3.15.3 ***Structure-Supported Vault.*** A vault that is supported by the framework of a fire-resistive building and that can be supported individually on any floor of such a building.

3.3.16 Vault Floor. The ground-supported slab or the slab between vaults in a tier.

3.3.17 Vault Roof. The ceiling or roof of a single vault and the ceiling or roof of the top vault of a tier, but not the slab between vaults in a tier, which is classified as a floor.

Chapter 4 General Requirements

4.1* Required Levels of Protection. The requirements of this chapter shall be used to determine the levels of protection needed for the various classifications of records used by records and information management professionals to ensure that protection is afforded to the types of records typically stored in privately held or commercially operated records centers.

4.1.1 Records shall be permitted to be stored as shown in Table 4.1.1.

Table 4.1.1 Allowable Storage Environments

Record Type	Vault	Archive	File Room	Records Center
Vital	x			
Important	x		x	x
Archival material	x	x		
Permanent	x			x
Active			x	x
Inactive			x	x
Unscheduled records	x		x	x

Notes:
(1) Nothing in this table precludes the storage of records in an environment providing a higher level of protection.
(2) Any record type is permitted to be stored in records protection equipment rated for the media stored.

4.1.2 Vital records shall be maintained in a records vault, or, for small volumes, a listed 1-hour device in a fire-resistive building.

4.1.3 Permanent records shall be maintained in a records vault, a file room, an archive, or a records center.

4.1.4* Active or inactive records shall be maintained in a file room or a records center.

4.1.5* Duplication.

4.1.5.1 Duplication shall be permitted to be used as a method of record protection.

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4.1.5.2 Where the duplication is used as a method of record protection, the duplicated records shall be stored in a separate location not subject to a single fire event.

4.2* Establishment of Risk Tolerance.

4.2.1 The responsible party shall establish an acceptable level of risk tolerance for both limited and catastrophic events.

4.2.2 Archives and records centers shall be protected by a professionally designed fire protection system specifically designed to achieve the stipulated level of risk tolerance.

4.2.3 If the design is not in strict compliance with established NFPA standards (e.g., NFPA 13), the authority having jurisdiction shall be permitted to require design verification through full-scale fire testing by an independent organization acceptable to the authority having jurisdiction.

4.3* Responsibility of the Records Manager and Archivist or Responsible Party.

4.3.1 The responsible party, records manager, or archivist shall determine which, if any, of the records need a higher level of protection as provided by the use of records and/or media vaults, safes, or insulated containers as specified in Chapter 11.

4.3.2 Storage of cellulose nitrate film shall not be permitted in records vaults, file rooms, archives, or records centers.

4.3.3 NFPA 40 shall be followed for protection requirements for cellulose nitrate film.

4.4 Fire Risk Evaluation Factors. In considering the protection of records stored en masse, the following basic factors shall be evaluated:

(1) The exposure from the building housing the records, from nearby buildings, or from neighboring operations (e.g., the possibility of involving the records in a fire originating outside of the records facility)
(2) The potential of fire initiation within the records facility, including the susceptibility of the records or containers to ignition
(3) The potential of fire development posed by the stored records themselves, particularly as that potential relates to the available or proposed fire control capabilities or mechanisms
(4) The potential impact of fire development in the stored records on the housing structure and adjacent operations
(5) The fire control systems with the resultant extent and type of damage from fire, fire effects (e.g., heat, smoke), and fire-extinguishing efforts (principally water and physical disruption of records necessary to effect manual fire fighting)
(6) The potential threat to life of occupants and fire service personnel

4.5* Exposure.

4.5.1 The responsible party shall consider the potential for the records to be destroyed by a fire that initiates in an area external to the operations.

4.5.2 The building exterior and tenant separations shall meet or exceed the requirements of the local building code and this standard.

4.6* Operations in Records Storage Areas.

4.6.1 Records storage areas shall be separated from offices and research rooms by a minimum 1-hour rated fire barrier.

4.6.2 Other fire risks in the records storage areas shall be reduced by the following means:

(1) Using electric instead of gas-fueled fork lifts
(2) Prohibiting the use of portable space heaters, lights on extension cords, hot plates, coffee makers, duplicating devices, battery chargers, welding or cutting torches, and other such ignition sources within storage areas
(3) Prohibiting the storage of oils, paints, or other flammables in or contiguous to the records areas
(4) Prohibiting smoking in the building

4.7 Housekeeping.

4.7.1 Stairwells, corridors, doorways, and any other portions of the means of egress for a building shall be free of combustibles, trash containers, and other materials.

4.7.2 Electrical rooms, mechanical rooms, and telephone closets shall be kept free of combustibles and locked.

4.7.3 Stacks, exhaust ducts, and filters shall be cleaned as frequently as necessary to prevent the buildup of combustible dusts and fibers.

4.7.4 Packing Materials.

4.7.4.1 Combustible packing materials, such as shredded paper, Styrofoam™ peanuts, plastic, and excelsior, shall be stored in metal containers with self-closing covers.

4.7.4.2 Areas where packing materials cannot be protected using these methods, such as dedicated crating and packing areas, shall be enclosed in 1-hour fire-resistive construction or shall be protected by an automatic sprinkler system.

4.7.5 Dumpsters.

4.7.5.1 Dumpsters or compactors used for bulk collection of trash or recyclable paper shall be constructed of metal with metal or plastic covers.

4.7.5.2 Dumpsters and other large trash containers, if inside buildings, shall be stored in one of the following:

(1) In trash rooms having both automatic sprinklers and a 1-hour fire resistance rating
(2) In loading dock areas having both automatic sprinklers and a 1-hour fire resistance rating

4.7.6 Trash shall be collected and disposed of at the end of each work day and more often if necessary.

4.8 Emergency Planning.

4.8.1 General. Emergency planning shall be performed.

4.8.1.1 Emergency plans shall be based upon hazard identification and risk assessment in accordance with Section 5.3 of NFPA 1600, and ANSI/ARMA 5.

4.8.1.2 A strategy to eliminate hazards or mitigate the effects of hazards that cannot be eliminated shall be developed in accordance with Section 5.4 of NFPA 1600.

4.8.2 Planning for Response. [**909:**5.3]

4.8.2.1* The risk manager shall develop and implement an emergency management plan.

4.8.2.1.1 There shall be an annual exercise to ensure that management and staff can implement and work with the plan and incorporate lessons learned from the exercise into an updated plan.

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4.8.2.1.2 The plan shall include provisions for notifying the fire department of the type and location of the emergency and directing them to the site once they arrive.

4.8.2.1.3 Emergency telephone numbers shall be posted on or adjacent to all telephones. [**909:**4.3.3]

4.8.2.2 An emergency evacuation plan shall be prepared in cooperation with the local fire department and other applicable authorities and updated annually. The plan shall include the following:

(1) Fire safety precautions when normal operational conditions are substantially changed
(2) Fire safety precautions to make necessary adjustments for temporary storage
(3) Modification of staff training and drills to adjust for circumstances created by special conditions
(4) Provisions to notify the local fire service of special conditions expected to require adjustments to the emergency evacuation plan [**909:**5.4.3]

4.8.2.3 Fire exit drills shall be conducted annually.

4.8.2.3.1 Fire exit drills shall be in accordance with NFPA *101*.

4.8.3 Recovery Plan. A recovery plan shall be prepared in cooperation with the fire department, appropriate building staff, police, and insurance representatives. This plan shall be updated annually and shall include the following:

(1) Procedures to identify and prioritize collections and other valuable materials in accordance with the facility's policy.
(2) A list of recovery equipment suppliers (e.g., pumps, freezing equipment, storage facilities, and so forth) and tradespeople.
(3) A current list of disaster recovery specialists for damaged fine arts, collections, and archives, such as conservators from museums, archives, and other cultural properties willing to lend mutual aid assistance.
(4) A list of people assigned to assist with recovery operations, including staff to deal with the press, fire authorities, police, and authorities that can restrict entry following a fire of suspicious origin.
(5) Measures to maintain up-to-date copies of important documents in a secure, off-site location. Examples of such records include, but are not limited to, the following:
    (a) Collections inventories (e.g., accession, catalog, conservation, and loan documents along with copies of donation and gift forms)
    (b) Historical records (including baptismal and wedding records)
    (c) Essential business and insurance records
    (d) Building plans and systems documentation (e.g., drawings, specifications, and operating manuals)
(6) Procedures to identify and handle hazardous materials, such as asbestos or PCPs, that can cause a health hazard or contaminate the structure or contents after a fire, including impoundment of fire-fighting water where it poses a hazard to the environment. [**909:**5.4.7]

4.8.4 Fire Protection Plan.

4.8.4.1 Format of Plan.

4.8.4.1.1 A fire protection plan shall be developed for systematic achievement of fire safety goals and updated annually.

4.8.4.1.2 This plan shall include a yearly comprehensive facility inspection procedure with a documentation and corrective action process to ensure that all problems and hazards identified during the inspection are documented and corrected as soon as possible.

4.8.4.2 Fire Safety Log.

4.8.4.2.1 The risk manager shall be responsible for maintaining a permanent, current file of the facility's fire protection program.

4.8.4.2.2 As a minimum, permanent records documenting the following shall be kept:

(1) Training of staff, including fire evacuation drills and use of portable fire extinguishers
(2) Testing, inspection, and maintenance reports for all fire safety equipment and systems, including records of actions taken to correct deficiencies
(3) "As-built" plans, specifications, wiring and layout diagrams, and acceptance test reports for all fire protection systems (e.g., fire detection and alarm systems, automatic fire suppression systems)
(4) The facility's fire protection plan
(5) The facility's emergency plan
(6) Inspection reports by local code enforcement officials, the authority having jurisdiction, local fire service officials, and insurance loss control representatives, including records of actions taken to correct deficiencies identified during each inspection
(7) Fire protection systems actuation and alarm reports complete with the cause of the alarm or activation, response, and corrective action(s) taken
(8) Full reports, including cause, extent of damage, response, and recovery of all fire incidents

4.8.4.3 Arson. Facilities shall implement precautions to prevent arson. [**909:**6.1.3]

4.8.5 Training. In accordance with the requirements of this section, the risk manager shall ensure that the staff receive periodic and regular training in all aspects of the following:

(1) The emergency management plan
(2) The emergency evacuation plan
(3) The recovery plan
(4) The fire protection systems
(5) The use of portable extinguishers

4.8.6 Inspection, Testing, and Maintenance.

4.8.6.1 Where water-based fire suppression systems protect records, they shall be inspected, tested, and maintained in accordance with NFPA 25.

4.8.6.2 Where other fire suppression systems are installed, they shall be inspected, tested, and maintained in accordance with the appropriate standard.

4.9 Fire Suppression Systems and Signaling Equipment.

4.9.1 Where required, an automatic sprinkler system shall be designed and installed in accordance with NFPA 13.

4.9.2 Where records media are mixed (e.g., paper and magnetic tape), the design shall be for the highest hazard commodity.

4.9.3 In lieu of sprinkler protection, a gas extinguishing system shall be permitted to be in accordance with NFPA 2001 or NFPA 12A.

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4.9.4 Sprinkler and gas extinguishing systems shall be supervised by a listed fire alarm system.

4.9.5 Fire detection and alarm systems shall be in accordance with *NFPA 72*.

4.9.6 Fire extinguishers shall be provided in accordance with NFPA 10.

4.10 Existing Systems. Where new file rooms, vaults, archives, or record centers are developed in buildings equipped with existing fire protection systems, the responsible party shall obtain written confirmation from a qualified fire protection professional approved by the authority having jurisdiction that the existing fire protection systems meet or exceed the requirements of NFPA 13 for the occupancy.

Chapter 5 Building Equipment and Facilities

5.1 Heating Systems.

5.1.1* Boilers and furnaces of central heating systems shall be separated from the remainder of the structure by rated fire walls or separations.

5.1.2 Oil-fired and gas-fired heating equipment, piping, and fuel oil storage facilities shall be installed and maintained in accordance with the requirements of NFPA 54, NFPA 58, and/or NFPA 31.

5.1.3 Heating equipment shall be inspected and serviced at least annually by qualified personnel or a service contractor.

5.1.4 All heating units shall have safety devices for the particular type of installation.

5.1.5 Combustibles, such as paper, wood, and textiles, shall be kept away from steam piping or other heat piping and ducts.

5.1.6* Where gas is used as fuel for heating, the requirements for safety and fire protection shall be in accordance with NFPA 54.

5.1.7 The requirements for the use of liquefied petroleum gas as fuel shall be in accordance with NFPA 58.

5.1.8 The installation of oil burners and equipment used with them shall be in accordance with NFPA 31.

5.1.9 The requirements of NFPA 90A shall be applied to air duct systems used for heating and ventilating.

5.2 Electrical Systems.

5.2.1 Installation and modifications to provide for the changing needs of the records center or archive, including lighting, television, sound systems, shop machinery, and appliances, shall be made by licensed or qualified electricians in accordance with NFPA 70.

5.2.2 The equipment shall be listed.

5.3* Locking Devices.

5.3.1 Locking devices on egress doors shall comply with NFPA *101*.

5.3.2 A daily functional test protocol shall be conducted by an individual specifically assigned the responsibility.

5.4 Air-Conditioning and Ventilation Systems.

5.4.1 If provided, central air-conditioning equipment shall be located and installed in a manner that does not increase fire hazards in records centers, vaults, file rooms, or for archives' facilities.

5.4.2 Where air-conditioning ducts penetrate rated walls, they shall be equipped with automatic fire dampers and fan shutoffs in accordance with NFPA 90A.

5.5* Lightning Protection. NFPA 780 shall be used in applying methods of protecting buildings from damage by lightning.

Chapter 6 Standard Records Vault

6.1 General.

6.1.1 The vault shall be equipped, maintained, and supervised to minimize the possibility of origin of fire within and to prevent entrance of fire from outside for a specified period of time.

6.1.2 To resist the maximum expected exposure fire, a vault shall be constructed as specified herein with a minimum fire rating of 4 hours in noncombustible constructed buildings and 6 hours in combustible constructed buildings.

6.1.3 Structures or buildings containing vaults shall meet or exceed the requirements of the local building code.

6.2 Design.

6.2.1 In a fire-resistive building, the vault shall be of either the ground-supported or the structure-supported type.

6.2.2* In a non-fire-resistive building, the vaults shall be of the ground-supported type, and the walls of a building shall not be used as walls of the vault.

6.2.3* Plans and specifications shall be prepared and construction shall be supervised by a licensed or registered structural engineer or architect in consultation with a licensed or registered fire protection engineer.

6.2.4 The design and construction of a vault shall provide a flame barrier and a heat retardant to limit damage to the interior of the vault.

6.2.4.1 The vault design shall take into consideration floor loading to avoid settlement and consequent cracking.

6.2.4.2 The design shall maintain the integrity of the vault structure under the stresses and impacts to which it can be subjected during a fire.

6.3* Location. Vaults in non-fire-resistive buildings shall be located to reduce the probability of exposure to falling heavy objects.

6.4 Size. For the purpose of restricting the quantity of vital records exposed to destruction by fire in a single enclosure and reducing the possibility of fire originating within a vault, the vault volume shall not exceed 5000 ft^3 (142 m^3), and the interior height shall not exceed 12 ft (3.7 m). *(For conditions requiring storage of a larger volume of vital records, see Section 6.14.)*

6.5 Foundations.

6.5.1 Ground-Supported Vaults.

6.5.1.1 Foundations for vaults shall carry the entire load of the vault or tier of vaults and contents without settlement or cracking.

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6.5.1.2 Unburied structural members supporting vaults shall have fire resistance at least equal to that of the vault.

6.5.2 Structure-Supported Vaults.

6.5.2.1* The supporting structures for vaults shall be of a strength to carry the full load, including the wet weight of the vault structure and its contents.

6.5.2.2 There shall be no combustible material in any portion of the building structural members that support the vault.

6.5.2.3 All building structural members that support the vault shall have fire resistance at least equal to that of the vault.

6.6 Floor.

6.6.1 Floors shall be noncombustible and shall have floor surfacing limited to concrete sealer.

6.6.2 In structure-supported vaults, the floor of the fire-resistive building shall be permitted to serve as the floor of the vault, provided it is of noncombustible construction throughout and complies with the following:

(1) Floors above grade shall be adequate to support the full load (wet weight) and shall have unrestrained fire resistance equivalent to that required for the walls of the vault. *(See Section 6.7.)*
(2) Floors above grade shall not be pierced for any purpose.
(3) The floor of the vault installed above grade shall be not less than the rating of the walls and ceiling.

6.7 Walls.

6.7.1 Materials. Walls shall be noncombustible and of fire-resistive construction throughout.

6.7.2 Structure-Supported Vaults. The walls of a structure-supported vault shall follow the column lines of the building.

6.7.3 Reinforcing Rods. Reinforcing rods in concrete shall be located to avoid failure from fire exposure.

6.7.4 Trim. Noncombustible material shall be used for trim or partitions within the vault.

6.7.5* Minimum Resistance.

6.7.5.1 The design shall provide the necessary minimum resistance to fire and fire hose streams according to structural consideration and variations in the quality of materials and workmanship.

6.7.5.2 The vault shall have a minimum fire resistance rating of 4 hours.

6.7.5.3 The walls shall have lateral strength to withstand impact.

6.7.6 Openings in Walls.

6.7.6.1* The walls of vaults shall have no openings other than those necessary for access, electric lighting, power-limited circuits, ventilation, and sprinkler piping. *(See 6.7.6.5 and 6.14.1.)*

6.7.6.2 Door openings shall be protected with listed vault doors with a rating that meets or exceeds the ratings of the walls.

6.7.6.2.1 Doors shall not open into elevator, conveyor, or other shafts.

6.7.6.3 The number of door openings shall not exceed two for any single vault and shall be limited in size to that necessary for convenient ingress and egress and for ventilation.

6.7.6.4 Wall penetrations shall be sealed with a listed fire-rated through penetration assembly with a minimum rating that meets or exceeds the rating of the vault, to prevent smoke, heat, flame, or water penetration.

6.7.6.4.1 Conduit, if used, shall be sealed inside and outside.

6.7.6.5 Wall penetrations for sprinkler piping, electric lighting, conduit, and power-limited circuits shall be sealed with a listed fire-rated material with a minimum rating that meets or exceeds the rating of the vault to prevent smoke, heat, flame, or water penetration.

6.7.6.5.1 Conduit, if used, shall be sealed inside and outside.

6.7.6.6* Wall penetrations for ventilation shall be as small as possible and shall be protected to maintain the required rating of the wall.

6.7.6.6.1 In addition, smoke dampers activated by automatic sensing devices shall be provided.

6.7.7 Bonding.

6.7.7.1 Vault walls of masonry units shall be laid with corners that are well bonded for their full height.

6.7.7.2 If the floor construction of a fire-resistive building forms the roof of the vault, the joint between the top of the vault wall and the underside of the floor arch or slab shall be finished and filled with a listed sealing material that maintains the rating of the vault.

6.7.7.3 If any wall(s) of a building is of fire-resistive construction and forms part of the vault enclosure, the wall(s) of the vault that intersects with the building wall(s) shall be bonded or keyed into it.

6.7.7.3.1 The joints of the building walls to the vault shall be sealed with listed material that maintains the rating of the vault.

6.8 Independence from Building Structure.

6.8.1 Vault construction shall not be used as a support or bearing for the structural members of the building.

6.8.2 In ground-supported vaults, the walls and supports of vaults shall be structurally independent of the building.

6.9 Roof.

6.9.1 In non-fire-resistive buildings, the roofs of the vaults shall be entirely independent of the walls, floor, ceiling, columns, piers, or roof construction of the building.

6.9.2 In structure-supported vaults, the roof or the floor of the fire-resistive building shall be permitted to serve as the roof of the vault, provided it is of noncombustible construction throughout and complies with the following:

(1) The roof of the vault shall be reinforced concrete or reinforced concrete on protected steel supports.
(2) The roof of the vault shall have a fire resistance at least equivalent to that of the walls and shall have structural strength adequate to carry the design load or greater if subject to unusual impact or if exposed to fire from outside the vault.
(3) All interior supports shall have a fire resistance equivalent to that of the walls.
(4) The roofs of vaults shall not be pierced for any purpose.

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6.10* Vault Door.

6.10.1* The vault door shall be listed and labeled in accordance with ANSI/UL 155.

6.10.2 The vault door shall have a rating, in hours of fire resistance, equivalent to the rating of the walls of the vault, as follows:

(1) 4-hour vault — 4-hour door
(2) 6-hour vault — 6-hour door

6.10.3 Installation of the vault door unit shall be made in conformity with instructions supplied by the manufacturer and shall be entrusted only to those experienced in such installation work.

6.10.4* The door-locking mechanism shall permit the door to be opened easily from the inside to prevent an individual from accidentally being locked in the vault.

6.10.5 Doors shall be equipped with an automatic closing device operated by a heat-actuated or smoke-actuated release for doors that are held in the open position.

6.11 Electrical Service.

6.11.1 All electrical service within the vault shall be enclosed in conduit and installed in accordance with NFPA 70.

6.11.2 The wiring shall provide as many fixed lamps as needed for illumination.

6.11.2.1 Pendant lamps and extension cords shall not be used within a vault.

6.11.2.2 Fixed lighting shall be used for illumination of all portions of the vault to preclude the use of matches or other hazardous lighting.

6.11.3 Lighting shall be limited to enclosed sealed-type fixtures controlled by a two-pole switch equipped with a pilot light outside the vault.

6.11.3.1 No other electrical devices or appliances shall be permitted within the vault.

6.11.3.2 Power-limited circuits shall be permitted within the vault.

6.12 Operating Practices.

6.12.1* Filing equipment shall be noncombustible throughout.

6.12.2 All records shall be stored in fully enclosed noncombustible containers.

6.12.3 The records in the filing equipment shall be not less than 3 in. (76 mm) above the floor.

6.12.4 Records containers shall be separated by at least 6 in. (152 mm) from piping and conduit that penetrates the wall. Where sprinklers are installed, records containers shall be kept 18 in. (457 mm) below sprinkler deflectors.

6.12.5 The vault shall be under supervision from opening until closing time, and inspections shall be made daily, particularly before closing time, to ensure that all records containers are closed, no records are left on top of the records containers or are elsewhere exposed, all wastepaper is removed, and the vault doors are closed and locked.

6.12.6 Vaults shall not be used as working spaces.

6.12.7 Persons other than those authorized to handle the records shall not be permitted in the vaults.

6.13 Fire Suppression and Signaling Equipment.

6.13.1* Vaults shall be protected with an automatic fire suppression system in accordance with NFPA 13, NFPA 750, or NFPA 2001.

6.13.2 Where automatic fire detection systems are installed for providing warning of fire inside the vault, they shall be in accordance with Section 6.11 and *NFPA 72*.

6.13.3 Portable fire extinguishers rated for Class A fires in accordance with NFPA 10 shall be provided outside of the vault within 25 ft (7.6 m) of the vault door.

6.13.4 Where standpipe systems are provided, they shall be installed in accordance with NFPA 14 and they shall be located outside the vault and within 25 ft (7.6 m) of the vault door.

6.14 Oversize Vault.

6.14.1 Where the volume of vital records exceeds that which can be stored in a record vault of maximum permitted size [5000 ft^3 (142 m^3)], an oversize vault with a volume of not greater than 25,000 ft^3 (708 m^3) shall be designed and constructed as a standard vault and equipped with an automatic fire suppression system in accordance with NFPA 13, NFPA 750, or NFPA 2001.

6.14.2 Filing equipment shall be noncombustible but shall not be required to be completely enclosed.

6.14.3 Where mobile shelving is used, smoke detection in accordance with 6.13.3 shall be provided in addition to automatic sprinklers.

6.14.4 In accordance with 6.11.3, no electrically operated mobile shelving shall be permitted.

6.15 Protection Against Outside Exposure Fires. The exterior walls of the records center, vault, file room, or archives facing adjacent buildings shall be protected or rated in accordance with the requirements of NFPA 80A and the local building code. Where openings in an exposed wall are necessary, provision shall be made to prevent the transmission of heat or flames in accordance with the requirements of NFPA 80A and the local building code.

6.16 Existing Systems. Where new vaults are developed in buildings equipped with existing fire protection systems, the responsible party shall obtain written confirmation from a qualified fire protection professional approved by the authority having jurisdiction that the existing fire protection systems meet or exceed the requirements of NFPA 13 for the occupancy.

Chapter 7 Archives

7.1 General Requirements.

7.1.1* Structures or buildings containing archives shall meet or exceed the requirements of the local building code.

7.1.2* Automatic sprinkler systems installed in accordance with NFPA 13 shall be required in all areas of an archive.

7.1.3* For an archive, the maximum storage volume of archival materials or records shall not exceed 125,000 ft^3 (3540 m^3) in a single compartment.

7.1.4* Each storage compartment shall be designed to contain fire from spreading to any adjacent records storage compartment.

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7.1.4.1 Fire barrier walls separating records storage compartments shall be a minimum of 2-hour fire-resistive construction.

7.1.4.2 Fire-resistive construction shall be in accordance with NFPA 221.

7.1.4.2.1* Building columns within the records storage area shall be in accordance with the local building code and shall be a minimum of 2-hour fire-resistive construction.

7.1.5 Archives shall not be constructed with combustible concealed spaces.

7.1.6 Combustible wall and ceiling finishes shall be in accordance with NFPA *101* and the building code.

7.2* Records Storage Areas. In records storage areas where high-rise, self-supporting stacks are used, a plan of action shall be established in advance with the fire department to determine the best means of gaining access to the stacks, venting smoke, and reaching and fighting a stack fire at its source.

7.3* Protection Against Outside Exposure Fires.

7.3.1 The exterior walls of the archive facing adjacent buildings shall be protected or rated in accordance with the requirements of NFPA 80A and the local building code.

7.3.2 Where openings in an exposed wall are necessary, provision shall be made to prevent the transmission of heat or flames in accordance with the requirements of NFPA 80A and the local building code.

7.3.3 Where new archives are developed in buildings equipped with existing fire protection systems, the responsible party shall obtain written confirmation from a qualified fire protection professional approved by the authority having jurisdiction that the existing fire protection systems meet or exceed the requirements of NFPA 13 for the occupancy.

Chapter 8 File Rooms

8.1* General.

8.1.1 All file rooms shall be provided with automatic sprinkler protection or other automatic suppression system in accordance with NFPA 750 or NFPA 2001.

8.1.2 Structures or buildings containing file rooms shall meet or exceed the requirements of the local building code.

8.1.3* File rooms shall be used for the storage and handling of nonvital records and shall be equipped, maintained, and operated to minimize the effects of fires of both internal and external origin.

8.1.4 File rooms shall not be used as work areas.

8.1.5 File rooms shall be constructed and operated as specified in this chapter.

8.1.6 The minimum fire-resistive rating shall be 2 hours.

8.2 Design.

8.2.1 Plans and specifications shall be prepared and construction shall be supervised by a licensed or registered structural engineer or architect in consultation with a licensed or registered fire protection engineer.

8.2.2 Fire resistance ratings prescribed for file rooms shall be of the same duration that materials or assemblies have been shown to withstand for a fire exposure that has been established in accordance with the test procedures of NFPA 251.

8.3 Location.

8.3.1* File rooms shall not be located in basements.

8.3.1.1 Underground storage shall be permitted in areas specifically designed by licensed or registered fire protection engineers to mitigate the inherent problems of subterranean storage.

8.3.2 File rooms shall be located to prevent severe impact from a falling machine, safe, water tank, or other heavy object or structure.

8.4 Size. The volume of file rooms shall not exceed 50,000 ft^3 (1416 m^3).

8.5 Supporting Structure.

8.5.1* The supporting structures for file rooms shall be of adequate strength to carry the full load, including the wet weight of the file room structure and its contents.

8.5.2 There shall be no combustible material in any portion of the building structural members that support the file room.

8.5.3 All building structural members that support the file room shall have fire resistance at least equal to that of the file room.

8.6 Floor. In structure-supported file rooms, the floor of the fire-resistive building shall be permitted to serve as the floor of the file room, provided it is of noncombustible construction throughout and complies with the following:

(1) Floors above grade shall be adequate to support the full load (wet weight) and shall have unrestrained fire resistance equivalent to that required for the walls of the file room.
(2) Floors above grade shall not be pierced for any purpose.

8.7 Walls.

8.7.1 Materials. Walls shall be constructed of noncombustible or limited-combustible materials.

8.7.2 Trim. Noncombustible material shall be used for trim or partitions within the file room.

8.7.3 Openings in Walls.

8.7.3.1* The walls of file rooms shall have no openings other than those necessary for access, electric lighting, power-limited circuits, fire suppression piping, ventilation, and hot water or low-pressure steam piping.

8.7.3.2 The penetrations shall be sealed with a listed through-penetration assembly that will maintain the rating of the wall.

8.7.3.3 Door openings shall be protected with listed file room doors that have a minimum rating that is equal to or exceeds the rating of the walls.

8.7.3.4 Doors shall not open into elevator, conveyor, or other shafts.

8.7.3.5 Wall penetrations for ventilation shall be protected to maintain the required rating of the wall, and penetrations shall be sealed with a listed through-penetration assembly with the same rating as the walls.

8.7.3.6 Smoke dampers shall be activated by fusible element, smoke detector, or fire suppression system.

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8.7.4 Bonding. Building walls shall be permitted to be used as part of the file room enclosure if they are of the same rating as the file room walls.

8.7.4.1 The wall(s) of the file room that intersect with the building wall(s) shall be bonded or keyed into the building wall(s) for the full height and width of the file room wall(s).

8.7.4.2 The joints of the building walls to the file room shall be sealed with listed material that maintains the rating of the file room.

8.8 Roof.

8.8.1 In non-fire-resistive buildings, the roof of the file room shall be entirely independent of the walls, floor, ceiling, columns, piers, or roof construction of the building.

8.8.2 In fire-resistive buildings, the roof or the floor shall be permitted to serve as the roof of the file room, provided it is of limited-combustible or noncombustible construction throughout and complies with the following:

(1) The roof of the file room shall be reinforced concrete or reinforced concrete on protected steel supports.
(2) The roof of the file room shall have a fire resistance at least equivalent to that of the walls and shall have structural strength adequate to carry the design load or greater if subject to unusual impact or if exposed to fire from outside the file room.
(3) All interior supports shall have a fire resistance equivalent to that of the walls.
(4) The roofs of the file rooms shall not be pierced for any purpose.

8.9 File Room Door.

8.9.1 The file room door shall be listed or labeled in accordance with ANSI/UL 155.

8.9.1.1 The file room door shall have a rating, in hours of fire resistance, equivalent to the rating of the walls of the file room, as follows:

(1) 6-hour file room — 6-hour door
(2) 4-hour file room — 4-hour door
(3) 2-hour file room — 2-hour door

8.9.2 Installation of the file room door unit shall be in accordance with instructions supplied by the manufacturer.

8.9.3* The door-locking mechanism shall permit the door to be opened from the inside to prevent an individual from accidentally being locked in the file room.

8.9.4 Doors shall be equipped with an automatic closing device operated by a heat-actuated or smoke-actuated release for doors that are held in the open position.

8.10 Dampproofing. Where the walls, floor, or roof of a file room are dampproofed, the methods and materials used shall be such that the desired fire resistance of the file room is not impaired.

8.11 Electrical Service.

8.11.1 All electrical service within the file room shall be enclosed in conduit and installed in accordance with NFPA 70.

8.11.2 The wiring shall provide as many fixed lamps as needed for illumination.

8.11.2.1 Pendant lamps and extension cords shall not be used within a file room.

8.11.2.2 Fixed lighting shall be used for illumination of all portions of the file room to preclude the use of temporary lighting.

8.11.3 Lighting shall be limited to enclosed sealed-type fixtures, controlled by a two-pole switch equipped with a pilot light outside the file room.

8.11.3.1 No other electrical devices or appliances shall be permitted within the file room.

8.11.3.2 File maintenance equipment specifically designed and approved for installation and use shall be permitted within the records room.

8.11.3.3 Power-limited circuits shall be permitted within the file room.

8.12 Heating and Ventilation.

8.12.1 Where steam heating is used, the coils or radiators shall be located to avoid the possibility of records coming in contact with them.

8.12.1.1 Piping shall be placed close to floor level.

8.12.1.2 Forced-air heating systems shall be supplied by air-handling units located outside the file room and shall comply with Section 5.4.

8.12.1.3 Where the pipe is carried through the wall, the pipe shall be provided with a close-fitting noncombustible sleeve, and the space around the inside of the sleeve shall be filled completely with listed material that will maintain the rating of the wall.

8.12.1.4 Floors and roofs of file rooms shall not be pierced for piping.

8.12.1.4.1 Slab floors on grade shall be permitted to be pierced for piping.

8.12.1.5 No devices such as open-flame heaters and electrical heaters shall be used in file rooms.

8.12.1.6 Heating systems shall not reduce the level of humidity inside the file room to a level that results in deterioration of the records.

8.12.2* Depending on the records media, ventilation shall be provided to maintain humidity within established limits, to prevent excessive temperatures, and to remove volatile organic chemicals (VOCs) produced by the media themselves.

8.12.2.1 Any wall penetrations necessary for adequate ventilation shall comply with 8.7.3.

8.13 Fire Protection and Signaling Equipment.

8.13.1 All file rooms shall be provided with an automatic sprinkler system designed and installed in accordance with NFPA 13.

8.13.1.1 Sprinkler protection shall not be required where all storage is held in records protection equipment as defined in Chapter 10.

8.13.2* Where automatic sprinklers are installed, sprinkler alarms and shutoff valves outside the file room shall be provided.

8.13.3 Smoke detection systems shall be provided and shall be supervised in accordance with *NFPA 72* and shall be one of the following:

(1) Central station fire alarm systems
(2) Remote supervising station fire alarm systems

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(3) Proprietary supervising station fire alarm systems
(4) Local fire department

8.13.4 Where automatic fire detection systems are installed to provide early warning of fire, the systems shall be in accordance with *NFPA 72*.

8.14 Operating Practices.

8.14.1 The records in the filing equipment shall be not less than 3 in. (76 mm) above the floor.

8.14.2 Records containers shall be separated by at least 6 in. (152 mm) from piping and conduit that penetrate the wall.

8.14.2.1 Where sprinklers are installed, records containers shall be kept 18 in. (457 mm) below sprinkler deflectors.

8.14.2.1.1 Where sprinklers are located in each aisle, the 18 in. (457 mm) clearance shall not be required.

8.14.3 The file room shall be under supervision from opening until closing time, and inspections shall be made daily, particularly before closing time, to ensure that all records containers are closed, no records are left on top of records containers or are elsewhere exposed, all wastepaper is removed, and the file room doors are closed and locked.

8.14.4 File rooms shall not be used as working spaces.

8.14.4.1 No workstations shall be permitted.

8.14.4.2 Persons other than those authorized to handle the records shall not be permitted in the file rooms unless under the condition of 8.14.4.2.1.

8.14.4.2.1 Persons other than those authorized to handle the records shall be permitted in the file room when file rooms are fully sprinklered.

8.14.4.2.2 File rooms shall have smoke detection systems and all storage held in six-sided noncombustible containers.

8.15 Protection Against Outside Exposure Fires. The exterior walls of the file room facing adjacent buildings shall be protected or rated in accordance with the requirements of NFPA 80A and the local building code.

8.15.1 Where openings in an exposed wall are necessary, provision shall be made to prevent the transmission of heat or flames in accordance with the requirements of NFPA 80A and the local building code.

8.15.2 Where new file rooms are developed in buildings equipped with existing fire protection systems, the responsible party shall obtain written confirmation from a qualified fire protection professional approved by the authority having jurisdiction that the existing fire protection systems meet or exceed the requirements of NFPA 13 for the occupancy.

Chapter 9 Records Center

9.1 General.

9.1.1* Structures or buildings containing records centers shall meet or exceed the requirements of the local building code.

9.1.2 Automatic sprinkler systems installed in accordance with NFPA 13 shall be required in all areas of a records center. *(See A.7.1.2.)*

9.1.2.1* Sprinkler systems for records centers shall be designed in accordance with NFPA 13 but for not less than a Class III commodity.

9.1.3* For compartmented records centers the maximum storage volume of records shall not exceed 1.2 million ft^3 (33,980 m^3) in a single compartment.

9.1.3.1 Storage compartments within a compartmented records center shall be separated from each adjacent storage compartment by a fire barrier wall having a minimum of one of the following:

(1) Two-hour fire-resistive construction if the area of the storage compartment is 40,000 ft^2 (3716 m^2) or less
(2) Three-hour fire-resistive construction if the area of the storage compartment is greater than 40,000 ft^2 (3716 m^2)

9.1.4 Height and area requirements for all record centers without storage compartments shall comply with the local building code.

9.1.4.1 Records centers without storage compartments shall also comply with all other aspects of this standard with respect to records centers.

9.1.5 Each storage compartment shall be designed to contain fire from spreading to any adjacent storage compartment.

9.1.5.1 Fire barrier walls separating records storage compartments shall be a minimum of 2-hour fire-resistive construction.

9.1.5.2 Fire-resistive construction shall meet the requirements of NFPA 221.

9.1.5.3 Building columns within the records storage area shall meet the requirements of the local building code and shall be a minimum of 2-hour fire-resistive construction.

9.1.6 Records centers shall not be constructed with combustible concealed spaces.

9.1.7 Combustible wall and ceiling finishes shall be in accordance with NFPA *101* and the building code.

9.2 Records Storage Areas. In records storage areas where high-rise, self-supporting stacks are used, a plan of action shall be established with the fire department in advance to determine the best means of gaining access to the stacks, venting smoke, and reaching and fighting a stack fire at its source. *(See A.7.2.)*

9.3 Protection Against Outside Exposure Fires. *(See A.7.3.)*

9.3.1 The exterior walls of the records center facing adjacent buildings shall be protected or rated in accordance with NFPA 80A and the local building code.

9.3.2 Where openings in an exposed wall are necessary, provision shall be made to prevent the transmission of heat or flames in accordance with NFPA 80A and the local building code.

9.4 Existing Fire Protection. Where new records centers are developed in buildings equipped with existing fire protection systems, the responsible party shall obtain written confirmation from a qualified fire protection professional approved by the authority having jurisdiction that the existing fire protection systems meet or exceed the requirements of NFPA 13 for the occupancy.

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Chapter 10 Records Protection Equipment

10.1* General. Records protection equipment shall conform to the requirements of this chapter.

10.2* Classification of Devices. Records protection equipment shall be listed and labeled in accordance with ANSI/UL 72.

10.3 Selection of Equipment.

10.3.1* The selection of the class of records protection equipment shall be based on the requirements in Section 10.3 and Chapter 11.

10.3.2 The label on the device shall include the name of the equipment, the temperature rating, and the time rating.

10.3.2.1 The label shall be applied to the equipment and shall be located so as to be visible after the equipment has been installed.

10.3.3* Cabinets made of wood, fiberboard, or other combustible materials shall not expose containers housing vital or important records to fire.

Chapter 11 Fire Resistance Requirements for File Rooms and Vaults

11.1* General. The fire resistance requirements for file rooms and vaults shall be in accordance with the type of building construction and the fire resistance ratings for the floors, walls and ceilings, as defined in NFPA 220, whether or not the building is equipped throughout with an automatic sprinkler system, and the location of the file room or vault in the building, as indicated in Table 11.1.

11.2 Restrictions. File rooms or vaults shall not be installed in buildings of Type II (000), Type III (200), or Type IV or V (000) rated construction as defined in NFPA 220.

11.3 Impact Resistance. Records for protection equipment located in a non-fire-resistive and unsprinklered building or buildings of Type III, IV, or V construction shall be rated for impact resistance.

Annex A Explanatory Material

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

A.1.1 Businesses have been forced to close due to the insurmountable task of replacing organizational and operational records. Although accurate nationwide statistics are needed, it is known that the losses sustained in fires by such businesses have had the adverse effect of lowering their credit ratings and that some went out of business because of the destruction of their records.

Since the early 1900s, the volume of records, especially of business records, has increased rapidly. These records have to be stored. This need, stimulated by competition among manufacturers, led to the development of better records containers, especially that of lighter weight containers with greater capacity and fire resistance. The heavy, old-line safes of uncertain fire resistance could no longer meet the needs of business and have been replaced largely by modern fire-resistive containers. Newer techniques of record keeping (e.g., microfilm and electronic computers) are creating new problems and new demands.

The issues facing the records protection field today are better acknowledgment and increased study of the records protection problem. Technically, the equipment needed to provide the necessary protection has been produced and rigorously tested. It is now the responsibility of records owners and custodians to learn how to estimate the protection needed and the responsibility of architects, contractors, and builders, as well as custodians, to understand how to provide this protection.

Archives are intended for the permanent retention of records specifically selected because of their legal, historical, or intrinsic value. The responsible party should also consider environmental conditions that impact records protection. Although fire is the ultimate risk to the records, other factors such as high temperatures [in excess of 76°F (24.4°C)], rapid fluctuation in temperatures, excessively high or low humidity, exposure to volatile organic chemicals (VOCs), particulates,

Table 11.1 Maximum Fire Resistance Rating of a File Room or Vault Permitted for Different Construction Types and Conditions

Maximum Fire Resistance Rating of File Room or Vault	6 hour	4 hour		2 hour									
Type of Construction*	Type I	Type I	Type II	Type I	Type II	Type II	Type II	Type III	Type III	Type IV	Type IV	Type V	Type V
Rating of (walls, floor) (hours)	443	332	222	332	222	111	111	211	211	2HH	2H	111	111
Floor rating	3 hours	2 hours	2 hours	2 hours	2 hours	1 hour	1 hour	1 hour	1 hour	H	2H	1 hour	1 hour
Sprinklers mandatory	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	No	Yes	No
Location of file room or vault in building	Grade level	Grade level	Grade level	N/R	N/R	Grade level	N/R	Grade level	N/R	N/R	Grade level	N/R	Grade level
Basement below	No	No	No	—	—	No	No	No	—	—	No	—	No
Building height limit (stories)	Single story	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R

* See NFPA 220.

H: Heavy timber members. N/R: Not restricted.

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and pests can over time lead to the destruction of the records. The records medium is a major factor in determining the degree of environmental controls necessary in an archive storage area. Audiovisual and magnetic media require the highest levels of environmental control.

A.1.1.5 See NFPA 40. Neither NFPA 40 nor NFPA 42 currently apply to cellulose nitrate still-film negatives.

A.1.2.2 In accordance with ISO 15489-1 and ISO 15489-2, persons assigned such responsibilities require specialized knowledge of records management requirements and techniques as well as the organization's business operations.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

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

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

A.3.3.2.1 Fire-Resistive Building. See Table A.3.3.2.1. For more information on Type I and Type II (222) construction, see NFPA 220.

A.3.3.3 Compartment. The intent is to create defensible areas to limit the potential spread of fire or smoke for the purpose of limiting damage to the holdings in the area in which the fire originates.

A.3.3.8 Processing Area. This area can include activities, such as computer-based data entry for indexing records into a tracking system, that can be performed in a computer room and also be used for processing records retrieved from, or returning records to, storage.

A.3.3.9.5 Permanent Record. A permanent record includes all records that have been accessioned into an archive and those the responsible party has designated as permanent.

A.3.3.9.7 Useful Record. This type of record, if lost, would cause temporary inconvenience but otherwise would entail no serious disadvantage.

A.4.1 For recommendations on appropriate levels of protection, see ANSI/ARMA 5.

A.4.1.4 If permanent records are maintained in a records center, supplemental environmental controls could be required.

A.4.1.5 For recommendations on appropriate levels of protection, see ANSI/ARMA 5.

A.4.2 The authority having jurisdiction, generally the records management officer, should consider the following factors in determining an acceptable level of risk tolerance for various categories of records:

(1) *Intrinsic Value.* Are the records of significant monetary value (e.g., bearer bonds or rare manuscripts) or great symbolic value retained more as an artifact than a record (where a reproduction cannot be substituted for the original, such as founding documents, treaties, etc.)?
(2) *Critical Need.* Are the records vital, important, or simply useful for retention?
(3) *Historical Significance.* Do the records contain sufficient historical significance for permanent retention?
(4) *Retention Period.* Does the level of risk tolerance match the retention period established by legal requirements (generally, the longer the retention period, the lower the level of risk tolerance)?

The National Archives and Records Administration has established a range of risk tolerances for federal records varying from near zero tolerance (requiring extraordinary protective systems) for the *Charters of Freedom* to 300 ft^3 (8.5 m^3) for general archives and records maintained in records centers.

A total system concept, rather than just a suppression design, is essential.

A.4.3 It is not possible to ensure total fire protection of records in all cases, especially when they are maintained in archives and records center facilities. It is possible, however, to provide a very high level of fire protection that normally can limit the potential loss of records in such facilities. It is important that the archivist or records manager is aware of the degree of protection available or, conversely, the degree of potential damage possible using the protection systems available for the archives or records center.

Storage devices include, but are not limited to, traditional file cabinets, records storage boxes (corrugated or solid fiberboard cartons), transfer cases, and miscellaneous containers of varying construction. The usual arrangement consists of either cartons on freestanding shelving or filing cabinets. Locations can vary from a separate area within a general office complex to specially constructed records facilities. It is not uncommon for records to be stored in basements or attics, in office spaces, in factories or warehouses, or in underground or other readily available facilities, with all such facilities of various types of construction and levels of fire safety. Keeping all records storage at least 3 in. (76 mm) above the floor minimizes the effect of flooding.

A.4.5 A maximum amount of care or the most sophisticated of protection systems within the records storage area is of little value for records stored within a structure that burns as a result of some occurrence or operation outside of the records area.

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Table A.3.3.2.1 Fire Resistance Ratings for Type I through Type V Construction (hr)

	Type I		Type II			Type III		Type IV	Type V	
	442	332	222	111	000	211	200	2HH	111	000
Exterior Bearing Walls										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0*	2	2	2	1	0*
Supporting one floor only	4	3	2	1	0*	2	2	2	1	0*
Supporting a roof only	4	3	1	1	0*	2	2	2	1	0*
Interior Bearing Walls										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	2	1	0
Supporting one floor only	3	2	2	1	0	1	0	1	1	0
Supporting roofs only	3	2	1	1	0	1	0	1	1	0
Columns										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	H	1	0
Supporting one floor only	3	2	2	1	0	1	0	H	1	0
Supporting roofs only	3	2	1	1	0	1	0	H	1	0
Beams, Girders, Trusses, and Arches										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	H	1	0
Supporting one floor only	2	2	2	1	0	1	0	H	1	0
Supporting roofs only	2	2	1	1	0	1	0	H	1	0
Floor-Ceiling Assemblies	2	2	2	1	0	1	0	H	1	0
Roof-Ceiling Assemblies	2	1½	1	1	0	1	0	H	1	0
Interior Nonbearing Walls	0	0	0	0	0	0	0	0	0	0
Exterior Nonbearing Walls†	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*

H: heavy timber members *(see text for requirements).*

*See A.4.1.1 in NFPA 220.

†Exterior nonbearing walls meeting the conditions of acceptance of NFPA 285 shall be permitted to be used.

The degree of additional risk imposed by neighbors varies according to the type and height of the building, the nature or the hazard of the neighbors, and the type of protection used by the neighboring operations.

Where a separate building or a segregated floor or section of a fire-resistive building is used for records storage, the methods described in Chapters 4 through 9 provide a degree of protection commensurate with the type of system selected.

A.4.6 Work within records storage areas normally is limited to placing records in, retrieving records from, or removing records from storage. Any additional operations could introduce ignition hazards and could be inappropriate in records storage areas. Records center facilities involve considerably more staff activity in the records storage areas.

A.4.8.2.1 The development of an emergency plan should be in accordance with NFPA 1600, which provides guidance for managing an emergency condition to minimize loss of life, collections, and property, and to plan for recovery from the emergency situation.

A.5.1.1 A major potential source of fire is malfunction of heating equipment.

A.5.1.6 This standard prescribes reasonable provisions for safety to life and property from fire.

A.5.3 It is imperative that security measures do not impede the safe emergency evacuation of visitors and employees. Attendance can vary greatly with the time of year, the exhibits offered, and other special events. Therefore, in planning the capacity of exits, serious consideration should be given to the maximum number of people who could be expected to be in the building at any given time. NFPA *101* contains information on construction, protection, and occupancy features designed to minimize danger to life from fire, smoke, fumes, and panic before buildings are vacated. NFPA *101* is the basis for legal requirements governing exit facilities in many government jurisdictions and should be consulted in planning life safety measures for a records center or archives.

It is common for records centers and archives security measures to funnel all occupants through a few exits that can be

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monitored closely. Unfortunately, this arrangement often means that other doors required for egress are locked in violation of NFPA *101*. The 1997 edition of NFPA *101* includes equivalency concepts that allow the authority having jurisdiction to permit locking systems on these doors, provided that such systems afford a level of life safety equivalent to that prescribed in NFPA *101*. There are electromechanical and electromagnetic locking devices available that satisfy this requirement where installed in a properly designed system. Some of these systems provide an appropriate time delay before opening. Hydraulic and pneumatic devices are available that could meet this requirement.

A.5.5 Lightning is always a potential fire hazard, more so in some areas or locations than in others. Lightning protection can be incorporated more effectively and economically in new construction than as an afterthought.

A.6.2.2 Collapse of the building can cause damage to the vault and its contents.

A.6.2.3 Vaults require unusually good design and construction to ensure that the structure satisfactorily withstands all of the conditions that could be imposed upon it by fire.

A.6.3 Vaults below grade are undesirable because under certain conditions, sufficient burning or smoldering debris can accumulate in a basement to produce a cooking effect of such duration that the effects of combustion cannot be resisted by construction alone (within practical limitations). Also, vaults located below grade could be damp, causing destruction of records by the formation of mold, and could be subject to flooding under either flood or fire conditions, with consequent damage to records.

A.6.5.2.1 The wet weight of records is approximately 2.4 times the dry weight. Dry correspondence files weigh approximately 30 lb/ft^3 (480 kg/m^3).

A.6.7.5 Traditionally recognized construction that meets the requirements in 6.7.5.1 through 6.7.5.3 is as follows:

(1) Reinforced concrete with steel rods at least ½ in. (13 mm) in diameter spaced 6 in. (152 mm) on center and running at right angles in both directions. Rods are wired securely at intersections not over 12 in. (305 mm) apart in both directions and installed centrally in the wall or panel.
(2) A structural steel frame protected with at least 4 in. (102 mm) of concrete, brickwork, or its equivalent tied with steel ties or wire mesh equivalent to No. 8 ASW gauge wire on an 8 in. (203 mm) pitch. Any brick protection used is filled solidly to the steel with concrete.
(3) Walls of ground-supported vaults are of greater thickness than those described herein where it is necessary to account for such factors as unusual structural conditions and loads.
(4) Fire resistance is determined by wall thickness as follows:
    (a) The minimum thickness of a 4-hour vault wall is 12 in. (305 mm) for brick and 8 in. (203 mm) for reinforced concrete.
    (b) The minimum thickness of a 6-hour vault wall is 12 in. (305 mm) for brick and 10 in. (254 mm) for reinforced concrete.

A.6.7.6.1 Traditional practice has been to prohibit wall penetrations in vaults and file rooms for the purposes of ventilation. Minimal ventilation was provided by leaving the door open during the operational hours. Although this indirect ventilation can be adequate for records on high-quality bond paper, many nontextual media require far more extensive heating, ventilating, and air-conditioning (HVAC) controls to prevent premature deterioration. Vaults and file rooms containing audiovisual materials or magnetic media on acetate or polyester bases require not only cool storage at low humidity but also frequent air exchanges to remove the harmful gases generated by the media themselves.

A.6.7.6.6 Environmental requirements such as heating, cooling, and humidity control can be permitted to be provided by controlling the environment outside of the vault.

A.6.10 Vault doors are capable of the following:

(1) Preventing the passage of flame or heat above a specified temperature into the vault chamber for the time period indicated on the label
(2) Withstanding the stresses and strains due to fire or the application of a fire hose stream while the unit is in a highly heated condition without materially reducing its fire resistance

A.6.10.1 Ordinary fire doors such as hollow metal, tin-clad, sheet metal, or metal-clad types; steel-plate type; and file room doors cannot be permitted to be used as vault doors. Figure A.6.10.1(a) and Figure A.6.10.1(b) illustrate the importance of installing labeled vault doors.

A two-story vault was in the sprinklered, four-story, brick, plank-on-timber hardware factory in Syracuse, NY, shown in Figure A.6.10.1(a). The $977,000 fire was detected by the security guard. After this fire of suspicious origin was extinguished, sprinkler valves were found shut off. Satisfactory performance of a labeled vault door saved records in the upper story of this two-story vault *[see Figure A.6.10.1(b)]*. A labeled fire door (not a vault door) on the first story was damaged, and records in the first story were destroyed.

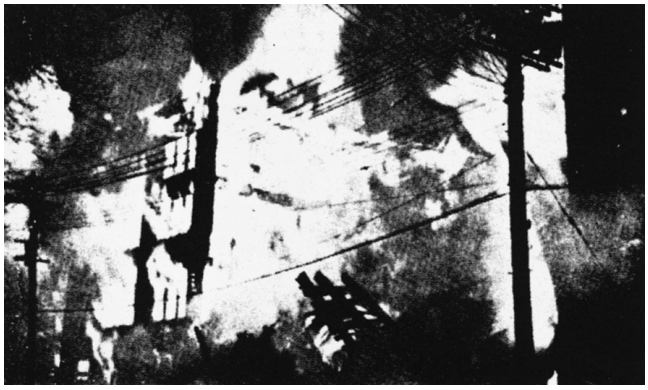

FIGURE A.6.10.1(a) A Hardware Factory Fire in Syracuse, NY, That Involved a Two-Story Vault.

A.6.10.4 Interior emergency lighting could be necessary.

A.6.12.1 For storage of records in open-type equipment, see 6.14.1 and Chapter 8.

A.6.13.1 Sprinklers in vaults on grade can be permitted to be supplied by pipes that rise through the floor.

A.7.1.1 Detailed recommendations for good practice are also contained in various NFPA publications. In most localities, building codes and ordinances govern the type of construction to be

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FIGURE A.6.10.1(b) The Labeled Vault Door in the Upper Story of the Two-Story Vault Saved the Records.

used to a large extent. Codes frequently provide for the safety of persons in the building but not for the preservation of the building or the collections. Therefore, it is of critical importance during the development of the project for the records custodian to specify the level of fire safety to be achieved in the construction. The consulting services of a qualified fire protection engineer, acceptable to the records custodian, should be obtained to participate in the development of the fire safety system, including the determination of the requirements to be provided in the final project documentation. Multistory and/or belowgrade facilities are extremely hazardous and require substantial research and redundant protection.

A.7.1.2 The design of the automatic sprinkler protection and other fire protection and detection systems and building construction are interrelated. In addition to protecting combustible contents and providing improved safety to life, automatic fire suppression systems can, in some cases, enable the use of less expensive construction than would be possible without them.

Automatic sprinklers are the best fire protection devices. Records custodians, librarians, and others responsible for maintaining documents are gradually coming to accept the use of automatic sprinklers for the protection of books and records with the understanding that the sprinklers add negligible water hazards and mitigate serious fire hazards.

The following is an example of the role sprinklers play as a possible records protection medium.

The FM Global engineering division ran a test on sprinklered and unsprinklered four-tier, steel, open-deck library stacks. Two fires of identical nature were started in a test section containing 11,000 books. The first test used automatic sprinklers and the second did not.

In the sprinklered test, the fire burned unhampered for 3 minutes and 43 seconds before the first sprinkler opened. All fire spread halted at this point. Another sprinkler opened at 7 minutes and 53 seconds, and they both discharged for the remainder of the test (30 minutes from start). Combined, their output was 41 gpm (2.6 L/sec) for a total of 978 gal (3701 L) discharged on 27 percent of the books. Wetting of the books ranged from slightly damp to soaked. Ten percent of the books were fire damaged within a range from slight charring to deep burns. No book was knocked from its shelf by the sprinklers.

In the unsprinklered test, the fire burned unhampered for 10 minutes, when all four tiers became heavily involved. Hoses were applied, because the test structure was in danger. A 1 in. (25.4 mm) hose line was tried first but had little effect, and a 2½ in. (63.5 mm) line discharging 265 gpm (16.7 L/sec) had to be brought in 17 seconds later in order to save the test structure. Books were knocked onto the floor of the tiers and out of the stack. As a result, 89 percent of the books were charred deeply or destroyed, 2½ percent were scorched, and the remaining 8½ percent were soaked.

Sprinklers work effectively to provide protection for records. The sprinkler performance history shows premature operation of sprinklers to be a negligible problem.

The provision of sprinklers does not ensure that no records are destroyed by fire, but it can minimize the probability of a disastrous records fire.

A.7.1.3 The basis for the volume is a 60 ft (18.3 m) high storage area with 40,000 ft^2 (3,716 m^2) area for a sprinkler system and assuming a 50 percent fill density.

The principle of compartmentation can be applied to records centers and archives without restricting the flexibility of the arrangement of stack areas or the flow of visitors. Compartmentation necessitates fire-resistive wall and floor construction with openings that are provided with self-closing or automatic fire doors having specific fire resistance ratings.

In a similar way, properly enclosed stairways equipped with fire doors prevent the spread of fire, smoke, and heat from one level to another. Elevator shafts, dumbwaiter shafts, and all other vertical openings that pass through the structure also should be safeguarded. Air-handling systems (e.g., ventilation, heating, and cooling) should be constructed and equipped to prevent the passage of smoke, heat, and fire from one fire area to another or from one level to another in accordance with NFPA 90A.

The contents of an archive, or even a records center, often are considered to be of very high value or even irreplaceable, but they are always combustible. Therefore, every effort should be made to construct the building so that it resists the spread of fire. This means that during a fire, the walls, roof, floor, columns, and partitions should prevent the passage of flame, smoke, or excessive heat and should continue to support their loads. Fire resistant is not equivalent to noncombustible. A noncombustible structure might not keep a fire from spreading, since some materials that do not burn lose their strength when exposed to intense heat. This loss of strength could cause walls or floors to collapse. Many types of construction using various building materials have been tested and rated according to the length of time they resist fire. The duration of the resistance needed by the archive or records center depends on the quantity of combustible material in the contents of each room as well as the structure itself. Different structural assemblies have fire resistance ratings ranging from less than 1 hour to more than 6 hours.

NFPA 220 classifies and defines various kinds of building construction. The "Building Materials List" published by Underwriters Laboratories Inc., under the heading "Fire Resistance Classification," provides information on structural assemblies that have been tested in accordance with NFPA 251. Detailed recommendations for good practice also are contained in various NFPA publications.

A.7.1.4 Given the amount of fire loading in a records storage compartment, the potential is there for a 16- to 24-hour fire without effective fire control measures.

Some architects have designed facilities that are located underground or largely underground, windowless, or completely ventilated by mechanical means. Although these types

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of construction provide advantages in controlling temperatures, humidity, and air pollution, they do create problems for fire extinguishment and life safety in the event of fire. These problems are greatly magnified if loss of power impairs ventilating systems. Alternative means for allowing the escape of heat and smoke should be provided. Adequate roof ventilation is particularly essential, since heated gases and smoke tend to rise.

Provisions should be made for the safe emergency evacuation of people as well as for access by the fire department to the fire area. Knockout panels located to allow direct access to well-maintained aisles within the structure are invaluable for this purpose. Fire department officials should be consulted and should be aware of the existence of these panels to avoid unnecessary breaching of walls in the event of fire.

Automatic sprinklers are essential in these types of buildings and are recommended. Smoke detection systems can provide critically important early detection to activate a smoke control system and provide early warning to occupants.

See Chapter 11 of NFPA *101* for guidance in providing life safety measures for underground structures and windowless buildings.

A.7.1.4.2.1 Columns within shelving are potentially exposed to high temperatures exceeding the fire resistance of steel.

A.7.2 Fuel loads in records storage areas can range from 30 lb/ft^2 to hundreds of lb/ft^2 (146 kg/m^2 to approximately 1000 kg/m^2), with corresponding fire durations greater than those of commonly used building construction. Furthermore, the higher fuel loading in records storage areas can result in fire durations that more closely resemble those in warehouse occupancies than those found in business occupancies. Analysis of the Military Personnel Records Center fire in St. Louis in 1973 indicates that a fire in a lower floor of a multistory building with sprinklers not installed, shut off, or inadequately designed will result in a total loss of the building, regardless of the way in which it is subdivided, unless the fire load is less than the structural fire resistance. There is no construction recognized that will support a building above an uncontrolled archives or records center fire.

In some archives and records centers, the structures on which the records are stored are not connected to the perimeter walls of the structure itself. The structures on which the records are stored, typically steel racks with shelves, are typically self-supporting and extend throughout the interior of the building. Storage heights range from 8 ft (2.4 m) to 80 ft (24.4 m) or more and usually consist of several levels. The catwalks are supported from the rack structure and are of grilled or expanded metal. Such stacking results in numerous, virtually clear, vertical spaces [30 in. (762 mm) to 36 in. (914 mm) wide aisles]. In some configurations, narrower vertical spaces (transverse flues) are provided within the individual storage racks. In the absence of properly installed protection, these vertical spaces could allow for the uninterrupted upward flow of air, heat, smoke, and flames. These "flue" spaces can create a high-challenge fire potential, especially if the files are oriented parallel to the openings. In a fire involving the cartons, the faces of the cartons facing the aisles are soon weakened or destroyed by heat. That condition allows some of the front files stored parallel to the aisles to exfoliate (i.e., tumble into the openings), thus creating a continuous source of new fuel. Steel structural members exposed to temperatures exceeding 1000°F (537.8°C) for more than 10 minutes can buckle, lean, or even collapse.

In other records storage buildings, the records storage arrays are similar in height, with narrow aisles separating the rows, but without elevated walkways. In these stacks, the records are stored and serviced through the use of aisle-guided carriages either automatically or with an onboard operator.

Such records storage, with or without elevated walkways, pose a fire severity potential; thus, their protection should be designed in accordance with NFPA 13 by a qualified fire protection engineer.

In 1999, the National Archives and Records Administration (NARA) sponsored and Rolf Jensen Associates, Inc. (RJA) designed an automatic sprinkler system for a 30 ft (9.1 m) high [nominal] records storage system with dual-level catwalk access (Full Scale Fire Test of Records Stored on 30 ft High Shelving). The sprinkler system was tested successfully on a full-scale basis at the Southwest Research Institute's (SwRI) fire test facility on December 10, 1999. The tested storage system included steel shelving units with solid shelves size 30 in. (762 mm) deep by 42 in. (1067 mm) wide spaced on 12 in. (305 mm) vertical centers. The units were installed in double row arrangements with a total depth of 60 in. (1524 mm), aisle to aisle. For the test, two double rows were installed, each row 5 ft (1.5 m) deep, 21 ft (6.4 m) long, and 30 ft (9.1 m) high with a 30 in. (762 mm) aisle between the racks. The racks had a 28 in. (711 mm) wide metal-grated (80 percent open) catwalk between the rows at the 16 ft 4 in. (5 m) and 24 ft 8 in. (7.5 m) elevations. Below and in the center of each catwalk, 1 ft (0.3 m) wide by 4 ft (1.2 m) long mockup light fixtures were installed. There were no vertical "flue" spaces within the double rows of shelving. The test array was filled with paper-based records in cubic foot size corrugated cardboard cartons, including a 5 percent mix of uniformly distributed 11 in. (279 mm) diameter plastic computer tapes in plastic reels shelved horizontally (10 tapes per location) along the aisle face of the array. The test records had been stored in a constant temperature of 70°F (21.1°C) and 50 percent relative humidity for about 10 days before the test.

A worst-case fire scenario was developed for the test. Both the ceiling and under-catwalk sprinklers, wet pipe type, were positioned at their most adverse locations from the floor ignition point. Designed to flow at nominal 25 gpm (94.6 L/min.) per sprinkler, the under-catwalk 155°F (68°C) QR sprinklers [½ in. (12.7 mm)] orifice, upright type, were positioned at the center of the aisle on 7 ft (2.1 m) centers staggered under the two levels of catwalks. The ceiling sprinklers were 286°F (141°C), 17⁄32 in. (13.5 mm) orifice, pendent type, designed to flow at 32 gpm (121.1 L/min) per sprinkler and were positioned on a 10 ft (3 m) grid. Orientation of all files in the cartons facing the aisle, 3½ ft (1.1 m) on each side of the floor ignition point, below and above the catwalks, was parallel for maximum exfoliation under fire conditions. Ignition was at floor level in the aisle midway between sprinklers under the lowest catwalk. At about 4 minutes after ignition, and with recorded temperatures exceeding 1100°F (593.3°C) for about 2.5 minutes, a single sprinkler located directly above the fire but under the upper-level catwalk fused and controlled the fire. The files burn loss was determined to be 40 ft^3 (1.1 m^3), located within the 219 partially burned boxes. Set in advance, the performance goal that no more than 300 ft^3 (8.5 m^3) of files would be burned was met.

A.7.3 Outside fires pose an exposure hazard. Clear space provides optimum protection.

The requirements for protection from exposure fires are determined by the distance between the archives and records

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centers and neighboring buildings and the hazards associated with the individual occupancies (e.g., residence, factory, office building). With so many variables, the responsible party for the records center or archives should consider the risk of fire spreading from neighboring occupancies, whether in other buildings or in the building housing the records center or archives (e.g., universities, museums, and other institutions). Determining the severity of such exposures is a matter of judgment based on the factors contributing to the hazard of radiant and convected heat. See NFPA 80A for further guidance with regard to exposure fires.

A.8.1 Additional information can be found in ANSI/UL 72 regarding equipment used for the storage of records.

A.8.1.3 Volumes of vital records too small to require a standard vault should not be exposed to the severe fire loading present in a file room, even where protected by an automatic fire suppression system. Such records could be stored in appropriate fire-rated file devices in an ordinary office environment, which poses a fire exposure that is less hazardous.

The presence of filing personnel and processing operations within the file room, the additional hazards of lighting and heating equipment, and the greater volume of records likely to be exposed at one time add to the possibility of origin of fire and destruction of records within the enclosure.

A.8.3.1 File rooms should not be located underground because, under certain conditions, burning or smoldering debris can accumulate in a basement in sufficient quantities to produce a "cooking effect" of such duration that it cannot be resisted by construction alone (within practical limitations). Underground storage imposes risk factors such as inaccessibility, delayed or impaired access, smoke and heat ventilation, water accumulation, and availability of safe refuge.

A.8.5.1 The wet weight of paper records is approximately 2.4 times the dry weight. Dry correspondence files weigh approximately 30 lb/ft^3 (480 kg/m^3).

A.8.7.3.1 Traditional practice has been to prohibit wall penetrations in vaults and file rooms for the purposes of ventilation. Minimal ventilation was provided by leaving the door open during the operational hours. Although this indirect ventilation can be adequate for records on high-quality bond paper, many nontextual media require far more extensive HVAC controls to prevent premature deterioration. Vaults and file rooms containing audiovisual materials or magnetic media on acetate or polyester bases require not only cool storage at low humidity but also frequent air exchanges to remove the harmful gases generated by the media itself. Use of hot water or steam heating should be carefully considered if the file room contains records on media other than high-quality bond paper because these types of radiant heating frequently produce unacceptably low levels of humidity that can lead to the premature destruction of records.

A.8.9.3 Interior emergency lighting could be necessary.

A.8.12.2 If forced ventilation is not required [i.e., for records on high-quality bond paper in locations where the ambient temperature does not exceed 80°F (27°C)], an electric fan can be permitted to be placed close to the door and directed through the door opening. Such fans can be permitted to be mounted conveniently near the top of the door. Fans should be located so that they do not obstruct the closing of the door.

A.8.13.2 Sprinklers in file rooms on grade can be permitted to be supplied by pipes that rise through the floor.

A.9.1.1 See A.7.1.1. In locating file rooms or vaults in buildings, consideration should be given to minimizing the heat load on the exposed walls, for example, by locating them on the exterior walls or against stairwell or elevator shaft walls.

A.9.1.2.1 Where storage height exceeds 15 ft (4.6 m), generally at least one level of in-rack sprinklers is required.

A.9.1.3 See A.7.1.3. The basis for the volume is a 60 ft (18.3 m) high storage area with 40,000 ft^2 (3,716 m^2) area for a sprinkler system and assuming a 50 percent fill density.

A.10.1 Fire protection devices are intended to provide protection for various types of records for various durations of fire exposure by segregating them from surrounding fire exposure. Protection of records from the effects of fire is considered to have begun in about 1910 when Underwriters Laboratories Inc. conducted the first test in which both the temperatures of the furnace and of the air inside the record container being tested were recorded. Although the container first tested was lacking in fire-resistive properties and the test was crude compared with present-day tests of equipment, the method used set a precedent that was destined to exert an influence not only on the testing of records containers but on fire tests in general.

To establish the fire-resistive rating of a records container, it is necessary to measure interior temperatures and set the maximum allowable temperatures. In view of the fact that the rate of temperature rise inside a safe is influenced by the temperature of the furnace fire, the new method called for closer furnace control and the use of a specific schedule of furnace fire temperatures. Gradually, as fire tests increased, practices tended toward uniformity and led eventually to the standard curve now in use.

The maximum permitted interior temperature originally was set at 350°F (177°C) in order to provide a safety factor, because the ignition temperature of most paper is somewhat higher. This limit was set before the standard time–temperature curve was adopted and helped to emphasize the desirability of a uniform rule for regulation of testing furnace temperatures. The adoption of a temperature rise limit meant that records containers were to be rated on a quantitative basis.

Recently, requirements for records containers other than paper records storage (e.g., magnetic data processing and photographic media) were developed. The requirements provide limits for interior temperature and humidity due to their effect on the integrity of such media. There are two limits for maximum interior temperature and humidity: 150°F (66°C) and 85 percent relative humidity (RH) and 125°F (52°C) and 80 percent RH, respectively. It has been determined that these limits provide adequate protection for most of the magnetic and photographic media available today. Additional information can be found regarding equipment used for the storage of records in ANSI/UL 72.

A.10.2 Devices are classified as follows:

(1) Records protection equipment is classified in terms of an interior temperature limit and a time in hours. The following three temperature and humidity limits are employed:
   (a) 125°F (52°C) with 80 percent RH, which is regarded as limited conditions for floppy disks
   (b) 150°F (66°C) with 85 percent RH, which is regarded as limited conditions for photographic, magnetic, or similar nonpaper records
   (c) 350°F (177°C) with 100 percent RH, which is regarded as limited conditions for paper records

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The time limits employed are 4 hours, 3 hours, 2 hours, and 1 hour. The complete rating means that the specified interior temperature and humidity limits are not exceeded when the record protection equipment is exposed to a standard fire test for the length of time specified.

(2) Ratings are assigned to various categories as follows:
   (a) Insulated records containers
   (b) Fire-resistant safes
   (c) Insulated filing devices
   (d) Insulated file drawer

(3) Insulated records containers and fire-resistant safes are effective in withstanding exposure to a standard test fire before and after an impact due to a fall of 30 ft (9.1 m). Insulated filing devices and file drawers are not subjected to an impact test and are not required to have the strength to endure such an impact.

Insulated records containers, fire-resistant safes, and insulated filing devices can withstand a sudden exposure to 2000°F (1093°C) temperature without exploding as a result of a buildup of steam and other gases created by the exposure.

(4) Noncombustible cabinets with cellular or solid insulation of less than 1 in. (25 mm) thickness have been found to have less than a 20 minute rating under standard test conditions for insulated filing devices. The exact rating depends on the thickness and character of the insulation and other factors. Noncombustible, uninsulated steel files and cabinets have been found to obtain about a 5 minute rating under standard test conditions for insulated filing devices.

A total system concept, rather than just a suppression design, is essential.

A.10.3.1 Figure A.10.3.1(a) and Figure A.10.3.1(b) show the value of fire-rated containers for protection of records. These containers were in a one-story brick and steel building destroyed by fire.

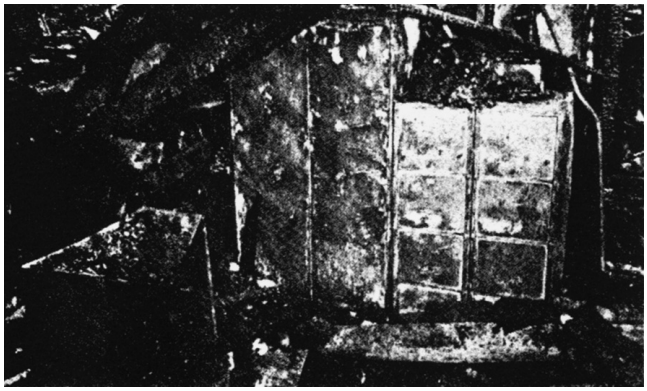

FIGURE A.10.3.1(a) The 1-Hour Rated Equipment at the Right and the 2-Hour Rated Safe in the Center Protected Their Contents.

A.10.3.3 In many fires, records protection equipment is subjected to severe impact. At times, in non-fire-resistive buildings, floors collapse, and the records devices fall one or more stories. The resistance of records protection equipment to impact where highly heated differs markedly from its resistance

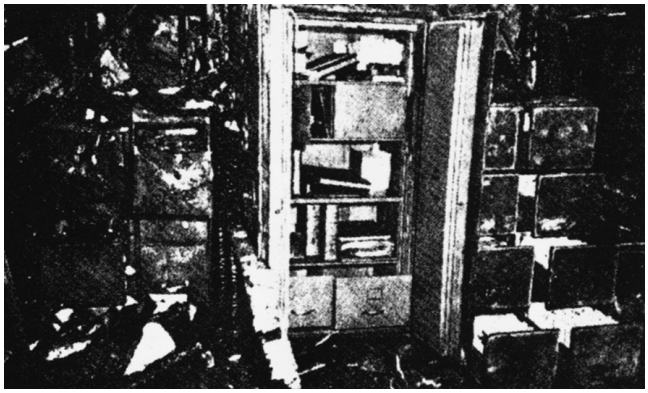

FIGURE A.10.3.1(b) Records in the Nonrated Equipment at the Left Were Destroyed.

where cold. It is essential that, if these devices are intended for a location where impact is probable, their classification should indicate resistance to impact.

For protection of vital or important records, it has been demonstrated that it is not good practice to rely on records protection equipment having less resistance to heat and fire than required for the fire hazard in its vicinity.

The fire records of the past 25 to 30 years show that many old-line or "iron" safes (i.e., safes of the types made prior to approximately 1917, which was before the availability of standards and testing facilities and before the availability of present-day construction methods and materials) involved in fires in non-fire-resistive buildings did not protect their contents due to their inability to withstand stress and strain due to the following:

(1) Impact caused by falling one or more floors as a result of building collapse
(2) Resistance to fire exposure that was less than assumed (Prior to approximately 1917, safes were usually not labeled with their fire rating. Today the fire resistance of such safes is considered uncertain. It is obviously not good practice to rely on any safe of unknown or uncertain resistance to fire or impact for use in the protection of valuable records.)

The selection of a suitable rating for a records device involves the exercise of a certain degree of judgment. When in doubt, it is obviously best to let judgment err on the side of making certain that vital and important records survive a fire that completely consumes the combustibles (fuel) in the fire area of the records enclosure.

If many various degrees of fire hazards exist where vital and important records are or could be stored or used, it is advisable to use a standard classification or rating that preserves such records at the location of greatest hazards so that, in the event a records enclosure is shifted from a location of lightest fire hazard to a location of greatest hazard, the safety of the records is not jeopardized. Increased protection from external fires can be provided by placing the records in rated containers in a vault or a file room.

Uninsulated steel containers (closed on six sides) provide housing protection for records stored in fire-resistive vaults or file rooms where all combustible material (other than records in the containers) is completely excluded. Such installations provide less opportunity for fire to originate and have a decided retarding effect on the spread of

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fire, reducing the possibility of a free sweep of flames or the buildup of room temperatures above the ignition point of ordinary combustible materials. Also, the files are protected from fires originating outside the vault or file room.

A.11.1 In locating file rooms or vaults in buildings, consideration should be given to minimizing the heat load on the exposed walls — for example, by locating them on the exterior walls or against stairwell or elevator shaft walls.

Annex B Fire Characteristics

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

B.1 Metal Containers.

B.1.1 Fire Initiation. In some facilities, all records are kept in metal filing equipment or equivalent metal containers (closed on six sides), and the arrangement, housekeeping, and operational methods prohibit the maintenance of any combustible materials of any type in locations outside the steel containers. Where the surrounding building and all its associated materials are noncombustible, the risk of fire or the possibility of fire development should be considered to be the burnout of one drawer and damage to the materials in the surrounding drawers above, below, behind, and beside the drawer of origin under the following conditions:

(1) All of the records are kept exclusively in metal file cabinets or equivalent metal cabinets (closed on all six sides).
(2) The arrangement, housing, and operational methods prohibit combustible materials outside the metal containers.
(3) The surrounding buildings and all their associated materials are noncombustible.

B.1.2 Initial Fire Development. Where all records housed are contained within closed metal filing equipment, transfer cases, or similar containers (whether or not of the insulated type) so that no fuel is exposed to flames outside the containers and there are no other combustibles in the area, no significant fire development would be expected from most initiating sources. Fire spread from a significant ignition source would be anticipated to be very slow.

B.2 Open Shelving.

B.2.1 Fire Initiation. Records facilities use various shelf-filing equipment, normally with the records either contained in file folders or stored in various styles of open or closed cartons. Typically, rows of records face each other across long service aisles about 30 in. (762 mm) in width. The exposed faces present a wall of paper. Paper has an ignition temperature of approximately 450°F (232°C). Where exposed files exist, the loose ends of the papers or the edge of the file folders can be ignited almost instantly by any source ranging from a match to a faulty fluorescent ballast or by direct contact with an exposed incandescent light bulb. Because of their mass, closed cartons resist ignition slightly longer, but there is a good probability that an ordinary match could ignite them. Ignition of a few pieces of paper, such as could occur on a service cart, could readily ignite the faces of the boxes.

Attempts have been made to develop economical methods of increasing the fire resistance of typical records storage cartons. The method tried most frequently is coating the cartons with an intumescent type of fire-retardant paint. Tests of cartons protected by such paint that has been properly applied show that the coating prevents actual ignition of the cardboard. However, intumescent paint does not intumesce effectively under approximately 400°F (204°C). The temperature of even a small exposure fire (such as could occur on a library cart) could weaken the paper in the box to the point where the box breaks open under the weight of the paper it contains, exposing the ordinary combustible paper contents of the box. Similar results have occurred in tests of boxes that have been covered with aluminum foil, with the additional effect of transmission of heat through the aluminum, causing ignition of the cardboard carton beneath it. In a small-scale test conducted as a joint effort of the NFPA Technical Committee on Record Protection and the U.S. General Services Administration, the effect of a fire-retardant paint coating on boxes demonstrated a very brief delay only in the ignition and development of fire up and across the face of the records storage. Therefore, as a records container still is made of paper, the inherent characteristics of easy ignition and rapid fire development associated with paper do not change.

B.2.2 Initial Fire Development. Where records are stored on open-type shelving, it can be expected that fire development would occur and would approximate a typical pattern of development demonstrated in tests conducted on high-piled storage by Underwriters Laboratories Inc., by FM Global Research, and in tests conducted on 6 ft (1.8 m) high archive shelving arrangements by the U.S. General Services Administration.

In each instance, the initiating fire was small [i.e., 2 lb (0.91 kg)] of paper laid on the floor in the Underwriters Laboratories test, ½ pt (0.24 L) of heptane on cellucotton in an open carton of records in the FM Global tests, and two open cartons of records on a library cart in the U.S. General Services Administration test. The initial fire development progressed for a brief period at a low level, producing the type of fire that could be approached and easily extinguished if promptly discovered. The period of low-level development lasted between a minimum of approximately 3 minutes to a maximum of approximately 12 minutes to 15 minutes, with an average of approximately 5 minutes. During this period, the fire was directly approachable, since heat levels were not high; however, significant quantities of smoke were produced. The temperature levels at the ceiling were sufficiently low to make it unlikely that any heat-reacting fire detection devices would have signaled the presence of fire.

In view of the relatively large smoke production, smoke detectors could have detected such a fire early in its development. In tests with 14 ft (4.3 m) open shelving, smoke detectors operated within 30 seconds to 1 minute, but fire was judged to be beyond portable extinguisher control in less than 3 minutes, providing little justification for the cost of installing smoke detection systems in this case.

B.2.3 Full Fire Development. By the end of the relatively short early development stage in each of the tests described in B.2.2, a sufficient number of the exposed boxes had been preheated so that the fire development characteristics changed suddenly, the temperatures increased rapidly, and the flames enveloped large areas, extending almost immediately beyond human approach and the ability to attack using simple portable extinguishers. Fire development increased rapidly from this point. In each of these cases, a fire control mechanism was being tested, and the fires were not allowed to progress to their ultimate potential.

In some FM Global tests, however, loose records in boxes were released by the fire and exfoliated into the aisle, providing very rapid acceleration of the fire and a condition approaching full

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fire development in a limited area, perhaps 60 ft^2 to 70 ft^2 (5.6 m^2 to 6.5 m^2). On the other hand, in the same test series, a fire test was conducted in which all of the papers were oriented perpendicular to the aisle and stored loose on edge in shelving 14 ft (4.3 m) high. The box fronts were removed to expose the loose paper edges. Contrary to expectations, the fire developed slowly and was never beyond the control of modest local forces employing small hose. Prevention of exfoliation of burning paper apparently served to avoid the dramatic increase in fire intensity.

B.2.4 Fire Severity Potential. Unless fire development is stopped by either manual or automatic fire extinguishment, the entire records storage in one room or on one floor could quickly become involved in fire. The spread of a fire and the extent of damage is related directly to the total quantity of combustibles involved. The severity of a fire is approximately 1 hour for each 10 lb/ft^2 (49 kg/m^2) of gross weight of combustibles involved. The weight of paper in a typical records storage area is equivalent to approximately 10 lb/ft^2 (49 kg/m^2) for each shelf height of storage. A typical center with records stored seven shelves high contains fuel in quantities of approximately 70 lb/ft^2 (342 kg/m^2) of floor area, and in a center where records are stored 15 shelves high, the weight of the paper would be approximately 150 lb/ft^2 (732 kg/m^2). In either case, there are no traditional types of fire-resistive construction capable of withstanding the total impact of burnout. This information is particularly important in any situation where records are stored in a multistory building.

B.2.5 Inherent Fire Capacity. Any archives or records centers using open-type shelving are inherently prone not only to the destruction of the records, but also to the destruction of the facility itself and its neighboring operations, unless all fires are stopped in their early stages.

B.3 Mobile Shelving.

B.3.1 Fire Initiation. Shelving that is mounted on rollers, usually on tracks, is used to conserve space in records facilities. One aisle is provided for a series of shelving units, and, to gain access to a particular shelf, units are moved manually or by motor until the desired shelf unit is positioned to be accessible from the aisle. Ignition sources are similar to those in open-type shelving but with the added potential of an ignition source from the electric-drive units. Slow-developing, burrowing fires can be expected except in the exposed aisle, where a fire would be similar in character to that in open-type shelving.

B.3.2 Initial Fire Development. Tests conducted by FM Global Research for the U.S. General Services Administration and Library of Congress indicated that fires originating in the open aisle could be expected to follow the pattern of open-shelving fires in initial development and quickly involve both faces. Additional tests conducted by Underwriters Laboratories Inc. for the U.S. National Archives and Records Administration indicated that mobile shelving units with electric-drive units and "fire park mode" can provide for early detection and operation of the sprinkler systems, limiting the fire spread tunneling effect. [The fire park mode setting automatically operates the motor drives on all shelving units to create a 4 in. to 5 in. (10 cm to 13 cm) mini-aisle between each shelving unit upon the activation of a smoke detector, water flow alarm, or manual fire alarm.] The length and height of mobile units is determined by available space, loaded weight, access time, and other factors. A recommended limit for length is 25 ft (7.6 m) if an automatic fire park mode is not utilized. Fire spread down an open aisle with facing combustible storage is likely to be rapid. Fire spread tunneling through the shelving array is likely to be very slow, providing some opportunity for control and extinguishment by a public fire department if the fire is discovered and reported promptly.

B.3.3 Fire Severity Potential. The potential for a total burnout of a records facility is exactly the same as for a similar quantity of records on open shelving, except that a fire that involves mobile shelving takes considerably longer to spread beyond the control of a municipal fire department.

B.3.4 Inherent Fire Capacity. As in the case of records stored on open shelving, records stored on mobile shelving are inherently prone not only to the destruction of the records, but also to the destruction of the facility itself. The slow spread of a fire within the shelves improves the effectiveness of outside efforts to stop the fire.

Annex C Salvage of Water-Damaged Library Materials

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

The following material is taken from *Procedures for Salvage of Water-Damaged Library Materials* by Peter Waters. This manual is the most comprehensive and up-to-date information on the salvage of water-damaged materials. It also contains a list of individuals to contact for professional advice and sources for supplies, equipment, and services. Emphasis is placed on having a plan of action before an emergency occurs. It can be obtained at no cost from the Library of Congress.

C.1 Assessment of Damage and Planning for Salvage. Weather is the critical factor in determining which course to take after any flood or fire in which museum, archival, or library materials are damaged. When it is hot and humid, salvage must be initiated with a minimum of delay to prevent or control the growth of mold. When the weather is cold, more time can be taken to plan salvage operations and experiment with various drying procedures.

C.1.1 The first step is to establish the character and degree of damage. Once an accurate assessment of the damage has been made, firm priorities and plans for salvaging the damaged materials can be drawn up. These plans must include a determination of the special facilities and equipment required. Overcautious, unrealistic, or inadequate appraisals of damage can result in the loss of valuable materials. Speed is of the utmost importance, but careful planning is equally essential in the salvage effort.

C.1.2 Where water damage has resulted from fire-fighting measures, cooperation with the fire marshal is vital for a realistic appraisal of the feasibility of salvage efforts. Fire marshals and safety personnel will decide when a damaged building is safe to enter. In some cases, areas involved in the fire may require a week or longer before they are cool enough to be entered. Occasionally, parts of a collection may be identified early in the salvage planning effort as being especially vulnerable to destruction unless they receive attention within a few hours after the fire has abated. If the fire marshal appreciates such needs, it may be possible to provide means of access to the area even when other parts of the building remain hazardous.

C.1.3 Once all entrances and aisles are cleared, the most important collections, including rare materials and those of permanent research value, should be salvaged first, unless other

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materials would be more severely damaged by prolonged immersion in water. Examples of the latter are books printed on paper of types widely produced between 1880 and 1946, now brittle or semibrittle. However, materials in this category that can be replaced should be left until last.

C.1.4 Salvage operations must be planned so that the environment of flooded areas can be stabilized and controlled both before and during the removal of the damaged materials. In warm, humid weather, mold growth may be expected to appear in a water-damaged area within 48 hours. In any weather, mold will appear within 48 hours in unventilated areas made warm and humid by recent fire in adjacent parts of the building. For this reason, every effort should be made to reduce high temperatures and vent the areas as soon as the water has receded or been pumped out. Water-soaked materials must be kept as cool as possible by good air circulation until they can be stabilized. To leave such materials more than 48 hours in temperatures above 70°F (21°C) and humidity above 70 percent will almost certainly result in heavy mold growth and lead to high restoration costs.

C.1.4.1 Damaged most by these conditions are volumes printed on coated stock and such highly proteinaceous materials as leather and vellum bindings. Starch-impregnated cloths, glues, adhesives, and starch pastes are affected to a lesser degree. As long as books are tightly shelved, mold will develop only on the outer edges of the bindings. Thus, no attempt should be made in these conditions to separate books and fan them open. Archival files packed closely together on the shelves in cardboard boxes or in metal file cabinets are the least affected.

C.1.4.2 As a general rule, damp books located in warm and humid areas without ventilation will be subject to rapid mold growth. Archival files that have not been disturbed will not be attacked as quickly by mold. Very wet materials, or those still under water, will not develop mold. As they begin to dry after removal from the water, however, both the bindings and the edges of books will be quickly attacked by mold, especially when in warm, unventilated areas. A different problem exists for books printed on coated stock, since, if they are allowed to dry in this condition, the leaves will be permanently fused together.

C.2 Summary of Emergency Procedures.

C.2.1 It is imperative to seek the advice and help of trained conservators with experience in salvaging water-damaged materials as soon as possible. The Library of Congress is an excellent information source for technical advice where needed. Contact: Preservation Office, Library of Congress, Washington, DC, www.loc.gov.

C.2.2 Turn off heat and create free circulation of air.

C.2.3 Keep fans and air conditioning on at night, except when a fungicidal fogging operation is in process because a constant flow of air is necessary to reduce the threat of mold.

C.2.4 Brief each worker carefully before salvage operations begin, giving full information on the dangers of proceeding except as directed. Emphasize the seriousness of timing and the priorities and aims of the whole operation. Instruct workers on means of recognizing manuscripts, materials with water-soluble components, leather and vellum bindings, materials printed on coated paper stock, and photographic materials.

C.2.5 Do not allow workers to attempt restoration of any items on site. (This was a common error in the first ten days after the Florence flood, when rare and valuable leather- and vellum-bound volumes were subjected to scrubbing and processing to remove mud. This resulted in driving mud into the interstices of leather, vellum, cloth, and paper; caused extensive damage to the volumes; and made the later work of restoration more difficult, time consuming, and extremely costly.)

C.2.6 Carry out all cleaning operations, whether outside the building or in controlled environment rooms, by washing gently with fresh, cold, running water and soft cellulose sponges to aid in the release of mud and filth. Use sponges with a dabbing motion; do not rub. These instructions do not apply to materials with water-soluble components. Such materials should be frozen as quickly as possible.

C.2.7 Do not attempt to open a wet book (wet paper is very weak and will tear at a touch). Hold a book firmly closed when cleaning, especially when washing or sponging. A closed book is highly resistant to impregnation and damage.

C.2.8 Do not attempt to separate single-sheet materials unless they are supported on polyester film or fabric.

C.2.9 Do not attempt to remove all mud by sponging. Mud is best removed from clothes when dry; this is also true of library materials.

C.2.10 Do not remove covers from books, as they will help to support the books during drying. When partially dry, books may be hung over nylon lines to finish drying. Do not hang books from lines while they are very wet because the weight will cause damage to the inside folds of the sections.

C.2.11 Do not press books and documents mechanically when they are water-soaked. This can force mud into the paper and subject the materials to stresses that will damage their structures.

C.2.12 Use soft pencils for making notes on slips of paper, but do not attempt to write on wet paper or other artifacts.

C.2.13 Clean, white blotter paper, white paper towels, strong toilet paper, and unprinted newsprint paper may be used for interleaving in the drying process. When nothing better is available, all but the color sections of printed newspapers may be used. Great care must be taken to avoid rubbing the inked surface of the newspaper over the material being dried; otherwise, some offsetting of the ink may occur.

C.2.14 Under no circumstances should newly dried materials be packed in boxes and left without attention for more than a few days.

C.2.15 Do not use bleaches, detergents, water-soluble fungicides, wire staples, paper or bulldog clips, adhesive tape, or adhesives of any kind. Never use felt-tipped fiber or ballpoint pens or any marking device on wet paper. Never use colored blotting paper or colored paper of any kind to dry books and other documents.

Annex D Fire Control

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

D.1 General. The basic elements of fire control are two-fold — detection of the existence of fire plus its extinguishment. The individual efficiency and capability of both detection and extinguishment determines the degree of safety or, conversely, the extent of damage in case of fire.

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D.2 Water. Most archivists or records managers are seriously concerned about water damage. In view of the constant problems involved in the leakage of domestic water systems and steam mains, the rain intrusion from leaky roofs or windows, and the resultant damage from mildew or decomposition of paper, this concern is understandable. It is important, however, for the archivist or records manager to realize that wet records can be recovered, but burned records are lost permanently. Furthermore, unless there is a specialized fire-extinguishing system to control the development and growth of a fire, responding fire-fighting forces have no choice but to attack the fire with fire department hose streams. In many records facilities, the quantity of paper fuel involved is such that the fire department has to attack a fire from a distance and under extremely adverse conditions. This situation normally forces the fire department to use heavy hose streams having the characteristics of a hydraulic ram. Wide and forceful disruption of the records storage arrangement is a routine consequence of efforts to prevent total destruction.

D.3 Recovery. Recovering wet records is a problem whether the source of water is a result of fire-fighting efforts, a fire, or another source, such as a flood, a hurricane, a heavy rainstorm, roof leakage, spillage from operations located above, or a breakdown of any of the numerous water or steam systems in a building. Virtually any wet paper records can be recovered, provided prompt and proper action is taken. Effective salvage necessitates prompt action, special techniques, facilities, and expert advice. Preplanning is essential.

Archivists and records managers interested in salvage should reference NFPA 909 and the Federal Fire Council Recommended Practice No. 2, *Salvaging and Restoring Records Damaged by Fire and Water*. Salvage of wet records from the 1973 fire at the Military Personnel Records Center, St. Louis, MO, is treated in considerable detail in the July 1974 *NFPA Fire Journal* and the October 1974 *American Archivist*. Also useful as background material is the publication *Conservation of Library Materials*, a manual (volume I) and bibliography (volume II) on the care, repair, and restoration of library materials by George M. Cunha and Dorothy G. Cunha.

D.4 Fire Extinguishers. Regardless of the other types of fire extinguishment systems provided, it is essential that every records storage facility be provided with an adequate supply of well-distributed Class A portable fire extinguishers suitable for extinguishing fires in paper and plastic records. The extinguishers should be of the trigger action type in which the flow can be started and stopped by the operator. NFPA 10 should be referenced for specific information regarding portable fire extinguishers. Gaseous extinguishers are not effective for extinguishing deep-seated fires in paper materials. The presence of proper extinguishers enables the working or guard force, on discovery of a fire or on response to an alarm from an early warning detection system, to attack and extinguish the fire while it is small, with minimum damage to the records. It is important that local forces are instructed properly in the use of small extinguishers.

D.5 Fire Departments. The fire department is an essential part of any fire protection plan. The role of the fire department depends on the type and capabilities of an automatic extinguishing system, if provided. Where no extinguishing system is provided and total dependence is placed on the fire department for control of any fire that exceeds the capabilities of persons using hand extinguishers, it is reasonable to expect that the fire department will be forced to make a massive attack because of the size and position of the fire at the time of arrival.

Fire fighters are limited by their tolerance to heat and smoke. To reach the actual seat of the fire, the fire department could undertake actions that are disruptive or damaging to records that are not actually burning. Rows of records could block access to the seat of the fire. High-density smoke could conceal the seat of the fire. To save the structure and to prevent propagation of the fire to other areas, it could be necessary for the fire fighters to disrupt the storage arrangement in unignited areas to obtain access to the ignited area or to use high-pressure hose streams in a general sweeping action in an effort to provide a general cooling/quenching effect. In any sizable records facility, the total amount of fuel necessitates the use of heavy hose streams. In some communities, fire departments have the capability and are likely to use monitor- or snorkel-type hose streams. Properly constructed fire walls, confining the fire to a single fire area, assist a fire department in limiting the size of a fire. All records within the fire area are likely to be seriously affected by either fire or by water from the high-pressure streams, or by both.

D.6 Role of Fire Department and Extinguishing Systems. Where an automatic extinguishing system of proper design is provided, the role of the fire department changes from the implementation of direct fire attack to assisting and supplementing the automatic extinguishing system.

D.6.1 If the system is an automatic sprinkler system, the primary responsibilities of the fire department are to supplement the water supply, determine the proper time to discontinue the flow of water, extinguish fire in any small, shielded areas that the sprinkler system could not reach, and overhaul the actual burned areas to prevent rekindling or re-ignition. For further information, NFPA 13E should be referenced.

D.6.2 Where a total flooding carbon dioxide, Halon 1301, or other gaseous system is provided and has been successful in its operation, the primary responsibility of the fire department is to vent the gas and to prevent the possibility of rekindling by wetting and removing the materials that were ignited. The period during which carbon dioxide gas is phased out is critical, and, unless the smothering action has been totally effective, rekindling of a serious fire can occur. This procedure is potentially hazardous and should be executed only with the full capabilities of the fire department in readiness.

D.6.3 If high-expansion foam is used, the primary responsibility of the fire department is to assist in removal of the foam and to extinguish any small glows (i.e., deep-seated fires) or flames that are found while the foam is being removed. Depending on the situation, it could be desirable to continue the application of the high-expansion foam for a soaking period. However, the length of time that the foam is kept in place affects the degree of wetting. Therefore, overhaul procedures should be carried out rapidly but cautiously, with extinguishing equipment standing by in readiness.

D.7 Fire Department Preplanning. Fire department preplanning for attack in specific locations is essential in all systems of fire control. It is important that the archivist or records manager contact the appropriate chief officer of the responding fire department to establish pre-fire planning arrangements. The best extinguishing system can be overcome if a fire officer, due to lack of knowledge, makes improper use of the system or prematurely removes an automatic system from operation. Conversely, lack of knowledge and a sense of caution can result in a fire officer maintaining the operation of an extinguishing system for an excessive length of time, increasing damage to the records from the extinguishing agent.

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Annex E Fire Control Systems

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

E.1 Detection.

E.1.1 General. In any fire control system, the first step should be the detection of the presence of fire with immediate notification of emergency response forces, including the fire department. A number of different methods of detection are available, ranging from highly sophisticated devices for almost immediate detection of products of combustion to dependence on passersby *(see Section E.5)*. Detection of fire, although vitally important, does not in itself prevent fire damage. Detection needs to be followed by extinguishment, which includes the use of fire extinguishers or other first aid fire equipment by facility personnel or guards, attack by the fire department using the various manually directed appliances at its disposal, or control by automatic suppression systems, such as sprinklers, carbon dioxide, or halon. The capabilities and efficiency of each of these systems vary significantly and also can affect the extent of fire damage.

E.1.2 Human Detection Capabilities. An evaluation of the various methods of fire detection demonstrates that any detection system that relies only on casual observation by those persons whose activities take place outside the records storage area is undependable, and a facility that depends upon detection by passersby is at risk of total burnout. Some records centers assign responsibility for fire detection to watchpersons or guards around the clock or a combination of employee responsibility during the workday and watchpersons or guards after business hours. Although this approach is superior to dependence on casual observation, it should be considered very limited. (The major fire at the Military Records Center in St. Louis, MO, was first reported by a passerby, although the building had guard patrols.)

As previously described, the period during which such observation can result in the detection and response to a small fire situation is quite limited if, for instance, a fire initiates within the service aisles of the stack area. Since this type of fire usually is the most critical and damaging, it is considered to be the type that most necessitates early detection. Normally, guard rounds are regulated at intervals of 1 hour or more. A major fire catastrophe could develop between periods of observation of the most alert and conscientious guard. The presence of guards can be effective in peripheral situations, such as a small office fire. They also can function in fire prevention programs. Guards are, however, of limited value in controlling a fire in record shelving, except in notifying the fire department.

E.1.3 Heat Detection. Fixed temperature or rate-of-rise heat detection equipment sometimes is used in records facilities. As described in Annex B, these devices are not likely to respond to a fire until it has developed into its major stage. At this point, unless there is an installed automatic extinguishing system, the fire is likely to be beyond the capabilities of local forces. The heat detection system alone cannot control the fire. It is likely that, when the municipal fire department arrives at the scene and sets up operations, they will be severely challenged by the fire. This situation complicates fire-fighting efforts and increases the resultant records damage. As an alternative, if the heat-actuated detection equipment is used to operate an automatic fire control system, it could provide a very effective function.

E.1.4 Automatic Sprinkler Detection. In considering detection systems that initiate the operation of an extinguishing system, it is necessary to consider briefly the detection aspects of automatic water sprinkler systems. Each automatic sprinkler is a fixed temperature device that opens (fuses) when heated to a preset temperature. Where the automatic sprinkler system is equipped with a waterflow detection device, the sprinkler system virtually becomes a fixed temperature fire detection system as well as an automatic water extinguishing system. For this reason, the detection of water flow in the sprinkler system is important, and it is considered axiomatic that every sprinkler system installed in a records storage facility should be equipped with waterflow detection that activates the building fire alarm system and thus transmits the alarm.

E.1.5 Early Warning Detection. These devices, known generically as smoke detectors, respond to either the visible (e.g., smoke) or invisible (i.e., molecular size) products of combustion, or both, produced from the moment of ignition. In a properly engineered installation, these devices can detect a smoldering fire in its low-energy stage. Where ignition from a smoldering fire is likely, smoke detectors can provide warning very early in the development of fire.

E.1.5.1 Listed or approved smoke detectors include ionization type, photoelectric beam or spot type, infrared type, and others. It is possible, if necessary, for these early warning systems to activate associated fire-extinguishing systems. Such smoke detectors should be considered part of the overall system in any important records collection where a smoldering fire is possible.

E.1.5.2 Total dependence on a combination of smoke detection and hand fire extinguisher attack still leaves the facility subject to a major disaster. Dependence solely on an early warning detection system exposes the facility to full fire development before effective efforts can be undertaken.

E.1.6 Locating Smoke Detectors. It is important that the system be individually engineered by competent personnel. Where the devices are used, they are installed because of the need to detect fire as early in its development as possible. The various types of air movement, including stratification caused by heating or other air-handling systems, as well as those caused by the records storage arrangement, are important considerations. The system should be capable of detecting and locating the presence of fire in any portion of the records storage area within a brief time in order to obtain maximum protection. While the time element specified directly affects the cost of the system, it also affects the extent of the damage. Generally, the shorter the time for detection, the higher the cost of the system. *NFPA 72* should be referenced for further information on the spacing of smoke detectors.

E.1.7 Fire Alarm Systems. Fire alarm systems can perform numerous functions, such as detecting incipient fire, notifying on-premises first-response teams, notifying the fire department, sounding evacuation signals, shutting fire doors, starting smoke control systems, monitoring system status, and printing a permanent record of all events. They also can be used to activate certain types of fire suppression systems.

E.1.7.1 *NFPA 72* should be referenced for minimum standards for system components and their installation.

E.1.7.2 Three categories of input signals — alarm, supervisory, and trouble signals — normally are provided. Alarm signals take priority over supervisory and trouble signals

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and include activation of manual fire alarm boxes, signals from automatic smoke and heat detectors, waterflow indications from sprinkler systems, and agent-release signals from special hazard suppression systems. Supervisory signals take priority over trouble signals and include activation by off-normal sprinkler functions (such as temperature, pressure, and valve position). Monitoring functions include status of control and circuit conditions in fire alarm systems, status of certain fire suppression systems, status of watchperson tours, and other functions. The status of critical non-fire systems also can be monitored.

E.1.7.3 System output functions can include some or all of the following, depending on the size of the building, local codes, availability of trained emergency response teams, and other factors:

(1) General evacuation signals (e.g., bells, horns, and strobes)
(2) Presignal alarm devices for initially alerting only selected staff
(3) Selective evacuation signals (e.g., voice/tone signals, zoned)
(4) Lamp or light-emitting diode (LED) text displays identifying the type and source of the alarm or monitoring signal
(5) Logs (e.g., electronically recorded or printed) of all "change of status" events
(6) Remote indications of alarm and monitoring signals at locations such as central stations and fire departments
(7) Activation of fire suppression systems
(8) Activation of smoke control systems, including HVAC shutdown and damper and door releases
(9) Transmission of signals to building energy management systems, security monitoring systems, and other systems

E.1.7.4 Fire and security functions can be integrated into a single system, but generally these functions should not be controlled from the building energy management system.

E.2 Automatic Sprinkler Systems.

E.2.1 General. The most effective fire protection element and the most economical automatic fire control system for protection of archives and records centers is the automatic wet-pipe sprinkler system. Such systems are also the most frequently opposed by records managers because of concern with water damage. The following three factors serve to alleviate this concern:

(1) Sprinklers actually constitute a method of fire control involving a minimum rather than a maximum of water.
(2) Each sprinkler operates individually so only those sprinklers in the heat of the fire operate and discharge water.
(3) Wet records are recoverable, and burned records are not.

E.2.1.1 The probability of sprinkler operation when no fire exists is insignificant.

E.2.1.2 Because of the rapid heat development in records storage areas, high-temperature-rated sprinklers [250°F to 300°F (121°C to 149°C)] are used commonly in lieu of ordinary-rated sprinklers [135°F to 170°F (57°C to 77°C)] to limit the number of sprinklers that operate in a fire to those that act directly in extinguishment. NFPA 13 should be referenced for additional information on the use of sprinklers. In archival storage areas, consideration should be given to using ordinary ratings [135°F to 170°F (57°C to 77°C)] where the risks of fire development exceed the risks of water damage.

E.2.2 Waterflow Alarms. Where a records center is protected by an automatic sprinkler system, provision of a waterflow alarm that transmits a signal to the fire department on the fusing (opening) of one or more sprinklers eliminates the possibility of a sprinkler operating undetected and discharging water for a long period, excessively wetting the records underneath, after the fire has been successfully extinguished. The waterflow alarm feature, in addition to signaling the existence of a fire, also detects the flow of water in the rare instance of accidental or malicious damage to the system.

E.2.3 Sprinkler Operation Characteristics. The sprinkler system operates only when the fire has reached the point of rapid heat rise and has passed the phase of development where hand fire extinguishment is effective. Both tests and fire experience have shown that sprinklers can confine the fire to a relatively small portion of the row of shelving where the fire started. The sprinkler discharge does not necessarily extinguish fire concealed under the shelves or inside mobile shelving. It definitely does slow down or prevent further fire propagation, removes the heat, and prevents further damage or collapse of the stack equipment. Thus, fire fighters entering the building can approach the seat of the fire and use small hose streams to quench the glowing or flaming areas.

E.2.4 Sprinklers — Expected Results. Under normal conditions in a facility protected by sprinklers, it is probable that fire would be confined to an area of 100 ft^2 to 500 ft^2 (9.3 m^2 to 46.4 m^2). Water damage would consist primarily of superficial wetting of cartons in those areas where cartons were involved or wetting of the edge and bottom of open file records. These areas of water damage probably would extend approximately 10 ft to 20 ft (3.0 m to 6.1 m) to each side of the area of fire damage. The records on top of the top shelves would be the wettest. Those on lower shelves would be shielded from the direct impact of water and would be considerably drier.

Total extinguishment and shutdown likely would take place before failure of the corrugated or pressboard cartons. In this respect, cartons with wire-stapled lap-joints (rather than those that are glued) are less likely to fail. Containers that are die cut for assembly without the use of glue or staples are also suitable as protection against water damage and for avoiding possible injury and the problems associated with wire staples. Boxes with handholes are more susceptible to water damage.

Water discharge from the sprinklers is in the form of a fine spray and, therefore, would not disturb the position of the records storage. Fire department operations in a sprinklered facility likely would cause only minimal physical disruption. It is probable that smoke and soot damage would be minimal. Solid fiberboard (archival) boxes resist water damage to a much greater extent than corrugated cartons.

E.2.5 Sprinklers — Special Systems. The following are four sprinkler types and systems that are considered to be suitable for records protection. NFPA 13 should be referenced for installation details.

(1) *Pre-Action System.* A pre-action system is a system in which the sprinkler piping normally is dry and the control valve opens only when the heat detection devices sense the development of a fire. As in the wet-pipe system, individual sprinklers are fused so that only those located directly over the fire operate. Although more costly than the ordinary system, it has the advantage of eliminating the discharge of water if a sprinkler or a line is broken accidentally or deliberately. It is more expensive than a wet-pipe system, since a complete detection system is needed in addition to the sprinkler system. It is less reliable than a wet-pipe system, since it cannot operate if the detection system is inoperative.

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(2) *Recycling System.* A recycling system is an adaption of a preaction sprinkler system with a recycling feature. When the sprinkler or sprinklers have extinguished the fire and the heat drops below a preset temperature [e.g., 140°F (60°C)], the detectors initiate a timing cycle that automatically discontinues the water flow by closing a special valve in about 5 minutes. The system remains in readiness, and, if the fire rekindles, it recycles to start the water flow. The system has the advantages of automatically determining when the temperature has decreased and of shutting the system off, making it almost impossible for maintenance personnel or others to close the valve accidentally. As in the pre-action system, the recycling system needs a separate detection system. Because the system is designed to recycle, the detection system needs to be fire resistant and, therefore, is somewhat more expensive. An advantage of the recycling system over other sprinkler systems is that, if the system shuts off prematurely and fire continues or rekindles, it is reactivated automatically when the ceiling temperature increases.

(3) *On-Off Sprinklers.* Sprinklers with a recycling feature are available. Installed on wet-pipe sprinkler systems, each sprinkler operates individually at a predetermined temperature, but when the temperature drops below the predetermined temperature, the sprinkler shuts off. Each sprinkler operates independently, cycling on and off depending on the fire situation in its immediate area. No separate detection system is necessary.

(4) *Dry-Pipe Sprinkler Systems.* A dry-pipe system also is useful for the protection of records storage. The sprinkler piping is filled with compressed air. The release of air pressure through a fused sprinkler allows the water valve to open and supply water to the sprinkler piping. Each sprinkler operates independently, as do all other types described in E.2.5. Releasing air pressure through a fused sprinkler takes appreciable time, during which the fire could grow and open additional sprinklers. Dry-pipe sprinkler systems are used primarily for protection of unheated areas where freezing temperatures are likely to occur.

E.3 High-Expansion Foam.

E.3.1 General. High-expansion foam is a total flooding extinguishing agent that inundates the protected space. The foam surrounds all materials within the protected area with an aggregate of bubbles, each of which carries a small quantity of water. NFPA 11 should be referenced for more extensive coverage of the characteristics of this extinguishing agent.

In tests conducted by the U.S. Atomic Energy Commission involving records media, high-expansion foam extinguished test fires quickly and easily by filling the entire volume of the storage space. The degree of wetting was low. Generally, the foam did not penetrate normal corrugated fiberboard cartons. Cartons with stapled or interlocking edges tend to hold up quite well, but cartons with glued edges tend to come apart and expose the records contents to foam. Identification labels tend to slip off.

However, after exposure to the foam, it was necessary to take corrective drying action on all the materials within the area contacted by the foam.

Data on these tests are published in an Atomic Energy Commission report, "High Expansion Foam Fire Control for Records Storage Centers." Also see "High Expansion Foam Fire Control for Records Storage" by R. J. Beers.

E.3.2 Design of High-Expansion Foam Systems. NFPA 11 should be referenced for the minimum requirements and design for systems that provide adequate protection. There are the following three types of high-expansion foam systems available:

(1) Total flooding systems
(2) Local application systems
(3) Portable foam application devices

For the purposes of this standard, total flooding systems are most applicable. Total flooding involves filling the storage space with foam to a level above the combustible material.

Total flooding systems need to maintain sufficient foam to submerge the hazard, sufficient time to cover the hazard, and a minimum rate of discharge to compensate for the breakdown of the foam by sprinkler discharge, shrinkage, fire, and other factors. High-expansion foam systems require venting, closure of openings through which foam can escape, and maintenance of sufficient foam to cover the hazard to ensure control and extinguishment of fires. The rate of application of high-expansion foam is rapid, and a large vent area is needed for the displaced air. Automatic activation of the system is by means of a heat detection system similar to that described for other systems.

E.4 Gaseous Extinguishment.

E.4.1 General. Extinguishment by total flooding with gas is favored by many archivists and records managers because no water damage can occur and salvage problems are simplified. Two principal gases used for this application are Halon 1301 (bromotrifluoromethane) and carbon dioxide. Total flooding involves filling the entire protected volume with a specific concentration of gas.

E.4.2 Halon 1301 Gas Systems. Although water-based agents depend on cooling and quenching and carbon dioxide depends primarily on oxygen exclusion, Halon 1301 inhibits burning by chemically interacting with the flame radical. Halon 1301 is a liquefied gas under pressure, which is an effective flame inhibitor that also exhibits low toxic and corrosive properties. The design of Halon 1301 systems is covered by NFPA 12A. The use of this agent for total flooding applications in records storage facilities has been limited, and installation should be attempted only with expert guidance.

Because it is a flame inhibitor, Halon 1301 is not effective against smoldering fires at normal concentrations. In a records storage facility, it is important that application be undertaken as early in the fire as possible, before it becomes deep-seated. To be effective, it also is important that the system be automatic and total flooding and that it employs a properly responsive detection system. It is essential that means be provided to contain the gas without significant leakage for an extended period. Halon 1301 systems are relatively expensive, and most installations have been limited to the protection of high-value collections in moderate-size spaces [less than 50,000 ft^3 (1416 m^3)]. Total extinguishment by Halon 1301 of a fire in Class A (paper) storage is not likely due to smoldering. Prevention of flaming fire pending the arrival of the municipal fire department might be adequate. Rapid fire growth would be inhibited in the interim. The fire department would be likely to use water to complete the extinguishment, possibly under conditions of low visibility. Many installations sound an evacuation alarm prior to gas discharge to prevent occupants from breathing halon or halon decomposition products. Use of Halon 1301 is not recommended for

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ordinary records centers or archive facilities but could be appropriate for the protection of isolated smaller collections and records of high intrinsic value.

E.4.3 Carbon Dioxide Systems. Fire extinguishment can be accomplished by a total flooding carbon dioxide system with a soaking period. The design and proper installation of such a system are critical. NFPA 12 should be referenced for further information.

E.4.3.1 Systems for records storage protection are designed to provide a carbon dioxide concentration of 65 percent in the protected space to control stratification and to maintain soaking for 30 minutes. Openings that are not necessary for pressure venting are to be closed at the time of discharge to avoid loss of carbon dioxide during the soaking period. Underdesigned carbon dioxide systems are subject to failure at the time of fire. Proper performance can be ensured only by actual testing to make certain that the design concentration is achieved and maintained for the full soaking period.

E.4.3.2 Because atmospheres containing fire extinguishing concentrations of carbon dioxide cannot sustain life, it could be fatal to be trapped in the flooded space. Ample warning and time delay are to be given prior to discharge to allow occupants to escape from the area to be flooded. A person cannot leave the area safely after the discharge starts. Provision should be made for exhausting the atmosphere after the soaking period without creating a hazardous atmosphere in another location.

E.4.3.3 For effective fire control, the activation of the carbon dioxide system should be automatic in response to fire and triggered by a properly designed and installed heat detection system.

E.4.3.4 Discharge of carbon dioxide can cause condensation of humidity (fogging), which can obstruct vision.

E.5 Comparisons of Extinguishing Systems.

E.5.1 Factors to Be Considered. There are a number of factors involved in comparing extinguishing systems. Initial cost, reliability, cost of agent, susceptibility to false operation, area of application, damage to records by fire and by extinguishing agent, and consequences of failure are all important factors to be considered. All automatic systems are damage-initiated. That is, a fire that causes damage needs to occur before an automatic system detects it and activates. Generally, the smaller the fire a system can detect, the more sensitive the system, and the more likely it is to operate falsely. It is important that the alarms for all systems be connected to the municipal fire department so that it is notified of a fire when the system activates.

E.5.2 Automatic Sprinkler Systems. Automatic sprinklers are the most reliable and economic means of controlling fire in a records center. Wet-pipe sprinklers with hydraulically designed piping, adequate water supply, and supervised valves are reliable and trouble-free. Cyclic systems, pre-action systems, and dry-pipe systems, provided for insurance against water damage, introduce the potential for failure in the system and can slow system functioning during a fire, resulting in a larger fire. In the event of a fire, only sprinklers in the immediate vicinity of the fire are activated.

In the FM Global full-scale test series, with sprinklers located in positions as ineffective for extinguishment as possible, the three tests opened 6 sprinklers, 16 sprinklers, and 3 sprinklers, respectively. This test covered 600 ft^2, 1600 ft^2, and 300 ft^2 (56 m^2, 149 m^2, and 28 m^2) using an installed array of 77 heads in a facility having approximately 400 heads. In these tests, as in most records fires, regardless of the extinguishment means, final extinguishment was by hose line. All records wetted but not burned were recoverable.

E.5.3 Detection Systems. These systems use devices that respond to the smoke system's particles produced by a fire. They operate on the ionization, photoelectric, cloud chamber, or other smoke particle analysis principle of operation. Spot-type smoke detectors use either the ionization principle of operation or the photoelectric principle. Line-type smoke detectors use the photoelectric principle. Aspiration-type smoke detectors use either the ionization, photoelectric, cloud chamber, or other particle analysis principle of operation.

Properly installed, smoke detectors can detect smoke particles in very early stages of fire in the areas where they are located. The selection of a particular detector or mixture of detectors should be based on building and fire-load conditions by a fire protection specialist.

E.5.4 Gaseous Systems. Gaseous extinguishment has the potential for causing the least damage if all elements of the system perform as designed. Automatic operation of the system and automatic closure of leakage openings is essential to the success of these systems. Neither halon nor carbon dioxide can be expected to extinguish a deep-seated fire condition that occurs if an archives or records center fire is allowed to become well-developed before application of the extinguishing gas. Gas leakage through an open door, a temporary opening, or a fire-caused breach also could result in a failure. Gas extinguishing systems that are equipped with more sensitive detectors are used mainly on incipient fires to minimize damage because the larger the fire, the less likely that extinguishment can be accomplished. However, using more sensitive detection can result in increased false operations, which are undesirable because of the high cost of agent and because of the hazards to personnel. All materials in the enclosure are exposed equally to the gas, whether near to or remote from the fire. Final extinguishment usually is performed by the fire department using hose streams. If the area is obscured by smoke, which is likely, directing hose streams could be haphazard and could result in widespread water damage.

E.5.5 Foam Systems. High-expansion foam discharged through an automatic means has the capacity to overcome a well-established fire and, therefore, is far superior to gaseous extinguishment and is superior to the use of sprinklers. As in the case of gaseous extinguishment, high-expansion foam escapes through unenclosed openings, although a very lightweight partition such as fine mesh screen can contain it. In addition, as with gaseous agents, all materials in the enclosure are exposed equally to the extinguishing agent. Since foam dampens kraft boxes (and perhaps loosens identification labels), all materials in the enclosure become slightly damaged and need to be dried. Final extinguishment by fire department hose streams is likely to be necessary.

E.6 Installation and Maintenance of Systems and Equipment. To reasonably ensure that a fire detection control system, appliance, or device performs satisfactorily, it is necessary for the installation to be in compliance with the recognized standards and the manufacturer's instructions and that complete operational tests are conducted.

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After installation, it is important that a complete routine scheduled maintenance program that follows recognized standards and manufacturer's instructions be developed and followed. This program can be performed either by competent maintenance employees or by service contractors.

NFPA 25 should be consulted for inspection, testing, and maintenance of fire sprinkler systems and standpipe systems and all related water-based fire-extinguishing systems.

Annex F Informational References

F.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.

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

NFPA 10, *Standard for Portable Fire Extinguishers*, 2007 edition.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2005 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2005 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 2004 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2007 edition.

NFPA 13E, *Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems*, 2005 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2002 edition.

NFPA 40, *Standard for the Storage and Handling of Cellulose Nitrate Film*, 2007 edition.

NFPA 42, *Code for the Storage of Pyroxylin Plastic*, 2002 edition.

NFPA 72®, National Fire Alarm Code®, 2007 edition.

NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, 2007 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 2002 edition.

NFPA *101®, Life Safety Code®*, 2006 edition.

NFPA 220, *Standard on Types of Building Construction*, 2006 edition.

NFPA 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*, 2006 edition.

NFPA 285, *Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components*, 2006 edition.

NFPA 909, *Code for the Protection of Cultural Resource Properties — Museums, Libraries, and Places of Worship*, 2005 edition.

NFPA 1600, *Standard on Disaster/Emergency Management and Business Continuity Programs*, 2004 edition.

NFPA Fire Journal, July 1974.

Beers, R. J., "High Expansion Foam Fire Control for Records Storage," *Fire Technology*, Vol. 2, No. 2, May 1966, pp. 108–117.

F.1.2 Other Publications.

F.1.2.1 ANSI/ARMA Publications. ARMA International, 13725 W. 109th Street, Suite 101, Lenexa, KS 66215.

ANSI/ARMA 5, *Vital Records Programs: Identifying, Managing, & Recovering Business-Critical*, 2003.

F.1.2.2 ISO Publications. International Organization for Standardization, 1, rue de Varembé, Case postale 56, CH-1211 Geneve 20, Switzerland.

ISO 15489-1, *Information and Documentation — Records Management — Part 1 General*, 2004.

ISO 15489-2, *Information and Documentation — Records Management — Part 2 Guidelines,* 2004.

F.1.2.3 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 72, *Standard for Tests for Fire Resistance of Records Protection Equipment*, 2001.

F.1.2.4 U.S. Department of Commerce Publications. Clearinghouse, U.S. Department of Commerce, Springfield, VA 22151.

Atomic Energy Commission report, "High Expansion Foam Fire Control for Records Storage Centers," IDO-12050, March 1966.

Federal Fire Council Recommended Practice No. 2, *Salvaging and Restoring Records Damaged by Fire and Water,* 1963.

F.1.2.5 U.S. National Archives and Records Administration Publications. U.S. National Archives and Records Administration, Space and Security Management Division (NAS), 8601 Adelphi Road, College Park, MD 20740-6001.

Full Scale Fire Test of Records Stored on 30 ft High Shelving, 1999.

F.1.2.6 Additional Publications.

American Archivist, October 1974.

Cunha, George M. and Dorothy G. Cunha. 1971. *Conservation of Library Materials*. Metuchen, NJ: The Scarecrow Press, Inc.

Waters, Peter. 1975. *Procedures for Salvage of Water-Damaged Library Materials*. Washington, DC: Library of Congress.

F.2 Informational References. The following documents or portions thereof are listed here as informational resources only. They are not a part of the requirements of this document.

Advisory Committee on the Protection of Archives and Records Centers. 1977. "Protecting Federal Records Centers and Archives from Fire." Washington, DC: U.S. General Services Administration. Following the disastrous fire in the Military Personnel Records Center in Overland, Missouri, in July 1973, U.S. General Services Administration (GSA) appointed a committee to review the present state-of-the-art in records protection and to make recommendations on improved fire protection practices for federal archives and records centers. This report is from that committee.

Bryan, John L. 1990. *Automatic Sprinkler and Standpipe Systems*. Quincy, Mass.: NFPA. This book is a detailed study of the functioning, engineering, and application of a variety of fire suppression systems utilizing water as the extinguishing agent.

"Building Materials List," 1999.

Custer, Richard L. P. and R. G. Bright. 1974. "Fire Detection: The State-of-the-Art." NBS Technical Note 829. Washington, DC: National Bureau of Standards, U.S. Dept. of Commerce.

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Morris, John. 1975. "Managing the Library Fire Risk." Berkeley: University of California Office of Insurance and Risk Management. This publication is an investigation of various aspects of fire prevention and control, with emphasis on the value of automatic fire protection systems. It contains descriptions of several library fires and a chapter on the salvage of wet books. It includes photographs, chapter bibliographies, and articles reprinted from fire journals.

Spawn, William. 1973. "After the Water Comes." *Bulletin of the Pennsylvania Library Association,* November, Vol. 28, pp. 243–251. This publication is an outline of the general principles for salvaging water-damaged materials. It presents a hypothetical disaster and details recommended salvage procedures. The importance of planning for disaster recovery, the necessity for prompt action, and the value of freezing wet materials are highlighted. Photographs are included.

UL Testing of Compact Shelving (two 7 ft high tests), 1990.

UL Testing of Compact Shelving (two 8 ft high tests), 1996.

F.3 References for Extracts in Informational Sections. (Reserved)

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- Committee votes by written ballot on Proposals. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Proposals (ROP) is published for public review and comment.

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Revise definition of effective ground-fault current path to read:

3.3.78 Effective Ground-Fault Current Path. An intentionally constructed, permanent, low impedance electrically conductive path designed and intended to carry ~~underground~~ electric fault current ~~conditions~~ from the point of a ground fault on a wiring system to the electrical supply source.

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