Vaults and Vault Doors

and

Record Rooms and Record Room Doors

1937

NATIONAL FIRE PROTECTION ASSOCIATION
INTERNATIONAL
60 Batterymarch Street
Boston, Mass., U. S. A.

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National Fire Protection Association.

International

Executive Office: 60 Batterymarch St., Boston, Mass.

The National Fire Protection Association was organized in 1896 *to promote the science and improve the methods of fire protection and prevention; to obtain and circulate information on these subjects and to secure the coöperation of its members in establishing proper safeguards against loss of life and property by fire.* Its membership includes over a hundred national and regional societies and associations and more than three thousand individuals, corporations, and organizations.

Note.

This pamphlet contains Section 10, Vaults and Vault Doors, and Section 11, Record Rooms and Record Room Doors, reprinted from the Consolidated Reports of the N.F.P.A. Committee on Protection of Records as adopted by the National Fire Protection Association from 1923 to 1936 inclusive.

Vaults and Vault Doors

Introduction.

It is the purpose of this committee not only to develop specifications for the construction of vaults which will properly protect their contents under all conditions, but also to point out the deficiencies of certain common methods of construction by which the safety of records in vaults is often endangered.

Fundamental Requirements.

In the design of a vault there are a number of fundamental requirements which must not be overlooked if the structure is to withstand successfully the effects of a severe fire and is to protect the records which it contains. These requirements include:

a—Wall, floor and roof construction of materials having sufficient fire resisting qualities to resist the action of the most severe fire to which the enclosure may be exposed and also having adequate heat insulating resistance to prevent destruction of contents from high temperatures due to heat transmitted to the interior of the vault.

b—Foundations and other supporting members of such design and construction that they will safely carry the weight of the vault and its contents when these supports are subjected to fire.

c—Provision against the impact of falling building members and building contents, such as safes, machinery and other heavy objects.

d—Independence of the structure of the vault enclosure from the building members, at least to such an extent that failure of the building will not cause failure of the vault.

e—Proper protection of door openings.

Existing Vaults.

Many existing vaults in the construction of which fundamental principles have not been observed, are of such construction that if exposed to a fire of appreciable magnitude, they would be of practically no value in protecting the valuable records which they contain.

In many office buildings the vaults are of light construction, and are sometimes structurally deficient in many respects, to an extent that can often be easily noted by a casual inspection. Some vault installations have actually been discovered having combustible framework flimsily protected with plaster. It is not unusual to find vault walls carried up to the under side of false ceilings which would be quickly destroyed in a fire. Even where the vault has an independent roof, it is sometimes of such light construction that it would be easily ruptured by the slightest impact. It is not uncommon to find walls supported directly on the wooden floors of buildings and with supporting walls or columns of such construction that the vault would quickly collapse in a fire. Other vaults make use of parts of building walls without proper bond or anchorage to these walls so that the failure of the building would also destroy the integrity of the vault structure. It is always desirable to build the vault entirely independent of the building members whenever this can be accomplished.

Usually in the eyes of the layman nearly any enclosure is regarded as a vault if its entrance is equipped with single or double steel plate doors. The construction and supports of the enclosures are seldom if ever investigated. The door itself very often fails to protect the opening properly. This important feature of construction is covered in another section of this report.

Vault construction calls for an unusually good grade of workmanship, if it is to meet satisfactorily all the conditions which may be imposed upon it in case of fire. For this reason the committee feels that there is need for the development of recognized and organized agencies competent to pass upon the design and supervise the erection of such structures.

Vault Classification.

In considering classifications, the committee is of the opinion that but two classifications will be necessary, the first known as the "ground supported vault" and the second as the "structure supported vault," the definitions of which are obvious. The specifications are prepared from the standpoint of the fire resisting qualities of the enclosures rather than from that of protection against burglary.

In addition to the vault enclosures proper there are two other forms of vaults known as the "document building" and the "record room."

Vault Enclosures and Supports.

(Officially adopted 1926 and amended 1934)

General.

These specifications are designed to apply to the construction of vaults which are built for the protection of records from fire only and are not intended to include

protection against burglary such as is necessary in the bank vault.

A vault is designed to accomplish a specific purpose, i.e., the complete protection of its contents in case of fire. It is accordingly most important that its construction be such that there will be no doubt as to its ability to fulfill the object for which it is installed. This depends not only upon its heat insulating qualities, but also upon the maintenance of the integrity of the structure under the strains and impacts to which it may be subjected during a fire. Therefore, the design, the selection of materials, and supervision of the construction should be entrusted only to a competent engineer or architect.

It is recognized that under certain conditions the accumulation of hot or burning débris about a vault may produce a "soaking effect" of such duration that it cannot be taken care of by construction alone within practicable limitations. The cooling of this débris by the application of water in such cases is of the utmost importance.

Concrete, on account of its monolithic character, is well suited for this type of construction. Reinforcement is desirable to prevent the formation of large cracks, particularly if siliceous aggregates are used. For walls designated as "plain concrete," metal reinforcement should be incorporated, suitably distributed near the outer face, of area not less than two-tenths of one per cent of that of the wall. Brick masonry can also be so laid as to be practically monolithic, but as usually found, with vertical joints without mortar, except what happens to be forced into them from the horizontal bedding, may develop serious weakness at the critical time. Only by "shoving" joints, or grouting, can monolithic work be secured in which full confidence can be placed. For vaults of a height exceeding a few stories, the use of a structural steel framework in connection with protecting concrete or brick masonry may be considered favorably as assuring monolithic integrity, even if the walls of the main building fail. This type of construction also materially aids in bonding together such parts of the structure as might otherwise be difficult to unite positively. It will be evident that if the building in which a vault is located is of other than fire-resistive construction, no main building members should have any structural connection with the vault structure, unless specially designed so that the integrity of the vault will not be affected by collapse of the building.

Thickness of vault walls will usually be determined primarily by structural considerations, such as load capacity, general stability, and resistance to impact. Generally, walls thus designed will have adequate, if not surplus, heat insulating properties, and this has been a determining factor in the schedule of recommended wall thicknesses.

The impression seems to persist that air space between thin walls of masonry tied together at intervals is a necessity in vault construction, and that for the same reason, vault doors must be double with air space between. On the contrary, the resistance against transmission of heat, as demonstrated by furnace tests, is not appreciably influenced by such air spaces, but is in general a direct function of the thickness of masonry available to afford such resistance. Moreover, the presence of air spaces and the separation of walls into two thin walls reduces the resistance of the structure to impact from falling materials, such as building walls, machinery, and safes, a condition that must always be anticipated in the design of a vault. The committee accordingly recommends the use of solid wall construction where greatest resistance is necessary.

Vaults are classified in two groups, according to the type of support, ground supported vaults and structure supported vaults, as indicated and defined below. There is also a sub-division in each class based upon the resistance periods to fire. The fire conditions in buildings will, of course, vary according to the type of building construction and nature of the contents. No attempt has been made to specify the class of vault needed for any particular building or occupancy.

These specifications are applicable to vaults of any size so far as fire exposure is concerned. It will be appreciated, however, that with increase in size there are possibilities of larger values subjected to loss in a single enclosure, and there is also an increased hazard from fire within the vault. It is therefore recommended that individual vaults or divisions of a vault be limited to 5000 cubic feet with a maximum height limitation of 11 feet.

The use of materials and constructions other than those specified in these requirements will be recognized upon submission of proof as to their merits from both a fire-resistance and structural standpoint.

Masonry stresses, proportions for concrete and mortar and provisions for lateral support of walls shall conform with the "Recommended Minimum Requirements for Masonry Wall Construction" of the Building Code Committee of the U. S. Department of Commerce as they apply for outside bearing walls.

Full protection against destruction of contents by heat for the given time periods shall be considered as obtained when so constructed that no point on the interior wall surfaces shall reach a temperature exceeding 300° F. when the separate vault members or the vault as a whole are exposed to a fire regulated according to the standard time-temperature exposure curve. It is considered that this requirement will keep the general inside temperatures of the vault considerably below 300° F. and insure usability of records or other contents after the fire.

Specifications for Ground Supported Vaults.

(Officially adopted 1926)

Fire Resistance Classifications.

Ground supported vaults are those supported directly on the ground and independent of the building in which they are located. They are intended to afford full protection to their contents even in the event of complete destruction of the building.

Six Hour Vaults.

This classification is recommended where the construction and occupancy are such that a degree of fire resistance equivalent to six hours of the standard test is deemed necessary.

Four Hour Vaults.

This classification is recommended where the construction and occupancy are such that a degree of fire resistance equivalent to four hours of the standard test is deemed necessary.

Two Hour Vaults.

This classification is recommended where the construction and occupancy are such that a degree of fire resistance equivalent to two hours of the standard test is deemed necessary.

Six Hour Vaults.

Foundations.

Foundations shall be of concrete, stone or brick masonry of ample size to take the entire load of the vault structure and its contents.

Walls.

a. MATERIALS. Walls shall be built solid of reinforced concrete, or brick well bedded in mortar, or of protected steel or reinforced concrete framework with panels of reinforced concrete, plain concrete or brick. Stone and gravel aggregates for concrete shall be selected with regard to their fire-resistive properties. Siliceous gravel shall not be used for the coarse aggregate, unless adequately reinforced against spalling as by wire mesh near the surface, as this material is particularly subject to disintegration under heat. There shall be a covering of at least 2 inches of concrete over all reinforcement.

NOTE: The concrete and reinforcement shall comply with the recommendations of the current report of the Joint Committee on Concrete and Reinforced Concrete. Brick shall conform to the current standards for building brick of the American Society for Testing Materials.

Where a structural steel framework is used, the steel shall be protected with at least 4 inches of concrete, brick, or its equivalent tied with steel ties or wire mesh equivalent to No. 7 (A. S. W. gage, 0.177 inch diameter) wire on 8-inch pitch. Brick protection, if used, shall be filled solidly to the steel with concrete. At the joints between columns, beams and panels, the panels shall be well bonded to the columns by notching or rabbeting into the concrete to a depth and width of at least 1 inch. Temperature reinforcement for concrete shall consist of steel rods at least ½ inch in diameter spaced 4 inches on centres and running at right angles in both directions. Rods shall be securely wired at intersections not over 12 inches apart in both directions and be installed centrally in each panel wall. Any equivalent form of temperature reinforcement may be used.

b. THICKNESS. Walls shall be at least of the thickness specified in Table 1, the variations depending on the materials used, the type of building construction, and the number of stories. However, in the lower story of buildings over two stories in height, the minimum thickness shall in no case be less than 12 inches for reinforced concrete nor 16 inches for brick. These minimum thicknesses apply to the vault construction only.

c. INDEPENDENCE. Vault walls shall be structurally independent of the building wherever possible. If connected in any manner, the connection shall be so made that in event of the collapse of the building the building members may move or fall without affecting the stability or fire-resistive qualities of the vault.

In fire-resistive construction provision shall be made for expansion of the interior building members, as otherwise severe thrusts may be exerted on the vault structure.

NOTE: Under moderately severe conditions of heating an expansion in the concrete or steel equivalent to 1/16 inch per foot is possible.

Where building members join those of the vault they shall project into the vault not more than 4 inches, and in no case shall the wall thickness be less than 8 inches at these points. All beams or bearing members adjoining the vault shall be designed to release freely in case of failure. Where the outside walls of a building are used to serve as a portion of the vault walls, the latter shall be effectively bonded to the building walls.

NOTE: Attention is called to the fact that the method of building a vault wall against the outer wall of building, and omitting bonding, will not insure the integrity of the vault, and that vault walls erected after the building are likely to settle and break connections with building walls. Also, falling building walls may tear away wall used jointly for building and vaults, and cause failure of vault.

Roof.

a. MATERIALS. Roof construction shall be of reinforced concrete or protected structural steel with reinforced concrete slabs or fillers of adequate strength and fire resistance.

b. THICKNESS. Roof shall be unpierced and shall be at least 8 inches in thickness. Greater thickness may be necessary to provide strength for loads and impacts as specified below.

TABLE 1.

Minimum Wall Thicknesses — Ground Supported Vaults.

a. Six Hour Vaults.

No. of Stories Counting from Top down	KIND OF WALL CONSTRUCTION			
	Reinforced Concrete	Brick or Plain Concrete	Protected Steel or Reinforced Concrete Frames	
			Reinforced Concrete Panels	Brick or Plain Concrete Panels
Top	10	12	10	12
2nd	10	12	10	12
3rd	10	12	10	12
4th	12	16	10	12
5th	12	16	12	16
6th	12	20	12	16
7th			12	16
8th			12	16
9th			12	16
10th			14	16

b. Four Hour Vaults.

No. of Stories Counting from Top down	KIND OF WALL CONSTRUCTION			
	Reinforced Concrete	Brick or Plain Concrete	Protected Steel or Reinforced Concrete Frames	
			Reinforced Concrete Panels	Brick or Plain Concrete Panels
Top	8	12	8	12
2nd	8	12	8	12
3rd	10	12	10	12
4th	10	16	10	12
5th	12	16	12	16
6th	12	16	12	16
7th			12	16
8th			12	16
9th			12	16
10th			12	16

c. Two Hour Vaults.

No. of Stories Counting from Top Down	KIND OF WALL CONSTRUCTION					
	Reinforced Concrete	Brick	Hollow Clay Tile or Concrete Block	Protected Steel or Reinforced Concrete Frames		
				Reinforced Concrete Panels	Brick or Plain Concrete Panels	Hollow Clay Tile or Concrete Block Panels
Top	6	8	12	6	8	12
2nd	8	12	12	8	12	12
3rd	10	12	16	10	12	16
4th	10	16	20	10	12	16
5th	12	16		12	16	20
6th	12	16		12	16	20
7th				12	16	20
8th				12	16	20
9th				12	16	20
10th				12	16	20

c. INDEPENDENCE. Vault roofs shall be entirely independent of floors, roofs, or ceilings of buildings. Vaults should preferably be built to extend to the top floor of the building, and the top of the vault located as close to the underside of the building roof as possible.

d. BONDING. The roof and walls of the vault shall be thoroughly bonded together. If construction is of reinforced concrete throughout, the reinforcing steel in the roof shall be carried into the walls and the wall reinforcement into the roof. If there are steel beams in the roof, these shall be securely fastened to structural members imbedded in the walls. If walls are of brick, suitable anchors shall be provided.

e. PROVISION AGAINST IMPACT. Where the roof is more than 12 inches below the roof of the building, the vault walls should be parapeted at least 12 inches above the vault roof, and the space thus formed filled with sand, gypsum or similar material, to act as a cushion against impact from falling materials and also to serve as further insulation against accumulation of burning débris on the vault roof. Adequate drainage shall be provided for this space above the roof.

f. DESIGN. Roof shall be designed for a live load of at least 350 lbs. per sq. ft. to take care of impact loading. Where local conditions are especially severe, such as near masonry walls or large tanks, loads of from 500 to 1000 lbs. per sq. ft. should be assumed and maximum spans in at least one direction should not exceed 10 feet.

NOTE: It is not deemed practicable to design the roof entirely to prevent possibility of damage from a heavy safe or machine falling through a considerable distance. Such equipment should be so located as not to endanger vault structures below.

g. INTERIOR SUPPORTS. Where long spans are needed, the introduction of interior columns, girders or division walls may be necessary. All interior steel work and reinforcing shall be protected with a covering having a fire resistance classification of not less than three hours.

Floors.

a. MATERIALS AND THICKNESS. Floors shall be of noncombustible material of a construction having a fire resistance classification not less than two hours. Floors shall be unpierced, not less than 6 inches thick, and greater if necessary to support the full load of floor and contents.

b. FLOORING. No wood or other combustible material shall be used in the floor or surfacing.

c. INDEPENDENCE. Floors shall be thoroughly bonded to the vault walls and shall be independent of floors of the building.

Doors.

Shall conform to specifications as given in the section on Vault Doors and shall be of the same fire resistance classification as the vault in which installed.

Water Tightness.

a. WALLS, ROOFS AND FLOORS shall be effectively waterproofed, preferably using a mixture of concrete of proper grading, mixture and placing for the purpose. No combustible membrane or coating shall be employed except on a roof exposed to the weather.

b. Provision shall preferably be made to prevent entrance of water at door openings. Raised or sloping sills and large drains in building floors outside of vaults are suggested.

Ventilation.

Ventilation of interior shall be only through door openings. Walls, floors, and roofs shall not be pierced.

Inspection.

The construction of the vault shall be under the immediate supervision of a competent engineer or architect to insure that it is built in accordance with the above recommendations and that careful workmanship is obtained throughout.

Four Hour Vaults.

Foundations.

Same as for six hour vaults.

Walls.

a. MATERIALS. Same as for six hour vaults.

b. THICKNESS. Shall be as specified for four hour classification in Table 1. In the lower story, however, the minimum thickness shall in no case be less than 12 inches for reinforced concrete nor 16 inches for brick. These minimum thicknesses apply to the vault construction only.

c. INDEPENDENCE. Same as for six hour vaults.

Roof.

Same as for six hour vaults.

Floors.

Same as for six hour vaults.

Doors.

Shall conform to specifications for vault doors as given in the section on Vault Doors, and shall be of the same fire resistance classification as the vault in which installed.

Water Tightness.

Same as for six hour vaults.

Ventilation.

Same as for six hour vaults.

Inspection.

Same as for six hour vaults.

Two Hour Vaults.

Foundations.

Same as for six hour vaults.

Walls.

a. MATERIALS. Walls shall be built of reinforced concrete, brick well bedded in mortar, load bearing hollow clay tile, hollow concrete blocks, or of protected steel, or reinforced concrete framework with panels of these materials.

The hollow concrete building block shall have cement proportions from 1:3 to 1:7 and either air or steam cured, and mixed with either dry, damp, or wet consistencies and of fine and coarse aggregates of crushed limestone, of crushed slag, or crushed cinders or of sand and calcareous pebbles, when assembled into walls one unit thick.

The hollow clay tile shall be not less than two-cell for 8 inch and not less than three-cell for 12 inch, conforming with the current Specifications of the A. S. T. M. for load bearing wall tile.

Hollow walls shall be plastered on both sides with at least ⅝ inch of gypsum or Portland cement plaster. Where a structural steel framework is used the steel framework shall have protection having a fire resistance classification of not less than two hours. At the joints, between columns, beams and panels, the latter shall be well bonded to the columns and beams, the panels to be notched or rabbeted into the concrete of the column for a depth of at least one inch, but in no case shall the construction be such that the fire resistance classification of any portion is less than 2 hours.

b. THICKNESS. Walls and wall panels shall be not less than the minimum thickness specified in Table 1 for two hour vaults.

c. INDEPENDENCE. To conform with requirements for six hour vaults except that when concrete block or hollow clay tile are used for walls without frames, such walls shall serve as bearing members for the vault only.

Roof.

Same as for six hour vaults.

Floors.

Same as for six hour vaults.

Doors.

Shall conform to specifications given in the section on Vault Doors, and shall be of the same fire resistance classification as the vault on which installed.

Water Tightness.

Same as for six hour vaults.

Ventilation.

Same as for six hour vaults.

Inspection.

Same as for six hour vaults.

Specifications for Structure Supported Vaults.

(Officially adopted 1927)

Fire Resistance Classifications.

Structure Supported Vaults are those supported by the framework of buildings of fire-resistive construction. These vaults may be located individually on any floor of such a building and are designed to afford full protection to their contents, assuming the integrity of the supporting structure.

Six Hour Vaults.

This classification is recommended where the construction and occupancy are such that a degree of fire resistance equivalent to six hours of the standard test is deemed necessary.

Four Hour Vaults.

This classification is recommended where the construction and occupancy are such that a degree of fire resistance equivalent to four hours of the standard test is deemed necessary.

Two Hour Vaults.

This classification is recommended where the construction and occupancy are such that a degree of fire resistance equivalent to two hours of the standard test is deemed necessary.

General Specifications.

Supporting Structure.

a. STRENGTH. The structure supporting the vault shall be of adequate strength to carry the full building loads as well as the entire weight of the vault structure and contents.

b. FIRE RESISTANCE. There shall be no combustible material in any portion of the supporting members of the structure. All structural members of the building shall have a degree of fire resistance equivalent to at least the same number of hours of the standard test as that for which the vault is rated.

Walls.

a. LOCATION AND ARRANGEMENT. The walls of the vault shall follow the panels of the building whenever possible, and shall extend from floor to ceiling of the building in the stories where the vault is located.

If vaults are located on more than one story, they shall preferably be placed one above the other in the several stories.

b. MATERIALS. Walls of vaults of the various classifications shall be built of the materials and in the manner specified for ground supported vaults of equivalent classifications.

c. THICKNESS. The thickness of vault walls of the various classifications shall be not less than the minimum thickness for the various materials specified for the top stories of ground supported vaults as given in Table 1, except that the minimum thickness of brick or plain concrete may be 8 inches for four hour vaults, and the thickness of walls of two hour vaults, if of plain concrete, may be 6 inches, and of hollow clay tile, hollow concrete block, or hollow walls of brick, 8 inches, walls of hollow units or hollow construction to be plastered on both sides.

d. BONDING. Vault walls shall be effectively bonded at the top and bottom to the floor or roof of the building in the stories where the vault is located. Suitable bonding shall also be secured between the walls and adjoining building columns as well as between vault walls and outside walls of the building where the latter are used to serve as a portion of the vault walls.

Roof and Floor.

a. The building floors or roof of the building shall serve for the roof and floors of the vault. The roof or floor shall be unpierced.

b. No wood or other combustible material shall be used in the flooring or surfacing.

Interior Supports.

Where there are interior supporting columns in a vault they shall have a degree of fire resistance equivalent to not less than three hours of the standard fire test.

Doors.

Shall conform to the specifications as given in the section on Vault Doors, and shall be of the same fire resistance classification as the vault on which installed.

Water Tightness.

Shall conform to the specifications for Ground Supported Vaults.

Ventilation.

Ventilation of interior shall be only through door openings. Walls, floors and roofs shall not be pierced.

Inspection.

The construction of the vault shall be under the immediate supervision of a competent engineer or architect to insure that it is built in accordance with the above recommendations and that careful workmanship is obtained throughout.

Vault Doors.

(Officially adopted 1934)

Definition.

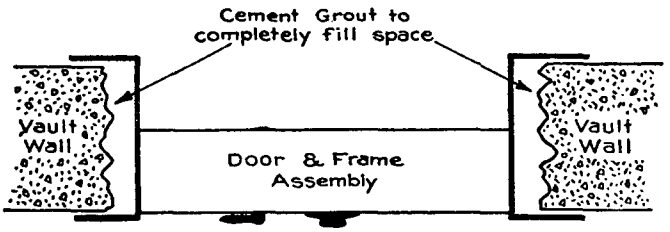
The term Vault Door, as used in this section, designates a unit consisting of a frame generally known to the trade as a vestibule, which is built into the masonry of the vault, and a single door or pair of doors hung and fitted into the frame.

Selection.

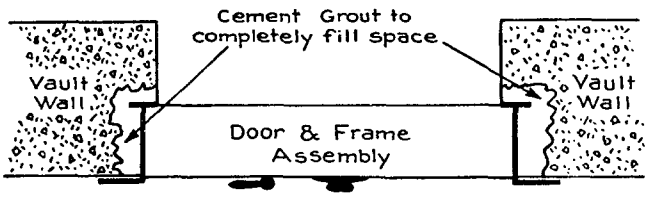
In order to obtain the greatest amount of fire resistance, vaults should be provided with vault doors affording fire protection approximately equivalent to that of the walls in which they are installed. Structural considerations, however, sometimes demand wall thicknesses greater than are essential for purposes of fire protection, and in such cases a door having a lower classification than the wall in which it is installed may give the necessary protection. In these cases, the classification of the vault is obviously determined by the door rather than by the vault structure. Doors classifying at less than two hours are not recommended for vaults.

The effectiveness of various types of vault doors, in resisting fire exposure, can only be based on reliable information such as can be obtained by tests under standard conditions. Therefore, doors may be recognized and should be given preference if bearing evidence of 6-hour, 4-hour, or 2-hour classifications by an organization which is properly equipped and qualified for experimental testing, and subjected to inspection in course of manufacture, doors of such designs having demonstrated their effectiveness by passing recognized tests.

It is believed that inner doors have some value in keeping combustible material well inside of the vault chamber and they may be installed if desired.



Installation when vestibule laps both faces of wall



Installation when vestibule fits into recess in wall

Installation.

The installation is very important, as under fire conditions the vault door must be held securely in place despite impact from falling objects, settlement of wall and expansion or distortion of the vault door itself. If under these conditions the device distorts sufficiently to allow the passage of flame or intense heat, the protection afforded is materially reduced. It is probable that vault failures may occur from neglect of this important installation feature. It is urged that the installation of vault doors be entrusted only to those experienced in such work.

Two methods of installing vault doors are in general use, namely, the building of the frame into the wall during erection, and the placing of the frame in a wall opening previously prepared. To permit the proper installation of the door in an opening previously prepared, it is necessary to make the opening larger than the frame. When the frame is set into such an opening, it is necessary to completely fill the space between the wall and the vestibule with a cement grout. (See diagram.) While this can be done without great effort, it is obvious that it would be difficult after the work is finished to distinguish a well-grouted installation from one in which the joint was only pointed with mortar, and as the latter method is much cheaper and quicker, it seems probable that it may be followed, unless careful supervision is given to the installation. When doors are built into the wall, the masonry is built up to the bottom of the sill of the frame and covered with a thick coat of cement mortar on which the frame is placed. The door is braced in position and built into the wall. Care is necessary to assure intimate and continuous contact of the frame with the wall structure.

When doors are provided with tongues and grooves at the sill, a metal bridge should be installed, maintained and used for the protection of tongues and grooves against mechanical injury.

Fire Tests.

The tests by means of which classifications are made consist of a fire endurance test and a hose stream test. In the endurance test, the door is mounted in the test wall with the unexposed side surrounded by an insulated compartment representing the vault chamber.

This chamber consists of an insulated box with an open side so designed that it may be closed by the wall of the furnace in which the door is mounted, making a tight joint. Walls, floor and ceiling of chamber are lined with insulation at least 2 inches in thickness. The cubic feet of space inside of chamber are not more than 20 times the number of square feet in the door opening.

Temperatures on the exposed side are increased in accordance with the standard time-temperature curve, and the classification is based on the time at which a temperature of 300° F. is indicated on a temperature measuring device located 2 inches from the unexposed surface of the door opposite the joints or when passage of flame is observed.

In the hose stream test the door is subjected to fire for half the classification period determined from the endurance test, then subjected for one minute to a hose stream from a 1⅛-inch nozzle 20 feet from the door under a pressure of 30 lbs. and is promptly re-exposed to the fire for the other half of the period. The failure point in this test is the same as in the endurance test, namely a temperature of 300° F. or passage of flame.

Uninsulated Steel Vault Doors.

Since the uninsulated vault door is widely used, it is felt that it should be given a classification at this point for reference purposes, although this classification is outside the group recommended for use in connection with vaults. On the basis of such furnace tests as have been made, a classification of one-half hour is given to this type of door. This assumes the presence of a vestibule not less than 12 inches deep with inner steel plate doors in place and in closed position.

Vault Interior Equipment.

(Under this heading are grouped a number of points which relate to the proper equipment and maintenance of a vault.)

(Officially adopted 1927)

Filing Equipment.

Filing equipment should be non-combustible throughout. Containers should be entirely enclosed if possible, but if contents are such as to make complete enclosure impracticable, containers having only the front end

open are advisable. Cubical contents of individual containers should be kept as small as possible.

The bottom of the lowest record storage space in filing equipment or on shelving should be not less than 4 in. above the floor of the building. In basements the lowest shelves or drawers should not be used for the storage of vital or important records, or records particularly subject to water damage.

Lighting.

The lighting should be electric, so arranged that both wires of the circuit are cut off when the doors are closed. Common methods of accomplishing this are given below in order of merit.

(a) Interior wiring in conduit with as many fixed lamps as are needed for adequate illumination; this interior system to be supplied by a short extension cord through doorway to live receptacle outside vault. Cord may be protected by flexible armor or by short length of rigid steel conduit with bushings and taped in place, on the cord at the point of door closure.

(b) Interior wiring controlled by door switch, switch opening *both* sides of the circuit.

(c) Interior wiring controlled by outside switch with red pilot light.

Wiring should be in conduit preferably exposed, and there should be no pendant or extension cord within the vault.

Care should be taken to make vault lighting adequate. Otherwise matches or other hazardous forms of illumination are likely to be used.

Heating.

Ordinarily vaults require no heating. Where steam coils are used a hazard is invariably introduced. Open flame heaters, electrical heaters, etc., should not be employed.

Ventilation.

Many examples of hazards introduced into vaults by ventilating systems are found. Openings are cut through walls to permit of ventilation. Fans are installed, usually supplied by makeshift wiring.

It is possible to install mechanical ventilation, either drawing through or discharging through doorway, and not necessitating additional wall openings. Increase in height of door will be desirable when this is done, and any such system should be so arranged that electric power supply to any apparatus within the vaults will be cut off when doors are closed.

Ducts passing through walls, even though protected by doors or shutters, create an additional hazard.

Housekeeping.

General cleanliness should be of the highest type. Foreign materials should not be kept in vaults. This has been emphasized by finding in vaults such things as gasoline, kerosene, lubricating oils, oily rags, nitrocellulose moving picture and X-Ray films, and the film mounts used by dentists, turpentine, reserve supply of matches, etc.

Smoking inside vaults should be positively forbidden.

No refinishing of any sort should be done inside vaults, since this means the presence of common and special hazards incidental to refinishing work. Special emphasis should be laid upon the undesirability of any refinishing by means of spraying now so commonly used.

Telephone and Alarm.

Where possible, telephone connections should be installed inside the vault, or alarm bells should be arranged so that a person locked inside the vault can ring an alarm on the outside.

Alarm bells have also been successfully arranged that ring inside when the door is about to be closed, a second switch on the outside door or the other half of a double inside door shutting off the bell.

Record Rooms and Record Room Doors

(Officially adopted 1928, amended 1934)

Introduction.

As has been pointed out in earlier reports, situations exist in which there are large volumes of records not of the utmost importance, but whose value justifies a certain amount of special protection. Because the volume of the records is too great, or their importance not vital, or by reason of other considerations, protection by vaults or safes may be impracticable or disproportionately costly. In cases of this kind, the record room is applicable.

Interior wall thicknesses have been indicated having fire resistance classifications of 2 hours or more. On the other hand, the protection specified for door and window openings is believed to have a classification not greatly in excess of ½ hour. In the judgment of the committee this discrepancy is justified for the time being, at least, by the following considerations:

(a) Practical structural requirements necessitate wall thicknesses having higher fire resistance classifications than doors and windows.

(b) Owing to the necessity for clear space, combustible materials will not be in immediate proximity to doors, thus materially decreasing the severity of the exposure to them. Similarly the protection on window openings in exterior walls will be subject, it is believed, to exposure less severe than would be indicated by the standard heat curve.

(c) Protective devices for door and window openings having higher classification than those indicated, and at the same time of suitable type for record room use, are not widely available commercially at present. If and when they become so, it may be desirable to raise the requirements somewhat.

It should be remembered that where protection of a higher grade is needed, specifications are available for vaults either ground supported or structure supported, and having fire resistance classifications of 2 hours and upwards.

Record Rooms.

Definition.

A Record Room is an enclosure of fire-resistive construction intended for use where the volume of records is too large and not of sufficient importance to justify economically the provision of vaults or safes, but where values warrant a certain amount of special protection.

Records requiring a greater degree of protection should be placed in vaults or safes.

Location.

A Record Room shall not be located within a building unless of fire-resistive construction having a fire resistance classification of at least two hours.

Size.

The size of an individual Record Room shall be limited to 50,000 cubic feet with a maximum height of 15 feet. A volume limitation of 40,000 cubic feet is generally preferable.

Walls.

Interior walls shall be of incombustible construction throughout and have a fire resistance classification of at least two hours. This will permit walls of the following constructions:

Material	*Thickness*
Reinforced concrete	4 in.
Plain concrete	6 in.
Brick (solid or hollow)	8 in.
6 in. Hollow Tile (2 cells in thickness) or 6 in. Concrete Block, plaster on both sides	7 in.
6 in. Gypsum Block, plaster on both sides	7 in.

NOTE. Some of the wall thicknesses specified above have fire resistance greater than 2 hours, but the given thicknesses are needed for structural strength and stability.

In some cases the occupancies in surrounding rooms will be such that the Record Room will be subjected to unusually severe exposure. In such cases the wall construction should be sufficient to provide protection in the event of a complete burn-out of the contents of the surrounding rooms. The construction specified for the top story of the 2-hour, 4-hour, or 6-hour ground supported vaults should be used in such cases.

The joinings of all walls with the building and with each other shall be tight. Vertical joints shall be well anchored or bonded.

The openings in interior walls shall be restricted to doorways. Window and door openings are permitted in exterior walls. The door and window area should be kept at a minimum.

No elevator, stairway or shaft shall have a door or other opening directly into a record room whether or not such openings are fitted with fire doors. The walls between any such vertical shafts and the record room shall have a fire resistance classification of at least two hours.

Floors and Ceilings.

The floors and ceilings shall be non-combustible throughout and of a construction having a fire resistance classification of at least two hours. The floors and ceilings of the building in which the record room is built will ordinarily serve for the record room.

Floors and ceilings shall be unpierced and shall be of ample strength.

No wood or other combustible material shall be used in the floor, surfacing or trim.

Record Room Doors.

Definition.

Doors capable of preventing the development of 300° F., for periods of 30 min. or more, in fire tests conducted under standard conditions by organizations properly equipped and qualified for experimental testing, can be classified as record room doors.

The term, record room door, as used in this section, designates a unit consisting of a frame generally known to the trade as a vestibule, which is installed into the masonry of the record room and into which a door or pair of doors equipped with locking mechanism is hung and fitted.

Fire Tests.

The tests by means of which classifications are made, consist of a fire endurance and a hose stream test similar to those described in the section on Vault Doors, except that the temperatures are recorded at different locations. On the assumption that combustibles in record rooms will not be stored nearer than 3 ft. in front of the door opening or nearer than 6 in. in line of the opening the classification is based on the time at which a temperature of 300° F. is indicated by temperature-measuring devices at these locations, or by the time passage of flame is recorded.

Selection and Installation.

Record room doors are generally of two types, those constructed of sheet metal into which is incorporated some insulating material, and those constructed of plates, angles and channels, designated by the trade as steel vault doors.

The latter type is widely used and varies in construction principally in the number of locking bolts and hinges. These doors are generally provided with a vestibule equipped with inner doors. The fire-retardant value of some of these doors may warrant comparison with the ½-hr. record room door classification.

The effectiveness of various types of record room doors in resisting fire exposure can only be based on reliable information such as can be best obtained by fire tests under standard conditions. Doors bearing evidence of classifications as ½-hr. or 1-hr. record room doors should be given preference when selections are made.

The installation of record room doors should be entrusted only to those experienced in such work. Two methods of installing record room doors are in general use; namely, the building of the frame into the wall during erection, and the placing of the frame in a wall opening previously prepared. When frames are installed in openings previously prepared, the masonry opening should be as nearly as possible of the size of the frame, into which the assembly should fit snugly. Instructions for installation furnished with the door should be observed.

Door Closers and Service Doors.

Doors shall be self-closing and normally closed, controlled by door closers ("door checks") or similar devices. When conditions are such that doors are liable to be fastened in the open position, they shall be equipped with automatic releases. When so equipped an additional service door may be used if so arranged that it cannot interfere with the operation of the fire door.

Windows and Window Openings.

Window openings shall be located in exterior walls and shall be as few and as small as practical considerations will admit. In no case shall any single opening exceed 5 ft. in width or 9 ft. in height.

All window openings shall be fitted with wired glass in metal frames and in addition shall be protected with one of the following devices. Devices shall be of a type approved by inspection department having jurisdiction.

(a) Automatic shutters;

(b) Swinging shutters (sheet steel not acceptable);

(c) Outside sprinklers.

NOTE. Difficulties of both a practical and an engineering nature may often be encountered in the use of outside sprinklers. In all cases, sprinklers should be so arranged that the water flows over the surface of the device protecting the opening, as it is probable that a water curtain between the fire and the opening offers comparatively little protection.

Equipment, Maintenance and Supervision.

Filing Equipment.

All records shall be stored in containers which shall be of metal throughout. No furniture other than the equipment necessary for records and filing shall be permitted in the room.

Interior shelving shall be sub-divided into "openings" (between dividers or partitions), each having a volume of not more than ten cubic feet, enclosed on five sides and preferably on all six sides. It is recommended that in all cases at least a portion of the containers be enclosed on all six sides, distributing these containers to form fire stops. The safety is appreciably

increased by fully enclosed containers, thus preventing lateral as well as vertical spread of fire.

Records stored in open containers shall be located not less than 36 inches from a door or window. Records in fully enclosed containers shall not be located less than 6 inches from such wall openings.

The bottom of the lowest record storage space in filing equipment or on shelving should be not less than 4 in. above the floor of the building. In basements the lowest shelves or drawers should not be used for the storage of vital or important records, or records particularly subject to water damage.

Lighting.

Record rooms shall be lighted by electricity with wiring in conduit, preferably exposed. There shall be no pendent or extension cords.

The lighting system shall be designed to give sufficient light in all portions so that there will be little likelihood of using other more hazardous forms of illumination.

Main switches shall preferably be outside the room and provided with an indicator. If located inside the room, they shall be placed near the door.

Heating.

Heating shall be by hot water or steam. When heated by steam the coils or radiators shall be located preferably overhead or shall be so arranged at the side as to avoid the likelihood of records being in contact with the piping.

Means should be provided to guard against the possibility of fire communicating to the record rooms from other parts of the building through openings caused by movement or breakage of piping at time of fire.

Ventilation.

Ventilation of record rooms shall be only through doors or through exterior windows fitted with automatically closing sash. Walls, floors or ceilings shall not be pierced.

Housekeeping.

General cleanliness shall be of the highest type.

Foreign materials shall not be kept in record rooms.

NOTE. The hazard of such materials as gasoline, kerosene, turpentine, lubricating oils, oily rags, nitrocellulose films, reserve supply of matches or the like is obvious.

Supervision.

It is recommended that so far as possible the record room be not used as a working space for employes.

In all cases arrangements should be made for careful supervision of the room under responsible authority at all times and an inspection should be made daily before closing to insure that contents are in proper condition and all doors, windows and shutters closed.

Smoking inside record room should be positively forbidden.