

General Storage Standards

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**National Fire Protection Association
(International)**

**60 Batterymarch Street
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National Fire Protection Association

INTERNATIONAL

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

This pamphlet is one of a large number of publications issued by the Association and sent to the members as published. These include the monthly *News Letter*, standards on fire prevention and fire protection, special reports and bulletins, the *Year Book*, and the *Proceedings* of the annual meetings.

Membership in the National Fire Protection Association is open to any society, corporation, firm or individual interested in the protection of life or property against loss by fire. All the valuable engineering and popular literature issued by the Association is sent, as issued, to every member. The Association is the clearing house for all the authoritative information on Fire Protection and Prevention, and members are privileged to submit to it their individual problems for solution. The Association is always glad to send samples of its publications to prospective members upon request.

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General Storage Standards.

The following standard was presented and adopted at the 1946 Annual Meeting. It is the result of extensive consideration by the Committee on General Storage and is believed to represent good fire protection practice consistent with practical warehouse operation. Many of the provisions of the standard have been based upon the General Storage Specifications of the War Production Board which were developed to furnish guidance in the storage of critical and strategic materials during the war period, modified as necessary to apply to peacetime storage conditions.

FOREWORD.

The following standards covering general storage and that of special types of commodities presenting special storage problems have been developed by the Committee on General Storage. Their objective has been to provide adequate protection against fire and related hazards consistent with the best warehousing practice and designed to avoid as far as possible interference with efficient and economical warehousing operations.

The frequency, severity and dollar value of fires involving stored commodities have increased sharply since the beginning of World War II. Several factors, principally the following, have contributed to this increase:

1. An overall shortage of storage space resulting in overcrowding of warehouses and utilization of buildings of inferior construction not designed for storage and lacking proper maintenance and adequate fire protection facilities.
2. Concentration of values to simplify distribution problems.
3. Increased use of mechanical handling equipment with incidental hazards.

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General Storage Standards.

MANAGEMENT FEATURES

I. Responsibilities of Management:

(1) **General Management Responsibilities.** The most important single factor in the security of stored commodities is the character of the supervision and maintenance exercised by the management of the property. The warehouse management is responsible for good housekeeping, for the proper maintenance of buildings and building equipment, for the provision of adequate watch service and first aid fire fighting equipment, for the control of smoking, for the elimination of combustible waste materials, and for any other potential sources of the start and spread of fire and for proper practices in the piling of materials.

(2) **Instruction of Personnel.** All employees should be instructed in location and trained in the use of available fire protection equipment so that it may be put into operation with the maximum efficiency in case of fire. Wherever the size of the establishment permits, the organization of selected employees into a private fire brigade is recommended.

Advice and assistance of local fire officials and the Inspection or Engineering Bureau having jurisdiction should be enlisted in the organization, selection and training of personnel of the fire brigade.

Members of the fire brigade should be thoroughly instructed and trained and frequently drilled in the use of all fire protection equipment. Each member should know exactly what to do in an emergency. The importance of giving an immediate alarm and of summoning aid promptly should be stressed. Certain members should be assigned specific tasks. For example, if the fire protection system is supplied by a fire pump, the engineer or his assistant who should be a member of the fire brigade will be responsible for starting the fire pump.

(3) **Smoking.** Smoking shall be strictly prohibited in any location where carelessly discarded smoking materials might cause fire.

NOTE: Cooperation of employees is more readily secured when a reasonable policy of "control" of smoking is adopted, with smoking permitted in specified locations where there is little hazard, or at specified times under suitable supervision, rather than a complete prohibition which is likely to lead to surreptitious smoking in out of the way places where the hazard is most serious.

(4) **Waste Disposal.** Approved type containers for rubbish and other waste materials which frequently provide kindling for the start of fire or serve as the means of spread of fire, shall be provided as required. Containers shall be emptied and contents removed from the premises or otherwise safely disposed of at frequent intervals.

(5) **Repairing, Refinishing, Packing.** All repairing, refinishing, crating, packing and similar operations as well as storage of com-

bustible crating and packing materials, paints, lacquers, thinners and other finishing materials should be restricted to segregated areas, in separate buildings or separate fire areas. The hazards of all such operations and storage should be suitably safeguarded in accordance with established good practice and applicable standards, e. g. paint spraying operations should be conducted in accordance with the N.F.P.A. Standards on Paint Spraying and Spray Booths.

Metal lined containers or receptacles with self closing or fusible link operated covers shall be provided for excelsior or other packing materials as required.

(6) **Heat and Service Equipment.** Heating, lighting and service equipment shall be of approved type installed, maintained and operated in accordance with N.F.P.A. Standards (Reference: National Electrical Code).

(7) **Mechanical Handling Equipment.** All mechanical handling equipment such as fork or lift trucks, piling and stacking machines, shall be of approved type operated and maintained in a safe manner. Gasoline-powered equipment shall be refueled outside of storage buildings and shall be stored and serviced in separate fire areas. Electric-powered equipment shall be disconnected when not in use. No mechanical handling equipment of a type which may produce flame or sparks shall be used in any location where extra-hazardous materials are stored. Where mechanical handling equipment is used, necessary guards shall be provided to prevent accidental damage to fire doors, sprinkler piping, or other fire protection equipment.

(8) **Building Maintenance.** All outside openings in buildings shall be maintained tight against the weather. Buildings shall be maintained secure against the access of unauthorized persons. Fire walls and floors shall be maintained in good repair at all times to restrict the spread of fire from any area where it may originate.

It is especially important to provide protection of wall and floor openings resulting from any construction changes such as the installation of piping, conveyors or hoists.

(8a) **Stairways and Shafts:** All unnecessary vertical openings in multi-story buildings shall be eliminated as far as practicable. Stairways and other shafts should be enclosed with fire resistive construction with all openings protected with Class B fire doors installed and maintained in accordance with the N.F.P.A. Standards for the Protection of Openings in Walls or Partitions.

(9) **Fire Doors.** Fire doors shall be automatic closing and shall be maintained at all times in operative condition. Where possible, doors should be kept normally closed. No hook, wedge, or other fastening (does not apply to fusible link) shall be used to keep doors from closing. No materials shall be piled directly against doors or in the way of proper closing of doors.

(10) **Shutters.** Outside fire shutters designed to protect against exposure fires shall be maintained in good condition at all times and shall be kept normally closed.

NOTE: Experience shows that after a fire starts it is seldom possible to close a large number of open shutters with sufficient promptness to prevent the spread of fire to the storage building.

II. Location of Storage:

(1) **Areas.** Buildings having small areas or sub-divided into small units by fire walls and fire resistive floors are preferable to large, undivided areas, particularly for the more valuable or more combustible commodities and should be used wherever practicable. The larger the storage area, the greater the opportunity for loss. Large, undivided areas are undesirable, not only from the standpoint of excessive values subject to a single fire, but also because of greater difficulties in fire fighting and salvaging operations. Small areas are essential to the effective use of hose streams, especially where reliance is placed on manual fire protection.

(2) **Heights.** Low buildings, particularly one-story structures, are more readily accessible for fire fighting and salvaging than higher buildings. Multi-story buildings may be subject to spread of fire from lower to upper stories and water used on upper floors may cause damage on lower floors. However, the possible disadvantage of multi-story buildings may be offset by fire resistive construction, automatic sprinklers, the proper protection of vertical openings and suitable provision for drainage of upper floors. Excessive ceiling heights in one-story structures with high piling present unusual difficulties in fire fighting. Storage in such structures may, under some conditions, be inferior to storage in properly designed multi-story buildings with ordinary ceiling heights.

(3) **Basement Storage.** Basement storage shall not be used for materials subject to water damage unless adequate drainage facilities are provided.

(4) **Mixed Storage.** Extra-hazardous materials shall be stored in separate sections and segregated from other storage.

(5) **Temporary Storage.** All storage, even though considered of a temporary character, shall comply with these standards insofar as possible.

III. Piling:

(1) All materials stored shall be handled and piled with due regard to the characteristics of the material; and materials of different classes, so far as practicable, should be segregated. Any materials which may be hazardous in combination should be stored in separate areas.

The management should ascertain the fire hazard characteristics of all materials stored and where complete information is lacking it should be assumed to be possibly dangerous and segregated accordingly.

(2) **Piling.** Materials shall be so piled as to minimize the spread of fire internally, to permit convenient access for fire fighting and salvaging or the removal of portions of material which may constitute a hazard. Neat blocking and piling and good housekeeping shall be maintained at all times.

(3) **Floor Loads.** Safe floor loads shall not be exceeded. For water-absorbent materials, normal floor loads should be re-

duced accordingly. This is particularly important for fibers and fiber products.

(4) **Aisles.** Aisles shall be maintained at reasonable intervals to provide convenient access to all portions of the storage. They shall be so spaced that the total content of individual piles will not exceed 25,000 cubic feet. They shall be of sufficient width for removal or transfer of material and in general shall have a minimum width of 5 feet. Where mechanical handling equipment is used a minimum width of 8 feet is recommended.

As far as practicable, aisles should be located opposite window openings in exterior walls and provision should be made to avoid any obstruction which would prevent the effective operation of hose streams through windows.

Wall aisles sufficiently wide to permit passage of an employee should be maintained. Such aisles will facilitate opening or closing of windows in an emergency *and are absolutely essential in the storage of fibers and all other materials which swell or expand with the absorption of water.*

(5) **Pile Heights.** Height of piles shall be kept as low as practicable and in general should not be over 10 ft.

(6) **Sprinkler Clearance.** Where automatic sprinkler protection is provided, clearance of at least 18 in. shall be maintained under sprinklers.

(7) **Ceiling Clearance.** Where reliance is placed upon hose streams there shall be a clearance of not less than three feet between the tops of piles and the underside of the lowest beams, girders or other ceiling obstructions which might restrict the play of hose streams over the material.

(8) **Skidding.** Commodities which are particularly susceptible to water damage should be on skids, pallets or elevated platforms or such other measures should be taken as may be indicated in individual instances.

IV. Protection:

(1) **Alarm Service.** Provision shall be made for promptly notifying the public fire department or private fire brigade in case of fire. This should be by means of public or private fire alarm system.

(2) **Standard Watch Service.** Standard watch service (See Definition) shall be provided and shall be continuously maintained while the property is otherwise unoccupied. There should be some suitable method of supervising the watchman's activities to be sure that he makes his required rounds at *regular* intervals. An approved watchman's clock and various types of electrical supervisory systems are commonly used for this purpose.

NOTE: Where automatic alarm service such as central station supervisory service is provided and properly maintained, it may, in individual cases, be substituted for watch service to such extent as may be approved by the Inspection or Engineering Bureau having jurisdiction.

(3) **First Aid Fire Protection.** First aid fire protection shall be provided for all covered areas so that at least one conveniently accessible extinguisher unit is so located that a person will not

have to travel more than 50 feet from any point to reach the nearest unit, or where standpipe and hose systems are provided, the number and location must be such that all portions of the building can be reached with not more than 75 feet of hose.

Extinguishing equipment shall be of a non-freezing type when located in unheated buildings or be placed in suitable heated cabinets.

Extinguishers shall be of types suitable for extinguishing fires in the particular commodity stored and shall bear the label or designating mark of Underwriters Laboratories, Inc. or of the Factory Mutual Laboratories and be installed and maintained in accordance with the N.F.P.A. Standards on First Aid Fire Appliances.

(4) Automatic Sprinklers. Automatic sprinklers with adequate water supplies are recommended for the protection of buildings of combustible construction or housing combustible contents.

Automatic Sprinkler systems shall be provided with appropriate waterflow devices as specified in the N.F.P.A. Standards for the installation of sprinkler equipment to provide notification in case of flow of water from any cause, unless specifically waived by the authority having jurisdiction.

(5) Outside Fire Protection. Outside fire protection consisting of an adequately equipped and manned public fire department, and adequate municipal water supply and hydrant system should be available, or in lieu thereof, an adequately equipped fire brigade, and adequate private water supply and yard hydrant system, furnishing substantially equivalent protection, shall be provided.

NOTE: Where private yard hydrant system is installed all underground pipe, valves and fittings shall be not less than 6 inches.

(6) Exposure Protection. Exposure protection shall be provided as recommended by the Inspection or Engineering Bureau having jurisdiction. This may require solid masonry walls, the protection of openings in masonry walls by fire shutters kept normally closed, wired glass windows, open sprinklers or a combination of these installed in accordance with the standards of the National Fire Protection Association. Wooden cornices and any other feature which would permit transmission of fire to the storage building must be protected as well as window openings.

(7) Self Inspections. Periodic inspections (preferably weekly) of all fire protective equipment shall be made in conjunction with regular inspections of the entire premises. Trustworthy employees should be selected, preferably two or more, who will alternate in making inspections and who will conscientiously check over the equipment and record conditions found on suitable forms. *Copy of inspection report should be promptly submitted to someone with authority to correct faulty conditions.*

Inspections should be so organized and conducted that complete coverage will be secured of the following and report form designed accordingly:

General Order and Neatness. All locations where conditions are unsatisfactory should be noted paying special attention to out of the way places such as closets, under stair ways, racks, and steam pipes.

Valves. Examine all control valves of sprinkler and yard systems to make certain they are open. The surest method of determining that valves are open is by means of a drain test which should be made. *Valves found improperly closed should be reported and reopened at once.*

NOTE: Where Central Station Supervisory Service is provided, always notify central station before operating any valve or otherwise disturbing the sprinkler system.

Tag system should be used to identify valves closed to prevent freezing or for repairs and serve as a reminder to open in event of fire.

Dry pipe valves should be checked to make sure priming water is at proper level. Pressure should be checked on each system, and where necessary, systems should be pumped up. In cold weather make sure that valve closet is properly heated, and that heating equipment is safe and in order.

Before and during freezing weather, make sure that all low point drains of the system are kept free of water.

Further details of valve supervision are given in the N.F.P.A. Standards for the Supervision and Care of Valves Controlling Water Supplies for Fire Protection.

Alarms. Alarms should be tested at regular intervals and where found defective or inoperative, should be reported and repairs made at once.

Gravity Tanks. Check water level. Fill if necessary. During freezing weather, see that proper temperature is maintained in the tank and that all heating devices are in order.

Pressure Tanks. Check water level and air pressure and during freezing weather the heating of the tank enclosure.

Fire Pumps. Start the pump and operate until water is discharged freely from relief valve.

Automatic Sprinklers. Make sure sprinklers are in good condition, clean, free from corrosion or loading, not painted or white-washed, and not bent or damaged. Defective heads should be replaced, and an adequate supply of extra sprinklers should be on hand at all times. Keep hangers in good repair. Promptly replace any broken hangers and refasten any that become loose.

Open Sprinklers. Outside or open sprinklers should be tested each year during warm weather.

Hydrants and Hose Equipment. Make certain that hydrant barrel is free of water by sounding with the hand over the hydrant outlet. See that outlet gates are operative, outlet nipples tight and threads undamaged. Also see that proper amount of hose (250 feet minimum) and other equipment including hose spanners, playpipes and hydrant wrenches are in place and in good condition.

Fire Pails, Extinguishers and Small Hose. See that all such equipment is in place, the pails full, and that extinguishers have been re-charged within a year. See that small hose is in good condition and equipped with proper nozzles.

Fire Doors and Shutters. See that all fire doors and shutters and their hardware, including fusible links, are in good operating condition. Test action of automatic sliding doors by raising

the counter weight by hand. Check guides of rolling steel doors. These guides sometimes become so badly damaged by trucks that the door cannot drop the entire distance. Fusible link should be free of paint. Rolling doors should be given an occasional operating test by disconnecting the fusible link. When checking fire doors any openings in fire walls not properly protected by fire doors or shutters should be noted.

Floor Scuppers and Drains. These are provided in many instances to rid floors of water promptly in the event of fire or sprinkler leakage. They should be kept clear at all times.

Waterproof Covers. Where waterproof salvage covers are supplied they should be kept accessible and in good condition.

Electrical Equipment. Defective electrical equipment such as loose, frayed or temporary wiring, missing pilot lights and improper fusing should be reported. Switch and fuse boxes should be readily accessible and covers should be kept closed.

NOTE: Extension cords are a frequent source of fire as they are often left in contact with combustible material.

Special Extinguishing Equipment. Where special types of protection are provided such as automatic foam or carbon dioxide systems, they should be inspected with care to make sure that none of the equipment is disarranged or obstructed and that it will operate properly in event of fire.

Miscellaneous. Make notes of any items not covered in the inspection report form such as dangerous use of acetylene cutting equipment and improper storage, use or handling of flammable liquids.

(8) **Emergency Access.** Arrangements shall be made to permit ready access in case of fire or other emergency—of municipal fire departments, police departments, or such other assistance as may be summoned to deal with any emergency—without delay by gates, barriers, or procedures normally designed for the prevention of unauthorized access.

Each storage facility should be considered individually and arrangements made, particularly with the local fire department, which should be acquainted previously with conditions, so that in case of fire or other emergency, no time will be lost in reaching the seat of the trouble and utilizing fire protection equipment. Frequently plans can be made available that will assist materially.

CLASSIFICATION OF STORAGE BUILDINGS

Foreword:

Storage Buildings are classified in eight groups in accordance with the following table arranged in order of preference: Class 1, if standard sprinkler protection exists; Class 2, if not sprinklered.

When buildings are of mixed types of construction, the most vulnerable type constituting 10% or more of the actual storage area shall determine the classification. It is recognized that buildings of special type construction may occur, in which event the classification shall apply which most closely approximates a type of construction covered in the table.

In the case of multi-story buildings, it is assumed that adequate floor fire cut-offs exist. In the event such cut-offs do not exist, then the classification of the building in question shall be dropped one grade. For example, a sprinklered multi-story fire resistive building with adequate floor fire cut-offs would fall in Class 1-A. The same building *without* adequate floor fire cut-offs would fall in Class 1-B. Similarly, a sprinklered 2-4 story brick joist building with double board floors and adequate floor fire cut-offs would fall in Class 1-C. The same building *without* adequate floor fire cut-offs would fall in Class 1-D.

<p>CLASS 1 Sprinklered</p>	<p>CLASS 2 Not Sprinklered</p>
<p>A fire resistive, one or more stories; one story non-combustible; concrete on steel, one or more stories</p>	<p>A fire resistive, one or more stories; one story non-combustible; one story concrete on steel</p>
<p>B heavy timber, one or more stories; plank on steel, one or more stories; one story brick joist</p>	<p>B heavy timber, one or more stories; one story plank on steel; one story brick joist</p>
<p>C 2-4 story brick joist with double board floors; one story frame, or iron or asbestos on wood frame</p>	<p>C multi-story concrete or plank on steel; 2-4 story brick joist with double board floors; one story frame or iron or asbestos on wood frame</p>
<p>D 5 or 6 story brick joist; 2 story frame, or iron or asbestos on wood frame; buildings (any type of construction) with combustible supports with unsprinklered spaces underneath</p>	<p>D 5 or 6 story brick joist; 2 story frame, or iron or asbestos on wood frame; buildings (any type of construction) with combustible supports with spaces underneath inaccessible for fire fighting</p>

DEFINITIONS

(1) **Approved:** "Approved" refers to approval by the authority having jurisdiction in the application of these standards. Approved devices and materials are those tested and listed by Underwriters Laboratories, Factory Mutual Laboratories, or other nationally recognized testing agency, or in the case of any classes of devices and materials not regularly tested and listed, are those approved by the authority having jurisdiction.

(2) **Fire-Resistive Construction.** This type of construction, commonly called "fireproof," has walls, floors and roof of rein-

forced concrete or masonry construction with all steel work protected by at least one inch of concrete or masonry insulating material. The building is designed to preserve the integrity of the structure even though the contents may be completely destroyed by fire.

(3) **Concrete on Steel Construction.** This construction is the same as fire resistive construction except that steel columns, girders, and beams are not protected by fire resistive masonry insulating material. This type of construction has the advantage of having no combustible material in its construction and is highly satisfactory when equipped with a standard sprinkler system. Its prominent disadvantage is that under moderate temperature conditions during a fire the exposed steel members weaken and are subject to collapse such that with combustible contents and/or no sprinkler system, the building and contents are subject to heavier loss and damage than is the following classification—Heavy Timber Construction.

(4) **Heavy Timber Construction.** Also called Plank on Timber and Mill Construction: The essential feature of this type of construction is that all floor and roof timbers are of large dimensions (never less than four inches in either dimension) and that all floor thickness is at least equal to three inches. Walls are of substantial masonry. This type of construction can be destroyed only by a fire of considerable intensity and duration.

(5) **Plank on Steel Construction.** This type is similar to Plank on Timber Construction except that columns, girders, and beams may be of steel instead of heavy timber. There is slight difference in the amount of combustible construction in these two types of buildings, but Plank on Steel construction is more subject to collapse by heat.

(6) **Non-Combustible Construction.** This type has steel structural members, outside walls and roof of corrugated iron or other metal or asbestos board, and non-combustible floors. If wooden floors or structural members are used, the building is classed as iron or asbestos on wood.

(7) **Iron or Asbestos on Wood Frame Construction.** This type is similar to non-combustible, except that wooden floors and wooden structural members may be used.

(8) **Brick Joist Construction.** This type has brick or other masonry walls, floor and roof joists of two or three inch nominal thickness. Floor thickness is less than in mill construction.

(9) **Frame Construction.** This is the type of building construction commonly designated as "frame" by building codes. It consists of wooden structural members and wooden flooring as described for brick joisted construction but with wooden exterior walls.

(10) **Buildings with Combustible Supports.** Buildings with combustible supports with unsprinklered spaces underneath (in the case of sprinklered buildings) or with spaces underneath inaccessible for fire fighting (in the case of unsprinklered buildings), are those where the storage buildings rest on a combustible substructure which lacks protection and where a fire in the substructure, without means of extinguishment, could result in the collapse and destruction of the entire building. This condition

is most frequently found in piers, wharves and other waterfront structures.

(11) **Automatic Sprinklers.** Where automatic sprinkler protection is referred to in these standards, or the term "sprinklered" is used, reference is made to an automatic sprinkler system installed in accordance with the Standards of the National Fire Protection Association for the Installation of Sprinkler Equipment.

Automatic sprinkler systems shall be provided with appropriate water-flow devices as specified in the above Standards to provide notification in case of flow of water due to the operation of sprinklers from any cause, unless specifically waived by the authority having jurisdiction.

NOTE: Automatic sprinkler systems should be regularly inspected and maintained in accordance with the N.F.P.A. Standards on Care and Maintenance of Sprinkler Systems; lack of such care and maintenance will be grounds for classifying a building as unsprinklered.

(12) **Central Station Supervisory Service.** This service provides electrical supervision over valves controlling water supplies and other features essential to the operation of sprinkler systems and also provides notification of the flow of water due to fire or other cause, registered at a central station with facilities for immediate notification of the public fire department.

(13) **First Aid Fire Protection.** First aid fire protection consists of casks and pails, chemical fire extinguishers and stand-pipe and hose systems. Such equipment is designed to cope with fires in their incipency and is considered necessary even though the property is equipped with automatic sprinklers and other protection.

(14) **Standard Watch Service.** Standard watch service is that commonly specified by fire insurance organizations and described in the National Fire Protection Association pamphlet, "The Watchman." Emphasis is placed upon the employment of able-bodied, intelligent and reliable men, who are capable of a watchman's responsibilities.

(15) **Automatic Alarms.** Automatic alarms are devices or systems so designed, installed and maintained as to transmit with assured reliability a warning to appropriate personnel upon actuation of the device or system by fire, unauthorized entry or other cause.

(16) **Fire Area.** A fire area for the purpose of these standards is defined as a building or section of a building separated from other buildings or sections by fire walls or fire resistive floors, so arranged and maintained as to confine a fire to the area of origin under any normally expected fire conditions. (See definitions Fire Walls, Fire Doors.)

(17) **Location.** A location as referred to in these standards is the whole area which might be exposed or involved by a single abnormal catastrophe. It may contain more than one storage building or fire area. Separation of storage buildings by fire walls, party walls or open spaces of less than 200 feet shall not be considered as constituting separate locations.