PROTECTION OF RECORDS

Consolidated Reports of the
Committee on Protection of Records

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Note.

This pamphlet, consisting of extracts from the reports of the Committee on Protection of Records presented at the meetings of the National Fire Protection Association in 1923 to 1936 inclusive, is printed for the convenience of those interested in this subject. The present edition supersedes the similar publication dated 1936, and incorporates an amendment adopted in 1939 changing the designations "record room" and "record room door" to "file storage room" and "file storage room door" respectively. This pamphlet will be revised in future editions as the work of the committee develops. Most of the sections have been officially adopted by the Association as indicated. Some are in tentative form and are subject to revision and enlargement.

National Fire Protection Association.

August, 1939.

Contents.

PROTECTION OF RECORDS

Part I. Summary of Good Practice Requirements For The Protection of Records.

(Officially adopted 1935)

A. Introductory.

This summary has been prepared to assist in the best utilization of the reports on the different divisions of record protection given in Part II, to which reference is made.

While records are probably destroyed by fire every day, no one individual experiences or perhaps even realizes the serious effects of such losses more than a few times at the most. Some persons may never have first hand information of such disaster. This breeds an unwarranted sense of security, and in some cases, of indifference.

It is the individual who has lost valuable records who does realize the importance of the subject of protection and no one knows whether or not he may be the next victim. It is prudent to provide adequate protection even though it is hoped and expected never to have a fire. Protection is the only kind of insurance that can be provided for certain records.

"The vital value of important records is often not appreciated until loss, such as by fire, occurs. Other values of more apparent intrinsic worth may receive more thought and care in regard to methods of handling and safe disposition. An appeal for greater appreciation of the hazards to records may find less response than one relating to conservation of life and limb and tangible, readily realizable values. Yet on the fact of preservation or loss in a destructive fire may depend the decision as to whether or not the establishment will be rebuilt and its business resumed.

"The multitude of human interests hinging on this circumstance affect in varying degree the welfare and occasionally the very existence of the tributary community. The high mortality of firms suffering disastrous fires is influenced to no small extent by the extent of loss of the records forming the basis of tangible and intangible assets, the ability to rise, if not phenix-like, from the ashes of such a disaster, being contingent in part upon their preservation.

"Other apparent property and human values are also involved. Scattered throughout the length and breadth of the land and indifferently protected are the public records of birth, marriage, and death, deeds of conveyance and trust, testaments, court decrees and the multitude of written evidence on which proof of citizenship, legal status, rights and ownership depends. (Sec. 18. p. 87.)

"Their loss may mean expensive litigation and deprivation of rights and property that has required a lifetime of effort and sacrifice. Fire is an ever-present menace and is no respecter of persons or classes of property. Its toll for the country as a whole can be predicted within limits from year

to year and the only recourse by which the hazard for a given location or property can be reduced below that of the average is by the application of prevention and protection measures of proven effectiveness.

"That records have money value is demonstrated by the very considerable expense that is being incurred for their protection. The evaluation of the records of an establishment may disclose unexpectedly high values. The value of some records can be definitely appraised in terms of the labor and material cost of their replacement. Other records have what has been termed consequential value, which is stated in terms of the loss that would be sustained in their absence—records covering accounts receivable being an example.

"While some important records increase in value with age, most classes decrease in usefulness with time, which serves to place them successively in lower value classifications."*

B. Protection of Records.

Probably the majority of persons who have records in their care provide what they consider sufficient protection, or take it for granted that whatever housing is employed is adequate. Doubtless there are some to whom the thought has never occurred that some contingency might result in loss of records.

It is a far cry, however, from believing that records are protected to knowing that they are. It is because of so much misplaced confidence in housing that fails to afford protection when fire comes, that this report has been prepared.

The steps necessary to determine if records are adequately protected—and, if not, how it can be accomplished, are:

(a) Surveying and classifying the records involved.

(b) Estimating the probable duration of fire that might occur where the records are kept.

(c) Deciding, in the light of items (a) and (b), the proper method of protecting said records.

(d) Establishing regulations covering the handling of records in ordinary use, at time of and after a fire.

(a) Survey and Classification of Records.

Before a comprehensive plan for protecting records can be formulated, it is necessary to know the kind of records involved, their volume by class, their use, and present protection.

The Survey.

The survey should be under the general charge of a senior executive having a perspective of the entire business, department, public office or whatever unit be involved. The actual survey can be made by a capable junior executive who should familiarize himself with the entire contents of this report and other pertinent literature on the subject.

The survey should include:

(1) Actually viewing the records.

(2) Determining their physical volume by class.

(3) Determining the rate at which they are being produced, their subsequent history and their relation to other records.

(4) Recording the rate at which they may be transferred or discarded and their use and value after transfer.

*From paper by S. H. Ingberg given before the Fifth All-Ohio Safety Congress, 1932.

(5) Ascertaining how records are then housed.

(6) Estimating carefully the effects of the loss of each class upon the enterprise, office, or department.

CLASSIFYING THE RECORDS.

The next step, using the foregoing inventory, will be to classify the records into broad classes such as the following:

CLASS 1. VITAL, underlying the organization of an establishment and those giving direct evidence of legal status, ownership, accounts receivable and incurred obligations.

CLASS 2. IMPORTANT, records that while not irreplaceable, can be reproduced from original sources only at considerable expense.

CLASS 3. USEFUL, records, the loss of which would cause temporary inconvenience but otherwise would entail no serious permanent disadvantage.

CLASS 4. NON-ESSENTIAL, records that have no present value and should be destroyed.

NOTE: While every enterprise will have its own reasons for assignment to classifications, it is recommended that the discussion and recommendation of Sec. 3, p. 16 of this report be studied in this connection.

(b) SURVEY OF BUILDING.

Before the degree and nature of fire protection required for records can be determined, it is necessary to know to what fire hazard they are exposed. This can be found out only by a survey of the building and its occupancy, considered from the standpoint of fire hazard.

FIRE-RESISTIVE BUILDING.

The survey of a fire-resistive building should show:

(1) The general class of the construction—i.e., whether it is really fire-resistive or simply called such. If not, then it should be surveyed as a non-fire-resistive structure.

(2) Exterior fire exposure.

(3) External and internal fire fighting facilities.

(4) Protection of floor and wall openings.

(5) Subdivision of areas and whether subdividing partitions are fire-resistive.

(6) Nature of floor surfacing and of trim—i.e., whether combustible or not.

(7) Furniture and equipment, combustible or otherwise (Sec. 5, p. 27).

(8) Nature of occupancy and amount and kind of combustible material involved (Sec. 7, p. 35).

(9) The number and size of vaults or file storage rooms, together with the thickness, material, condition and support of their enclosing walls. Also the kind and fire-resistive rating, if any, of the doors to such vaults or file storage rooms (Sec. 10, p. 51, Sec. 11, p. 64).

(10) The number, size, location and fire-resistive ratings, if any, of the safes and other portable record containers in the building (Sec. 13, p. 70).

(11) The probable duration of fire under the worst possible condition, in the various parts of the building where records may be located. This may be estimated approximately by ascertaining the combustible content of typical rooms, in pounds per square foot of floor area, in-

cluding any combustible floor surface and trim, and applying Table 1, p. 36 in Sec. 7 of this report. Allowance should be made for materials having appreciably higher calorific values than wood and paper.

The purpose of estimating the possible duration of the fire is obviously to determine whether the protection provided is adequate or what protection should be provided.

NON-FIRE-RESISTIVE BUILDING.

In the case of a non-fire-resistive building, the survey should show:

(1) Type of construction, ground floor area and height.

(2) Exterior fire exposure.

(3) External fire fighting facilities available.

(4) Estimated amount of combustible material per square foot of ground area, including contents, combustible building members, and finish, except exterior walls (Sec. 7, p. 46).

(5) The nature of occupancy.

(6) The number size and location of vaults or file storage rooms, together with the thickness, material, condition and support of their enclosing walls. Also the kind and fire-resistive rating, if any, of the doors to such vaults or file storage rooms (Sec. 10, p. 51; Sec. 11, p. 64).

(7) The number, size, location and fire-resistive ratings, if any, of the portable record containers in the building (Sec. 13, p. 70).

(8) The probable severity of fire. While the maximum equivalent fire duration cannot be estimated as for fire-resistive buildings, the figure obtained under (4) will serve as a relative index. Information on its application to fire exposure conditions for vaults and safes is given in Sec. 7, pp. 42 to 47 and Table 2 (b), p. 45.

NOTE: The assistance of a capable fire or record protection engineer in making such surveys and in interpreting them is recommended.

(c) PROVIDING PROTECTION.

The degree of protection provided for records should be commensurate with their value.

Class 1, or Vital records, should be provided with protection such that there can be no question of their preservation in case of fire.

Class 2, Important records, should be given full protection where practicable. Under some conditions storage in record rooms may be the limit of protection practically obtainable.

Class 3, Useful records, should as a minimum be kept in incombustible filing cabinets or other similar containers.

Class 4, Non-essential records, need no protection so far as their own value is concerned. Their retention, however, in non-fire-resistive containers or in the open makes them a fire hazard to more valuable records.

Records may be protected by either one of three general methods, or by combinations of them. These are:

Protection in fire-resistive inclosures or containers.

By fire-resistive building construction.

By duplication.

PROTECTION IN FIRE-RESISTIVE INCLOSURES OR CONTAINERS.

These include vaults, file storage rooms, record storage buildings, and safes and other portable fire-resistive record containers. The following table

indicates the approximate average fire resistance that can be expected from the general run of devices used for housing records. The protection afforded varies considerably depending on design and materials. Reference is made to Sec. 9 to 13, inclusive, and particularly Table 2, p. 45.

Insulated vault doors with tongue and groove jambs, depending on thickness and construction .....1 hour to 6 hours
Steel plate vault doors with vestibule and inner doors.....½ hour
Modern safes and cabinets with 2-inch or more solid insulation and tongue and groove door jambs, depending on thickness and construction .....¾ hour to 4 hours
"Old Line," "Iron," or "Cast Iron" safes, 2 to 6-inch wall thickness .....½ hour to 2 hours
Insulated steel files and cabinets 1¼ to 2½-inch solid insulation .....½ hour to 1 hour
Cabinets and other containers with multiple air spaces or solid insulation, ½ to 1 inch in thickness .....10 to 20 minutes
Uninsulated steel files, cabinets—Wooden files—Wood or steel desks .....about 5 minutes

NOTE: The rating ½-hour, 2-hour, 6-hour, etc., means that the vault, safe or other record container to which such rating is applied will afford protection to records from standardized test fire conditions for that length of time—with a margin of safety. As applied to standard vaults, the term really refers to the fire resistance of the door, the latter being the weakest part of the assembly considered with respect to fire protection. Most modern vault doors and safes carry authoritative labels which indicate the degree of protection they may be expected to afford.

FIRE-RESISTIVE BUILDING CONSTRUCTION.

This is often the only practical protection method available where large volumes of valuable records are involved (Sec. 5, p. 26). The essential requirements of adequate protection in such cases are:

(1) That fire-resistive construction shall be of the highest order.

(2) That floor areas shall be subdivided into relatively small units by incombustible fire-resistive partitions.

(3) That floor surfacing and trim shall be of incombustible materials.

(4) That all openings shall be protected.

(5) That furniture and equipment shall be of incombustible material.

(6) Only a minimum of combustible materials shall be freely exposed as building contents, and extraneous accumulations avoided. Particular care in this respect need be taken during painting and repair operations and installation of equipment.

(7) That records shall be kept in incombustible containers at all times when not in actual use.

(8) Where all of the conditions, (1) to (6), inclusive, do not exist, compensating protection for the more valuable records shall be provided by means of vaults, safes, or other containers having the fire rating required by the location.

PROTECTION BY DUPLICATION.

(1) Records may be protected by duplication and storage of copies in two or more places at such distances apart that fire in all such places is im-

probable, even under conflagration conditions. Duplication may take the form of:

Carbon copies of typewritten matter.
Photographing.
Photographing on small film and projection of same on a larger scale.
Photostating.
Blue printing.

Some organizations have systematic plans for safeguarding certain records in this manner (Sec. 8, p. 48).

(2) Provision should be made for immediate reproduction, if one of two preserved copies be destroyed.

(3) Use of this plan is recommended in the case of very valuable records, where it is not feasible to provide adequate protection at the place of origin or principal use.

(d) Handling of Records.

Records in Normal Use.

(1) No more records than are absolutely necessary for use shall be out of their proper place of housing at any given time (Sec. 19, p. 88).

(2) All records shall be returned to their place of keeping, when the office in which they are used is closed.

(3) Watchmen shall have orders to remove to a designated safe place all records that they may find exposed. Persons responsible for such negligence are subject to reprimand, and if persistent offenders in this respect, to discharge.

(4) Only the most necessary activities shall be carried on within vaults, record rooms, and the storage portions of document buildings. No flammable liquids such as for cleaning typewriters, or motion picture film, shall be kept in such spaces.

At Time of Fire.

(1) Employees should be definitely instructed to return to their proper keeping places all records upon alarm of fire, if this be possible without danger to life or limb.

(2) In large organizations, fire drill regulations should include the putting away of records.

(3) Fire departments should play streams of water in the vicinity of and, if possible, upon vaults, safes and other containers for records in contact with or buried in hot debris in sufficient amounts to insure cooling below the temperature endangering the records. Excessive use of water for the purpose should, however, be avoided.

(4) Firemen should not dump out contents of filing drawers, etc., but extinguish each in place with a minimum of water (Sec. 15, p. 73).

After a Fire.

(1) Access should be had as soon as possible to record containers that are suspected to have been subject to fire of sufficient severity to endanger their contents and they should be cooled with water sufficiently to permit opening. Some means of producing fine spray should be at hand, also tubs of water, into which heated records may be quickly plunged, if necessary. Under almost all conditions, the sooner the container is opened the better the opportunity for salvage.

(2) Valuable documents that have been heated to brittleness may in some cases be salvaged by placing them between sheets of glass.

(3) Many records that have been charred may be copied photographically (Sec. 15, p. 73).

(4) Charred or partly charred records should be left in position in filing drawers until systematic inspection and reconstruction work can be undertaken.

C. Disposition of Useless Records.

(a) Records no longer useful should be destroyed. Besides taking up room, they add to the fire hazard.

(b) Obsolete records should be destroyed according to some systematic plan suitable to their character (Sec. 16, p. 77; Sec. 17, p. 79).

(c) Destruction should be carried out by authorized persons only, acting under written instructions from a senior executive responsible for the general care of records.

(d) Record should be kept of the date of destruction, kind of records destroyed, period covered, date destroyed, by whom, how, and by whom destruction was authorized (See forms, pp. 76 and 77).

Part II. Compilation of Committee Reports.

1. INTRODUCTION.

(From Preliminary Report, 1923)

Earlier Attitude Toward Care of Records.

Of late there has been a quickened appreciation of the value of records to business, and the alert have not failed to recognize the grave consequences which may follow their destruction by fire. This has stimulated marked progress in the engineering aspects of the subject with the result that the best practice today presents a marked contrast to that of a few years ago. The factors which contributed to this early indifference are of interest because they are by no means eliminated and still operate powerfully to retard recognition of the problem and progress toward its solution. The factors are such as these:

a—There is no direct economic incentive for improving the protection of uninsured records such as is found in the insurance savings which may be secured by the proper safeguarding of insurable property.

b—No proof of loss is required following their destruction since they are uninsured, and attempts to segregate the cost of a record loss have been almost unheard of. Indeed, many of the costs are indirect, concealed, and difficult to ascertain.

c—Reticence as to the consequences of record losses has been almost complete on the part of those who have suffered them. This has encouraged the mistaken inference that the losses have been of little real consequence.

d—"The books" have often been considered the only important records of business. The persistence of this tradition has permitted the neglect of other records equally important.

e—Since records are uninsured, their replacement cost must come out of the earnings of the business, often at a time when it is already crippled by fire. There has been failure to contrast this with the loss of property for which reimbursement in the form of insurance can be secured.

Clearly maximum precautions are justified for an uninsured risk.

f—Misplaced confidence, above all, has caused invaluable records to be entrusted to protective devices of little effectiveness. Many vaults and safes were good. For lack of definite engineering test data many more have contributed only a false sense of security. Today accurately controlled furnace and other tests are disclosing weaknesses hitherto unrealized.

Despite the still existing handicap of these earlier ideas, record protection is thrusting itself forward in a way that demands attention and an answer.

The Present Need.

The present growing interest in record protection is largely, though not entirely, a spontaneous and unguided recognition of need, following along lines of least resistance and often a by-product of other developments. Important progress has been accomplished in many special lines, but now there is need to view the whole problem broadly, to single out and weigh its various phases, and to recognize those which are under-developed. The Committee should endeavor to advance these backward portions of the whole subject in order that unbalanced knowledge may not lead to faulty conclusions.

Fundamentally, it is now necessary to do three things:

a—Establish the fact that records have a value translatable into dollars, and that their destruction is followed by financial loss, partly indirect but largely direct and measurable.

b—Determine and demonstrate the adequacy or inadequacy of present methods of record protection upon which reliance is commonly placed.

c—Ascertain what modifications of present practice are necessary to secure proper protection.

To do these things wisely, will be no small task, to only a portion of which the Committee can at any one time address itself. In general terms, however, the outline of the fire protection problem may be stated bearing in mind however that the first of the fundamentals above stated is not essentially an engineering question.

The Problem.

The problem of record protection may be considered under two major divisions:

a—General methods of fire protection.

b—Special methods of record protection.

General Methods of Fire Protection.

As to the first, no detailed discussion is required by members of this Association. It is clear that those things which contribute to fire safety in general must contribute to record safety and to the effectiveness of special devices for the protection of records. In this direction the Committee has only to apply the lessons which have been so thoroughly learned and the standards which have been so well developed by the Association in the past.

This important point of difference, however, should not be overlooked. Many records are irreplaceable at any cost. Others have a value which is intangible and not subject to statement in dollars. Still others can be appraised quite as accurately as any physical property. In whichever class they fall they represent, in the aggregate, astonishingly large values—usually far in excess of customary office contents. All of this means that for purposes of record protection there may be ample justification for a degree of protection much beyond customary practice when only commercial and replaceable values are involved. With this in mind, we may turn to more specialized parts of the question.

Special Methods of Record Protection.

In general three basic methods of protection may be distinguished:

a—Duplicate records may be kept at a point not subject to the same fire.

b—Records surrounded by combustible materials may be placed in con-

tainers constructed to withstand the heat of a fire and possible falls and blows.

c—Combustible surroundings may be eliminated, or records may be separated from them so that exposure becomes very slight.

Most methods of record protection partake of one or more of these principles. Out of the application of the principles have arisen many interesting questions of systems of duplication, document buildings, vaults, safes, file storage rooms, steel files, wooden files, supervision of records, record drills, etc.

DOCUMENT BUILDINGS. There are many instances of business concerns and others which have provided at an unexposed location a detached building of strictly fire-resistive construction, in which large numbers of infrequently used but important records may be kept. Many of the characteristics proper to such a building are known, but further study is needed on many other points not yet so clearly established.

VAULTS. Prior to the preparation of the present specifications probably the most authoritative attempt to date to establish standards for the fire-protection features of vaults is found in the specifications with which we are all familiar, entitled "Regulations of the National Board of Fire Underwriters for the Installation of Vaults, as Recommended by the National Fire Protection Association, Edition of 1916." If all vault construction followed the rules there laid down, there would be little room for criticism. However, other types of construction are most commonly met and must be dealt with. Here, as in many other aspects of record protection, there is pressing need for actual engineering test data upon which sound judgments can be based. Far too much of present practice seems to be based on traditions and inferences, perhaps not capable of withstanding too close scrutiny. Test data, as to walls, floors, etc., developed for other purposes, may serve quite conclusively. Much is to be desired however in the present state of knowledge concerning such things as doors, vestibules, vestibule settings, interior equipment, lighting, heating, ventilation, exclusion of water, etc., as applied to vaults for the storage of important records.

SAFES. Many years before scientific furnace tests were thought of, bitter controversies raged between safe manufacturers as to the relative fire resistive merits of their devices. Only of late years has orderly engineering study thrown dependable light upon the subject, much of which is as yet unexplored. New types have been developed and they display many virtues. Older types in tremendous number are still in use, however, and will doubtless continue to be so for many years. Far too little is known as to the degree of confidence which may be placed in these.

FILE STORAGE ROOMS. For bulky collections of records, not of the first importance, storage in vaults and safes often is impractical. In a building of strictly fire-resistive construction, such records may be separated from the exposure due to combustible contents by placing them in steel files, in a room separated from the remainder of the building, by proper incombustible partitions having any openings adequately protected. Questions then arise as to the value of such protection, the degree to which combustible contents and trim must be eliminated, the effectiveness of ordinary steel filing devices in separating the records into non-continuous groups between which fire may not be expected to spread, the need for automatic sprinklers, the degree of protection necessary against internal and external exposure, and many other points upon which it is true that data now available throws considerable but by no means conclusive light.

STEEL FILES. It is probably true that the fire-resistive merits of steel files have at various times been understated as well as overstated. Here again, such opinions as have been reached are based largely upon judgment aided only by actual fire experiences, which may easily be misleading, and such opinion is almost entirely unsupported by data derived from controlled tests. It is believed that there is a big field in record protection for the ordinary steel file, though perhaps not along the precise lines of use that hitherto have been followed.

WOODEN FILES. From a fire standpoint we may be inclined to condemn the wooden file almost without a hearing. Nevertheless, it must be recognized that its use is widespread, and it may very properly be a part of the duty of the committee to consider the forms of protection which must be thrown about such files if reasonable safety is to be secured in their use, perhaps for records not of the first importance.

CONSISTENT USE OF PROTECTIVE EQUIPMENT. Protective equipment, even though adequate, is of little value unless it is consistently used, and unless there has been forethought concerning procedure in an emergency. Grave oversights in both these directions are more commonly found than not, and the Committee in due course should emphasize this phase of the question, should outline drills for restoring records to their places of safety, quickly, accurately, and without confusion or oversight. Attention should be called to the inconsistencies introduced by permitting records ordinarily protected to be transferred, sometimes for considerable periods, to the custody of others, who do not similarly protect them; by failing to put records away at the close of working hours; and by allowing them to accumulate outside of protective containers as a matter of convenience or accessibility.

2. VALUE OF RECORDS.

[*From 1926 Report*]

To show that records have money value is to take a long step toward an inescapable conclusion that they must be protected against loss by fire. Indications multiply that increasingly the hard-headed business man clearly recognizes the existence and magnitude of such values, sometimes almost spectacular in amount, particularly when contrasted with the rather casual regard in which these values have often been held in the past.

The evidence so far groups itself for the most part under three headings:

a. The very substantial expenditures which are being made everywhere for the physical protection of records, and the increasingly rigid standards of protection that are demanded by record owners.

b. The placing of insurance on records in considerable amount, indicating a willingness on the part of record owners to pay a premium on such insurance, and on the part of the insurance carriers to recognize a tangible insurable value, as to which a practical settlement can be made in event of a loss.

c. In public utility valuation and rate cases, the introduction of the money value of records as one of the factors in "going value," and hence in the determination of rates. A recent decision by the United States Supreme Court specifically recognizes the inclusion of such values, and a number of public utilities are having actual appraisals made of the money value of their records for valuation purposes.

All of these things point to the fact that those who own considerable aggregations of records are observing in them a tangible value in dollars. With this realization comes an appreciation that they must be protected against loss, and upon this basis rests a much more practical interest in the subject than could be built upon any attempt, however enthusiastic, to emphasize purely intangible values.

Evaluation of Records.

[*From 1932 Report, officially adopted 1934*]

The title "Evaluation of Records" might be construed as covering a much broader field than it is intended to discuss in this report. The user of records would quite naturally think first of their values in terms of their usefulness and effectiveness in performing the functions for which they are intended. The alert business man from day to day matches these values against the cost of constructing and operating his records and on that basis decides to continue, modify or eliminate them.

There is, however, a quite different set of values, less often thought of and much less frequently given the same careful and hardheaded analysis. Perhaps the simplest and most direct way to define these values is to say that they represent the loss that would be sustained if the owner, suddenly and without warning, were deprived of the records. One of the ways in which this can occur is by the destruction of the records by fire.

This, then, is the field of this discussion—what losses are sustained, in dollars and otherwise, when records are destroyed by fire and how and to what extent we can forecast the nature and amount of such a loss.

Essentially, from this point of view, records have three kinds of value:

Replacement Value.

Replacement value is the first of these. By this is meant the actual labor and material cost of replacing the portion still useful, of those records which can be replaced. To do this may necessitate extensive field surveys or laborious reconstruction of records from external sources or from other records which have been saved. These, however, are largely predictable costs and this element of value is appraisable within fairly close limits. Such an appraisal should not be approached in a casual way nor attempted in general sweeping terms, but like any other good appraisal should be built up unit by unit with sound reasoning back of each estimate.

Consequential Value.

Consequential value is the second element. It refers to the losses which will be sustained as a result of the absence of the records destroyed. If the records of accounts receivable are destroyed, certain accounts may never be collected. If claims records are lost, claims will not be settled as advantageously. If records controlling and facilitating operations are lost, operations in their absence cannot be conducted as well nor as economically. If it were wise to keep the records at all, their absence must necessarily be a handicap. The disorganization attendant upon lack of vital records may gravely impair relations with customers and the public or may hamper the handling of involved legal or tax problems. Many other arresting illustrations will occur to the executive who will apply to each group of records the question "What would happen if these were suddenly destroyed?" Surprisingly valid estimates can often be made of the money value of the losses which would be sustained as a consequence of the destruction of records. Those familiar with accounting and credits can approximate the probable shrinkage in collections which will result if accounting records are gone. A skilled claims man can forecast with considerable accuracy the effect on the settlement cost of each claim if he were deprived of his carefully accumulated data. The sales manager can at least approximate the effect on customers of a disorganized service and the extent to which aggressive competitors may be expected to seize upon such a situation to their advantage. Nevertheless, it is true that consequential value is more difficult to appraise than replacement value, less accuracy can be expected and some elements of consequential value can be forecast with difficulty, if at all.

Contingent Value.

Contingent value, the third element, concerns the sort of loss which might be suffered contingent upon some other happening which may or may not occur. The Minutes of the meetings of the Board of Directors might be destroyed and no difficulty might ever result. But under other circumstances, the lack of the Minutes might cause incalculable harm. Legal complications may make vitally important certain classes of records which, normally, have only moderate value. The possible gravity of such contingencies may be recognized but it is very difficult to translate them into figures. Clearly, however, this factor furnishes thought provoking support to the belief that loss of records may mean a very real money loss.

Comparisons with Other Appraised Values.

In all of these phases of the questions, tenable conclusions are reached, not by broad generalizations but by the same analytical and detailed study that would be made for any other inventory. Group by group, records must

be scrutinized. For each group a theory must be constructed upon which the losses attendant upon their destruction can be evaluated. Some of the elements of value can be determined quite readily and with considerable precision. For others, the best approximations that sound judgment can furnish must be used.

Such inventories, properly and carefully prepared, may produce results that those hitherto unfamiliar with the subject may find almost incredible. In one Federal Government Department, such a study showed the following:

Approximate present value of buildings	$25,000,000
Inventory value of contents	11,000,000
Records and other uninventoried values	190,000,000

In the larger commercial, industrial and public utility establishments, record values running into the millions of dollars are not at all uncommon. Surely such grave possibilities of loss should not be disclosed only by bitter experience, but they should be wisely foreseen, intelligently appraised and vigorously guarded against.

3. CLASSIFICATION OF RECORDS.

(Consolidated Sections from 1924 and 1925 Reports)

An intelligent approach to the problem of record protection involves a recognition of the value of records, the hazards to which they are exposed, and the relative merits of the protective methods available.

But before these general principles can be wisely applied in a practical way, it is necessary to examine all of the records searchingly, and to separate them into groups based upon the importance of providing protection for them. This makes possible a program of protection within reasonable financial limitations, by indicating the minimum number of records demanding the highest degree of safety. At the same time, such a grouping, carefully done, guards against the probability of important links in the chain of records being overlooked, a condition almost certain to occur if decision is on the basis of generalities and not on a detailed analysis (from the point of view of possible fire loss) of each type of record and its relation to all others and to the carrying on of the affairs of the establishment.

Suggested Classification

It will be evident that any workable system of classification must be simple, and that it cannot be based on hard and fast definitions, for it will be found in the actual application, that nearly every case will be decided by a variety of factors the weights of which must be appraised as a matter of judgment, rather than on the basis of sharply drawn definitions.

A method that has been found satisfactory assumes four broad classes which may be designated as

Class 1—vital
" 2—important
" 3—useful
" 4—non-essential

These groups may be explained by the illustrations shown below. These are illustrations merely. There are many others in each class, and some of those indicated may be found to belong in other classes in many instances.

CLASS 1—VITAL RECORDS

In this group will be placed usually, such records as charters, franchises, minutes of directors' meetings, deeds, abstracts, easements, options, stock transfer and bond records, important contracts, general books and supporting papers, accounts receivable, tax returns, and many other accounting records. Here may be found also many engineering records, such as drawings and tracings, property plans, appraisals, inventories, etc. Numerous other items of similar importance will be discovered upon examination.

CLASS 2—IMPORTANT RECORDS

In this class will be placed many statistical studies, derived accounting records, which could be reproduced again from the original sources if necessary though at considerable expense and labor. The great mass of operating records usually belong in this group, particularly those of informative character whose purpose is to maintain a check upon efficiencies, operating costs, etc. Minor contracts and similar papers are included. In general, Class 2 covers those records not important enough to be placed in Class 1, but still clearly more valuable than those in Class 3 described below.

CLASS 3—USEFUL RECORDS

General correspondence is perhaps the best illustration of this group. Its loss would occasion much inconvenience, but with a few exceptions,

would present no insuperable obstacle to the continuous operation of the business.

CLASS 4—NON-ESSENTIAL RECORDS

This includes principally the material which upon examination is deemed eligible for destruction, as outlined elsewhere in this report.

Factors Influencing Classification

Some of the more common factors which influence classification may be readily stated, but it will be found in each individual case that there are many others which must be considered. All factors should be duly weighed before assigning a classification.

CONTINGENT VALUE

Some types of records have what might be called a contingent value. For instance, minutes of meetings might in many cases be lost without serious consequences, provided the business proceeds smoothly and without difficulty. Such minutes, however, might be of the utmost value in event of legal complications or internal difficulties.

LEGAL VALUE

Many records will be of value from a legal standpoint. It should be remembered that there are important differences to be observed in records in this regard. From a legal standpoint a duplicate copy of any sort is not as useful as the signed original, and hence for such purposes, the maintenance of duplicates at another point may not be an adequate safeguard. For this reason the originals would be placed in a higher classification than the duplicates.

INTERFERENCE WITH OPERATIONS

As business is handled to-day, particularly in the larger organizations, records are an important implement in carrying on productive operations. Without them production might be seriously interfered with, deliveries to customers might be delayed, and collection of outstanding bills might be seriously interrupted. All these consequences of possible loss should be considered in assigning a classification to any given record.

RELATIONS WITH PUBLIC OR CUSTOMERS

To almost any enterprise, records are an essential factor in rendering satisfactory service to the customer. In the case of a public service corporation, this is of particular importance, although it applies with evident force to the concern having customers in any form. Loss of records means that service to customers cannot be continued on the accustomed orderly basis, and dissatisfaction, if not resentment, is very likely to follow.

RELATIONS WITH GOVERNMENT AUTHORITIES

Public service corporations are faced by the problem of maintaining satisfactory relations (to which suitable records contribute) with public service commissions, and on account of relations with various taxing bodies and other governmental authorities, practically all business organizations could be thrown into very serious confusion by the destruction of the records pertaining to these contacts.

DIFFICULTY OF REPLACEMENT

Some records will be recognized at once as non-replaceable. This includes not only historical records, such as those in the possession of Governmental authorities, museums, libraries, and not a few business organizations, but also certain very common records, which, if lost, could not be reconstructed in the original form, but, at the most, could only be replaced by substitutes. To replace an old set of general books would be almost an impossibility. Minutes of directors' meetings cannot be replaced in the strictest sense because the meeting covered by the minutes can never be held over again. Many other such instances could be cited.

Other records are replaceable but only at a cost almost prohibitive. Consider, for instance, the cost of replacing the records covering an underground gas or electric distribution system for a large city. Or, consider the difficulties in the way of reconstructing, if completely destroyed, the stock transfer records of a large corporation.

These possibilities should be squarely faced and should be given due weight in determining the classification of records to which they apply.

EXPENSE OF REPLACEMENT

The clerical or engineering labor necessary to replace records, even when it is possible to replace them, may be astonishingly large. This will be recognized when thought is given to the current expenses of departments constantly at work on the making of records. To reconstruct, under emergency conditions, the work of many departments for many years clearly would involve a very substantial sum.

Thought must be given also to the additional expense attendant upon the absence of records. Instances are known, for example, where it is necessary to maintain additional engineering staffs, costing hundreds of thousands of dollars annually, by reason of the fact that data, previously available from records which were destroyed, must now be secured by physical survey in the field.

Method of Classifying

It is important that records be classified by actual physical survey of the records in detail. Misleading results are almost certain to follow any attempt to work from an assumed knowledge of the various record systems, and the factors that make them up. Detailed examination almost always discloses important points that are otherwise overlooked. With business methods as complex as they are to-day, the department head, though familiar with broad principles, cannot maintain an intimate knowledge of the detailed applications in the minute points of daily routine, which, however, constitute vital parts of the record system. The most practical procedure is to go over all records methodically, taking them as found at each location and examining each type of record to ascertain its relation to others, its importance, and hence its classification, making note meanwhile of the degree of protection existing for that particular unit, and of the protection probably warranted.

Department heads and those actually handling records should be freely consulted in establishing the classifications, but it will be found wise to have the one person make the classification for all departments, in order that there may be uniformity of viewpoint, and in order that there may be developed in the mind of one individual, a picture of the entire record situation, which will prevent the distorted judgments likely otherwise to arise. The individual making the classification should have a sufficiently broad knowledge of business in general, and of the affairs of the establishment in particular, so that he will be competent to draw out the facts from the department heads and others in charge of records, to temper their opinions where necessary, and finally to evaluate the records wisely, so that his conclusions may contribute accurately to proper decisions as to the protection justified in each case.

Typical Illustration

Taking a typical group of records for purposes of illustration, classifications such as the following might be assigned to them under the various headings. It will be realized that no hard and fast rules can be laid down, because each case must be decided on its own merits. Typical records of an electric light and power company have been used for this example. Orderly destruction of records is a matter of sufficient importance to require special treatment which is given elsewhere in this

report. Illustrations have been included in the list which follows merely to show how this factor may be included in a tabulated study of a record situation. See table below.

Classification of Records

Record	Relative Importance as to Protection against			Useful Life
	Fire	Water	Theft	
CORPORATE RECORDS				
Charters	1	1	2	Permanent
Franchises	1	1	2	Permanent
Minutes of Meetings of Board of Directors	1	1	2	Permanent
FINANCIAL AND ACCOUNTING				
Mortgages	1	1	2	Permanent
Legal Opinions	1	1	4	Permanent
Bond coupons (paid)	1	2	1	Optional but certificate of destruction should be made
Stock transfer records	1	1	2	Permanent
Vouchers and journal entries	1	1	4	Permanent
Cash books	1	1	4	Permanent
Journals	1	1	4	Permanent
Ledgers	1	1	4	Permanent
Consumers' Ledgers	1	1	4	7 years
Tax returns	1	1	4	Permanent
ENGINEERING AND OPERATING				
Surveys	1	1	4	Permanent
Power Station Tracings	1	1	4	Permanent
Overhead distribution maps	1	1	4	Permanent
Underground " "	1	1	4	Permanent
Transformer records	1	1	4	Permanent
Meter records	1	1	4	Permanent
PROPERTY RECORDS				
Options	1	1	2	Until expiration
Easements	1	1	2	Permanent
Leases	1	1	3	Permanent
Abstracts of title	1	1	2	Permanent
Deeds	1	1	2	Permanent
Rights of way	1	1	2	Permanent
Water rights	1	1	2	Permanent
Property record books	1	1	4	Permanent
Maps, plans, surveys	1	1	4	Permanent
CONTRACTS				
Contracts carrying guarantees penalties, etc.	1	1	3	Permanent or until expiration
Power contracts	2	2	3	7 years after exp.
Domestic consumer contracts	2	2	3	7 years after exp.
CORRESPONDENCE				
Executive correspondence	2	2	2	Permanent
General correspondence	3	3	4	Destroy at option
PRINTED MATTER				
Catalogs	4	4	4	Destroy at option
Periodicals	4	4	4	Destroy at option

Protection Appropriate to Each Class

Having established a classification of the various records under these headings, the next step is to define the protection appropriate for each class.

Protection Against Fire

Class 1 (vital) records clearly should have the best protection practically possible. This may be achieved by duplicates kept where not subject to the same fire, or by vaults or safes, such as may be expected to resist successfully any fire exposure to which they may be subjected.

Class 2 (important) records may include largely those whose importance is somewhat debatable and as to which further consideration may be necessary before final decision is made as to the provision of protection. Attendant circumstances often will need to be very carefully weighed.

Class 3 (useful) records, such as general correspondence, are generally quite voluminous, and are not of sufficient importance to demand special forms of protection. Reduction of combustible surroundings by use of steel filing equipment may be advisable in some instances, though this should not be regarded as protection against heat from the burning of combustible material.

Class 4 (non-essential) records manifestly demand no special protection save that any undue accumulations should be disposed of, and they should not be allowed to occupy space in vaults and safes to the exclusion of more important material.

Protection Against Water Damage

The seriousness of water damage to records is often over-rated. Many kinds of records can be even submerged in water without losing their legibility, although their physical conditions thereafter will probably be such as to necessitate copying for further use.

Most fire-resistive record containers afford considerable protection against serious water damage, though if submerged, few will completely exclude water for any extended period.

It will be evident that basement vaults are objectionable from the point of view of water damage, and in any story records should be raised a few inches above the floor, even in vaults.

Protection Against Theft

This Committee does not feel it to be within its scope to set up standards for protection against burglary or theft. Most of the current fire-resistive containers are moderately burglar resistive, but no more.

It may be proper to call attention to the fact that most good heat insulators do not resist mechanical attack, while on the other hand special steels, effective against burlgar attack, are excellent conductors of heat. Hence when protection against both fire and burglary is desired, the solution lies in burglar-resistive safes within fire-resistive vaults, or smaller burglar-resistive chests within fire-resistive safes.

4. RECORD LOSSES.

[*From 1924 Report*]

Any attempt to ascertain accurately the number, extent, and seriousness of record losses is handicapped by a number of obstacles. The money losses attendant upon record destruction are often indirect and concealed in operating costs, and since ordinarily they are uninsured, little effort is made to ascertain the precise amount of loss, as would be done if insurance were involved. There is a natural tendency toward reticence on the part of those who have lost their records, and this has brought about the mistaken inference that losses have been of little real consequence.

Nevertheless, if we are to arrive at a true understanding of the importance of this problem, we must endeavor to ascertain, to visualize, and to state the consequences of record losses in direct and indirect costs, inconvenience, interference with operations, loss of good will of customers, and the many other factors which properly apply.

The Committee is in the process of collecting data on this subject from available sources, and hopes in a later report to submit specific information to the Association. In the meantime, it is urged that all members of the Association call to the attention of the Committee any record losses of which they are aware, giving as full information as it is possible to obtain, and permitting the Committee to investigate further, if possible.

In any attempts to appraise the consequences of a record loss, it must be recognized that only a portion of the records will be capable of having a money value placed upon them. There are many records which cannot be so treated, but no responsible business man will deny the seriousness of the loss of these.

In those establishments where serious record losses have occurred, it will be found that there is little tendency to underestimate the consequences, and increasing numbers of executives are not awaiting the evidence of an actual record loss, but clearly foresee the seriousness of one, and are making provision in advance to protect themselves against such an occurrence.

Record Loss Fire Report.

[*From 1935 Report, tentatively adopted*]

The following form for reporting loss of records by fire will be found useful in obtaining definite information on the loss sustained and the performance of record protection equipment.

National Fire Protection Association

File No._____

RECORD LOSS FIRE REPORT

Name of Occupant_____ Date of Fire_____
Street Address_____ Report by_____
City and State_____ Business Address_____
Mail Promptly to_____

REPORT OF FIRE IN WHICH RECORDS WERE INVOLVED

INSTRUCTIONS: Use one set of report sheets for each building involved. Use additional sheets if needed for larger number of vaults and safes. If possible, obtain close-up photos of containers before opening and after opening, showing condition of records. Report insulated steel files on safe sheet. Number vaults and safes consecutively in any one building.

BUILDING CONSTRUCTION, OCCUPANCY, AND PROTECTION

1. Height (stories)_____ 2. Age (years)_____
3. Walls (Reinf. concrete, brick, etc.)_____ Thickness_____
4. Floors (fire-resistive, slow burning, joisted, etc.)_____ Thickness_____
5. Roof_____ Thickness_____ Roof Covering_____
6. Trim, partitions, etc. (combustible or incombustible)_____
7. Vertical openings. How inclosed?_____
8. Occupancy of building (general occupancy of building and specific occupancy of fire area)_____
9. Fire protection used_____ 10. Automatic Sprinklers_____
11. Hose streams_____ 12. Extinguishers_____
13. Was there a fire alarm system? Automatic?_____
14. Amount of loss other than records_____
15. Value of buildings involved_____

THE FIRE

16. At what time did the fire start?_____
17. How long before extinguished?_____

18. Point of origin_____ 19. Cause_____
20. Principal fuels for fire _____
21. Did debris contain unburned material?_____ 22. What?_____
23. How long after start of fire was debris still hot?_____
24. What temperatures were reached?_____

Aluminum melts at about	1200°F.	Copper melts at about	2000°F.
Glass softens at about	1500°F.	Cast iron melts at about	2100°F.
Brass melts at about	1650°F.	Steel melts at about	2700°F.

25. Did floors collapse?_____ 26. Were there any explosions?_____
27. Had brick, concrete, or stone exposed to fire spalled?_____
28. Did steel columns or beams bend or buckle badly?_____
29. Wind: Strong, medium, light, calm. 30. Did adjoining buildings take fire?_____
31. Did buildings across street take fire?_____ 32. Fire dept.: none, fair, good.
33. Water supply: Failed, low, fair, good. 34. Did private fire dept. do anything?_____
35. How long after fire started before the public fire dept. arrived?_____
36. Efficiency of public fire dept._____
37. Loss of life_____ 38. Amt. of insurance on building_____
39. Insurance rate on building_____ 40. Loss on building_____
41. Remarks_____

VAULTS

(Use Additional Sheets if Needed; in General, One for Each Vault.)

42. How many vaults were in the burned building?_____
43. Identification number of vault covered by this report_____
44. Inside dimensions of vault_____
45. Name of user of vault_____ Business_____
46. Where located (what floor, etc.?)_____
47. If floor construction did not collapse, give estimate of weight of combustible material per sq. ft. before fire on floor on which vault was exposed_____
48. If all interior building construction collapsed, give estimate of total amount of combustible material per sq. ft. of ground area in contents and building members, including roof but excluding exterior walls_____
49. How supported (on foundation to ground, on building structure?)_____
50. Wall construction_____ Thickness_____
51. Floor construction_____ Thickness_____
52. Roof construction_____ Thickness_____

DOOR:

53. Size_____ Was it closed?_____ Locked?_____
54. By whom manufactured?_____
55. Model or type_____ 56. Insulated or not_____
57. If insulated, what was door thickness?_____ 58. Frame: cast iron or pressed steel
59. Step or interlocking joints_____
60. Underwriters' Laboratories label number_____ How many hours?_____
61. Was vault interior equipment wood or steel?_____
62. Extent of exposure to fire_____
63. Did vault fail? If so, how?_____
64. Did doors buckle or warp?_____
65. How many hours elapsed after fire when vault was opened?_____
66. Effect of fire on contents: None, smoked, charred, partly burned, completely burned.
67. Effect of water on contents_____
68. What was nature of records and how valuable were they?_____
69. If destroyed, what will be consequence of loss?_____
70. Are you sending photographs, newspaper clipping?_____
71. Amount of insurance on vault contents_____ 72. Rate_____

SAFES

(Use Additional Sheets if Needed; in General, One for Each Safe.)

73. Identification number of safe covered in this report_____
74. Name of user_____ Business _____
75. Date purchased_____ 76. Location (floor)_____ 77. Inside dimensions_____
78. Name of manufacturer_____ 79. Model or type_____
80. Underwriters' Laboratories label number_____ Class _____
81. If floor construction did not collapse, give estimate of weight of combustible material per sq. ft. before fire on floor on which safe was exposed _____
82. If all interior building construction collapsed, give estimate of total amount of combustible material per sq. ft. of ground area in contents and building members, including roof but excluding exterior walls_____
83. Thickness of walls_____ 84. Thickness of door_____ Was it locked?_____
85. Door frame and jambs: cast iron or pressed steel. 86. Joints: step or interlocking.
87. Did the safe fall? (how many feet?)_____
88. Did it strike anything in falling?_____
89. Did anything strike it?_____
90. Position in which it was found_____
91. Character of surroundings into which safe fell (brick, embers, etc.) _____

92. Extent covered by debris
93. Estimated temperature
94. Probable duration of exposure to heat before fall After fall
95. How long was safe left before being removed?
96. How many hours elapsed after fire when safe was opened?
97. Was safe distorted by fall? 98. Was metal punctured or burned through?
99. What was the condition of the door?
100. Was insulation exposed?
101. Was the safe caved in without breaking the shell?
102. Could the combination be worked?
103. Was an attempt made to keep the safe cool during the fire or afterwards?
104. Did water enter the safe? 105. Was it lying in water?
106. Did vapors or anything else issue from interior of safe?
107. What was the nature of records? How valuable?
108. What was the interior equipment?
109. Did it contain a steel chest? 110. Was it anchored?
111. What was the condition of records? (Wet, damp, charred) Percent legible
112. If destroyed, what will be consequence of loss?
113. Are you sending photographs, newspaper clipping?
114. Amount of insurance on safe contents 115. Rate

COMMENTS

On this page, show a map of burned building and adjacent structures, location of the vaults or safes, and give a general description of the fire, the results to record containers, etc., and any interesting points not otherwise covered. How was fire handled by Fire Department? What happened to unprotected records, etc.?

5. CONSTRUCTION, EQUIPMENT AND MAINTENANCE OF BUILDINGS IN THEIR RELATION TO PROTECTION OF RECORDS.

(From 1931 Report, officially adopted 1932)

Previous reports of this committee have dealt with the classification of records from the standpoint of value and their protection by segregation in insulated safes, vaults, file storage rooms and record buildings, and protection by duplication. The present report is concerned with conditions where the records are kept with the rest of the occupancy without other protection than can be afforded by a well constructed and equipped building taken in connection with such general housekeeping conditions as can be maintained, considering the general requirements of the occupancy. Such conditions occur mainly where protection must be afforded for a large volume of records in current or occasional use and not of the most vital importance. For the really vital records of any business (usually a small proportion of the whole) it is believed that adequate protective containers (vaults or safes) should be provided and exception to this rule should be made only when building construction is of the very best fire-resistive type, areas are small, external exposure is amply protected against, and interior combustibles in consequential amounts are entirely eliminated except for the records themselves. Where conditions fall short of these much may still be done to increase record safety, but the limitations of such procedure should not be overlooked and a false sense of security should not be permitted to obscure the necessity for adequate protection for vital records.

The Building.

The only type of building construction that will give a degree of protection to its contents that can be evaluated with any degree of certainty involves incombustible fire-resistive construction throughout with a minimum amount of combustible finish. The structure must be designed and protected to withstand a complete burning-out of contents in any portion thereof without collapse. (See Section 6, on Severity, Duration and Control of Exposure, p. 30.) The building must be protected against fires in neighboring buildings or areas by means of suitable protections for exterior openings. (See 1925 report of Committee on Protection of Openings in Walls and Partitions, Proceedings, p. 404.) If located in an area where a conflagration may occur, this matter would need more careful consideration than otherwise. However, even under such conditions, modern fire-resistive buildings have given a good account of themselves where openings have been protected by wired glass, or protection of higher rating, combined with some fire fighting within the building.

The interior design involves protection of all vertical and horizontal openings that might communicate fire from floor to floor. The areas between fire division walls should be kept as small as consistent with the requirements of the occupancy. Incombustible fire-resistive partitions with metal doors, frames and trim should be used for subdivision within the fire areas since these constructions have a decided retarding effect on the spread of fire even for constructions rating below 1-hour as referred to the recognized testing and rating procedure.

Where several occupancies share one building, the problem of securing for one of these occupancies a desired degree of protection is, in a large part, the same as that involved in securing protection where the same occupancy covers the whole building. If the building has sufficient fire resistance to withstand burning-out of contents of any or all portions thereof, without collapse of main structure members, it is possible to secure for any portion

of the building the required degree of protection under conditions of a fire that involves the rest of the building.

Non-fire-resistive construction, which can be defined as construction that cannot withstand a burning-out of contents without collapse, is not adapted for affording the type of protection discussed. Exterior protection to the building is more difficult to obtain than with fire-resistive construction even where heavy masonry walls are used, since wood cornices and similar details can afford a fire an opportunity to enter. This type of building with combustible interior construction generally affords fire a more ready start and more rapid spread than the fire-resistive type. The protection that can be applied to interior vertical and horizontal openings is also generally less effective. Such factors as the stability of walls after the construction on one side has been destroyed by fire make the predication of definite degrees of protection difficult.

The same applies with even greater emphasis when attempts are made to protect an occupancy that covers only a part of the building against the hazards in the other portions. With this construction type records of high or moderate value should be protected in safes and vaults having fire resistance of a degree adequate for the conditions involved, or protected by other equally effective methods. Even with this type of building the general structural, occupancy and equipment conditions outlined as affording protection in fire-resistive buildings will also, to a degree, decrease the hazard to the contents.

Equipment.

Under this heading are included considerations of the effect on the degree of protection afforded by the furniture, record containers, and similar items that are a part of the general equipment of the building as well as the fire protection equipment.

In fire-resistive buildings, conforming with the requirements outlined above, a high degree of protection can be obtained by the use of incombustible furniture and record containers, combined with good housekeeping conditions. These give less opportunity for fires to originate and have a decided retarding effect on the spread of fire. This applies particularly to items of equipment such as desks, closed filing cabinets, and cupboards. While fire in a cupboard or inclosed shelf will be communicated to adjacent sections through a sheet metal wall, the spread will be relatively slow since there is no opportunity for the free sweep of flames or building up of room temperatures above the ignition point of ordinary combustible materials.

An incombustible floor finish is a material help in preventing spread of fire from one container to the other where they are separated. In fact, even under moderate exposure conditions from fires in large accumulations of combustibles within the room, no such spread of fire from one closed container to the other is likely to take place on incombustible floors. On wood finish floors a fire in the flooring, while spreading slowly, can communicate fire to the contents of cabinets, desks and tables in all portions of the room. Containers such as air-cell safes afford little more protection than plain metal filing cabinets under such exposure conditions.

The protection afforded by incombustible shelving is dependent largely on the design. With open back and sides little more protection than with wood shelving is afforded. A fire originating at one point in the shelving can be readily communicated to all portions of the room. For shelving with closed back and sides, the protection given is dependent to a considerable extent upon the size of the openings. The spread of fire is relatively slow for openings as large as those in the ordinary shelving bay, say 12 by 36 inches. As the openings decrease in size the spread of fire becomes much slower and where the openings are the size of pigeon holes, a few

inches in width and height, no appreciable spread of fire from one opening to the other should be expected provided the contents do not overhang the front of the opening. (For further information on the general subject reference can be made to the paper on "Record Protection and Office Equipment," published in the Quarterly, N.F.P.A., Vol. 24, No. 4, April, 1931, p. 410 and also reprinted in pamphlet form.)

In the tests made at the National Bureau of Standards employing metal desks and filing cabinets on a cement finish floor, no spread of fire of any consequence was obtained where fires were started in waste paper baskets closely adjacent to papers on top of desks or in open shelves. With a so-called "exposure start" for the fire in which temperatures were built up initially over the greater portion of the room that were considerably above the ignition point of wood and paper, exposed records near the source of heat were burned or damaged but not more than 3 per cent of the records in closed containers were made illegible by the blast of flame and hot gases and the subsequent fire in exposed records. Where a wood floor was used with similar equipment, more damage was done both from a slow and exposure start for the fire. From 40 to 60 per cent of the papers in filing cabinets were made illegible by the burning of the wood top floor beneath them. As started in a small accumulation of paper on the floor, this floor fire progressed very slowly, requiring 8 hours for a travel of about 8 feet. With an exposure start for the fire, the progress of the fire in the floor was more rapid on account of higher room temperatures and the destruction to the records greater.

In tests with metal shelving of the skeleton or open type, no difficulty was experienced in causing fires from small origins to involve the contents of the whole room. With backed and partitioned shelving the progress of the fire was very slow and in only one case was it communicated to stacks separated by an aisle from the one that was burning. In one test 9½ hours was required for a fire to travel 18 feet within a given stack, laterally through solid metal partitions spaced 3 feet apart with a closed or cupboard section every third bay. In none of the tests where a fire was started in such shelving at a single point, were room temperatures built up high enough to cause spread of fire throughout the room. Where the same type of shelving was employed and the fire given an exposure start, after the first blast of flame and hot gases from the exposure grate, the room temperatures dropped considerably below points required for general fire spread. However, fires had started in several portions of the room which gradually built up room temperatures sufficient to cause a complete burning-out of the contents after a 4-hour slow rise.

Where optimum conditions in point of structural details and equipment obtain, no inside fire protection equipment would be needed other than hand fire extinguishers, standpipe and hose, spaced as required for light occupancies.

In fire-resistive buildings with combustible trim and furniture, as well as in non-fire-resistive buildings, records should be classified on the basis of value and the proper protection measures applied for the different classes. It will generally be found that a small percentage of the volume of records constitutes a high percentage of the total value of all records and these can be given the protection afforded by insulated containers such as safes and vaults. In buildings of fire-resistive construction such measures of protection can be applied with somewhat greater precision than in non-fire-resistive buildings, since in the latter type of building it is more difficult to predict the severity of the fires that can arise. Where structural and equipment conditions are unfavorable from the record protection standpoint, and records of essential value cannot be economically safeguarded in insulated containers, it may be necessary to provide protection for the building as a whole or the fire division involved, by means of automatic sprinklers or other

equally effective measure. The possible water damage to records is generally over-estimated, considering that the main value of records is concerned with legibility.

Maintenance.

The proper maintenance of buildings from the standpoint of record protection as well as general fire safety, requires recognition of the conditions conducive to the origin and spread of fire. It is recognized that even in non-fire-resistive buildings, fires originate most frequently in accumulations of combustibles or in highly flammable materials, the presence of which can be avoided. Proper care in this respect will prevent fires from origins such as discarded cigarettes and matches. All waste materials should be cleaned up at the close of each day or more often and kept in proper containers until removed from the building. Proper containers should be provided for oil mops, oily wastes and materials of similar hazard. The hazard of materials like celluloid and other pyroxlin plastics, matches, disinfectants, cleaning fluids and other highly flammable materials should be recognized and the needed precautions taken.

Many fires that occur immediately after working hours from discarded matches, cigars and cigarettes can be prevented by systematic inspection of the premises during the first half-hour or hour following closing time.

Repair, painting and renovating operations present particular hazards that require precautions while they are in progress. Other special hazards peculiar to each occupancy will generally need attention as well as the general hazards from heating, lighting and power requirements common to most buildings, if a desired degree of fire safety is to be achieved particularly where structural and equipment conditions are unfavorable. Where these are favorable, deficiencies in housekeeping and maintenance are less serious.

The full utilization of equipment and other protective measures provided, requires systematic drill in their use. Records intended to be given special protection such as in safes and vaults, should be kept there at night and certain means provided for having them placed there in case of fire during the day. In order that this may be achieved, check-ups at intervals on conditions will be required. This should also include the protection given the records of the owner that are in the custody of others such as attorneys and trust companies. Due maintenance attention should also be given fire doors, fire shutters, first aid fire extinguishment, sprinkler systems and other protection equipment provided.

6. SEVERITY, DURATION AND CONTROL OF EXPOSURE.

(From 1924 and 1927 Reports)

[*From 1924 Report*]

This section is concerned with the fire conditions to which record vaults, safes or other containers may be subjected. These can be recognized as of four general types:

(1) Heat exposure from burning, glowing or hot materials.

(2) Impact from falling building members, materials, equipment or other building contents.

(3) Shock from explosions occurring within or outside the record container.

(4) Water damage incident to fire extinguishment.

The effects of impacts (2) and explosions (3) must be considered in the protection of records from fire since they lay the construction open to fire attack or make it less fire resistant.

Heat Exposure

The intensity and duration of a fire, even with a given building type and occupancy, is subject to great variations due to the particular conditions incident to each fire as regards amount, character and concentration of combustible materials, wall and floor openings and wind conditions in relation to the air supply and the extent to which the severity of the fire and its after effects are modified by the fire fighting methods employed. In considering the conditions for which provisions must be made it is, therefore, generally necessary to neglect conditions giving rise to fires of minor severity and consider only those giving maximum severity in intensity and duration. This necessitates assuming complete destruction of all combustible portions of buildings and contents under conditions favorable for the development of fires of the most destructive intensity and duration probable for the given building and occupancy.

Some information from observation of fire effects is available as it concerns maximum temperatures developed and effects on building materials, construction, and devices. By comparing these with effects in test fires of known temperature and duration, an approximate measure of the severity of building fires is obtained. A few experiments have also been made to determine directly, intensity and duration by burning out typical occupancies with measurement of temperatures from the beginning of the fire to the cooling of the ruins. While the results obtained are not as yet fully conclusive, taken in connection with information from fire effects in buildings, it can be tentatively stated that with fire-resistive interior and exterior construction, housing the lighter occupancies from the fire standpoint, the probable maximum severity of a fire completely destroying combustible contents and trim does not generally exceed the first hour of the standard fire test exposure, and only with exceptionally heavy con-

centrations of materials for the given occupancies will it equal the severity of the first 1½ hours of the standard test.*

Office, residential and institutional occupancies can be named as typical of those giving rise to fires of the probable severity outlined in the preceding paragraph. At the other end of the scale, fires in buildings or parts of buildings normally housing large amounts of combustible materials, such as those used for storage of merchandise, are known to have attained intensity and duration fully equal in effect to the standard 4-hour fire test.* Under conflagration conditions, severity may be somewhat increased due to the higher temperature of the air over the burning area. Where the building or its interior framing or structural members are of combustible or non-fire-resistive construction, the fire effects on record containers are usually more severe since they generally are exposed to the fire in a larger portion of the building than with fire-resistive construction where usually no exposure other than that incident to fire in one story (or portions thereof) need be considered. Also with combustible or non-fire-resistive construction the containers or portions thereof are more likely to be covered with hot debris for a longer period after the fire, which is one of the most severe conditions to which a container can be subjected.

Impacts

In fire-resistive construction no heavy impacts are probable both as regards objects falling on the container or the fall of the container itself. The most severe would be those from falling partitions, or sudden settling of safes resting on combustible top floors. With combustible or non-fire-resistive construction the impacts can have a wide range in severity, depending on the height of the building and the type of construction. Vault construction can also be severely taxed by stresses from failure of adjacent building members. Light vault construction may also be injured by high-pressure hose streams used in fire extinguishment.

Explosion Shock

Record vaults should not be located in buildings housing explosives in sufficient quantities to wreck them. Where this cannot be avoided, a measure of protection can be provided by vault construction that will resist explosion shock. Explosions from smoke produced by ordinary combustible materials sometimes occur and on this account even where there are no explosives present it is desirable to incorporate in record containers, the maximum structural strength that can consistently be attained.

Record containers must also be suitably safeguarded, by details incorporated in the construction, to prevent explosions occurring within them from gases generated when they are exposed to fire. Unless this is done the construction may be wrecked or the doors forced open.

Water Damage

Damage from the water used in fire extinguishment outside of record vaults can generally be avoided, except in basements, by using raised floors.

Doors of containers cannot with ordinary construction be made water tight; safes falling into basements in fires in non-fire-resistive buildings

* See section on Fire Test Data, pages 32 to 34, which gives the results of tests completed since the preparation of the 1924 Report.

may have their contents damaged by water. All openings to file storage rooms should be labelled to prevent firemen from opening the doors or directing hose streams into them, unless a fire is in progress within. At a distance from a file storage room or a vault, it may be desirable to provide a sign indicating the location of the records so that firemen may avoid any needless water damage, and so that they may make special effort to safeguard the records.

It should be noted that water damage seldom results in total destruction of records, as they are seldom so damaged from this cause that the record is illegible. The susceptibility to water damage varies with different types of records. Most forms of records can after wetting be dried and restored to usable condition, if attention is given promptly to salvage. Water applied for fire extinguishing purposes will with most types of record containers wet only a portion of the records. Where records are of types that are peculiarly susceptible to water damage special precautions may be indicated, including the use of carbon dioxide rather than water as a fire extinguishing agent. (See Section 12 on Fire Protection Equipment for Vaults and File Storage Rooms, p. 69).

Control of Exposure

As the fire that does the least damage is the one that is prevented from occurring or spreading beyond its initial stage all the means and methods of fire prevention outside and within record containers apply with particular force to record protection. Under no conditions in the ordinary course of business can all records be protected whose loss would cause serious inconvenience and financial loss.

All structural provisions that have been found effective in preventing and controlling the spread of fire can be employed to advantage. Attention has already been called to the superiority of the fire-resistive building type in decreasing the damage caused by fire, impact, and water. If to structural fire resistance are added incombustible floor surface and interior major trim, the probability of origin and rapid spread of fire is further greatly decreased. The fire can be confined to the portion of the building where it originates by suitable horizontal and vertical sub-division with vertical and horizontal openings properly protected. The above structural provisions apply with particular force in large rooms or buildings used exclusively for housing records. Protection against fires from without the building can be had by protecting all openings against the exposure to which they are subject.

A further degree of safety can be obtained by placing buildings to be used exclusively for records at such distance from other buildings, and making them of such construction as not to be endangered by the burning of surrounding buildings. The general fire loss records indicate that only about 15 per cent of the fire loss is from communicated fires. Where the occupancy is solely record handling and storage, the likelihood of fire originating on the premises is relatively slight and can be kept at a minimum by careful maintenance. Under these circumstances, the exterior exposure hazard occupies a relatively more important place than would ordinarily be the case. It is important also to bear in mind that for purposes of record protection there may be complete justification for a degree of protection much beyond customary practice when only commercial and replaceable values are involved.

Fire Test Data.

[*From 1927 Report; for further data see 1932 report, page 35*]

Data have become available through burning-out tests of office occupancies conducted at the National Bureau of Standards, some of these being

in a building (30 by 60 ft.) having four times the floor area of the one in which the tests were previously conducted. Tests were also made with regular office occupancy employing metal furniture, and also with record storage on wooden shelving, the amount of combustible materials for the last named condition being 48.7 and 58.5 lbs. per sq. ft. for tests in the large and small structures, respectively. The combustibles for the regular office occupancy with wooden furniture ranged from 13.5 to 15.3 lbs. per sq. ft. for tests in the small building and were 18.7 lbs. per sq. ft. for the test in the larger room. The tests with steel furniture were made in the small building, the amount of combustible materials being 8.8 and 11.9 lbs. per sq. ft. for tests with cement, and wood top floor finish, respectively. About one-half of the records in the steel furniture tests were exposed on open shelves, desks, or in open cabinets. For the different conditions outlined, one test each with slow start and exposure start for the fire was made. Further tests with steel furniture and a smaller amount of exposed records as also of record room occupancy with metal shelving, are to be conducted during the coming months.

While the results from the later tests have not been fully reduced and given the consideration that it is expected to give them, the following table of equivalent durations as referred to the standard time-temperature curve for control of fire tests is submitted. Pending completion of the work and publication of the report, they should be regarded as tentative. The periods assume a severity augmented by an exposure start for the fire that was present in some of the tests. Allowance is also made for the more rapid cooling of furnace test chambers as compared with that of the rooms burned out.

Tentative Equivalent Fire Durations for Office and Record Storage Occupancies Housed in Fire-Resistive Buildings*

Occupancy	Furniture or Shelving	Pounds per sq. ft. of combustibles (including wood top floor)	Equivalent fire duration hours
Office	Wood	10	1
Office	Wood	15	1½
Office	Wood	20	2
Record Room	Wood	50	7
Record Room	Wood	60	8*

The durations given in the table apply to air temperature and flame effects on record containers and thin partitions, the average room temperatures developed in the tests being considered as affecting records or thin partitions down to 300° F. (or 150° C.). As concerns effects on heavier partitions and walls, as well as on interior incombustible structural members whose strength is not appreciably reduced by temperatures throughout the section of 300° C. (572° F.), the periods can be reduced by 10 to 15 minutes for durations of 2 hours or less and by about 1½ hours for the 7 and 8 hour periods.

In the tests with office occupancy, the weight of furniture and of records was approximately equal. For the record room the weight of shelving was only one eighth of the weight of the room contents. A given weight of wood gives greater intensity but possibly no greater equivalent duration than the same weight of paper records. The relative amounts of wood and paper might have to be considered in interpolating for occupancies having combustible contents between 20 and 50 pounds per square foot. Twenty pounds of combustible contents per square foot, however, represents nearly the maximum that will be found with the usual type of office occupancy.

*See table p. 36 for further and later data.

The data from the tests with steel furniture have not been reduced to the point where equivalent fire endurance periods can be given. There was, however, a decided decrease both in intensity and duration as compared with what was obtained with wood furniture. No decided horizontal spread of fire was obtained except in the wood top floor.

It will be seen from the table that the file storage room occupancy with wood shelving and furniture would be likely to overtax the resistance of the fire-resistive type of office buildings if the fire were allowed to burn itself out. This would probably occur only under conflagration conditions where approach to the building is prevented by fire in surrounding non-fire-resistive structures, or in case of impairment of the water supply for fire extinguishment. Additional protection for structural members should therefore be provided where concentrations of materials in amounts corresponding to that obtaining in record rooms are present. Insulated record containers placed in file storage rooms should have about the highest degree of fire resistance that can be obtained with present constructions. It should also be noted that as concerns safes and similar containers, the effective durations as given in the table may be increased by contact with hot debris. The temperatures in the debris attain their maximum later and fall more slowly than the air temperatures on which the periods are based. However, with ordinary office occupancy, safes placed not nearer than two or three feet from extra high shelves, cabinets and other heavy containers would not be subjected to effects from the debris.

The above conclusions relative to file storage rooms apply where wood shelving and furniture are used. Where these are of metal as recommended by this Committee, there is without doubt a great reduction in the severity of the fire even where some initial spread occurs from exposure. No quantitative estimate of its amount can at present be given, but quite probably the resultant severity would not overtax the ordinary fire-resistive construction used for office buildings. For full or six-sided enclosure of all records the resultant fire could not obtain any serious proportions as concerns effects on building members or insulated record containers.

The use of the table of equivalent durations assumes possibility of computing the combustible contents of a given room or portions thereof. This can generally be done with sufficient accuracy and without much difficulty. Typical pieces of furniture and furniture contents can be weighed. The weight of shelves can be computed by using the board weight per square foot. The weight of a single, top floor of wood on wooden sleepers will be between 3 and 4 pounds per square foot, depending on the species of wood. The total combustible weight in a given area is then divided by the area to obtain the amount in pounds per square foot assumed uniformly distributed. Where rooms exceed 25 by 25 feet in floor area, it is desirable to compute the equivalent uniform load for the different portions of the room separately for units not exceeding the given 25 by 25 foot equivalent in size.

It is particularly emphasized that this procedure and conclusions relative to equivalent fire durations apply only where the occupancies are housed in fire-resistive buildings that can withstand a complete burning-out of contents without collapse of structural members.

7. FIRE EXPOSURE CONDITIONS FOR VAULTS AND PORTABLE RECORD CONTAINERS.

(From 1932 Report, officially adopted 1934)

Previous reports of this committee have submitted information on the severity, in terms of temperature and time, of fires to be expected in fire-resistive buildings, as an aid in providing the proper fire resistance in building constructions, vault structures and equipment employed in connection with the protection of records. Since that time more information has become available from fire severity tests, some general results of which have been published.* The evaluation of the fire severity to be expected with given combustible contents was made in terms of periods of exposure to the furnace test applied in determining the fire resistance of building columns, floors, walls and partitions, and building equipment such as insulated safes, vaults and vault doors.

The subject of fire exposure conditions for safes and vaults can best be considered under two main subdivisions. One is concerned with conditions in fire-resistive buildings, the structural members of which can withstand a fire consuming combustible contents and building trim without collapse and the other with those in buildings wherein such collapse will occur. For the former each story or fire division thereof can be considered as a separate unit, the severity of the fire within which will be dependent almost wholly on the combustibles present, the air supply and other conditions affecting combustion within it. Even with unprotected vertical and horizontal openings and a fire involving several adjacent fire areas, the fire severity within one area will be attributable mainly to the combustible material contained therein. With the non-fire-resistive building, after collapse of floors the building will burn as a unit and the burning debris from the whole structure will be in one mass that can produce more severe fire conditions for constructions and equipment in contact with it than those obtaining within individual stories in fire-resistive buildings housing comparable amounts of combustible contents in each story.

Fire-Resistive Buildings.

The tests on which the following table of equivalent fire durations (Table 1) are based were made in one story buildings, one size 15 by 29 feet, and the other 30 by 60 feet in inside horizontal dimensions, equipped to simulate offices and record rooms. The results from the standpoint of contents should accordingly be directly applicable for the present purpose. During the test fires the shutters in the wall openings were operated to give air supply that was deemed to give the most severe fire conditions. Escape of hot or unburned gases through the openings inevitably carried off a portion of the heat during the height of the fire, an effect that was most pronounced in a test wherein kerosene was used as fuel in amount to give the same total heat value as that of wood and paper in a preceding test. The shutters were maintained during the cooling period at the maximum opening required at the height of the fire which occasioned further loss. This is, however, considered representative of what would obtain for buildings with the window filling destroyed by the fire and on the whole, while efforts were made to obtain maximum severity, the conditions introduced can be defended as representative of what can obtain in fires unchecked by any extinguishing

* "Tests of the Severity of Building Fires", Quarterly N.F.P.A. Vol. 22, No. 1, July 1928, pp. 43-61. "Fire Test of Brick Joisted Buildings", Quarterly N.F.P.A., Vol. 22, No. 1, July 1928, pp. 62-68. "Record Protection and Office Equipment", Quarterly N.F.P.A. Vol 24, No. 4, April, 1931, pp. 410-419. (Also available as separate reprints.)

Table 1.—Equivalent Fire Durations for Office and File Storage Room Occupancies in Fire-Resistive Buildings.

Total combustible content (Inclusive of finish floor and trim) Lbs. per sq. ft.	Assumed B.T.U. per sq. ft.	Furniture	Equivalent fire duration hrs. min.
10	80,000	Combustible desks, filing cabinets and shelving	1–00
15	120,000	"	1–30
20	160,000	"	2–00
30	240,000	"	3–00
40	320,000	Mainly combustible filing cabinets and shelving	4–30
50	380,000	"	6–00
60	432,000	"	7–30
12	91,200	Incombustible desks and filing cabinets	0–30
50	350,000	Incombustible skeleton-type shelving	5–00
50	350,000	Incombustible partitioned and backed shelving	4–30

effort. The values given refer to free air temperatures which are generally the most important in connection with fire exposure within fire-resistive buildings. The periods contain an increment for exterior fire exposure somewhat greater than that produced by the 3 by 7 foot grate used to obtain a quick start for the fire in some of the tests. The equivalent durations were obtained by comparing the areas under the average time-temperature curve obtained in the fire severity tests with that of the furnace reference curve governing fire tests referred to above, temperatures below those that would cause charring of wood or paper being neglected. The calorific value of the contents is taken a little below that of wood for office occupancy with wood furniture and approximately that of paper for office occupancy with metal furniture and for record room occupancy. Where contents other than wood and paper are involved the following allowances for differences in heat value of the materials can be made: Cotton, wool, straw, grain, sugar and similar organic materials can be taken at their actual weight; the actual weight of animal and vegetable oils, fats, waxes, petroleum oils and other petroleum products, asphalt, bitumin, paraffin, pitch, alcohol and naphthalene, should be multiplied by two for the purpose of determining combustible contents approximately equivalent to wood and paper in fuel value. Coal, coke and charcoal, while having fuel value approximately 50 per cent higher, probably contribute no more if as much to the severity of fire above the debris as an equal weight of wood or paper. As concerns exposure in the debris, they should probably be rated at their full fuel value.

Metal furniture and shelving decrease the fire severity not only because of the decrease in combustible contents but also because the combustibles are contained in a manner that prevents development of free combustion in them. With equipment mainly of metal desks and filing cabinets on a cement finish floor, and with approximately one-half of the weight of records on top of desks and in open file drawers and cabinets, it was not possible to obtain any fire severity of consequence to insulated record containers even when the exposure grate was used. With a wood finish floor and an exposure start for the fire an equivalent severity of near one-half hour was obtained. The open skeleton type metal shelving without back or partitions collapsed soon after the fire had progressed to the point where it involved

the whole room and the decrease in severity was less than when backed and partitioned shelving was used. With the latter, conditions are not favorable for fires from a single small origin to involve the whole room, on account of the slow progress from shelf to shelf, the heat evolved being generally insufficient to build up room temperatures to the point inducing general spread of fire. This assurance against general fire spread is more fully achieved where the records are contained within filing cabinets or enclosed shelving of incombustible materials, supported on a fire-resistive floor construction finished with incombustible materials. This affords one method by which the severity of fires from high concentrations of combustible contents can be reduced to a point where fires in them will not overtax the fire resistance of the building members or insulated record containers exposed by them.

Portable Containers.

In some of the fire severity tests conducted in fire-resistive buildings insulated safes were introduced and their performance was comparable to that obtained in furnace tests of equivalent severity. Insulated safes having fire resistance not greatly exceeding one hour and placed closely adjacent to 4-drawer wood filing cabinets, were not affected by the fire beyond what would be expected from the general room temperatures. The debris from these cabinets was not of sufficient height to remain in contact with the body of the safe after the air temperatures within the room had fallen below values that would be prejudicial to the safety of the contents of the safe. In one case where an extra high wood cupboard filled with records was placed closely adjacent to a safe of higher fire resistance, the glowing debris remained in contact with it for a longer period and the fire effects on safe and contents were more severe than would be expected from the prevailing room temperatures. Hence, while insulated safes, at least those having fire resistance rating of two hours or more, can be stated as affording protection that is generally independent of local conditions within a room, extra high concentrations should not be placed closely adjacent to them. It might be noted that in locations involving combustibles producing a general fire severity within the area in excess of the rated fire resistances of the safes within it, the safes would afford temporary protection and their contents would be saved provided the fire is extinguished before its full severity is developed or sufficiently diminished by other conditions present. Extinguishment during the later stages of the test fires, during which a considerable portion of the fire severity was developed due to radiation from hot walls, ceilings and debris, could have been easily accomplished. However, in the case of fires covering a considerable area or several stories of a large building or group of buildings, the prompt quenching of fire ruins cannot be assumed as the main effort of the fire fighting force is directed to checking the spread of the fire.

Vaults and Vault Doors.

The fire exposure conditions for vault doors in fire-resistive buildings can be taken as comparable to that for safes as far as it concerns the door itself. The effect of a given fire exposure for the door in its relation to the safety of the contents within the vault is, however, modified by the comparatively greater fire resistance of the vault enclosure. According to previous reports of this committee, the minimum thicknesses recommended for structure-supported vaults range from 6 to 10 inches of reinforced concrete, 8 to 12 inches of brick or plain concrete, and 12 inches of hollow clay tile or concrete block plastered on both sides. These represent a range in fire resistance from 5 to 15 hours as exposed to the furnace test, the

lower protections pertaining to 2-hour vaults and the higher to 6-hour vaults. Hence at the point when the fire resistance limit of the door is reached in terms of temperature developed on or near the unexposed side, the interior surface of the vault enclosure will be comparatively cool, as far as transmission of heat from the outside is concerned. In vaults other than the smallest sizes, the increase in room temperature due to heat transmission through the door will also be less than within the small radiation chamber used in fire tests of vault doors. Hence, unless combustibles are in contact with or near the door, a condition generally prevented by the arrangement of vault interior equipment, a fire resistance considerably higher than that of the door will be developed by the vault assembly. This probably accounts for the protection, however limited, that has been afforded by the uninsulated steel plate vault door, until recently the only type available. Decrease in exposure to vault doors can also be due to location at points where little combustible material is present, such as in corridors.

Estimation of Combustible Contents.

No considerable difficulty should be encountered in estimating combustible contents. Typical pieces of furniture or other units of contents can be weighed and the weight of finish, floors and trim computed. Wood used as finish in building can be taken as weighing about 48 pounds per cubic foot, which gives 3 pounds per square foot for trim 3/4 inch thick. The accompanying illustrations show a range of typical conditions in offices, filing and record rooms. Fig. 1, shows an office with cement finish floor, metal sash and frames and wood doors and wood furniture that with contents weighs 6 pounds per square foot; Fig. 2, wood finish floor and wood furniture with combustibles totalling 15.4 pounds per square foot; Fig. 3, wood finish floor and wood furniture with total combustibles a little in excess of 20 pounds per square foot; Fig. 4, cement finish floor and wood cases having drawers partly of metal, with combustibles of 30 to 50 pounds per square foot, the lower figure applying for fairly full drawers of miscellaneous files and the latter for document storage in fully packed drawers. Fig. 5, cement finish floor and metal shelving with combustibles near 50 pounds per square foot, and Figs. 6 and 7 cement finish floor and all-wood files, double height, with fully packed drawers, total combustibles weighing near 80 pounds per square foot. For large rooms, computations should be

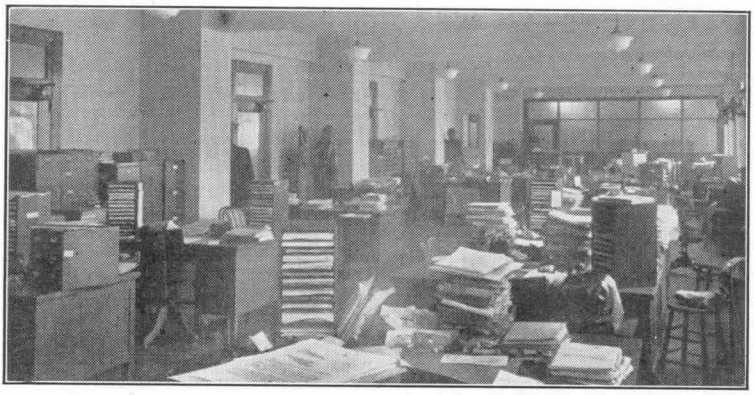


Fig. 1—Office with 6 lbs. per sq. ft. combustible contents. Cement finish floor, metal sash and frames, wood doors, wood furniture.

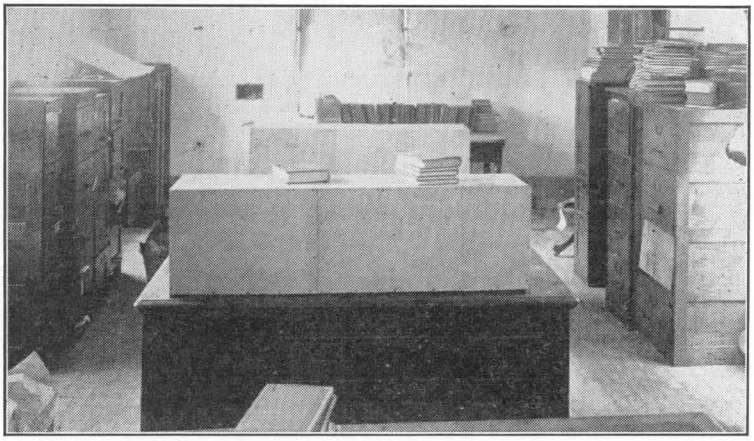


Fig. 2—Test room representing office with 14.2 lbs. per sq. ft. combustible contents. Wood finish floor, wood furniture.

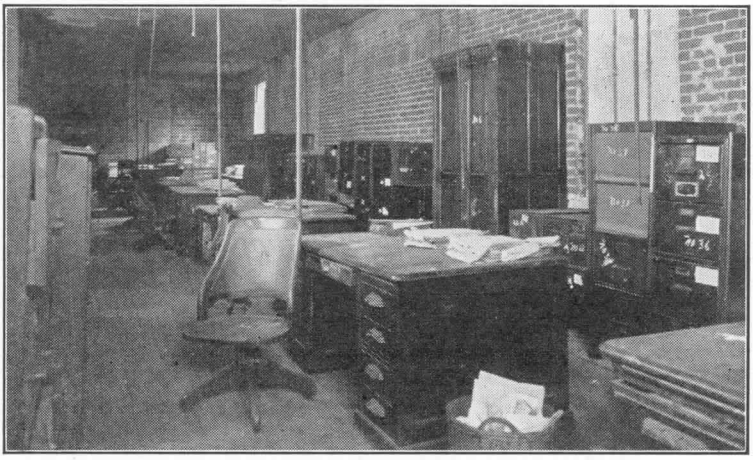


Fig. 3—Test room representing office with 20 lbs. per sq. ft. combustible contents. Wood finish floor, wood furniture.

made for units of area preferably not exceeding 500 sq. ft. for room widths not less than 20 feet, which should be reduced for narrower widths.

In a recent survey of a new Federal Government office building having cement finish floor and generally metal door frames and window sash and frames, 72 per cent of the floor area had combustibles of less than 10 pounds per square foot, 8 per cent from 10 to 20, 3 per cent from 20 to 30 and 17 per cent over 30 but not over 50 pounds per square foot. This range in combustible contents indicates that, considering possible change of location, portable record containers should preferably have fire resistance above the minimum requirements for the building, even if in the initial location a lower degree of protection would be adequate.

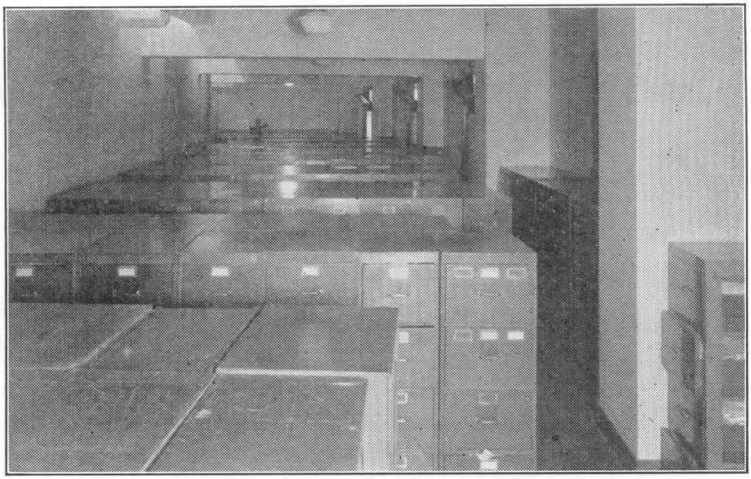


Fig. 4— File storage room with 30 to 50 lbs. per sq. ft. combustible contents, depending on type of material filed. Filing equipment part wood and part metal.

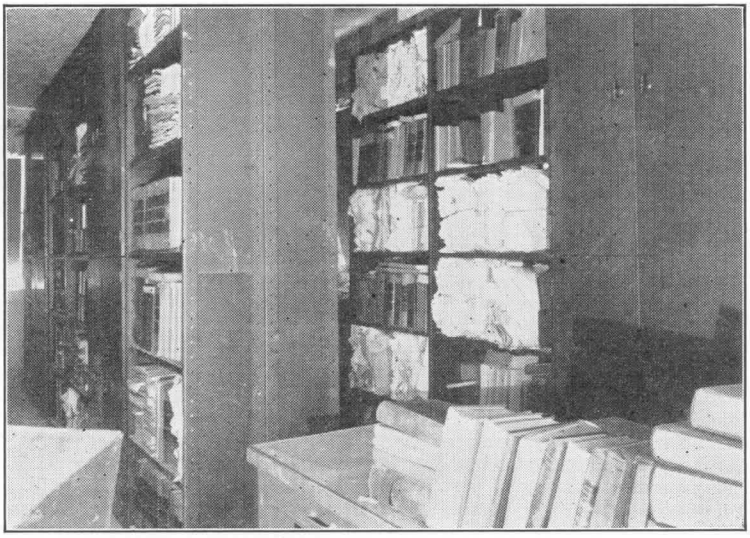


Fig. 5—File storage room with 50 lbs. per sq. ft. combustibles. Cement finish floor, metal shelving.

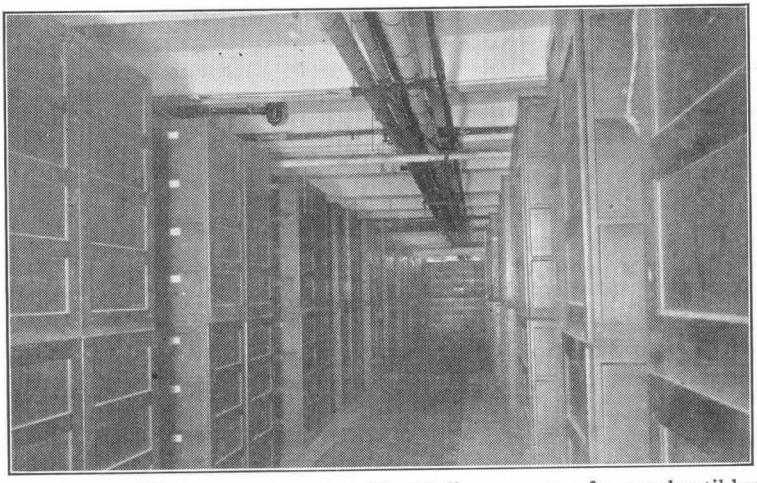


Fig. 6—File storage room with 80 lbs. per sq. ft. combustibles. Cement finish floor, wood files.

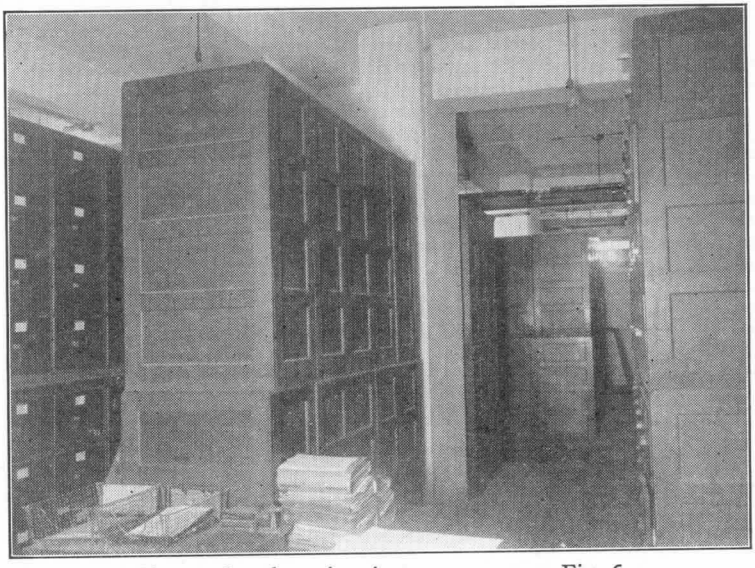


Fig. 7—Another view in same room as Fig. 6.

Non-Fire-Resistive Buildings.

Buildings in this group comprise those having wood exterior and interior framing, buildings with exterior masonry walls and interior wood framing which may be of the light joisted type or of heavy solid members as in timber mill construction and those having exterior masonry walls and

unprotected or insufficiently protected interior metal framing. In this group would also come buildings having incombustible exterior and interior framing and structural members, the fire resistance of which is deficient to an extent that permits general collapse of interior construction to occur. The main difference between conditions obtaining for this group and those for fire-resistive buildings is due to such collapse which destroys the value of floors as fire barriers, in effect making the whole space between exterior and fire walls one unrestricted fire area. Before collapse of wood interior framing occurs a fire severity equivalent to from 15 minutes to about one hour of the furnace test may have obtained within each story, the time depending on the size of beams and columns, thickness of the floor and the protection afforded by any ceiling, wall or partition finish that may be present. Collapsing roofs or upper floors often carry down with them floors below that may or may not be on fire. From this point on the fire exposure to contained safes and vaults will be from flames and hot gases above the debris and from contact with the same.

Protection Requirements for Vaults.

Any significant exposure from flames and hot gases above the debris will generally not extend above the first or second story above the base or basement story. Except for buildings of approximately six stories or over or those housing exceptionally large amounts of combustible contents, the glowing debris after initial settlement will not be more than one story in height. Hence in a tier of ground-supported vaults within a building of this type those in the second story above the basement or base story would be exposed for the hour or fraction thereof elapsing before floor collapse occurs and to mild effects from hot gases and flames from the debris. Those in the first story above the basement or base story would receive the same initial exposure before floor collapse and more severe exposure afterwards than those in the stories above. Actual contact of hot, burning or glowing debris with vault walls and door would not generally obtain for any considerable time after floor collapse has occurred and to judge from measurements made in connection with test fires and experience with vaults in fires, the equivalent fire severity for vaults in this story would not often exceed the first two hours of the furnace test; the first four hours can apparently be taken as representative of the limit for which protection would have to be provided. This includes allowance for an increment of exposure from fires in adjacent buildings occurring when several in a group are involved in the same fire. The vault in the basement or ground story will receive, besides any initial fire exposure before floor collapse, more prolonged effects from the debris, the severity of which is governed by the aggregate amount of combustible materials in the building construction and contents in all stories. Measurement of temperature within debris from a heavily loaded section of a five-story building indicate rather extreme conditions,—equivalent fire severities approximating 24 hours as computed on the basis previously outlined. Comparable severity was indicated by temperatures measured within the ruins of a heavily-loaded section of a two-story building over which the brick walls of the five-story building collapsed near the height of the fire. As they affect the fire resistance of vaults these results are subject to several qualifications. The temperatures being measured at a point that might have been in the hottest region of the debris may not apply as an average for a height or area comparable to that of a vault wall. Also, the presence of a vault at the location would have an effect in lowering the temperature of materials in contact. Further, a heat exposure at relatively low temperature extending over a period, as in the

present case, of about three days, may not be equivalent to one at considerably higher temperature for a shorter period, even if the areas under the two time-temperature curves above a given base line are equivalent. After making such allowances as can be made for differences in conditions such as those indicated above, the actuality of very severe effects from contact with hot fire ruins remains as a fact attested by both fire experience and tests. While it may not overtax the fire resistance of the 12 to 20 inch thick walls recommended by this committtee for vaults in the basement or base story of high non-fire-resistive buildings, it may develop the limit of the protection that can be given by the vault as such, considering the lower resistance offered by the door assembly. At what point the limit is reached under conditions favorable for development of high vault temperature may be somewhat indeterminate but indications are that uncertainty regarding the protection afforded by basement or base story 6-hour vaults constructed and equipped as recommended by this committee exists where the aggregate of combustibles for all floors including roof, in the given section of the building exceeds 150 pounds per square foot. This assumes combustibles having fuel values in the range applicable for wood and paper. Considering the lower fire exposure for vaults in stories above the basement or base story, for storage of valuable records these vault locations should be preferred. The possibility of damage from dampness and from water used in fire extinguishment is also less for locations above the basement story.

As constructed according to the recommendations of this committee the possibility of damage to the vault structure from falling floors, walls and building equipment is not imminent. Impacts from heavy building members or equipment might reduce the fire resistance of vault doors. The provisions for securing independence of the vault structure at connections with building members should be carefully observed otherwise collapse of the latter may seriously damage the vault structure.

Summarizing the conclusions relating to protection requirements for ground-supported vaults constructed according to the recommendations of this committee and located in non-fire-resistive buildings, the fire exposure for those in or above the second from basement or base story is comparatively light and 2-hour fire resistance for the vault assembly should give sufficient protection. For vaults in the first story above the basement or base story, 4-hour fire resistance can be taken as the limit of protection needed. For those in the basement or base story the fire resistance needed will vary with the building height and amount of combustible contents, from the range provided by the 2-hour, 4-hour or 6-hour vaults constructed according to the recommendations of this committee, to requirements exceeding what can be practically obtained, considering that the fire resistance of the vault assembly is limited in part by that of the vault door. Where the aggregate of combustibles for all stories in the section of the building where the vault is located exceeds 150 pounds per square foot it is recommended that valuable records be stored in vaults located in stories above the basement or base story.

Protection Obtainable with Safes.

Before collapse of floors occurs, safes will be subjected to fire exposure that, as previously indicated, will seldom exceed in severity the equivalent of the first hour of the furnace test. The severity of the effects from collapse of the interior and exterior construction and the resultant burning and hot debris has a wide range depending on the height of the building, the amount of combustible contents and the type of wall construction. The matter of chance enters to a greater extent than with resulting conditions

for vaults. Of two safes in comparable locations one may fall clear of the debris while the other may be buried under the burning building members and contents of several building stories. The safes in the lower story are more likely to be thus covered than those above, although it is conceivable that a safe in an upper story may fall through the lower stories before general collapse has taken place. The safes in the basement or base story will generally remain upright and hence not as likely to be fully covered by the debris as safes in other positions that have fallen from floors above. The disposition of the debris in piles occasioned by the fortuitous manner of floor and wall collapse introduces further variability.

Another circumstance introducing variability is different degrees of damage from impact due to falling of safe or from falling floor members, walls and building equipment. Requirements for proper resistance to impacts include not only sufficient strength of structural details but also ability to undergo racking strains and deformation in any direction without producing openings through insulation or at the door joint. Safes in the lowest story generally suffer less impact damage than those falling from floors above. Remaining upright, they are also in better position to resist impact from falling objects. On the whole for safes having fire resistance of two hours or more and passing the 30-foot drop requirement of the testing procedure for safes, the loss of contents due to impact damage is less imminent than from excess exposure because of contact with the hot ruins.

The qualifications that must be applied to temperature data obtained from observations of hot fire ruins in relation to the effects on safes in contact therewith, are of the same order as those outlined above for vaults. However, on account of the smaller dimensions and volume of the safe it is more likely to be fully covered by the debris and to exert less cooling effect on the surrounding hot material. The probability of collapse of masonry walls over the burning material must also be considered, this condition prolonging the time of exposure to temperatures high enough to cause charring of contents. While the variability of conditions incidental to fires in non-fire-resistive buildings inevitably introduces elements of uncertainty into estimates of severity of fire exposure to record containers such as safes, the following tentative recommendations are submitted: Not less than one hour protection for safe contents is recommended where location is in non-fire-resistive buildings not exceeding two stories in height, (one story and basement or two stories without basement), where the aggregate of combustible materials in interior building construction and contents in the given section of the building does not exceed 25 pounds per square foot of ground area and where impacts and blanketing of ruins from collapse of high masonry walls are not imminent; safes giving not less than 2-hour protection are recommended in all locations where such impacts can occur and in buildings or portions thereof where the total of combustibles in interior building construction and contents for all stories does not exceed 50 pounds per square foot, and 4-hour safes where the total of combustibles in all stories exceeds 50 but not 100 pounds per square foot. The above recommendations, assume that the severity of the fire and after-effects are not decreased by fire extinguishment at any stage. They also imply that safes in locations corresponding to more severe conditions than those for which they are herein recommended will preserve their contents if the actual fire and/or impact effects sustained are not within the higher range applicable for the location, and, on the other hand, safes in the locations recommended may not preserve their contents in a small percentage of cases where the exposure conditions are exceptionally severe. This low possibility of failure can be further decreased if safes one or more steps higher in rating than herein recommended, are used for given locations.

The following table summarizes the above recommendations. The text should be referred to for additional information and qualifying conditions.

Table 2.—Record Container Ratings.

For Various Conditions of Fire Exposure.
No cooling by hose streams is assumed.

(a) Fire-Resistive Buildings.

Total combustible contents per floor (including any combustible flooring and trim) per sq. ft. of floor area.	Incombustible desks, filing cabinets, lockers, and other closed containers. Not over 30 per cent of combustibles exposed.	Incombustible open-front shelving and other open containers.	Combustible desks, filing cabinets, shelving, containers, etc.
10 lb.	½-hour container	¾-hour container	1-hour safe
10 to 15 lb.	¾-hour container	1-hour safe	2-hour safe or vault
15 to 20 lb.	1-hour safe	2-hour safe or vault	2-hour safe or vault
20 to 30 lb.	1-hour safe	2-hour safe or vault	4-hour safe or vault
30 to 35 lb.	2-hour safe	4-hour safe or vault	4-hour safe or vault
35 to 45 lb.	2-hour safe or vault	4-hour safe or vault	6-hour vault
45 to 50 lb.	4-hour safe or vault	6-hour vault	6-hour vault
50 to 60 lb.	4-hour safe or vault	6-hour vault	6-hour vault with no combustibles near door

(b) Non-Fire-Resistive Buildings.

The degree of exposure to individual record containers in non-fire-resistive buildings varies widely with chance conditions. The recommendations given below are based on the higher ranges in severity as indicated in tests, although in exceptional cases the severity may be greater for given amounts of combustible contents. Ratings one step higher than those given will give a higher factor of safety.

Total weight of combustibles including contents and building members of all floors including roof, but not exterior walls, per sq. ft. of ground area.	Record container rating.
Less than 25 lb.	2-hour safe or vault; except in one-story and basement buildings (or two-story without basement) 1-hour safe. Where impacts or blanketing of ruins by collapse of masonry walls of adjoining buildings is possible a safe or vault of 2-hour or higher rating should be used.
25 to 50 lb.	2-hour safe or vault.
50 to 100 lb.	4-hour safe; or vault, 4-hour for basement or ground story, 2-hour above.
100 to 150 lb.	Vault: Basement or ground story, 6-hour; first floor, 4-hour; upper floors, 2-hour.
Over 150 lb.	Vault: Do not locate in basement or ground story. First floor, 6-hour; second floor, 4-hour: upper floors, 2-hour.

(From 1933 Report, tentatively adopted)

The recommendations refer to recognized ratings for record protection equipment and are derived partly directly from results of tests and otherwise from estimates based thereon. In the latter case an effort has been made to allow for differences in combustible contents, containers and pertaining conditions as defined in the table compared with those present in the tests.

The recommendations in the second column of Table 2(a) are for complete or nearly complete equipment of incombustible filing cabinets, desks and shelving, no more than 30 per cent of the weight of combustibles given in the first column of the table being assumed to be in open shelves, cupboards, or as material in the equipment or building trim. The estimates of severity are based on that obtainable from the exposed combustibles plus an allowance for those contained within closed containers, the heat evolution from the latter being too slow to contribute its full quota to the severity during the period significant from the standpoint of combustibles freely exposed.

Comparison of the recommendations in the last two columns of the table indicates a little lower severity where open incombustible shelving or other open containers are used, compared with that for an equal amount contained within or constituting a part of combustible equipment. Also, with the latter, a comparatively greater combustible content will be present for equal weights of contained records.

Estimation of Combustible Contents of Non-Fire-Resistive Buildings.

The weight of the wood in the building construction can be conveniently estimated as 3 pounds per board foot, using actual area of flooring, ceiling and partition facing and nominal dimensions of joists and other timbers. According to the basis previously outlined the combustible content of outside walls would not be included. The combustibles in the building contents can then be computed for each floor or portion thereof as outlined for fire resistive buildings. The total amount of combustibles per square foot of building area is then obtained by dividing the total for all floors by the area within walls of the portion of the building considered.

Explosion Effects.

Experience from fires as well as fire tests indicates that forcible opening of doors of safes can occur from explosion of gases generated within the safe or safe structure if exposed to fire of high intensity. These explosions will generally occur during the early stages of the fire before the steam generated by dehydration of the insulation has diluted such gases below the explosive limit. This subject has been given considerable study and it appears that materials and details of design can be incorporated into safes that will make the possibility of such occurrence very remote.

Quenching of Fire Ruins.

The recommendations in the preceding sections are based on the assumption that the severity of the fire is not decreased by fire extinguishment. Where such extinguishment takes place at any stage of the fire the fire resistance of record containers designed for the full fire severity applicable for the location will be developed only in part and containers having less fire resistance than thus required may preserve their contents. While it may

be difficult to decrease greatly the initial severity of a fire that has involved the greater portion of a non-fire-resistive building the fire effects on safes and vaults can be greatly decreased by quenching of the hot and glowing ruins. For fires involving only individual buildings or small groups of buildings, the ruins can be easily approached and where there is public fire protection the necessary water and extinguishing equipment will generally be present. Even in the case of fires approaching moderate conflagration proportions, such as that at Fall River, Massachusetts, in 1928, that may require intensive effort for eight hours or more before being brought under control, much salvage of records in insufficiently protected safes and vaults can be effected by systematic quenching of the ruins with this object in view. To judge from temperature measurements available, the maximum temperature in debris consisting of partly burned paper and wood covered by masonry from fallen walls is not attained before 6 to 36 hours after the start of the fire. Even in exposed burning debris several hours may be required before maximum temperatures are reached. It is the continuance of such temperatures for periods of a day or more that overtaxes the protection obtainable with insulated record containers buried in it and more general knowledge of the hazard thus presented should promote cooperation of fire departments and owners of buildings and their contained records in promptly locating and quenching the adjacent portions of the fire ruins.

8. PROTECTION OF RECORDS BY DUPLICATION.

(From 1924 and 1934 Reports)

Properly done, there is probably no more completely effective method of safeguarding records against loss by fire than by keeping duplicate records on other premises not subject to the same fire, even under conflagration conditions.

Based on the theory that fire will seldom, if ever, occur simultaneously in two places remote from each other, some companies have found it expedient to place duplicates of important records at a point some reasonable distance from the main base of operations, preferably in a fire-resistive vault, although this latter precaution is not essential to the fundamental principle of safety secured by separation of two or more sets of records. In the case of one important railroad, the point of duplicate storage is in a fire-resistive warehouse, in which space is rented for the purpose. A prominent life insurance company places its duplicate records in a fire-resistive building located in a suburban town, daily messenger service with which is maintained. Under such systems of operations, the original records would preferably be placed at the point having the lesser fire hazard, but of two points, otherwise equally desirable, at the point where least need for consulting them would exist, using the duplicates at the other location for that purpose. By means of duplication, the information carried by the records is safeguarded, and in event of loss of either set, the cost of replacement would be very materially less than were neither set available. It is evident that if one set is destroyed, extraordinary care should be taken of the other set, until new duplicates have been made.

Methods of Duplication

For the duplication of records, two important considerations must govern, i. e., accuracy of the copies, and permanency or durability. Photograph reproductions are usually considered ideal in respect to the former quality, legally and otherwise, but involve high first cost, on account of the negative and subsequent printing necessary. The quality of the sensitive paper used and proper handling of it chemically may have considerable bearing on the permanence of the results. The alternate process of photostating eliminates the cost of the ordinary photographic negative, but as often made commercially, the fixation and incomplete removal of the unused sensitizing chemicals may render the print subject to rapid deterioration after a few years. Whatever process is used must be thoroughly carried out as to details or the results are bound to be unfortunate. Some form of photographic reproduction is obviously desirable for types of records, the originals of which are made on heavy paper, or on paper printed on both sides, such as deeds, mortgages, insurance records, and similar documents. The photographic processes are limited to reproduction of sheets of only moderate size. For larger sheets and where a considerable number of copies warrant, lithographing or similar processes can be used to advantage.

With typewritten matter it is often very easy to secure an extra copy for filing at remote points simply by making the duplicate when the original sheets are written, a method involving negligible cost.

Another form of record for which duplication may be desirable is that made on tracing cloth or on thin paper through which light rays can easily penetrate, such as the drawings and specifications of engineers and architects. Exact duplication of such records is possible by contact prints on sensitized paper, in the form of blue prints, Van Dyke brown prints,

or white prints made from negatives first printed on Van Dyke brown paper. Unless made with more care than the usual commercial prints these cannot be considered as permanent in character, due to improper chemical fixation and subsequent deterioration, as well as by reason of the physical properties of the paper used, which may disintegrate. For scale drawings it may be necessary to consider the question of distortion due to shrinkage of the paper. In this respect, certain lithograph processes reproduce an ordinary drawing without change of dimensions and are permanent in character. As no special treatment of the surfaces is necessary, and the ink used is carbon black and varnish, the reproductions are not subject to deterioration. Tracings duplicated by this process can be used interchangeably with originals, thus permitting, if desired, originals to be permanently filed, and duplicates to be used for current work and consultation.

Before deciding on any form of duplication, careful consideration should be given to the treatment that the originals may receive in the process. Frequently some form of oil or paraffin treatment, to render original sheets transparent for ease of contact printing, may result in injury to these sheets. Similar consideration should be given to the quality of the material selected for the duplicate copies. Engineers' and architects' drawings and specifications should preferably be duplicated on a good quality of tracing cloth.

Photographic negatives on film are becoming common for record purposes. Records on sheet celluloid are being used in some cases. The Committee recommends that where film is used, it be of the acetate type only. Adequate protection of nitro-cellulose film or celluloid is not practicable except by highly specialized forms of construction or by duplicates not subject to the same fire. Acetate film may be adequately protected by the same means that would be used for any records on paper.

In this connection special consideration of the fire hazard must also be given to processes of reproduction involving final coating of collodion to preserve the integrity of the printed matter beneath.

For records that are to be preserved on paper, full consideration should be given to the relative durability of rag stock bond paper as compared to sulphite stock paper which may have a very limited life.

It must be remembered that in any system of duplication there may be two values at stake. The first, and probably most important, is the possession of the information carried by the record. The second value, often found, lies in the actual money cost of reconstructing duplicates from the copies saved. For instance, to retrace several thousand blue prints is a very costly operation.

Finally, if dependence is placed on duplicate records, care must be taken to maintain the duplicates in complete file. If removed for consultation or other use they should be returned promptly to the storage point. Even if they are only duplicates, they should be protected with the same care as original records, and should be checked periodically to insure that the set is complete, and that the records have not begun to deteriorate physically.

Photographing Records.

A method of photographing in miniature, on a roll of film, which subsequently can be enlarged and displayed on a ground glass plate or a screen for reference, or re-photographed for a permanent full size record, has been developed and is being used advantageously by banks to keep a permanent record of checks handled, deposit slips, etc. It would seem equally advantageous for other lines of business where papers recording transactions must be kept for a number of years. The picture on the film is

1/25th of the size of the original paper and one 100-foot film contains 8000 photographs—about the size of a package of cigarettes. The original papers may be destroyed, and the saving in storage space is about 98 per cent.

Acetate cellulose film should be used on account of greater permanence and lower fire hazard than nitrocellulose film.

9. DOCUMENT BUILDINGS.

(From 1924 Report)

The "document building" is defined as an isolated, strictly fire resistive building, usually in an outlying district, in which inactive records can be kept. A number of cases have come to the notice of the committee where companies have considered it worth while to provide such buildings. Such an arrangement permits the transfer of a large amount of records from working areas in valuable office space, releasing it for other purposes. Such records are thus brought together where they can be kept under proper conditions and supervision, and where they escape the hazards inherent upon storage at locations never really intended for that purpose. Very frequently important records are crowded out of vaults and other reasonably safe storages into out-of-the-way corners where they may not only lack protection but may actually be exposed to grave hazards.

A document building, if large enough, may be put in charge of one or more persons, competent to handle and file the records and to handle inquiries over the telephone, in order to avoid, as far as possible, actually removing the records.

A building of this type should of course have the characteristics of a vault as to construction, absence of combustible interior finish, arrangement of lighting, heating, etc. Exterior openings should be protected in suitable manner.

10. VAULTS AND VAULT DOORS.

Introduction.

(From 1924 Report)

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 debris 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 debris 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 rabetting into the concrete to a depth and width of at least 1 inch.

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

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.

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 parapetted 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 debris 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 rabbetted into the concrete of the columns 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 fol-

low 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.

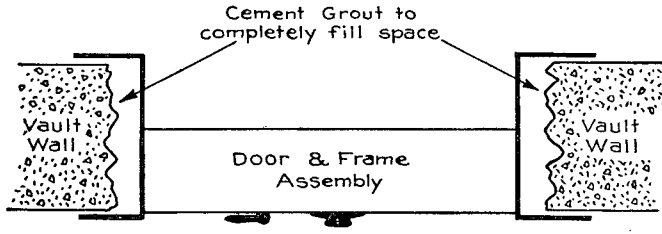
The effectiveness of various types of vault doors, in resisting fire exposure, can only be based on reliable information such as can be obtained by tests under standard conditions. Therefore, doors may be recognized and should be given preference if bearing evidence of 6-hour, 4-hour, or 2-hour classifications 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.

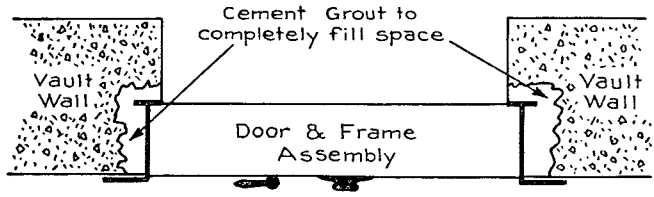
Installation.

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.



Installation when vestibule laps both faces of wall



Installation when vestibule fits into recess in wall

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.

11. FILE STORAGE ROOMS AND FILE STORAGE 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 file storage 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.

Definition.

A File Storage 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 File Storage 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 File Storage 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 File Storage 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 file storage room whether or not such openings are fitted with fire doors. The walls between any such vertical shafts and the file storage 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 file storage 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.

File Storage 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 file storage room doors.

The term, file storage 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 file storage 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 file storage 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.

File storage 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 file storage 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. file storage room doors should be given preference when selections are made.

The installation of file storage room doors should be entrusted only to those experienced in such work. Two methods of installing file storage 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.

File storage 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 file storage rooms from other parts of the building through openings caused by movement or breakage of piping at time of fire.

Ventilation.

Ventilation of file storage 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 file storage 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 file storage 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 file storage room should be positively forbidden.

12. FIRE PROTECTION EQUIPMENT FOR VAULTS AND FILE STORAGE ROOMS.

(Officially adopted 1934)

Conditions Requiring Protection.

Vaults constructed, equipped and maintained in accordance with the recommendations of Section 10 on Vaults involve such small probability of the start of interior fire or of spread from the point of origin that it is ordinarily unnecessary to provide automatic fire protection equipment. File storage rooms constructed, equipped and maintained in accordance with Section 11 involve similarly a small probability of fire, but conditions of their use more often introduce fire hazard due to non-compliance with recommendations. Whether built-in fire extinguishing and/or detecting equipment for vaults and file storage rooms is justifiable will depend on the fire hazard presented and the value of the records and properties.

Automatic fire detecting and/or extinguishing equipment is recommended where conditions favor the start and spread of fire owing to difficulty of enforcing no smoking rules, possibility of placing highly inflammable materials in the vault or file storage room, electrical or other equipment not in accordance with the recommendations of this report, together with wooden or other sub-standard vault equipment.

Types of Protection Equipment.

A system of automatic carbon dioxide fire protection installed in accordance with the N.F.P.A. Regulations for Carbon Dioxide Fire Extinguishing Systems, affords excellent protection and is particularly adaptable where large values are concentrated in a relatively small space. Relief vents opening automatically must be provided, preferably at or near the top of the vault, to prevent building up of pressures by the gas discharge that would rupture the vault construction.

Automatic sprinklers installed in accordance with the N.F.P.A. Regulations on Sprinkler Equipments are effective in extinguishing or limiting the spread of fire, but involve the possibility of some water damage (see p. 31, Water Damage). It would be expected, however, that the water damage to vault contents would be much greater if in the absence of needed automatic protection large hose streams were used. Where sprinklers are installed, sprinkler alarms and shut-off valves located conveniently outside the vault or file storage room should be provided to permit turning water off promptly after fire is extinguished, thus preventing unnecessary water damage.

Automatic fire detecting systems installed in accordance with the recommendations of the N.F.P.A. Regulations on Protective Signaling Systems are valuable in giving warning of fire inside vaults or file storage rooms. They should be relied upon only when there is assurance that the alarm will bring prompt response at all times.

First aid fire appliances of type suitable for Class A fires (see N.F.P.A. Regulations on First Aid Fire Appliances) or standpipe systems with small hose suitable for use by occupants of the building (see N.F.P.A. Regulations on Standpipe and Hose System) should be provided at a conveniently accessible location outside the door of the vault or file storage room. Such protection is recommended in all cases and is particularly indicated where automatic fire extinguishing equipment is not provided inside the vault.

13. SAFES.

(Officially adopted 1934)

Safes as here discussed are those shown by adequate tests to be capable of affording 4-hour, 2-hour, or 1-hour fire protection to their contents, to be capable of withstanding severe impacts while in highly heated condition, and to be free from tendency to explode when subjected to fire exposure. The fire protection afforded by safes has been the subject of scientific investigation for years past, and there is reliable information, such as can be obtained only by tests of appropriate character and severity, on their ability to protect their contents.

Various instances are on record in which safes have exploded in fires, with resulting loss of contents. Tests have been devised to investigate and disclose these possibilities, and, where they exist, to aid the designer in each case in providing safeguards against them. Those who undertake the testing and classification of safes must search thoroughly into these possibilities in every case and by suitable tests assure their elimination before awarding classifications. These explosions have been determined as due to ignition of hydrogen-air mixtures, the hydrogen being liberated by the contact of steam from the insulation with hot iron within the safe structure. The possibility of occurrence is confined mainly to the initial period of quick hot fires.

In many fires safes are subjected to severe impacts. At times floors collapse, safes thus falling through two or more stories; at times, safes must withstand the impacts of falling debris or structural building members which are detached from their fastenings by fire. It is obvious that the resistance of a safe to impact when highly heated will differ markedly from its impact resistance when cold. It is essential that safes be shown, by adequate tests which combine both fire and impact conditions, to be capable of withstanding these conditions which occur in actual fires.

It is probable that safes can be designed to protect their contents against any fire exposure to which they are likely to be exposed in burning buildings but the matter of weight and portability places practical limits on the protection that can be obtained. Obviously they cannot be expected to resist greater fire exposures than those for which they are designed. Hence, the severity of exposure to which a safe may be subjected should be expertly judged before the safe is selected.

From the foregoing, it is apparent that the fire protection to be expected from safes rests upon various technical considerations which can be settled only by tests and investigations made under conditions as representative as possible of those to which the containers will be subjected under actual fire conditions. Therefore safes for protection of records should be preferred that have been subjected to tests of appropriate and conclusive character, to inspection in course of manufacture and that bear evidence of classification by an organization properly equipped and qualified for experimental testing.

Insulated Letter Files.

Several makes of insulated letter files are now on the market, offered to the public as furnishing fire protection for their contents. The best of these devices which have been brought to the attention of the Committee have a construction which, in its judgment, would indicate a resistance of one half to three quarters of an hour under the standard fire test. Before placing reliance in such containers the location where they are to be used should be most carefully scrutinized to make sure that the fire exposures to be expected under the worst conditions, increased by the application of a proper factor of safety, will not exceed the limit of fire resistance of devices of this character.

14. SUB-STANDARD AND "COMMERCIAL" RECORD CONTAINERS.

(From 1927 Report)

Upon this subject the Committee desires to address itself to three groups:

a—The purchasing public;
b—Fire insurance carriers;
c—Manufacturers of devices.

To the Purchasing Public.

Those who possess records are increasingly realizing how vital it is to protect them against loss by fire. Their demands have stimulated the manufacture of a multiplicity of devices for that purpose, safes, vaults, special files, etc.

Quite naturally, the purchasers have desired to satisfy the needs they realized without needless expense and in the most convenient way. These purchasers have not been equipped technically to appraise quantitatively the severity of the fire exposure to records in each case, to set up specifications for protective equipment, nor to discriminate accurately between various devices offered commercially. Under these conditions, it is natural that price rather than engineering fitness and merit has often been the determining factor in selection.

It is urged that purchasers in the selection of record protection equipment hold fast to sound basic principles, that they be guided by unbiased and technically informed opinions, that they be cautious and indeed canny in the weight given to enthusiastic opinions, which, however sincere, may be influenced with the best of intentions by commercial zeal, that where impartial engineering test data are available, this information be given heavily predominating weight. Finally, it is urged that there be no failure to recognize that there should be certain minimum limits for each situation below which the purchaser, in his own interest, should not be tempted by consideration of price, convenience, or commercial expediency. Record protection has this in common with the traditional requirements of Caesar's wife—that there is little merit in approximate virtue.

To Fire Insurance Carriers.

The fire insurance carriers in this country have considerable amounts at stake in insurable values kept in safes, vaults, etc., as a means of protection against fire as well as theft. It is with the former only that we are at present concerned.

There is an increasing disposition to recognize the money value of records. There is even a United States Supreme Court decision and a growing literature in support of the belief that the money value of records of a public utility may properly be included in capital account as a part of the rate base. Such values in a single concern of ordinary size may easily mount into millions of dollars. With the widespread acceptance of such values must necessarily come the demand for insurance upon them. This Committee urges that the insurance companies inform themselves as to the validity of these ideas, and encourage them, if found sound, meanwhile preparing themselves to exercise the fine discrimination as to safeguards for records that they have long ago shown in the consideration of the hazards to and protection of other insured property. The name "vault" or "safe" on an enclosure should not determine its effectiveness regardless of intrinsic merit or of the conditions surrounding it.