NFPA No.

40

CELLULOSE NITRATE MOTION PICTURE FILM 1974

NATIONAL FIRE PROTECTION ASSOCIATION

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SHOULD is intended to indicate recommendations or that which is advised but not required.

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Standard for the Storage and Handling of

Cellulose Nitrate Motion Picture Film

NFPA No. 40 — 1974

1974 Edition of No. 40

On recommendation of the Sectional Committee on Storage, Handling, and Transportation of Hazardous Chemicals the 1967 edition of No. 40 was reconfirmed as suitable for current use by the National Fire Protection Association on May 23 at the 1974 Annual Meeting. The 1974 edition supersedes all previous editions.

Origin and Development of No. 40

The Standard for the Storage and Handling of Cellulose Nitrate Motion Picture Film (No. 40), developed by the Committee on Hazardous Chemicals and Explosives, was first adopted by the NFPA in 1919 after original presentation in 1918. Amendments were adopted in 1921 and 1926. A complete revision was adopted in 1931 and amendments were adopted in 1939, 1946 and 1947. An extensive revision was tentatively adopted in 1951 and finally adopted in 1953. With reorganization of the committee in 1960, the Sectional Committee on Explosives was given responsibility for future revisions of this standard. In 1970 responsibility was transferred to the Sectional Committee on Storage, Handling, and Transportation of Hazardous Chemicals. The 1953 edition was reconfirmed as a current NFPA standard at the 1962 Annual Meeting. Amendments were adopted in 1967, and the 1967 edition was reconfirmed in 1974.

Amendments Adopted in 1974

The technical provisions are the same as in the preceding (1967) edition. References to other NFPA standards have been updated where necessary.

Committee on Chemicals and Explosives

Correlating Committee

Dr. Robert W. Van Dolah, *Chairman,*
Pittsburgh Mining and Safety Research Center,
Bureau of Mines, U.S. Department of the Interior,
4800 Forbes Ave., Pittsburgh, PA 15213

Chester I. Babcock, †*Secretary,*
National Fire Protection Assn., 470 Atlantic Ave., Boston, MA 02210

W. H. Doyle, Simsbury, CT
Thomas E. Duke, Fire Prevention & Engineering Bureau of Texas
Dr. Richard Y. Le Vine, Olin Corp.
Henry T. Rittman, Institute of Makers of Explosives
Richard F. Schwab, Allied Chemical Corp.

†Nonvoting

Sectional Committee on Storage, Handling, and Transportation of Hazardous Chemicals

William H. Doyle, *Chairman,*
36 Massacott, Simsbury, CT 06070

Chester I. Babcock, †*Secretary,*
National Fire Protection Association, 470 Atlantic Ave., Boston, MA 02210

M. M. Anderson,[1] Manufacturing Chemists' Assn.
Capt. Hewlett R. Bishop, National Cargo Bureau, Inc.
Lt. Michael T. Bohlman, U. S. Coast Guard
William Bradford,[2] Olin Corporation
W. H. Butterbaugh,[3] Manufacturing Chemists' Assn., Inc.
John A. Davenport, Factory Insurance Assn.
Ben F. Day,[4] The Fertilizer Institute
Gerald Duarte, Fire Marshals Assn. of North America
C. R. Eastman,[5] American Petroleum Institute
L. P. Herman, Rolf Jensen & Associates, Inc.
George Huckeba, American Mutual Insurance Alliance
Harry McIntyre,[6] National Agricultural Chemists Assn.
Samuel J. Porter, Arlington, Va.
Anthony Santos, Factory Mutual Engineering Corp.
C. W. Schultz, Bureau of Explosives Laboratory
Gerald P. Schultz,[7] Society of the Plastics Industry
Arthur W. Sheldon,[7] Society of the Plastics Industry
Damon W. Snow,[8] Monsanto Co.
Herman H. Spaeth, Insurance Services Office — Pacific Region
Arthur Spiegelman, American Insurance Assn.
Eulan G. Tucker, Toledo Fire Division, Toledo, Ohio
Dr. Robert W. Van Dolah, Pittsburgh Mining & Safety Research Center, Bureau of Mines

Alternates.

J. P. Carroll (Alternate to A. W. Sheldon & G. P. Schultz)
Capt. D. W. Gates (Alternate to Capt. Hewlett R. Bishop)
R. D. Miller (Alternate to Ben F. Day)
Robert W. Nelson (Alternate to John A. Davenport)
Capt. S. F. Sammis (Alternate to Capt. Hewlett R. Bishop)
W. A. Tidridge (Alternate to M. M. Anderson)

†Nonvoting.

[1]Vote limited to NFPA 43A, 43B, 43C, 43D, 490
[2]Vote limited to NFPA 43A, 490
[3]Vote limited to NFPA 43A, 43B
[4]Vote limited to NFPA 490
[5]Vote limited to NFPA 43D, 490
[6]Vote limited to NFPA 43A, 43D, 490
[7]Vote limited to NFPA 43B
[8]Vote limited to NFPA 43A, 43B, 43C, 490

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

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Standard for the Storage and Handling of
Cellulose Nitrate Motion Picture Film

NFPA No. 40 — 1974

FOREWORD

1. Motion picture film for many years was manufactured with a supporting film base of cellulose nitrate (commonly called nitrocellulose). Since about 1951, no cellulose nitrate film base of any kind has been manufactured in the United States.

2. Cellulose nitrate contains chemically combined oxygen, sufficient in amount so that this material can partially burn or decompose without the presence of air. The gases formed by such decomposition are both toxic and flammable and may be produced so rapidly as to create dangerous pressures in building structures and a hazard to life.

3. Free burning results in production of less toxic gases but due to the rapid burning, such fires are intense and create a serious life hazard.

4. The actual heat of combustion of nitrate film measured in B.T.U. per lb. is 6,000–8,000 compared with 8,000–9,000 for wood but the rate of combustion is about fifteen times that of wood in the same form.

5. In recent years motion picture film has been produced having a "safety" base of cellulose acetate or other slow-burning esters or polyesters. The fire hazard characteristics of all these materials are roughly similar to those of ordinary paper of similar thickness and form. Unlike cellulose nitrate, they do not produce oxides of nitrogen when burning. This standard does not apply to the storage and handling of "safety-base" film.

6. Safety film is damaged by heat at a lower temperature than is required to destroy paper records. For this reason, "safety" film that has permanent value requires special protection to prevent damage by heat from an exposing fire. See NFPA No. 232, Protection of Records, for protection of "safety" film.

7. While cellulose nitrate film in actual theater use will gradually diminish in quantity, the storage of cellulose nitrate film for archival purposes, storage of old negatives, and some storage of foreign films will remain for many years.

8. While past experience in the storage and handling of cellulose nitrate film has been good, recent test fires indicate the desirability of a modification of existing standards. These new standards, therefore, apply specifically to long-term storage of cellulose nitrate film and include changes in protection for projection rooms and exchanges.

CHAPTER 1. INTRODUCTION

Article 11. General Information

111. Application of standards. These standards are intended to apply to the storage and handling of cellulose nitrate motion picture film, hereafter referred to as "nitrate film," in all places except establishments manufacturing such film and storage incident thereto. They are not intended to apply to the storage and handling of film having a cellulose acetate or other approved slow-burning base nor to photographic and X-ray film. The provisions of this standard are not retroactive although where improvements have been made over preceding editions of the standard the incorporation of these changes in existing structures is desirable, particularly where cellulose nitrate storage will continue.

112. Scope of Standards. These standards are intended to provide reasonable provisions for the storage and handling of nitrate motion picture film, based on minimum requirements for safety to life and property from fire.

113. Arrangement of Standards. These standards give general provisions regarding the storage and handling of film and special provisions for such occupancies as motion picture theaters, exchanges, laboratories and studios, which apply in addition to any and all of the general provisions which may also be applicable.

The grouping of the special provisions under the heading of special occupancies is merely for convenience in the application of these standards. Any particular process or operation in any type of occupancy shall be governed by the provisions given for that process or operation, whether under the heading of that occupancy or any other heading, unless otherwise specifically provided herein. For example, any process in a studio, which from the standpoint of the authority enforcing these standards is similar to some process covered under laboratories, shall be governed by the provisions for that process given under laboratories.

114. Construction. Film exchanges, laboratories and studios, except single story studio buildings, shall be in buildings of fire-resistive (fireproof) construction. Protection of openings in fire walls shall comply with requirements of the Standard for Fire Doors and Windows, NFPA No. 80. Construction should

be in accordance with applicable building codes and exits should be arranged in accordance with NFPA and other applicable exit codes.

115. Approval of Plans. Before constructing any building for use as a nitrate motion picture film occupancy, or remodeling any building for such occupancy, or building any nitrate film vault, or installing any enclosure for motion picture projection, or installing any screening room, complete plans for such proposed construction or installation should be submitted for approval to the authority having jurisdiction. These plans shall show in detail all proposed construction and structural changes and the means of protection to be provided, the heating system with the protection for it, the electrical equipment, and the character and location of exposures and shall indicate the maximum amount and type of film handled or stored in each area.

116. Definitions. Wherever used in these standards the following words shall be construed as having the following meanings:

(a) APPROVED. "Approved" refers to approval by the authority having jurisdiction.

(b) ARCHIVAL CABINET. A cabinet designed for the storage of high value or other permanent record film in which individual reels are placed in insulated compartments.

(c) ARCHIVAL FILM. Film of value for record purposes which will be kept in permanent storage.

(d) ARCHIVAL RACKS. Racks intended for use in archival vaults for the storage of high value or permanent record film. Such racks are constructed so that individual rolls or groups of two rolls are placed in insulated compartments. In certain cases a maximum of three rolls in a single container may be placed in an insulated compartment.

(e) CABINET. A cabinet constructed and equipped in accordance with the requirements of Article 25.

(f) CELLULOSE NITRATE FILM. Motion picture or sound recording film coated on a support or base consisting essentially of cellulose nitrate. The terms "cellulose nitrate film" or "nitrate film" are preferable to the term "nitrocellulose." However, for practical purposes, the terms are synonymous. This film may be in the form of unexposed film, positives, negatives, scrap, or used film.

(g) DECOMPOSITION VENT. A vent to permit escape of gases resulting from partial burning or decomposition of film.

(h) EXCHANGE RACKS. Racks intended for use in vaults for the storage of cellulose nitrate film in distribution and for theater use, for projection and other film exchange purposes. In such racks film is stored in cans placed on edge and racks are so constructed that there will not be more than a 3-ft. interval between vertical barriers.

(i) EXPLOSION VENT. A vent to relieve explosion pressures resulting from ignition of a mixture of decomposition gases and air.

(j) PARTITION. Except where some other form of construction is specified, a partition constructed in accordance with the specifications given in Section 212.

(k) SHALL. "Shall" is intended to indicate requirements.

(l) STANDARD ROLL. A roll of film 35 mm. (1⅜ inches) wide and 1,000 feet long, weighing approximately 5 pounds, used as a unit in calculating the weight of film.

NOTE: This definition is intended to establish a measure of length and weight and is not designed to prohibit the use of double rolls (2,000 ft.) of film in theaters and exchanges.

(m) VAULT. A vault constructed and equipped in accordance with the requirements of Articles 26 and 27.

CHAPTER 2.

GENERAL PROVISIONS REGARDING THE STORAGE AND HANDLING OF MOTION PICTURE FILM

Article 21. Construction and Arrangement of Buildings

211. Building Construction. Nitrate motion picture film shall be stored or handled only in buildings of fire-resistive construction. Refer to Articles 26 and 27 for film vault construction.

212. Partitions. All rooms in which nitrate motion picture film is stored or handled, except motion picture projection rooms and film vaults, shall be separated from each other and from all other parts of the building by partitions of suitable stability and having at least one-hour fire-resistive rating as determined by the Standard Methods of Fire Tests of Building Construction and Materials, NFPA No. 251.

2121. The following types of construction will meet the requirements of Section 212:

(1) Hollow clay tile not less than 3 inches thick laid in cement mortar, cement lime mortar or gypsum mortar, and plastered on both sides with not less than ½-inch of gypsum mortar or cement mortar;

(2) Gypsum blocks, not less than 3 inches thick, either solid or hollow, laid in gypsum mortar, and plastered on both sides with not less than ½ inch of gypsum mortar;

(3) Metal lath supported by noncombustible studs, plastered on both sides to fully cover the metal lath and studs with not less than ¾ inch of gypsum mortar or cement mortar and having a total thickness of not less than 2½ inches;

(4) Wood studs covered both sides with metal lath and ¾ inch gypsum mortar or cement mortar, and having a total thickness of not less than 5¼ inches. (This type of construction to be used only in buildings not of fire-resistive construction.)

2122. Partitions shall be continuous from floor to ceiling and securely anchored to walls, floor and ceiling.

2123. Openings in partitions shall be protected by approved fire doors of a type suitable for use in Class C situations as defined in the Standard for Fire Doors and Windows, NFPA No. 80.

213. Exits. It is essential that all rooms in which film is handled be provided with adequate aisle space and safe means of egress. Aisle space shall not be less than 30 inches clear wherever walking is necessary. Rooms in which film is handled and in which more than two persons work shall have two or more exits, remote from each other. Doors shall swing in direction of travel. Every exit shall be marked "Exit" by an illuminated sign with letters not less than six inches high. All exit lighting should be installed in accordance with the Life Safety Code, NFPA No. 101.

214. Explosion Venting. Explosion vents shall be provided in new construction for rooms or vaults used for storing and handling nitrate film, except projection rooms (Section 291), rewind

rooms (Section 312) or rooms where the total quantity of film not in vented cabinets will not exceed twenty (20) standard rolls.

2141. Explosion vents shall consist of approved explosion venting sash or equally effective vent construction acceptable to the authority having jurisdiction. Vents shall be provided in the ratio of one square foot of vent area for each 50 cu. ft. of room or vault volume.

2142. It is suggested that wherever practicable, explosion vents be provided in existing rooms or vaults used for storage and handling of nitrate film.

215. Space for Workers. A feature which often contributes materially to the hazard to life in film handling rooms is the congestion of workers together with large quantities of nitrate film. To prevent such congestion of workers and the attendant hazard to life, there shall be at least 35 sq. ft. of floor area for each worker in every room. Not over 15 persons shall work at one time in any one room (not including the stage of motion picture studios) in which nitrate film is handled.

216. Tables and Racks. Tables and racks used in connection with the handling of film (joining, inspection and assembling tables, for example) shall be noncombustible, or shall be of wood construction with no member less than 1½ inch in least dimension. It is desirable that they be kept at least 4 inches away from any radiator or heating apparatus. Tables shall not be provided with racks or shelves underneath them, which might be used for keeping film or other materials.

Article 22. Electrical and Heating Equipment

221. Artificial Illumination. In any room or vault where film is handled or stored, artificial illumination shall be restricted to incandescent or fluorescent electric lights, except that arc lights or other forms of electric lights may be used in studios.

222. Wiring. All electrical wiring and equipment shall conform to the National Electrical Code, NFPA No. 70. The wiring method shall be rigid metal conduit or other approved type of metal raceway. Fuses shall be enclosed.

223. Light Fixtures. Light fixtures shall be firmly set in place and provided with guards or located to avoid mechanical injury. Incandescent lights shall be protected by guarded globes or other protection which will prevent contact of film with the light bulb or heated metal. All lights shall be equipped with keyless sockets and operated by wall switches.

2231. Fluorescent tubes shall preferably be provided with a glass plate below the tube and located at ceiling height well away from contact with film. If the glass plate type of fixture is not used, wire guards or other noncombustible devices shall be provided to prevent breakage and keep the tubes in place.

224. Exit Signs. Exit signs shall be placed at the exits of all darkrooms and shall comply with the requirements of Section 5–11 of the Life Safety Code.

225. Portable Lamps and Motors. Portable electric lights on extension cords shall not be used in any room in which film is handled or stored, other than the stage of motion picture studios, except that in emergency such portable lamps may be used if equipped with approved keyless sockets, heavy glass globes, and metal protective lamp guards, and having cords of the Hard Service (type S) or Junior Hard Service (type SJ) varieties, with suitable locking plugs. Such lights shall operate at surface temperatures not in excess of 160°F.

2251. Motors shall be of dust-tight type (National Electrical Code, Class II, Division 1), or shall be of a totally enclosed type and located or arranged so film cannot come in contact with them.

226. Projectors. Motion picture projectors and other associated electrical equipment shall be of approved type and safeguarded in accordance with the requirements of the National Electrical Code.

227. Types of Heating Equipment Permitted. Artificial heating in any building or room, other than a vault, in which motion picture film is used, handled or stored, shall be restricted to steam not exceeding 15 pounds pressure or hot water, provided, however, that this shall not be construed as prohibiting the installation of an indirect system employing high pressure steam, when the radiators or heating coils of such system are not located

in the room or rooms to be heated. Heat generating apparatus shall be in a separate room.

Exception: Approved electric steam radiators operated at not to exceed 15 pounds pressure and protected with wire mesh guards as required below may be used, provided installation is of the fixed (non-portable) type.

228. Piping and Radiators. All steam pipes within 6 feet of the floor, and where passing through partitions or racks or near woodwork, shall be covered with adequate approved pipe covering. All radiators, heating coils, and pipes and returns that are near the floor or are so located as to permit any combustible material, waste or dirt to come in contact therewith shall be guarded and protected by means of ¼-inch mesh galvanized steel wire cloth (hardware cloth) No. 20 B. & S. gauge, or by its equivalent. The bottoms of such guards shall be arranged so as to lift up for cleaning purposes and the tops to slope so that guards cannot be used as shelves. Guards shall be so constructed that no film can come within 4 inches of the heating surface, and shall be made with a substantial metal framework which will prevent the wire mesh being forced against the radiator or pipes.

229. Duct Systems. Air conditioning, warm air heating, air cooling and ventilating systems employing ducts shall be installed in accordance with the Standard for the Installation of Air Conditioning and Ventilating Systems NFPA No. 90A. In addition to the fire dampers required by said standards, automatic fire dampers shall also be located at such points as may be necessary so that, as far as the duct system is concerned, each room in which film is handled is cut off by dampers from every other room. (See Sub-section 2916 regarding ventilation of projection rooms.) Any system used for air conditioning a film vault shall be entirely independent, with no duct connecting to any other vault or room except that conditioned air may be supplied to a film vault from a central source through a fire-resistive check valve or swing damper in the supply air pipe. This valve or damper shall be located within the vault wall or the pipe insulated so that fire within the vault will be confined. Such a system shall have supply air only without return.

NOTE: This does not prohibit a unit conditioner supplying only a single vault with both supply and return ducts, such unit conditioners to be outdoors or other safe location immediately adjoining the vault.

Article 23

Sprinklers and Other Fire Protection Appliances

NOTE: See Sections 265 and 275 regarding sprinklers in film vaults.

231. Automatic Sprinklers. Every room in which nitrate film is stored or handled in quantities greater than 50 pounds (10 standard rolls), except in motion picture projection booths or rooms and rewinding rooms connected therewith, shall be equipped with an approved system of automatic sprinklers installed in accordance with requirements for extra hazard occupancies as set forth in the Standard for the Installation of Sprinkler Systems, NFPA No. 13. Buildings or sections of buildings used as exchanges, laboratories or studios shall be equipped with automatic sprinklers, as provided under Sections 321, 331, and 341. It is recommended that buildings used for the storage or handling of film (except small areas possessing no fire hazard and so located that there is little opportunity of combustible gases entering the area) be completely equipped with automatic sprinklers.

NOTE: While this provision does not require automatic sprinklers in projections rooms, fire experience indicates that they do provide desirable protection, and their use is advised.

2311. Protection for other than film cabinets and vaults may utilize automatic sprinklers of the regular type or automatic spray sprinklers. Protection for film cabinets and vaults (archival or other than archival) may utilize regular sprinklers, automatic spray sprinklers or spray type fixed nozzles of the open or automatic type. The requirements of 5–3 of Standard for the Installation of Sprinkler Systems, NFPA No. 13 — 1973, shall apply where open sprinklers or sealed sprinklers are used with pre-action or deluge systems. Where spray type fixed nozzles are used the Standard for Water Spray Fixed Systems for Fire Protection, NFPA No. 15 — 1973, shall apply.

232. Sprinkler Spacing. The area protected in sections where nitrate film is handled shall not exceed 64 sq. ft. per sprinkler, with sprinklers and lines not over 8 ft. apart; provided, that in the stage section of motion picture studios the spacing of sprinklers shall be such that the area protected shall not exceed 80 sq. ft. per sprinkler. In existing buildings where spacing of sprinklers exceeds that specified above, the authority having jurisdiction may require the installation of additional sprinklers wherever

the hazard of some machine, process, or accumulation of film warrants such protection.

233. Water Supplies for Sprinklers. Water supply shall be provided acceptable to the authority having jurisdiction.

2331. Water supplies for automatic sprinklers shall be based on 20 gallons a minute per sprinkler for 20 minutes for the total number of sprinklers in one vault, plus 25 per cent of the number of sprinklers in the communicating fire area.

234. Portable Fire Extinguishers. Every room in which nitrate film is stored or handled, except film vaults, shall be provided with portable fire extinguishers of types using water or water solutions. In certain situations, first aid fire appliances may be omitted in particular areas where remaining to fight a fire would result in a severe life hazard. Instructions should be posted regarding the types of fire that should be handled by first aid fire appliances. The authority having jurisdiction shall be consulted.

NOTE: Small hose equipment is recommended, and the following types of extinguishers are considered suitable; Soda acid, cartridge-operated water, anti-freeze, pump tank, and loaded stream. See Standard for the Installation, Maintenance and Use of Portable Fire Extinguishers, NFPA No. 10 and Standard for the Installation of Standpipe and Hose Systems, NFPA No. 14.

Article 24. Storage of Film

241. Storage Requirements. Nitrate motion picture film, not in process or being worked on, shall be stored as follows:

2411. Except as provided in Sub-section 2413, amounts in excess of 25 pounds (5 standard rolls) but not in excess of 1,000 pounds (200 standard rolls) shall be kept in approved cabinets or in vaults.

2412. Amounts in excess of 1,000 pounds shall be kept in vaults.

2413. Unexposed nitrate film enclosed in the original, unbroken, shipping cases, conforming to DOT regulations shall be kept in a sprinklered room. If the amount exceeds 750 pounds (150 standard rolls), it shall be stored in a room used for no other purpose. Sprinkler spacing shall provide not less than one sprinkler for each 64 square feet.

2414. Archival nitrate film shall be stored in archival cabinets or vaults under the limitations in Sub-sec. 2411 and 2412.

Article 25. Film Cabinets

251. Standard Cabinets. Cabinets provided with self-closing doors used in connection with theaters and exchanges or similar non-archival use shall be of insulated or hollow metal construction, including doors, or may be built into the building with a type of construction complying with requirements for partitions (see Section 212) if otherwise conforming to the requirements of this Article. Doors shall be self-closing and provided with three-point lock. See Figure 1.

252. Capacity. Cabinets shall have a capacity not in excess of 375 pounds (75 standard rolls).

253. Shelves. Shelves in the cabinet shall be of noncombustible insulating material not less than ⅜-inch in total thickness or of hardwood not less than one inch thick.

2531. Shelves shall fit tightly to the back and sides of the cabinet. There shall be a clearance of at least one inch between front of shelf and inside of door.

2532. Shelves shall be one inch wider, with the tolerance of ¼ inch, than the diameter of the largest roll stored in the cabinet. Stops or bars shall be provided so that film cans shall not be stored with the front edge less than ¾ inch from the front edge of the shelf. There shall be no thumbholes or other indentation in the shelves which will allow any part of the containers to project forward of the front edge of the shelf.

254. Decomposition Vents. Each cabinet having a capacity of over 50 pounds of film (10 standard rolls) shall be provided with a vent to the outside of the building. The vent shall have a minimum effective sectional area of 14 square inches per 100 pounds of film capacity. For long lengths of vent pipe a larger size may be necessary to take care of friction loss and turns in the pipe.

2541. Vent flues shall be of construction equivalent to 18 U. S. gauge riveted sheet steel, and where inside the building shall be covered with 1 inch of approved heat insulating material.

255. Sprinklers. Cabinets holding over 75 pounds of film (15 standard rolls) shall be provided with at least one automatic sprinkler; provided, however, that a cabinet constructed so that each roll is in a separate compartment and will burn out without communicating fire to film in any other compartment, need not be provided with an automatic sprinkler.

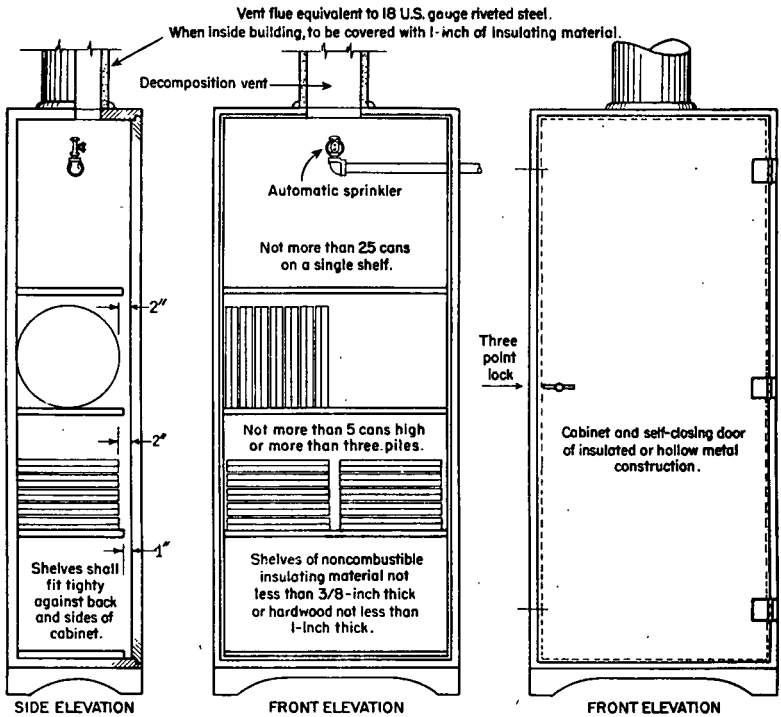

Fig. 1. Standard Film Cabinet. (For other than archival film.)

2551. Cabinets of not over 125 pounds capacity for use in projection booths and rewinding rooms only, may have the required sprinkler connected to the house supply by not less than 1-inch pipe, provided the water pressure at that elevation be not less than 15 pounds, and is sufficient to supply not less than 15 gallons a minute.

256. Storage in Cabinets. Film in cabinets shall be in individual roll containers or in DOT shipping containers. Materials other than film shall not be stored in the same cabinet with film. Where cabinets are provided with individual insulated compartments for each roll, the individual rolls stored therein need not be in cans or other containers.

2561. Film cans, if placed on edge, shall be limited to not more than 25 cans on a single shelf.

2562. Film cans, if placed flat, shall be piled not more than five (5) cans high, with not more than three (3) such piles on a single shelf.

257. Archival Cabinets. Archival cabinets shall be provided with individual drawers or compartments, each holding not more than 2,000 feet of film. Individual compartments shall be separated by ⅜-inch noncombustible insulating material (⅜-inch gypsum board is acceptable). Each compartment shall be provided with a hinged damper or equivalent device to allow release of decomposing gases into the cabinet vent. Such cabinet need not be provided with automatic sprinklers.

NOTE: For the storage of three-color separation film the three rolls may be in a single container in a compartment and shall not exceed a total of 3,000 ft. of film in each compartment.

2571. Vents. Each cabinet having a capacity of over 50 pounds of film (10 standard rolls) shall be provided with a vent to the outside of the building. The vent shall have a minimum sectional area of 14 square inches per 100 pounds of film capacity. For long lengths of vent pipe a larger size may be necessary to take care of friction loss and turns in the pipe.

2572. Vent flues shall be of construction equivalent to 18 U. S. gauge riveted sheet steel, and where inside the building shall be covered with 1 inch of approved heat insulating material.

Article 26. Vaults Other Than Archival Vaults

NOTE: Where the word "vault" is used in the following paragraphs it shall mean a vault used for storage of film in a film exchange for theater use or distribution. See Figure 2.

261. Construction. Vaults shall be constructed in accordance with plans submitted to and approved by the authority having jurisdiction.

2611. Vaults shall not exceed 750 cubic feet in inside volume except archival vaults, Article 27. Where the height of the vault ceiling results in a vault having a volume greater than 750 cubic feet, a heavy wire screen of not less than 2-inch mesh or its equivalent shall be installed below the ceiling to limit the interior vault space to 750 cubic feet.

2612. Walls and floor shall be constructed of not less than 8 inches of brick, 8 inches of hollow masonry units plastered both

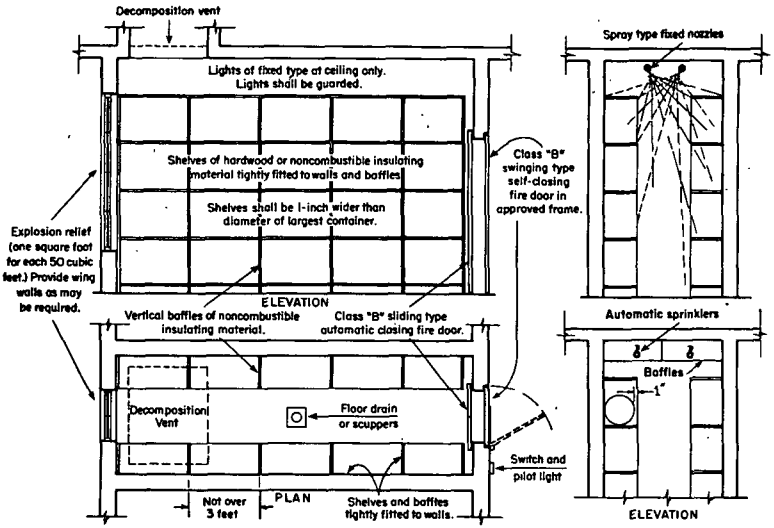

Fig. 2. Standard Film Vault. (For other than archival film.)

sides or filled solidly or of 6 inches of reinforced concrete, or 12 inches of hollow tile. Where the masonry units used may contain cracks or holes, the surface shall be plastered on both sides with a cement plaster to a thickness of at least ½ inch. Equivalent construction which will provide equal fire resistance and prevent escape of gases through wall cracks may be used.

2613. Vaults shall be supported by masonry or steel of sufficient strength to carry the load safely. Beams shall rest at both ends on steel girders, iron or steel columns, or walls or piers of masonry. The supports shall afford at least 4 hours protection as determined by the Standard Methods of Fire Tests of Building Construction and Materials, NFPA No. 251, or be of a design approved by a nationally recognized testing laboratory as affording equivalent fire resistance.

2614. Where the ceiling of a vault is a bearing floor, it shall be of reinforced concrete at least 6 inches thick, or of equivalent construction. Where the roof of the building is the ceiling of the

vault, and where dislodging parts of the roof by explosion will not create an undue hazard to surrounding buildings or be apt to cause personal injury, the roof may be of lightweight noncombustible construction such as asbestos cement board or gypsum plank and may serve as an explosion vent.

NOTE: Where this light type of roof construction is used, parapets and wing walls shall be provided where needed to prevent transmission of fire from vault to vault or to another part of the building by roof failure. A wing wall or parapet extending 3 feet above the roof will provide this protection.

2615. Vaults shall be provided with suitable drains or scuppers to the outside of the building or to corridors where extending to outdoors is impractical.

2616. Proximity to stacks and other sources of heat shall be avoided.

262. Doors. Door openings shall be protected with approved fire doors, one on each face of the wall except in the case of openings directly to the outdoors.

NOTE: Vaults may have two door openings. Such an arrangement is often a great convenience, as in laboratories, where the vault is located between rooms and used for the temporary storage of film in process.

2621. Doors shall be of the type suitable for use in Class B situations as defined in the Standard for Fire Doors and Windows, NFPA No. 80. The interior door shall be a sliding fire door arranged for automatic operation. The outer door shall be of the swinging type and close into an approved frame or be otherwise made tight to prevent the passage of flame around the edges. It shall be self-closing, and if fastened open shall be arranged to close automatically in case of fire originating in or out of the vault. Approved quick-operating devices for closing vault doors are recognized as having advantages over the fusible link, and their use is recommended.

263. Decomposition Vents. Each vault shall be provided with an independent vent having a minimum effective sectional area of 200 square inches per 1,000 pounds of film capacity (equivalent to one square inch for each standard roll) except that in construction provided with explosion vents (see Section 214), the decomposition vent may be omitted. Existing vaults shall have an effective minimum sectional area of at least 140 square inches per 1,000 pounds of film capacity. The vent area for a standard 750

cubic foot vault of new construction shall be not less than 2,000 square inches. (See Figure 3.)

NOTE: In determining the proper vent opening, allowance must be made for the window frame and sash, as the area of the glass is considered the effective sectional area of the vent opening.

2631. Vent flues inside the building shall be constructed of 5 inches of reinforced concrete or of a construction equivalent to that required for smoke chimneys. Exterior flues shall be of a construction equivalent to that of smoke stacks for solid or liquid fuel.

(a) The extension of a vent outlet by means of flues extending a considerable distance adds appreciably to the frictional resistance and greatly decreases the effectiveness of such vents. If it is necessary to construct such vents longer than 25 feet proper allowance shall be made for frictional loss and the area increased progressively to insure adequate venting. Such cases shall be regarded as special and subject to approval of the authority having jurisdiction.

2632. The outlet of each vent shall be above the roof and where vents discharge horizontally, a deflector wall or other device shall be provided to deflect gases upwards. Vents shall be located at least 50 feet horizontally from any window or other opening exposed thereby and a distance of at least 25 feet from any fire escape on the same or higher level.

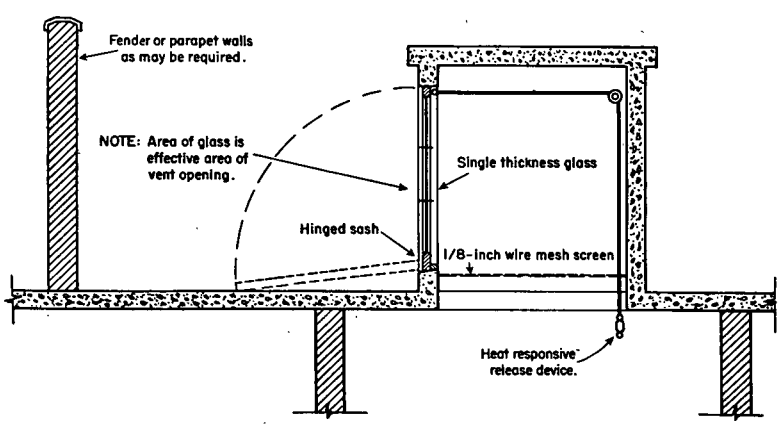

Fig. 3. Decomposition Vent.

2633. Vaults, especially those having a vent in the form of a window, shall be arranged in some manner which will protect the film in the vault against ignition by —

(1) Rays of the sun, whenever the film in the vault is exposed to direct rays of the sun entering through the vent. This may be done by painting the glass in the vent opening a dark color.

(2) Radiated heat entering through the vent opening, as from an exposure fire, whenever the vent is severely exposed by buildings or storage of combustible material, or by other openings in the same wall.

NOTE: A method of effecting this protection is to use a hinged insulated or hollow metal panel as a vent. Another acceptable method which has been used employs two baffle walls inside the vault. The baffle wall nearer the vent should extend from the ceiling down to within about 3 feet of the floor, and the inner baffle wall from the floor up to within about 3 feet of the ceiling. Baffle walls should be of substantial construction and should be so spaced and arranged as to afford the full required vent area from the film storage space to the outside.

2634. Each vent shall be protected against the weather by single thickness glass (1/16-inch thick), in a sash arranged to open automatically in case of fire by the means of an approved releasing device placed inside the vault or by a hinged hollow metal or insulated vent panel equipped with an approved releasing device placed inside the vault. The use of approved quick operating devices is recommended. The vents shall be arranged to open by both temperature operation and by internal pressure of 5 pounds per square foot. The area of the glass or of the insulated panel shall be the effective sectional area of the vent opening. No pane of glass shall be smaller than 200 square inches. Protection equivalent to the above may be accepted in lieu thereof.

2635. A light wire screen not coarser than ⅛-inch mesh may be placed in each vent. No bars or screens other than this light insect screen shall be placed in vent openings.

2636. Where there is a possibility of fire being transmitted from one vault to another, or to another building, through open skylights, glass windows, light roof panels, or venting devices, adequate provision shall be made to prevent this possibility. This may be done by the provision of extended wing walls or roof parapets between such openings.

2637. Vaults shall be provided with suitable drains or scuppers to the outside of the building or to corridors where extending to outdoors is impractical.

264. Racks. Racks in new film vaults shall be of hardwood or noncombustible insulating material and shall consist of shelves tightly fitted to walls and vertical baffles. Vertical baffles shall be of noncombustible insulating material at least ⅜-inch thick, spaced so as to divide racks into sections not over 3 feet wide. The shelves shall be at least 1 inch wider than the diameter of the largest container stored. Metal supports may be used to keep containers in place. Open racks shall not be used in new construction except for vaults intended for the storage of film in standard DOT containers or in insulated boxes.

265. Sprinklers. In new vaults fire protection shall be provided by means of a standard wet pipe sprinkler system, or where speed of operation is important a deluge system may be used if it will be adequately maintained.

2651. Sprinkler protection utilizing regular automatic sprinklers or open sprinklers of the regular pattern shall be calculated on the basis of not less than one sprinkler for each 62½ cubic feet of the total interior volume of the vault. The minimum number of sprinklers required for a standard 750 cu. ft. vault shall be not less than twelve. Sprinklers shall be arranged to provide adequate coverage over the tops and fronts of shelving. Where sealed sprinklers are used baffles shall be installed between each sprinkler. Baffles shall be of sheet steel of at least 24 U.S. Standard gauge or may be of other acceptable noncombustible material. Baffles shall be of substantial construction rigidly fastened in place and shall extend from the ceiling to a level at least 4 inches below the deflectors of sprinklers. Where open sprinklers are used baffles shall not be required. For water and arrangement requirements for sprinkler protection utilizing automatic spray sprinklers or spray type fixed nozzles, the authority having jurisdiction shall be consulted. Sprinklers or nozzles should be arranged to provide adequate coverage over the tops and fronts of shelving. Nozzles shall be stagger-spaced where necessary to avoid interference of spray patterns.

NOTE: The arrangement of sprinklers to give good distribution over the face of shelving is a matter requiring knowledge of sprinkler patterns and location and should be done only by properly qualified men familiar with the particular type of sprinklers employed. When properly arranged, the use of automatic spray sprinklers or spray type fixed nozzles should provide better protection than the use of standard sprinklers uniformly arranged at the ceiling.

266. Lights. All lights in film vaults shall be at the ceiling and of the fixed type. Incandescent lights shall be enclosed and with guarded globes. A glass panel shall be installed below the tubes of fluorescent lights or in lieu thereof, wire guards or other non-

combustible devices shall be provided to keep the tubes in place. All wiring shall be in rigid conduit. All switches shall be outside the vault and provided with pilot lights to indicate whether vault lights are on or off.

267. Heat. Heating, when required to prevent sprinkler pipes from freezing, shall be by hot water or low pressure steam with automatic control limiting steam pressure to 10 pounds and the vault temperature to not in excess of 70°F. Radiators shall be placed at the ceiling, over aisle space with pipes and radiators protected with wire guards so arranged that no film can be placed within 12 inches of such pipes or radiators.

268. Storage in Vault. All film in vaults shall be in containers, either in single or double roll containers, cardboard boxes conforming to DOT Specification 12-B or DOT shipping containers.

Article 27. Archival Vaults

NOTE: Vaults intended for the storage of archival film (see Figure 4) shall be constructed in accordance with this section. Archival film is defined in Section 116(c).

271. Construction. Vaults shall be constructed in accordance with plans submitted to and approved by the authority having jurisdiction.

2711. Archival vaults shall not exceed 1,000 cubic feet in inside volume but where conditions of exposure to surrounding buildings result in little hazard, this volume may be increased with permission of the authority having jurisdiction. (See Sub-section 2714.)

2712. Walls and floors (except floors in contact with the ground) shall be constructed of not less than 8 inches of brick, 8 inches of hollow masonry units, 6 inches of reinforced concrete or 12 inches of hollow tile. Where the masonry units used may contain cracks or holes, the surface shall be plastered on both sides with a cement plaster to a thickness of at least ½ inch. Equivalent construction which will provide equal fire resistance and prevent escape of gases through wall cracks may be used.

2713. Unless resting directly on the ground, vaults shall be supported by masonry or steel of sufficient strength to carry the load safely. Beams shall rest at both ends on steel girders, iron or steel columns, or walls or piers of masonry. The supports shall afford at least 4 hours protection as determined by the Standard

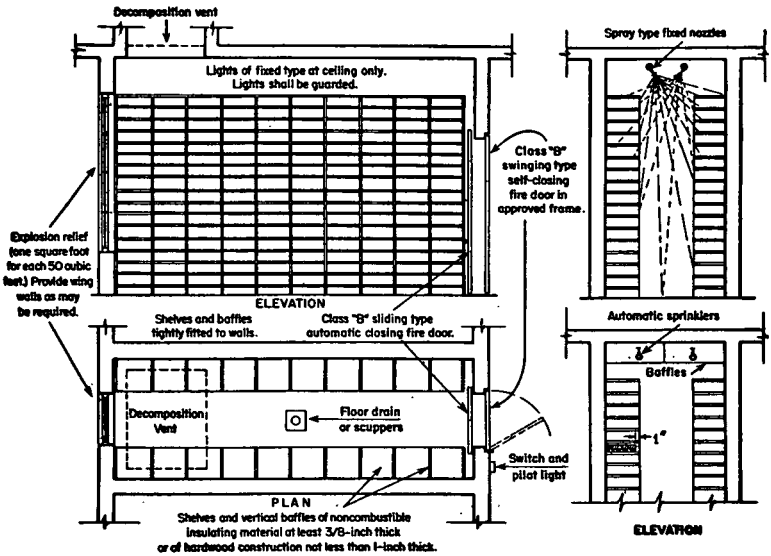

Fig. 4. Archival Vault.

Methods of Fire Tests of Building Construction and Materials or be of a design approved by a nationally recognized testing laboratory as affording equivalent fire resistance. Hollow tile shall not be used for foundation walls or for walls of other than the top vault where vaults are superimposed.

2714. Where the ceiling of the vault is a bearing floor, it shall be of reinforced concrete at least 6 inches thick or equivalent construction. Where the roof of the building is the ceiling of the vault and where dislodging parts of the roof by explosion will not create an undue hazard to surrounding buildings or be apt to cause personal injury, the roof may be of lightweight noncombustible construction such as asbestos cement board or gypsum plank and may serve as an explosion vent. Where the volume of the vault may be in excess of 1,000 cubic feet or in excess of the volume agreed upon by the authority having jurisdiction, a heavy wire screen of not less than 2-inch mesh may be installed below the ceiling to limit the interior vault space.

NOTE: Where this light type of roof construction is used, parapets and wing walls shall be provided where needed to prevent transmission of fire from vault to vault or to another part of the building by roof failure. A wing wall or parapet extending 3 feet above the roof will provide this protection.

2715. Vaults shall be provided with suitable drains or scuppers to the outside of the building or to corridors where extending to outdoors is impractical.

2716. Proximity to stacks and other sources of heat shall be avoided.

272. Doors. Door openings shall be protected with approved fire doors, one on each face of the wall except in case of openings directly to the outdoors.

2721. Doors shall be of the type suitable for use in Class B situations as defined in the Standard for Fire Doors and Windows, NFPA No. 80. The interior door shall be a sliding fire door arranged for automatic operation. The outer door shall be of the swinging type and close into an approved frame or be otherwise made tight to prevent the passage of flame around the edges. It shall be self-closing, and if fastened open shall be arranged to close automatically in case of fire originating in or out of the vault. Approved quick-operating devices for closing vault doors are recognized as having advantages over the fusible link, and their use is recommended.

273. Decomposition Vents. Each vault shall be provided with an independent vent having a minimum effective sectional area of 200 square inches per 1,000 pounds of film capacity (equivalent to 1 square inch for each standard roll) except that in construction provided with explosion vents, the decomposition vent may be omitted. Existing vaults shall have an effective minimum sectional area of at least 140 square inches per 1,000 pounds of film capacity. The vent area for a standard 1,000 cubic feet vault shall be not less than 2,670 square inches. (See Figure 3.)

NOTE: In determining the proper vent opening, allowance must be made for the window frame and sash, as the area of the glass is considered the effective sectional area of the vent opening.

2731. Vent flues inside the building shall be constructed of 5 inches of reinforced concrete or of a construction equivalent to that required for smoke chimneys. Exterior flues shall be of a construction equivalent to that of smoke stacks for solid or liquid fuels.

The extension of a vent outlet by means of flues extending a considerable distance adds appreciably to the frictional resistance and greatly decreases the effectiveness of such vents. If it is necessary to construct such vents longer than 25 feet, proper allowance shall be made for frictional loss and the area increased progressively to insure adequate venting. Such cases shall be re-

garded as special and subject to approval of the authority having jurisdiction.

In no case shall a vent outlet exceed 25 feet in length for a vault exceeding 1,000 cubic feet.

2732. The outlet of each vent shall be above the roof and where vents discharge horizontally, a deflector wall or other device shall be provided to deflect gases upwards. Vents shall be located at least 50 feet horizontally from any window or other opening exposed thereby and a distance of at least 25 feet from any fire escape on the same or higher level.

2733. Vaults, especially those having a vent in the form of a window, shall be arranged in some manner which will protect the film in the vault against ignition by —

(1) Rays of the sun, whenever the film in the vault is exposed to direct rays of the sun entering through the vent. This may be done by painting the glass in the vent opening a dark color.

(2) Radiated heat entering through the vent opening, as from an exposure fire, whenever the vent is severely exposed by buildings or storage of combustible material, or by other openings in the same wall.

NOTE: A method of effecting this protection is to use a hinged insulated or hollow metal panel as a vent. Another acceptable method which has been used employs two baffle walls inside the vault. The baffle wall nearer the vent should extend from the ceiling down to within about 3 feet of the floor, and the inner baffle wall from the floor up to within about 3 feet of the ceiling. Baffle walls should be of substantial construction and should be so spaced and arranged as to afford the full required vent area from the film storage space to the outside.

2734. Each vent shall be protected against the weather by single thickness glass (1/16-inch thick) or by insulated or hollow metal hinged vents. The sash or vent shall be arranged to open automatically in case of fire by means of an approved releasing device placed inside the vault. The use of approved quick operating devices is recommended. The vents shall be arranged to open by both temperature operation and by internal pressure of 5 pounds per square foot. The area of the glass shall be the effective sectional area of the vent opening. No pane of glass shall be smaller than 200 square inches. Any protection equivalent to the above may be accepted in lieu thereof.

2735. A light wire screen not coarser than ⅛-inch mesh shall be placed in each vent. No bars or screens other than this light insect screen shall be placed in vent openings.

2736. Where there is a possibility of fire being transmitted from one vault to another, or to another building, through open

skylights, glass windows, light roof panels, or venting devices, adequate provision shall be made to prevent this possibility. This may be done by the provision of extended wing walls or roof parapets between such openings.

274. Racks. Archival vaults shall be provided with horizontal shelves and vertical baffles spaced so that not more than two containers, each containing 1,000 feet of film, may be placed on each shelf. The space between shelves shall be arranged so that the container covers may lift approximately ½ inch but cannot be lifted entirely off the container. In the case of three-color separation negatives a maximum of three standard rolls in a single container may be placed on shelves designed for this purpose and arranged so that the container cover may not be lifted off completely.

The shelves shall be separated by vertical barriers so that not more than one container may be placed between vertical baffles.

Vertical baffles shall be of noncombustible insulating material at least ⅜-inch thick (gypsum wallboard is acceptable) or of hardwood construction measuring not less than 1 inch in thickness. Shelves shall be of noncombustible insulating material not less than ⅜-inch thick or of hardwood not less than 1-inch thick and both vertical baffle and shelving shall be fitted tightly to the vault wall. Each shelf and baffle shall be of such width that at least one inch of the shelf or baffle shall extend beyond the container. Containers shall be placed on shelves in contact with the back wall. There shall be no thumb holes which will reduce this one-inch clearance. Racks shall be so designed in relation to the sprinkler system that the open face of each rack structure shall be adequately covered by water from the sprinkler systems.

275. Sprinklers. In new vaults, fire protection shall be provided by means of a wet pipe sprinkler system, or where speed of operation is important a deluge system may be used if it will be adequately maintained.

2751. Sprinkler protection shall be provided as prescribed in Sub-section 2651, except that sprinklers shall be provided in a ratio of one head to each 120 cubic feet of vault volume. Vaults of 1000 cubic feet volume shall have a minimum of eight sprinklers. With the approval of the authority having jurisdiction, deluge or sprinkler arrangements providing adequate coverage with a lower ratio of sprinklers per cubic foot of vault volume may be used.

NOTE: The arrangement of sprinklers to give good distribution over the face of shelving is a matter requiring knowledge of sprinkler patterns and location and should be done only by properly qualified men

familiar with the particular type of sprinklers employed. When properly arranged, the use of automatic spray sprinklers or spray type fixed nozzles should provide better protection than the use of standard sprinklers uniformly arranged at the ceiling.

276. Lights. All lights in film vaults shall be at the ceiling and of the fixed type. Incandescent lights shall be enclosed and with guarded globes. A glass panel shall be installed below the tubes of fluorescent lights or in lieu thereof, wire guards or other noncombustible devices shall be provided to prevent breakage and keep the tubes in place. All wiring shall be in rigid conduit. All switches shall be outside the vault and provided with pilot lights to indicate whether vault lights are on or off.

277. Heat. Heating, when required to prevent sprinkler pipes from freezing, shall be by hot water or low pressure steam with automatic control limiting steam pressure to 10 pounds and the vault temperature to not in excess of 70° F. Radiators shall be placed at the ceiling, over aisle space with pipes and radiators protected with wire guards so arranged that no film can be placed within 12 inches of such pipes or radiators.

278. Storage in Vault. All film in vaults shall be in containers either in single or double roll containers, cardboard boxes conforming to DOT Specification 12-B or DOT shipping containers. The use of round cans is preferred to square cans. In any case the cover of the container used shall not lift off when the container is properly placed in the rack. Empty containers may be used for blocking the covers of single rolls if necessary.

Article 28. Handling of Nitrate Film

281. Containers Required. All nitrate film shall be kept in closed containers except during the actual time it is being worked upon or examined. This is very essential from the standpoint of fire hazard and safety to life. Individual metal cans for each roll of film are acceptable.

DOT containers, either the shipping container or the cardboard box DOT Specification 12-B, are recommended.

282. Shielding Prohibited. Nitrate film shall not be placed or kept under benches, tables, or other surfaces which would shield it from the discharge of sprinklers.

283. Scrap Film. Scrap nitrate film shall be kept separate from waste paper, safety film, and other rubbish, and shall be kept under water at all times. It shall be collected from work rooms

at least once daily, and removed to a room used for no other purpose, where it shall be kept under water in steel drums or metal containers with tight covers. Film shall be disposed of at frequent intervals. Discarded film in full or part rolls shall be kept in containers in vaults. Scrap film shall not be baled or burned.

NOTE: Nitrate film in the form of clippings and short lengths is in a very hazardous form. Safe precautions in the handling of such scraps are most essential. Baling and burning of film are processes offering a distinct fire hazard. Sending film to a central reclaiming plant in lieu of burning is recommended.

284. Transportation. Nitrate motion picture film shall not be transported in any vehicle, aircraft or other public conveyance used for the transportation of passengers, unless complying with DOT shipping regulations and other applicable regulations.

2841. Nitrate film shall not be allowed in any underground subway train or station unless under the jurisdiction of the U.S. Department of Transportation and conforming to the regulations thereof.

Article 29

Motion Picture Projection and Special Processes

291. Enclosures for Motion Picture Projectors. Motion picture projectors using nitrate film shall be operated or set up for operation only within an approved enclosure, not less than 48 square feet in area and 7 feet high. If more than one machine is to be operated, an additional 24 square feet shall be provided for each additional machine.

For new construction, an enclosure not less than 8 feet wide, 10 feet deep, and 8 feet high is recommended for one projection machine, and not less than 14 feet wide, 10 feet deep and 8 feet high for two machines.

2911. The walls and ceiling of the enclosure shall be built of brick, tile or plaster blocks (plastered on both sides), or of concrete, or of a rigid metal frame, properly braced, and sheathed and roofed with sheet iron of not less than No. 20 U. S. gauge, or with ¼-inch hard asbestos board, securely riveted or bolted to the frame, or 2 inches of solid metal lath and cement or gypsum plaster. All joints shall be sufficiently tight to prevent the discharge of smoke. Noncombustible acoustical material may be used on ceiling and walls, on top of the plaster.

For new construction, it is recommended that the walls of the enclosure be constructed in accordance with the requirements

of Section 212, with floor and ceiling of equivalent fire resistance. Modern heavy equipment may require special attention to floor strength and support. In some cases it may be necessary to support the projection room independently of the structure.

2912. The entrance door into the enclosure shall be at least 2 feet by 5 feet, of construction equivalent to the sheathing permitted above for rigid frame construction, and shall be self-closing, swinging out, and shall be kept closed at all times when not used for egress or ingress.

For new construction, it is recommended that at least two doors be provided, each not less than 30 inches wide and 6 feet high. Doors shall be approved fire doors of a type suitable for use in corridor and room partitions (Class C openings as defined in the Standard for Fire Doors and Windows, NFPA No. 80. It is recommended that exits be in accordance with requirements of authorities having jurisdiction, particularly as to size and location. At least one shall be of the conventional stairway type, having a suitable landing at the top or open directly onto a corridor.

2913. Two openings for each motion picture projector shall be provided; one for the projectionist's view (observation port) shall be not larger than 200 square inches, and the other through which the picture is projected (projection port) shall be not larger than 120 square inches. Where separate stereopticon, spot or flood light machines are installed in the same enclosure with picture machines, not more than one opening for each such machine shall be provided for both the operator's view and for the projection of the light, but two or more machines may be operated through the same opening; such openings shall be as small as practicable and shall be capable of being protected by approved automatic shutters.

2914. Each opening shall be provided with an approved gravity shutter set into guides not less than 1 inch at sides and bottom, and overlapping the top of the opening by not less than 1 inch when closed. Shutters shall be of not less than 10-gauge iron or its equivalent, or of ¼-inch hard asbestos board. Guides shall be of not less than 10-gauge iron or its equivalent. Shutters shall be suspended, arranged and interconnected so that all openings will close upon the operating of some suitable fusible or mechanical releasing device, designed to operate automatically in

case of fire to isolate the contents of the enclosure from other portions of the building. Each shutter shall have a fusible link above it, and there shall also be one located over each upper projector magazine which, upon operating, will close all the shutters. There shall also be provided suitable means for manually closing all shutters simultaneously from any projector head and from a point within the projection room near each exit door. Shutters on openings not in use shall be kept closed.

2915. All shelves, furniture and fixtures within the enclosure shall be constructed of noncombustible material, except that tables shall conform to Section 216. No combustible material of any sort whatever shall be permitted or allowed to be within such enclosure, except the films used in the operation of the machine, and film cement. See Section 314.

2916. Ventilation shall be provided by one or more mechanical exhaust systems which shall draw air from each arc lamp housing and from one or more points near the ceiling. Systems shall exhaust to outdoors either directly or through a noncombustible flue used for no other purpose. Exhaust capacity shall be not less than 15 nor more than 50 cubic feet per minute for each arc lamp plus 200 cubic feet per minute for the room itself. Systems shall be controlled from within the enclosure and have pilot lights to indicate operation. The exhaust system serving the projection room may be extended to cover rooms associated therewith such as rewind rooms. No dampers shall be installed in such exhaust systems. Ventilation of these rooms shall not be connected in any way with ventilating or air conditioning systems serving other portions of the building.

2917. Exhaust ducts shall be of noncombustible material, and shall either be kept 1 inch from combustible material or covered with ½ inch of noncombustible heat insulating material.

2918. Fresh air intakes other than those direct to the open air shall be protected by approved fire shutters arranged to operate automatically with the port shutters.

2919. Provision shall be made so that the auditorium lights can be turned on from inside the projection room and from at least one other convenient point in the building.

NOTE: Automatic sprinklers in projection rooms have been very successful in controlling fires and reducing losses, and their installation is recommended wherever practicable.