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NFPA 232AM Archives and Records Centers 1986

National Fire Protection Association Batterymarch Park, Quincy, MA 02269

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

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

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

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NFPA 232AM

Manual for Fire Protection for

Archives and Records Centers

1986 Edition

This edition of NFPA 232AM, *Manual for Fire Protection for Archives and Records Centers*, was prepared by the Technical Committee on Record Protection, released by the Correlating Committee on Storage, and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 18-20, 1985 in Baltimore, Maryland. It was issued by the Standards Council on December 10, 1985, with an effective date of December 30, 1985, and supersedes all previous editions.

The 1986 edition of this standard has been approved by the American National Standards Institute.

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

Origin and Development of NFPA 232AM

The Committee on Record Protection prepared this manual on Fire Protection for Archives and Record Centers as a source of guidance in planning fire protection for collections of records stored in large volumes. It supplements NFPA 232, *Standard for the Protection of Records*, which does not contain provisions for protecting large Archives and Record Centers. This document is neither a standard nor a recommended practice, but a manual that hopefully will give records managers and others charged with safeguarding large collections the information they need to intelligently plan for fire protection. The manual was first presented to the 1970 NFPA Annual Meeting which tentatively adopted it.

The revised 1980 edition was officially adopted on May 21, 1980 at the NFPA Annual Meeting in Boston, Massachusetts. It was released by the Standards Council on June 11, 1980. The 1986 edition is a reconfirmation of the 1980 edition and includes updates primarily to the referenced publications chapters.

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

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

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Chapter 1 Introduction

1-1 Scope. This manual applies to collections of records in file rooms exceeding 50,000 cu ft (1416 m^3) and to all archives and records centers.

Since its adoption in 1947, NFPA 232, *Standard for the Protection of Records*, has been the recognized standard for protection of records against fire. However, it is concerned primarily with relatively small quantities of records kept immediately accessible to the originator or user. NFPA 232AM covers facilities larger than contemplated in NFPA 232.

1-2 Purpose. The purpose of this manual is to provide guidance for firesafe storage in archives and records centers where the size or character of the records holdings is not contemplated in NFPA 232 and to give archivists, records managers, and others charged with safeguarding large collections the information they need to intelligently plan for fire protection.

1-3 Definitions. For the purpose of this manual, the following terms have the meanings indicated.

File Room. An area for the storage and reference of current records.

Records Center. A building or enclosure for the retention and reference of semicurrent records pending their ultimate disposition.

Archives. Noncurrent records preserved because of their historic value. Also applied to the building, structure or enclosure where they are deposited or retained.

Chapter 2 General

2-1 Types of Record Media. This manual concerns traditional paper records and records on magnetic, photographic, micrographic, and other special media. It is not possible to assure total fire protection of records in archives and records center facilities. It is possible, however, to provide a very high level of fire protection that would normally limit the potential loss of records in such facilities to a small amount. In view of this, it is important that the archivist or records manager knows the degree of protection available or, conversely, the degree of potential damage from the protection systems available for the archives or records center and determine which, if any, of the records need a higher level of protection available from the use of special vaults, safes, or insulated containers (*see NFPA 232, Standard for the Protection of Records*). It is essential that storage of cellulose nitrate film is not permitted in archives or records centers. (*See NFPA 40, Standard for the Storage and Handling of Cellulose Nitrate Motion Picture Film, and NFPA 232.*)

2-2 Arrangement. 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 is either cartons on freestanding shelving or filing cabinets. Locations may vary from a separate area within a general office complex to especially constructed records facilities. It is not uncommon to find records stored in basements or attics, in office spaces, in factories or warehouses, or in underground or other readily available facilities, all of various constructions and levels of firesafety. Keeping all records storage at least 3 in. (76 mm) above the floor will minimize the effect of flooding.

2-3 Fire Risk Evaluation Factors. In considering the protection of records stored in mass, several basic items to be evaluated are:

(a) Exposure from the building housing the records, from nearby buildings, or from neighboring operations; i.e., the possibility of involving the records in a fire originating outside of the records facility;

(b) Potential of fire initiation within the records facility, including the susceptibility of the records or containers to ignition;

(c) Potential of fire development presented by the stored records themselves, particularly as it relates to the available or proposed fire control capabilities or mechanisms;

(d) Potential impact of fire development in the stored records to the housing structure and adjacent operations;

(e) Fire control systems with the resultant extent and type of damage from fire, fire effects (heat, smoke, etc.), and fire extinguishing efforts (principally water and physical disruption of records necessary to effect manual firefighting); and

(f) Potential life threat to occupants and fire service personnel.

2-4 Exposure. A maximum amount of care or the most sophisticated of protection systems within the records storage area would be of little avail for records stored within a structure that burns as a result of some action or operation outside of the records area. A consideration of any archivist or records manager is the potential of the records being the victim of fire initiating external to the operations. The degree of additional risk imposed by neighbors varies according to the type and height of the building, the nature or hazard of the neighbors, and the type of protection the neighboring operations have. Any reasonable degree of protection for records stored in mass in any multistory building needs fire-resistive construction adequately designed to withstand the maximum fire impact of the exposing occupancy within. The same applies to single story buildings unless a proper fire wall

separates the records area from the remainder of the building. When records must be housed in a building that may burn around them, properly rated vaults, safes or insulated containers capable of resisting a total burnout (*see NFPA 232, Standard for the Protection of Records*) are the only known means of protection that can give reasonable assurance of records recovery. When a separate building or a segregated floor or section of a fire-resistive building is used for records storage, however, the methods described in the following chapters would provide a degree of protection commensurate with the type of system selected.

2-5 Facility Design. It may be necessary for many of those charged with planning, inspecting, approving, operating, and maintaining the facility to consult with an experienced and competent fire protection engineer on these matters.

Chapter 3 Fire Initiation

3-1 Fire Prevention Program. The most important factor in preventing fire loss in records facilities is the maintenance of a good fire prevention program based on good housekeeping, orderliness, maintenance of equipment, and absolute prohibition of smoking or use of open flame devices. All of these items are fundamental precepts of good records management. Experience has shown, however, that regardless of how careful or complete the fire prevention program, the risk of fire initiation through either human error or situations beyond the control of the archivist or records manager (as lightning striking the facility) is a distinct possibility, and any program based entirely on fire prevention activities will be perpetually at risk of a major disaster.

3-2 Operations in Records Storage Areas. Work within records storage areas is normally limited to placing records in, retrieving records from, or removing records from storage. Any additional operations introduce ignition hazards and are inappropriate in records storage areas.

Other fire risks in the records storage areas can be reduced by:

(a) The use of manual instead of power-operated equipment.

(b) The use of electric instead of gas-fueled fork lifts.

(c) 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.

(d) Prohibiting the storage of oils, paints, or other flammables in or contiguous to the records areas.

3-3 Metal Containers. In some facilities all of the records are kept in metal file equipment or equivalent metal containers (closed on six sides), and the arrangement, housekeeping, and operational methods prohibit the maintenance of any combustible materials whatsoever outside of the steel containers. Where the surrounding building and all materials involved in it are noncombustible, the risk of fire or the possibility of fire development may 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 where:

(a) All of the records are kept exclusively in metal file cabinets or equivalent metal cabinets (closed on all six sides);

(b) The arrangement, housing, and operational methods prohibit combustible materials outside of the metal containers; and

(c) The surrounding buildings and all materials involved in them are noncombustible.

3-4 Open-type Shelving. Records facilities use various shelf filing equipment, normally with the records either contained simply in file folders or in various styles of open or closed cartons. Typically, rows of records face each other across long service aisles about 30 in. (76.2 cm) in width. The exposed faces present a wall of paper. Paper has an ignition temperature of approximately 450°F (232°C). Where exposed files are involved, 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 a simple match could ignite them. Ignition of a few pieces of paper, such as might occur on a service cart, could readily ignite the faces of the boxes.

3-5 Mobile Shelving. Records facilities in which shelving is mounted on rollers, usually on tracks, are used to conserve space. One aisle is provided for a series of shelving units, and, to gain access to a particular shelf, units are moved manually or by a motor until the aisle appears at the desired shelf unit. 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 may be expected except in the exposed aisle, where a fire would be similar to that in open-type shelving.

3-6 Fire Retardant Treatments. Some attempts have been made to develop economical methods of increasing the fire resistance of typical records storage cartons. The most frequently attempted method is coating the cartons with an intumescent type of fire retardant paint. Tests of cartons protected by such paint properly applied show that the coating prevents actual ignition of the cardboard. However, intumescent paint does not intumesce effectively under about 400°F (204°C). The temperature of even a small exposure fire (such as might occur on a library cart) would weaken the paper in the box to the point where the box would break 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 the 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 Committee on Record Protection and the U.S. General Services Ad-

ministration, the effect of 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. In essence, the fact that paper is in the form of a records container does not change its inherent characteristic of easy ignition and rapid fire development.

Chapter 4 Fire Development

4-1 Metal Containers. Where all of the records housed are contained within closed metal file equipment, transfer cases, or similar containers (whether or not of the insulated type) such that no fuel is exposed to flames outside the containers, and there are no other combustibles in the area, there would not be any significant fire development from most initiating sources. Fire spread from a significant ignition source would be very slow.

4-2 Open Shelving.

4-2.1 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., and Factory Mutual Research Corporation and in tests conducted on 6-ft (1.8-m) high archives shelving arrangements by the U.S. General Services Administration. In each instance the initiating fire was small (two pounds 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 Factory Mutual 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 which could be approached and easily extinguished if promptly discovered. The period of low-level development lasted between a minimum of about three minutes to a maximum of about 12 to 15 minutes, with the average about five minutes. During this period the fire was directly approachable, heat levels were not high; however, significant quantities of smoke were produced. The temperature levels at the ceiling were sufficiently low so that it is 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 one minute, but fire was judged to be beyond portable extinguisher control in less than three minutes, providing little justification for the cost of installing smoke detection systems in this case.

4-2.2 Full Fire Development. By the end of the relatively short early development stage in each of the tests described above, 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 capability of attack by simple portable extinguishers. Fire development moved 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 Factory Mutual tests, however, loose records in boxes were released by the fire and exfoliated into the aisle, providing very rapid acceleration of the fire and something approaching full fire development in a limited area, perhaps 60-70 sq ft (5.6-6.5 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 control of modest local forces employing small hose. Prevention of exfoliation of burning paper apparently served to avoid the dramatic increase in fire intensity.

4-2.3 Fire Severity Potential. Unless fire development is stopped by either manual or automatic fire extinguishment, the entire records storage in one room or floor could quickly become involved in fire. The extension of the fire and the extent of damage would be directly related to the total quantity of combustibles involved. The severity of a fire is approximately one hour for each 10 lbs per sq ft (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 lbs per sq ft (49 kg/m^2) for each shelf height of storage. A typical center with records stored seven shelves high contains approximately 70 lbs of fuel per sq ft (342 kg/m^2) of floor area, and in one where records are stored 15 shelves high, the weight of paper would approximate 150 lbs per sq ft (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 is particularly important in any case where records are stored in a multistory building.

4-2.4 Inherent Fire Capacity. Any archives or records centers using open-type shelving have the inherent capability of not only self-destruction of the records holdings but also destruction of the facility itself and the neighboring operations unless all fires are stopped in their early stages.

4-3 Mobile Shelving.

4-3.1 Initial Fire Development. Tests conducted by Factory Mutual Research Corporation for the U.S. General Services Administration and U.S. 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. The length and height of mobile units is determined by available space, loaded weight, access time, and other factors. For practical reasons, 25 ft (7.6 m) is a practical limit for length. 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, giving some opportunity for control and extinguishment by a public fire department if the fire is discovered and reported promptly.

4-3.2 Fire Severity Potential. The potential for a total burnout of a records facility is exactly the same as for a similar amount of records on open shelving, except that for a fire to spread beyond control of a municipal fire department will take considerably longer with mobile shelving.

4-3.3 Inherent Fire Capacity. Like records stored on open shelving, records stored on mobile shelving have the inherent capability to self-destruct and destroy the facility itself. Slow spread of a fire within the shelves improves the chance of outside aid being effective.

Chapter 5 Fire Control

5-1 General. The basic elements of fire control are twofold — detection of the fact that a fire exists, plus its extinguishment. The individual efficiency and capability of both the detection and extinguishment actions determine the ultimate degree of safety or, conversely, the extent of damage in case of fire.

5-2 Water. Most archivists or records managers have a very significant concern about water damage. In view of the constant problems involved in leakage of domestic water systems, steam mains, rain intrusion from leaky roofs or windows, and the resultant damages from mildew or decomposition of paper, this concern is readily understood. It is important, however, for the archivist or records manager to realize that wet records can be recovered, but burned records cannot. Also, unless there is a specialized fire extinguishing system to control the development and growth of a fire, responding fire fighting forces would 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 would have to attack a fire from a distance and under very adverse conditions. This would normally force the department to use heavy hose streams having the characteristics of a hydraulic ram. Wide and forceful disruption of the records storage arrangement would be a normal effect of efforts to prevent total destruction.

5-3 Salvage. Recovering wet records is a problem whether the records are wet or damp as a result of a fire or from another source, such as flood, hurricane, heavy rainstorm, roof leakage, spillage from operations located above, or a breakdown of any of the numerous water or steam systems in the building. Virtually any wet paper records can be recovered, provided prompt and proper action is taken. Effective salvage requires prompt action, special techniques, facilities, and expert advice. Preplanning is essential.

NOTE: Archivists and records managers interested in pursuing this point further should obtain a copy of NFPA 910, *Recommended Practice for the Protection of Libraries and Library Collections from Fire*, which contains Appendix E on "Salvage of Wet Books," and the Federal Fire Council Recommendation Practice No. 2, "Salvaging and Restoring Records Damaged by Fire and Water" is available from the Clearinghouse, U.S. Department of Commerce, Springfield, Virginia 22151. Salvage of wet records from the 1973 fire at the Military Personnel Records Center, St. Louis, Missouri, 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 and bibliography on the care, repair, and restoration of library materials by George M. and Dorothy G. Cunha, (Metuchen, NJ: The Scarecrow Press, Inc., 1971; two volumes; LC #77-163871). Volume I is the manual and Volume II is the bibliography.

5-4 Fire Extinguishers. Regardless of 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. It is desirable that the type of extinguishers provided be the trigger action type in which the flow can be started and stopped by the operator. More thorough coverage of extinguishers is provided in NFPA 10, *Standard for Portable Fire Extinguishers*. Gaseous extinguishers are not effective for extinguishing deep-seated fires in paper materials. The presence of proper extinguishers would enable the working or guard force, on discovering a fire or responding 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 such local forces are properly instructed in the use of small extinguishing appliances.

5-5 Fire Departments. The fire department is an essential part of any fire protection. The role that the fire department plays depends on the type and capabilities of an automatic extinguishment system. 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 could be expected that the fire department would be forced to make a massive attack because of the size and position of the fire at the time of arrival. The actions of fire fighters are limited by their tolerance to heat and smoke. To reach the actual seat of the fire, the fire department may undertake actions disruptive or damaging to records that are not actually burning. Rows of records may block access to the seat of the fire. High density smoke may conceal the seat of the fire. To save the structure and to prevent propagation of the fire to other areas, it may be necessary for the fire fighters to disrupt the storage arrangement in unignited areas to obtain access to the ignited area or to place high-pressure hose streams in a general sweeping action, attempting to provide a general cooling/quenching effect. In any sizable records facility the total fuel would certainly require the use of heavy hose streams (in some communities fire departments have the capability and would likely use monitor- or snorkle-type hose streams). Properly constructed fire walls (confining the fire to a single fire area) would assist a fire department in limiting the size of a fire. All of the records within the fire area would probably be seriously affected by either fire or water from the high pressure streams or both.

5-6 Role of Fire Department and Extinguishing Systems. When an automatic extinguishing system of proper design is provided, the role of the fire department changes to one of assisting and supplementing the

automatic extinguishing system, rather than direct fire attack.

5-6.1 If the system is an automatic sprinkler system, the primary actions of the fire department would be 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 reignition. For additional information see NFPA 13E, *Recommendations for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems.*

5-6.2 Where a total flooding carbon dioxide or Halon 1301 system is provided and has been successful in its operation, the prime purpose of the fire department would be to vent the gas and to prevent the possibility of rekindling by wetting and removing the materials that were actually ignited. The phasing out of the carbon dioxide gas is a critical period, and, unless the smothering action has been totally effective, rekindling of a serious fire can occur. This is a very critical point and should be executed only with the full capabilities of the fire department standing in readiness.

5-6.3 If high expansion foam is used, the operation of the fire department would be to assist in removal of the foam and to extinguish any small glows (deep-seated fires) or flames that may be found as the foam is removed. Depending on the situation, it may be desired to continue the presence of the high expansion foam for a soaking period. The period of time that the foam is kept in place, however, affects the degree of wetting. It is, therefore, desirable that overhaul procedures be carried out rapidly but cautiously, with extinguishing equipment standing by in readiness.

5-7 Fire Department Preplanning. Essential in all systems of fire control is fire department preplanning for attack in specific locations. It is important that the archivist or records manager contact the appropriate chief officer of the responding fire department and work out prefire planning arrangements with him. The best extinguishing system can be defeated if a fire officer, for lack of proper knowledge, makes improper use of it or prematurely removes an automatic system from operation. Conversely, lack of knowledge and a sense of caution may cause him to keep an extinguishing system in operation for an excessive period of time, increasing damage to the records from the extinguishing agent.

Chapter 6 Fire Control Systems

6-1 Detection.

6-1.1 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. (*See Section 5-5.*) 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. Detection of fire, while vitally important, does not in itself prevent fire damage. Detection must be followed by extinguishment, which includes the use of fire extinguishers or other first aid fire appliances by personnel or guards of the facility, 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 can also affect the extent of fire damage.

6-1.2 Human Detection Capabilities. An evaluation of the various methods of fire detection will recognize that any detection system that relies only on casual observation by persons external to the records storage is undependable, and a facility which depends upon detection by passersby is at risk of total burnout. Some record centers assign responsibility for fire detection by providing watchmen or guards around the clock or a combination of employee responsibility during the workday and watchmen or guards during the remainder of the period. While this approach is superior to dependence on casual observation, it must be considered very limited. (The major fire at the Military Records Center at St. Louis was first reported by a passerby, although the building had guard patrols.) As previously described, the period during which such observation could detect and react to a small fire situation is quite limited if, for instance, a fire were to initiate within the service aisles of the stack area. Since this is usually the most critical and damaging type of fire, it is considered to be the most necessary for early detection. Normally, guard rounds are regulated at intervals of one 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 on peripheral situations, such as a small office fire. They also can function in fire prevention programs. They are, however, of limited value in controlling a fire in record shelving, except to call the fire department.

6-1.3 Heat Detection. Heat detection equipment, either fixed temperature or rate-of-rise, is used, at times, in records facilities. As described in Chapter 4, Fire Development, 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. It may severely challenge the municipal fire department by the time they are summoned and set up o 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. It may severely challenge the municipal fire department by the time they are summoned and set up operations, thereby complicating the fire-fighting problems and resultant records damage. On the other hand, if the heat-actuated detection equipment is used to operate an automatic fire control system, it could provide a very effective service.

6-1.4 Automatic Sprinkler Detection. In considering detection systems that cause 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 which opens (fuses) when heated to a preset temperature. When the automatic sprinkler system is equipped with a waterflow detection device, the sprinkler system becomes inherently a fixed temperature fire detection system as well as an automatic water extinguishing system. For this reason the detection of waterflow 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 which activates the building fire alarm system and thus transmits the alarm.

6-1.5 Early Warning Detection. These devices, known generically as smoke detectors, respond to either the visible (smoke) or invisible (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, they can give warning very early in the fire development.

6-1.5.1 Listed or approved smoke detectors include ionization type, photoelectric beam or spot type, infrared type, etc. It is possible, if the need warrants, that these early warning systems may activate associated fire extinguishing systems. These may be considered as part of the overall system in any important record collection where a smoldering fire is possible.

6-1.5.2 Total dependence on the 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.

6-1.6 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 desire to obtain the earliest possible knowledge of the existence of a fire. The various types of air movements, including stratification caused by heating or other air-handling systems, as well as that provided by the records storage arrangement, are important considerations. It is best practice that the system be capable of detecting and locating the presence of fire in any portion of the records storage area within a brief period of time. While the time element specified will directly affect the cost of the system, it will also affect the extent of the damage. Generally, the shorter the time for detection, the higher the cost of the system. For further information refer to NFPA 72E, *Standard on Automatic Fire Detectors*.

6-1.7 Protective Signaling Systems. Heat and smoke detectors as described in 6-1.2, 6-1.3, 6-1.4 and 6-1.5 require a signal transmission system to report the fire to the fire department, sound the local alarm, and/or activate fire suppression systems, ventilation controls, etc., as appropriate. Installation requirements and recommendations for signaling systems are detailed in NFPA 71, 72A, 72B, 72C, and 72D. Each of these systems is briefly described as follows:

(a) *Central Station Signaling Systems (NFPA 71).* This type of an alarm system directs the transmission of an emergency signal to an accredited central station. In turn, the central station will alert the public fire department. Regular testing and maintenance are normally the contractual responsibility of the central station operator.

(b) *Local Protective Signaling Systems (NFPA 72A).* This type of an alarm system, though essentially designed as an evacuation building alarm for life safety purposes, is capable of providing an audible emergency signal to anyone in attendance and who may be in a position to take emergency action.

(c) *Auxiliary Protective Signaling Systems (NFPA 72B).* This type of an alarm system deals with direct connection to a municipal fire alarm system (manual street fire alarm boxes) by means of an "auxiliarized" circuit to the nearest manual fire alarm station. A split responsibility exists for testing and maintenance needs between that portion of the system owned by the municipality and that which is privately owned.

(d) *Remote Station Protective Signaling Systems (NFPA 72C).* This type of transmission system incorporates a direct connection, by the use of leased wire facilities, to a fire department alarm headquarters. Testing and maintenance requirements are normally the contractual responsibility of the accredited organization that provides the service.

(e) *Proprietary Protective Signaling Systems (NFPA 72D).* This type of system typically exists within a single large privately owned or governmental complex of buildings. The transmission of the emergency signal is directed to a central headquarters, also similarly owned and operated and which is fully manned 24 hours a day as well as equipped to provide a permanent record of all emergency signals.

6-2 Automatic Sprinkler Systems.

6-2.1 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 their concern with water damage. Three factors serve to dispel this reaction:

(a) Sprinklers actually constitute a method of fire control involving a minimum rather than a maximum of water.

(b) Each sprinkler operates individually and the operation of any one does not cause the operation of any other sprinkler; therefore, only those sprinklers in the heat of the fire operate and discharge water.

(c) Wet records are recoverable; burned records are not recoverable.

6-2.1.1 The probability of sprinkler operation at a time when no fire exists is insignificant.

6-2.1.2 Because of the rapid heat development in records storage areas, high temperature ratings of the sprinklers [250°F to 300°F (121°C to 149°C)] are commonly used in lieu of the ordinary rating [135°F to 170°F

[57°C to 77°C)], to limit the number of sprinklers that would operate in a fire to those which must directly act in extinguishment. (*See NFPA 13, Standard for the Installation of Sprinkler Systems.*)

6-2.2 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 of time, excessively wetting the records underneath, even though it had already successfully extinguished the fire. The waterflow alarm feature, in addition to signaling the existence of a fire, will also detect the flow of water in the rare instance of accidental or malicious damage to the system.

6-2.3 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 could be expected to be undertaken successfully. Both tests and fire experience have shown that sprinklers can be expected to confine the fire to a relatively small portion of the row of shelving where the fire started. The sprinkler discharge would not necessarily extinguish fire concealed under the shelves or inside mobile shelving. It would definitely slow down or prevent further fire propagation, remove the heat, and prevent further damage or collapse of the stack equipment. Thus, fire fighters entering the building could approach the seat of the fire and use small hose streams to quench the glowing or flaming areas.

6-2.4 Sprinklers — Expected Results. In a normal situation, it is probable that in a sprinkler protected facility fire would be confined to an area of between 100 and 500 sq ft (9.3 and 46.4 m^2). Water damage would consist primarily of superficial wetting of cartons in those areas where cartons were involved, or edge and bottom wetting of open file records. The areas of water damage to the degree described above would probably extend about 10 to 20 ft (3.0 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 direct impact of water and considerably drier. It is expected that total extinguishment and shutdown should take place normally before failure of the corrugated or pressboard cartons. In this respect, cartons with wire-stapled lap-joints (rather than glued) are less likely to fail. Containers that are die cut for assembly without use of glue or staples are also well-suited as protection against water damage and for avoiding possible injury and corrosion problems involved 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 will probably cause only minimum 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.

6-2.5 Sprinklers — Special Systems. There are four special types of sprinklers that lend themselves to records protection. (For installation details refer to NFPA 13, *Standard for the Installation of Sprinkler Systems.*) They are:

(a) The 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 detect the development of a fire. As in the wet-pipe system, individual sprinklers are fused so that only those directly over the fire will 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 accidentally or deliberately broken. It is more expensive than a wet-pipe system in that a complete detection system is required in addition to the sprinkler system. It is less reliable than a wet-pipe system in that it will not operate if the detection system is inoperative.

(b) The Recycling System is an adaption of the pre-action sprinkler system with a recycling feature. When the sprinkler or sprinklers have extinguished the fire and the heat drops below a pre-set temperature [such as 140°F (60°C)] the detectors cause a timing cycle to start that automatically discontinues the water flow by closing a special valve in about 5 minutes. The system remains in readiness, and, should the fire redevelop, it would cycle and start again. 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 shut the valve accidentally.

Like the pre-action system, the recycling system requires a separate detection system. Since the system is designed to recycle, the detection system must be fire resistant and thus somewhat more expensive. An advantage of the recycling system over other sprinkler systems is that if the system shuts off prematurely (fire continues or rekindles), it is reactivated automatically when the ceiling temperature increases.

(c) *On-Off Sprinkler Heads.* Sprinkler heads are available which have a recycling feature. Installed on wet-pipe sprinkler systems, each head operates individually at a predetermined temperature, but when the temperature drops below the predetermined temperature, the head shuts off. Each head works independently, on and off, depending upon the fire situation in its immediate area. No separate detection system is required. The technology of the on-off heads is relatively new, and long term reliability data are not available.

(d) *Dry-Pipe Sprinkler Systems.* Also of interest for protection of records storage is the dry-pipe system. The sprinkler piping is filled with compressed air. The release of air pressure, as through a fused sprinkler head, allows the water valve to open and supply water to the sprinkler piping. Each head operates independently, as do all other types in this section. Releasing air pressure through a fused sprinkler head takes appreciable time, during which the fire may grow and open additional sprinkler heads. Dry-pipe sprinkler systems are used primarily for protection of unheated areas where freezing may occur.

6-3 High Expansion Foam.

6-3.1 General. High expansion foam is a total flooding medium, meaning that it inundates the protected space with the extinguishing agent. The foam surrounds all the

materials within the protected area with an aggregate of bubbles, each of which carries a small amount of water. The characteristics of high expansion foam are more extensively covered in NFPA 11A, *Standard for Medium and High Expansion Foam Systems.*

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 it did not penetrate normal corrugated fiberboard cartons. (Cartons with stapled or interlocking edges tend to hold up quite well, while 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 found necessary to take corrective drying action on all the materials within the area contacted by the foam.

NOTE: Data on these tests is published in an Atomic Energy Commission report, "High Expansion Foam Fire Control for Records Storage Center," IDO-12050, March 1966. Available from the Clearinghouse, U.S. Department of Commerce, Springfield, Va. 22157. See also Beers, R.J., "High Expansion Foam Fire Control for Record Storage," Fire Technology, Vol. 2, No. 2, May 1966, pp. 108-117.

6-3.2 Design of High Expansion Foam System. NFPA 11A, *Standard for Medium and High Expansion Foam Systems*, states the minimum requirements and design of systems that would provide adequate protection. There are three types of high expansion foam systems available: total flooding systems, local application systems, and portable foam application devices. For the purposes of this manual, 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 require maintenance of sufficient foam to submerge the hazard, length of time of coverage of the hazard, and minimum rate of discharge to compensate for breakdown of foam by sprinkler discharge, shrinkage, fire and other factors. High expansion foam systems require venting, closure of openings through which foam would escape, and maintenance of foam to cover the hazard to ensure control and extinguishment of fires. The rate of application of high expansion foam is high, and a large vent area is needed for the displaced air. Automatic activation of the system is by a heat detection system similar to that discussed for other systems.

6-4 Gaseous Extinguishment.

6-4.1 General. Extinguishment by total flooding with gas is favored by many archivists and records managers on the basis that, if no water is applied to a fire, no water damage occurs and salvage problems are simplified. Two principal gases for this application are Halon 1301 and carbon dioxide. Total flooding involves filling the entire protected volume with a specific concentration of gas.

6-4.2 Halon 1301 Gas Systems. While 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 (bromotrifluoromethane) is a liquefied gas under pressure, which is an effective flame-inhibitor while at the same time exhibiting low toxic and corrosive properties. Design is covered by NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems.* Use of this agent for total flooding applications in records storage facilities has been limited, and installation should be attempted only with expert guidance.

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

6-4.3 Carbon Dioxide Systems.

6-4.3.1 General. 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 is critical. (The basic reference in this area is NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems.*)

6-4.3.2 Systems for record storage protection are designed to provide a concentration of 65 percent in the protected space, to control stratification, and to maintain soaking for 30 minutes. Openings not required for pressure venting must 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 only be assured by actual testing to make sure that the design concentration will be achieved and maintained for the full soaking period.

6-4.3.3 Since atmospheres containing fire extinguishing concentrations of carbon dioxide will not sustain life, it could be fatal to be trapped in the flooded space. Ample warning and time delay must be given prior to discharge to allow occupants to escape from the area to be flooded. A person could not safely leave the area after the discharge starts. Provision is made for exhausting the atmosphere after the soaking period without creating a hazardous atmosphere in another location.

6-4.3.4 For effective fire control, the activation of the carbon dioxide system should be automatic in response to fire, triggered by a properly designed and installed heat detection system.

6-4.3.5 Discharge of carbon dioxide may cause condensation of humidity (fogging) which can obstruct vision.

6-5 Comparisons of Extinguishing Systems.

6-5.1 There are a number of factors involved in comparing extinguishing systems. Original 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 for consideration. All automatic systems are damage initiated; a fire must be established which causes damage before an automatic system detects and reacts. Generally, the smaller the fire a system will detect, the more sensitive it is and the more subject it is to false operation. 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.

6-5.2 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 assurance against water damage, introduce failure potentials in the system and can slow system functioning in a fire and result in a larger fire to extinguish. In a fire, only sprinklers in the immediate vicinity of the fire are activated. In the Factory Mutual full-scale test series, with sprinklers located as unfavorably as possible, the three tests opened six, 16 and three sprinklers, respectively. This covered 600, 1600 and 300 sq ft (56, 149 and 28 m^2) out of an installed array of 77 heads which represented a facility having approximately 400 heads. In these tests, as in most records fires, whatever the extinguishment means, final extinguishment was by hoseline. All of the records wetted but not burned were recoverable.

6-5.3 Detectors are available which will react to a spark, but the most sensitive used in a records center is a smoke detector. When used for discharging agent, it is usually desensitized by requiring two detectors on alternate circuits to react prior to agent discharge. Although smoke detectors react promptly when exposed to smoke, a smoldering fire does not have the "lift" to carry smoke to a high ceiling, and detectors generally react to a smoldering fire after a long period by process of diffusion. A strong heat column from a brisk flaming fire will cause a smoke detector to operate promptly, but heat detectors, including sprinklers, also react quickly to this type of fire. Full-scale fire tests (*see 4-2.1*) showed little advance warning in flaming fires in a records center by smoke detectors.

Detectors are of value only to initiate extinguishment and life safety warnings. To initiate manual extinguishment by local forces is advantageous in that an incipient fire may be discovered and extinguished with minimal damage by employees using extinguishers or hand hose. If fire is more than incipient, employees are at hazard because of lack of experience, breathing equipment, and protective gear. A municipal fire department is much better equipped for manual fire fighting with protective gear, heavy hose streams, and broad experience. The times required for discovery, reporting, travel, and setup may result in an established fire beyond manual control by municipal forces, as occurred in the unsprinklered Military Personnel Records Center fire and many other fires in records centers.

6-5.4 Gaseous extinguishment has the potential for least damage if all elements 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 would occur if an archives or records center fire were allowed to become well-developed before application of the extinguishing gas. Gas leakage through a blocked-open door, a temporary opening, or a fire-caused breach could also result in a failure. Gas extinguishing systems, using more sensitive detectors, are used mainly on incipient fires to minimize damage and because the larger the fire, the less assured is extinguishment. Using more sensitive detection results in more false operations, which are undesirable because of the high cost of agent and because of hazards to personnel. All materials in the enclosure are equally treated by the gas, whether near the fire or away from the fire. Final extinguishment is usually performed by the fire department using hose streams. If the area is obscured by smoke, which is likely, directing hose streams may be haphazard and result in widespread water damage.

6-5.5 Automatic high expansion foam has the capacity to overcome a well-established fire and in this factor is much superior to gaseous extinguishment and better than sprinklers. Like gaseous extinguishment, high expansion foam will escape through unclosed openings, although a very lightweight partition such as fine mesh screen will contain it. Also, like gas, all materials in the enclosure are equally exposed to the extinguishing agent. As the foam will dampen kraft boxes (and perhaps loosen identification labels) all materials in the enclosure are damaged slightly and must be dried. Final extinguishment by fire department hose streams will probably be required.

6-6 Installation and Maintenance of Systems and Equipment. To provide reasonable assurance that a fire detection control system, appliance, or device will perform satisfactorily, it is necessary that the installation be in compliance with the recognized standards, the manufacturer's instructions, and that complete operational tests be conducted.

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

Chapter 7 Referenced Publications

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

are listed separately to facilitate updating to the latest edition by the user.

7-1.1 NFPA Publications. National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 10-1984, *Standard for Portable Fire Extinguishers*

NFPA 11A-1983, *Standard for Medium and High Expansion Foam Systems*

NFPA 12-1985, *Standard on Carbon Dioxide Extinguishing Systems*

NFPA 12A-1985, *Standard on Halon 1301 Fire Extinguishing Systems*

NFPA 13-1985, *Standard for the Installation of Sprinkler Systems*

NFPA 13E-1984, *Recommendations for Fire Department Operations in Properties Protected by Sprinker and Standpipe Systems*

NFPA 40-1982, *Standard for the Storage and Handling of Cellulose Nitrate Motion Picture Film*

NFPA 71-1982, *Standard for the Installation, Maintenance and Use of Central Station Signaling Systems*

NFPA 72A-1985, *Standard for the Installation, Maintenance and Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm and Supervisory Service*

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

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

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

NFPA 72E-1984, *Standard on Automatic Fire Detectors*

NFPA *101*-1985, *Life Safety Code*

NFPA 232-1980, *Standard for the Protection of Records*

NFPA 910-1985, *Recommended Practice for the Protection of Libraries and Library Collections.*

Appendix A

Specimen Specification for Firesafe Construction of Archives and Records Centers

It is emphasized that this is a specimen specification only, and in no way should it be construed as overall fire protection requirements for archives and records centers. Other systems of fire protection can equally well fulfill the records management fire protection needs.

This appendix is a specimen specification adapted from instructions provided to an architect for guidance in the development of plans for a proposed records center and archives. The fire protection system selected for the facility is based on automatic sprinkler protection.

Height. Multistory and subgrade construction should be avoided for archives and records center storage areas. There is no recognized construction which will support a building above an uncontrolled archives or records center fire. Observations on the Military Personnel Records Center fire in St. Louis in 1973 indicate that a fire in a lower floor of a multistory building with sprinklers not installed, shut off, or inadequately designed will result in total loss of the building, no matter how it is subdivided, unless the fire load is less than the structural fire resistance.

Area. There is no firesafety limit on the total building area. A management determination should be made of the acceptable ultimate loss limit in case of extinguishing system failure. A major records keeper limits storage in a single fire subdivision to about 200,000 cu ft (5663 m^3) of records, archives, or other important collections.

Fire Walls. All walls separating records storage areas from each other and from other portions of the building shall be 4-hour fire-resistive fire walls. In addition to fire resistance, all fire walls shall be structurally sound and capable of standing impact and imposed loads if severe fire exposure would cause collapse of the framing members on one side of the wall. All openings in fire walls shall be protected on each side by fire doors suitable for Class A openings. No ducts shall pass through fire walls that separate two records storage areas. Properly protected duct passes may be established between records storage areas and corridors or office areas. Fire walls should be erected preferably without expansion joints. If expansion joints are essential, they shall be protected with Number 10 iron astragals lapping the opening on each side of the wall and floor or a tested and approved fire resistant joint material.

Columns. Building columns located within the records storage area shall be 2-hour fire-resistive from the floor to the point where they meet the roof-framing system.

Roof. Roofs shall be noncombustible. If framing is simple, no fire resistance is required, except that the roof shall have an inherent fire resistance of at least 10 minutes so that it will not fail or deform prior to sprinkler operation. However, should the sprinklers fail for any reason, it would be advantageous for the roof to vent freely, which would permit the fire department to make a close approach to the fire. Precast concrete panels simply supported on steel beams, for instance, would provide such catastrophe prevention.

Any continuous members or other framing systems having a direct effect on more than one structural bay shall be of 2-hour fire resistance. No portions of the roof framing shall pass across a fire wall.

Light Fixtures. Light fixtures for lighting stacks shall not be more than 9 in. (22.9 cm) wide, including the maximum width of the reflector. The fixture shall be of all-metal construction and shall be equipped with thermally protected ballasts. The lowest point on any fixture shall be at least 12 in. (30.5 cm) higher than the top of the highest records storage.

Air-Handling. The air-handling system shall be designed so that it can be manually converted to total out-

side air and used for emergency smoke removal. All ducts shall be steel. Ducts may be above or below the roof level, but shall be coordinated with the sprinkler system to maintain full distribution and required clearances from maximum records storage height.

Exits. Exits shall comply with the requirements for storage facilities in NFPA *101®*, *Life Safety Code®*.

Heating. Any furnaces or boilers shall be separated from the records storage by a 4-hour fire wall, with no openings directly from the furnace or boiler room to the records storage areas. No open flame (oil or gas) equipment shall be used in any records area.

Service Aisles. The stack arrangements shall be such that there will be no dead-end aisles. Where stacking runs perpendicular to the wall, it shall terminate at least 18 in. (45.7 cm) from the wall.

Loading Docks. Loading docks shall be separated from records areas by 4-hour fire walls with proper fire door protection and 2-hour fire partitions from any other portions of the building.

Vaults. Vaults shall conform with the requirements for 4-hour, ground-supported, fire-resistive vaults as defined in NFPA 232, *Standard for the Protection of Records*.

Automatic Protection. All records storage areas, loading docks, corridors, offices, service areas, or other space within the general records storage area shall be sprinkler protected. Sprinklers shall be rated at 286°F (141°C). For storage heights up to 14 ft (4.3 m), systems shall be hydraulically designed to deliver a minimum rate of water application of 0.30 gpm per sq ft (0.20 L/s/m²) for the most remote 1,500 sq ft (139 m²) of floor area. The design area should be increased to 2,000 sq ft (186 m²) if expanded metal catwalks are used. Positioning of sprinklers above floor shall be such as to provide complete unobstructed coverage with at least 18 in. (45.7 cm) clearance from highest stacking height (from top of highest stored container).

Water Supply. If the water supply for the records center is of a design whereby both sprinkler protection and fire hydrants are taken from the same source, the water supply system shall be capable of delivering the sprinkler demand plus at least 1,500 gpm (95 L/s) for fire department hose streams. The system shall be capable of delivering the maximum capacity requirement [3,000 gpm (189 L/s)] for a period of at least 2 hours.

A dependable water supply virtually free of interruption is required. This will frequently but not universally require a two-source system. A single-feed main from the public water system would not be considered a dependable source. Two feeds from different points in the public system separated by at least one sectional valve in the public system would be considered satisfactory if dependable facility fire pumps are provided. An on-site reservoir with both electric motor and internal combustion engine-driven pumps is another example of a single, but adequate and dependable, supply. Any two-source system with sufficient pressure and capacity in each source is, of course, also satisfactory.

Interior Hose Stations. Interior hose stations connected to the sprinkler systems and conforming to the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, shall be provided in such a manner that any point in the stack area can be reached by a 50-ft (15.2-m) hose stream from a 100-ft (30.5-m) hose lay. Each hose station shall be provided with a rack and reel capable of holding 100 ft (30.5 m) of 1½-in. (38-mm) rubber or latex lined hose. A hose and a shutoff-type nozzle shall be provided.

Fire Hydrants. Fire hydrants shall be located so that each entrance or other access to the facility that could be used by fire fighters shall be within 250 ft (76.2 m) of a fire hydrant. All hydrants shall be at least 50 ft (30.5 m) away from the building wall and adjacent to a roadway usable by fire apparatus.

Alarm System. The building shall be provided with a fire alarm system which complies with NFPA 72A, 72B, 72C, or 72D. Manual boxes shall be located at each of the exits from stack areas and each of the exits from the building. No other fire alarm boxes shall be located in stack areas. The fire alarm system shall be provided with central station service or other automatic means of notifying the municipal fire department. The system shall be operable from manual boxes, sprinkler waterflow, and any automatic fire detectors and arranged to indicate the area of initiation.

All water control valves on the sprinkler systems or other principal valves on the fire protection system shall be provided with tamper supervision. Tamper supervision shall be separate from the manual fire alarm system.

Electrical Equipment. No transformers, regardless of size, except thermally protected devices included in flourescent light ballasts, i.e., Class P ballasts, shall be permitted within the stack areas. All electric control boxes and light switches shall be located at the main entrance to the stack area.

Emergency Vents. Automatic emergency heat and smoke vents shall not be provided.

First Aid Fire-Fighting Equipment. Water-type fire extinguishers [2½-gallon (9.5-L) stored pressure type] shall be provided at each fire alarm striking station.

Appendix B Referenced Publications

B-1 The following documents or portions thereof are referenced within this manual for informational purposes only and thus should not be considered part of the recommendations of this document. The edition indicated for each reference is current as of the date of the NFPA issuance of this document. These references are listed separately to facilitate updating to the latest edition by the user.

Bryan, John L. *Automatic Sprinkler and Standpipe Systems*. Boston: National Fire Protection Association, 1976, 402 pp. illus., bibliography.

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.

Custer, Richard L. P. and R. G. Bright. *Fire Detection: The State-of-the-Art*. NBS Technical Note 839. Washington, DC: National Bureau of Standards, US Dept. of Commerce, June 1974, 110 pp., illus., bibliography.

Morris, John. *Managing the Library Fire Risk. Berkeley: University of California Office of Insurance and Risk Management,* 1975, 99 pp.

Investigates various aspects of fire prevention and control, with emphasis on the value of automatic fire protection systems. Contains descriptions of several library fires and a chapter on the salvage of wet books. Includes photos, chapter bibliographies, and articles reprinted from fire journals.

Advisory Committee on the Protection of Archives and Records Centers. *Protecting Federal Records Centers and Archives From Fire*. Washington, DC: General Services Administration, April 1977, 202 pp., illus., bibliography.

Following the disastrous fire in the military personnel records center in Overland, Missouri in July 1973, 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 book is the report of that committee.

Waters, Peter. *Procedures for Salvage of Water-Damaged Library Materials*. Washington, DC: The Library of Congress, 1975, 30 pp.

The most comprehensive and up-to-date manual on the salvage of water-damaged materials. 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 the emergency occurs. Free from Library of Congress.

Federal Fire Council Recommended Practice No. 2 (see page 8). (See also page 16.)

SUBMITTING PROPOSALS ON NFPA TECHNICAL COMMITTEE DOCUMENTS

Contact NFPA Standards Administration for final date for receipt of proposals on a specific document.

INSTRUCTIONS

Please use the forms which follow for submitting proposed amendments. Use a separate form for each proposal.

1. For each document on which you are proposing amendment indicate:
   (a) The number and title of the document
   (b) The specific section or paragraph.

2. Check the box indicating whether or not this proposal recommends new text, revised text, or to delete text.

3. In the space identified as "Proposal" include the wording you propose as new or revised text, or indicate if you wish to delete text.

4. In the space titled "Statement of Problem and Substantiation for Proposal" state the problem which will be resolved by your recommendation and give the specific reason for your proposal including copies of tests, research papers, fire experience, etc. If a statement is more than 200 words in length, the technical committee is authorized to abstract it for the Technical Committee Report.

5. Check the box indicating whether or not this proposal is original material, and if it is not, indicate source.

6. If supplementary material (photographs, diagrams, reports, etc.) is included, you may be required to submit sufficient copies for all members and alternates of the technical committee.

NOTE: The NFPA Regulations Governing Committee Projects in Paragraph 10-10 state: Each proposal shall be submitted to the Council Secretary and shall include:

(a) identification of the submitter and his affiliation (Committee, organization, company) where appropriate, and

(b) identification of the document, paragraph of the document to which the proposal is directed, and

(c) a statement of the problem and substantiation for the proposal, and

(d) proposed text of proposal, including the wording to be added, revised (and how revised), or deleted.