NFPA No.

231

INDOOR GENERAL STORAGE 1972

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NATIONAL FIRE PROTECTION ASSOCIATION
International

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Official NFPA Definitions

Adopted Jan. 23, 1964: Revised Dec. 9, 1969. Where variances to these definitions are found, efforts to eliminate such conflicts are in process.

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Standard for

Indoor General Storage

NFPA No. 231 — 1972

1972 Edition of No. 231

This edition of the Standard represents a complete revision, following a thorough review by the Committee. Protection requirements for empty combustible pallets and design curves for sprinkler water demands have been added. It was adopted at the Annual Meeting in May 1972 and supersedes the 1970 edition.

Origin and Development of NFPA No. 231

The U. S. War Production Board promulgated in 1943 General Storage Specifications for Critical-Strategic Materials. These were largely based on existing NFPA standards and upon generally accepted good practice in fire protection. They were published for convenient reference in NFPA National Fire Codes for Building Construction and Equipment in 1944, and an NFPA Committee on General Storage was appointed that same year. On recommendation of that Committee, a General Storage Standard was adopted by the NFPA Annual Meeting in 1946. This covered both indoor and outdoor storage. A revision of the Standard was tentatively adopted in 1953.

In 1955 the Committee presented a draft of a new document, Recommended Safe Practices for General Storage, No. 231-T, covering Indoor Storage, Outdoor Storage and Refrigerated Warehouses. This was tentatively adopted leaving the 1946 General Storage Standard still official. With a few amendments, Recommended Safe Practices for General Storage, NFPA No. 231, was adopted in 1956.

In 1965 this was changed from a recommended practice to a standard, and the present title was introduced. The sections of the 1965 edition pertaining to Outdoor Storage and Refrigerated Warehouses were deleted, and an Appendix on Pallets and Palletized Storage was added.

In the 1970 edition, amendments included doubling the maximum recommended area for Type I and Type II Storage, placing height limitations on empty wooden pallet storage, and reducing the water requirements for Type II Storage.

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SCOPE: General warehousing and storage practices for materials and commodities not covered by other NFPA committees.

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Contents

Standard for

Indoor General Storage

NFPA No. 231 — 1972

INTRODUCTION

1. Application and Scope.

(a) This standard applies to storage of materials representing the broad range of combustibles, 25 feet or less in height, stored in solid piles or palletized piles. This standard applies only to buildings protected by automatic sprinklers.

(b) Storage piled higher than 25 feet is not within the scope of this standard and requires special consideration.

(c) This standard does not apply to storage (1) on racks, (2) storage of commodities which, with their packaging and storage aids, would classify as noncombustible, (3) unpackaged bulk storage, such as grain, coal or similar commodities, (4) special hazard commodities such as tires, plastics, roll paper, flammable liquids, and wax-coated cartons, and other commodities covered by other NFPA standards.

NOTE: See list of Standards in Appendix B.

(d) The provisions contained in this standard apply to new buildings, and when converting existing buildings to warehouse occupancy. They should be used as a basis for evaluating or improving arrangements, safeguards and protection at existing storage facilities or when converting existing buildings to warehouse occupancy.

2. Definitions.

AVAILABLE HEIGHT FOR STORAGE. The maximum height at which commodities can be stored above the floor and still maintain adequate clearance from structural members and the required clearance below sprinklers.

NONCOMBUSTIBLE. This term designates commodities, packaging or storage aids which will not ignite, burn or liberate flammable gases when heated to a temperature of 1,380 degrees Fahrenheit for five minutes.

PACKAGING. This term designates any commodity wrapping, cushioning or container.

PALLETIZED STORAGE. Storage of commodities on pallets or other storage aids that form horizontal spaces between tiers of storage.

SOLID PILE STORAGE. Storage of commodities in piles without horizontal spaces.

STORAGE AIDS. This term designates commodity storage devices, such as pallets, dunnage, separators and skids.

CHAPTER 1. CLASSIFICATION OF STORAGE

11. Commodity Classification.

111. Class I commodities are defined as noncombustible products on wood pallets, or in ordinary paper cartons or wrapping with wood or noncombustible pallets or without pallets, such as metal parts, empty cans, noncombustible food stuffs or beverages, stoves, washers, dryers and metal cabinets. Such commodities may have a negligible amount of plastic trim, such as knobs or handles.

112. Class II commodities are defined as Class I products in slatted wooden crates or solid wooden boxes, with wood or noncombustible pallets or without pallets.

113. Class III commodities are defined as wood, paper, natural fiber cloth, or products thereof, containing no more than a negligible amount of plastics in the products or in the packaging material, with wood or noncombustible pallets or without pallets, such as natural fiber clothing or textile products, wooden cabinets, furniture or wood products, bicycles, luggage (except plastic); combustible foods or cereal products, paper products, and leather goods. Bicycles with plastic handles, pedals, seats, and tires, are an example of a commodity with no more than a negligible amount of plastic.

114. Class IV commodities are defined as Class I, II, and/or III containing more than a relatively negligible amount of plastics used in the product or packaging material, with wood or noncombustible pallets or without pallets, such as small appliances with plastic parts, typewriters, cameras or electronic parts in plastic packaging and cartons, plastic back tapes, and synthetic fabrics or clothing.

CHAPTER 2. BUILDING CONSTRUCTION

21. Construction.

211. Buildings used for solid pile or palletized storage of materials, which are protected in accordance with this standard, may be of any of the types described in Standard Types of Building Construction, NFPA No. 220.

22. Emergency Smoke and Heat Venting. (See A221.)

221. Protection outlined in this standard applies to buildings with or without roof vents and draft curtains.

CHAPTER 3. STORAGE ARRANGEMENT

31. Piling Procedures and Precautions.

311. Any commodities which may be hazardous in combination with each other shall be stored so they cannot come in contact with each other.

312. Safe floor loads shall not be exceeded. For water absorbent commodities, normal floor loads shall be reduced to take into account the added weight of water which can be absorbed during fire fighting operations.

32. Commodity Clearance.

321. The clearance between top of storage and sprinkler deflectors shall conform to NFPA No. 13, Installation of Sprinkler Systems.

322. If the commodity is stored above the lower chord of roof trusses, at least 1-foot clear space shall be maintained to permit wetting of the truss unless the truss is protected with one-hour fireproofing.

323. Commodity clearances shall be maintained in accordance with the following NFPA Standards.

Heat Producing Appliances — NFPA No. 89M
Blower & Exhaust Systems — NFPA No. 91

324. At least 1-foot clearance shall be maintained between commodities and lights or light fixtures to prevent breakage.

33. Aisles.

331. Wall aisles shall be at least 24 inches wide in warehouses used for the storage of commodities which expand with the absorption of water.

34. Storage of Empty Wood Pallets.

341. Wood pallets shall not be stored in excess of six (6) feet high except in areas meeting the protection requirements of Table 341.

TABLE 341

Height of Wood Pallet Storage	Sprinkler Density Requirements (GPM-Min-Sq. Ft.)	Area of Sprinkler Operation (sq. ft.) 286°	165°
Up to 6′	.20	2,000	3,000
6′ to 8′	.30	2,500	4,000
8′ to 12′	.60	3,500	6,000
12′ to 20′	.60	4,500	—

342. In buildings with exposed steel roof structures where wood pallets are stored in excess of eight (8) feet in height, maximum sprinkler spacing shall not exceed 50 square feet per sprinkler with ½″ orifice and 70 square feet per sprinkler with $^{17}/_{32}$″ orifice in order to provide protection for roof steel.

CHAPTER 4. FIRE PROTECTION

41. Automatic Sprinkler Systems.

411. Sprinkler systems installed in buildings used for solid pile or palletized storage shall be in accordance with the Standard for Installation of Sprinkler Systems, NFPA No. 13, except as modified by this chapter.

412. Sprinkler design criteria for solid pile storage over 15 feet high and palletized storage over 12 feet high shall be in accordance with Figure 412. The density provided for the area of application may be selected from any point on the curve applicable to the commodity, classification and arrangement of the stored commodities. It is not necessary to meet more than one point on the selected curve.

413. Sprinkler system design density shall not be less than .15 GPM/Sq. Ft. for any commodity class.

414. Where palletized or solid pile storage is placed on top of racks, the provisions of NFPA No. 231C, Rack Storage of Materials, shall apply to the entire height of storage with regard to sprinkler requirements and water supplies for ceiling and rack sprinklers.

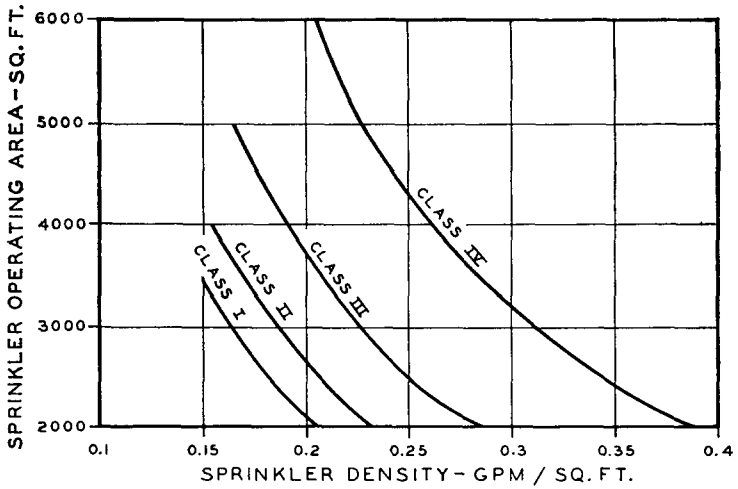

Fig. 412. Sprinkler System Design Curves

20 ft. High Storage— 165° Sprinklers. For 286° Sprinklers, reduce Sprinkler Operating Area 40%, but to not less than 2,000 sq. ft.

415. In warehouses that have portions containing rack storage and other portions containing palletized or solid pile storage, the standard applicable to the storage configuration shall apply.

42. Water Supplies.

421. Sprinkler water demand for solid pile storage over 15 feet high and palletized storage over 12 feet high shall be in accordance with Figure 412.

422. Where storage height is less than 25 feet high, but more than 15 feet high in solid piles and 12 feet high if palletized, ceiling densities indicated in the design curves, based on 20 foot nominal storage height, shall be modified in accordance with Figure 422. The minimum operating pressure at any sprinkler in the design area shall be 7 p.s.i.

423. Where dry pipe systems are used, the areas of operation indicated in the design curves shall be increased by 30 percent. Densities shall be selected so that areas of operation, after the 30 percent increase, do not exceed the upper area limits given in the design curves.

424. For large and small hose stream demand, at least 500 GPM shall be added to the sprinkler demand for Class I, II and III commodities and at least 750 GPM shall be added for Class IV commodities.

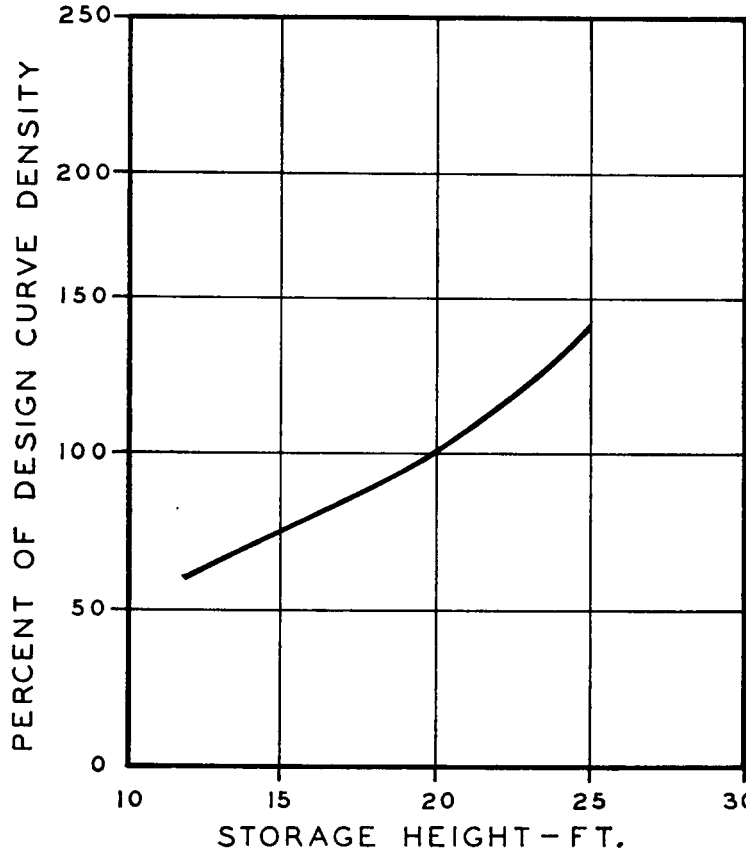

Figure 422

425. Water supply duration shall be at least 90 minutes for Class I, II and III commodities and at least 2 hours for Class IV commodities.

43. Manual Inside Protection.

431. Portable Fire Extinguishers.

4311. Portable fire extinguishers shall be provided in accordance with NFPA No. 10, Standard for the Installation of Portable Fire Extinguishers. In locations where small (1½ inch) hose is provided, portable fire extinguishers for Class A fires may be omitted.

432. Small Hose Systems.

4321. Small hose lines (1½ inch) shall be available to reach all portions of the storage area. Such small hose may be supplied from:

(a) Outside hydrants.

(b) A separate piping system for small hose stations.

(c) Valved hose connections on sprinkler risers where such connections are made upstream of sprinkler control valves.

(d) Adjacent sprinkler systems.

44. Hydrants.

441. At locations without public hydrants, or where hydrants are not within 250 feet, private hydrants shall be installed in accordance with Standard for Outside Protection, NFPA No. 24.

45. Fire Organization.

451. Arrangements shall be made to permit rapid entry into the premises by the municipal fire department, police department, or other authorized personnel in case of fire or other emergency.

452. Plant emergency organizations where provided shall be instructed and trained in the following procedures:

(a) Maintaining the security of the premises.

(b) Means of summoning outside aid immediately, in an emergency.

(c) Use of hand extinguishers and hose lines on small fires and mop-up operations.

(d) Operation of sprinkler system and water supply equipment.

(e) Use of material handling equipment while sprinklers are still operating to effect final extinguishment.

(f) Supervision of sprinkler valves after system is turned off so that system can be reactivated if rekindling occurs.

Information on emergency organization is given in the following publications:

Recommendations for Organization of Industrial Fire Loss Prevention — NFPA No. 6.

Recommendations for Management Control of Fire Emergencies — NFPA No. 7.

Suggestions for the Organization, Training and Equipment of Private Fire Brigades — NFPA No. 27.

Recommended Practice on Salvaging Operations — NFPA No. 604.

453. A fire watch shall be maintained when the sprinkler system is not in service.

46. Alarm Service.

461. Central station, auxiliary, remote station, or proprietary sprinkler waterflow alarm shall be provided. Local waterflow alarm is acceptable where standard recorded guard service is provided. (See NFPA Nos. 71, 72A, 72B, 72C and 72D.)

CHAPTER 5. EQUIPMENT

51. Mechanical Handling Equipment.

511. Industrial Trucks.

5111. Power operated industrial trucks shall comply with NFPA 505, Standard for Type Designations, Areas of Use, Maintenance and Operation of Powered Industrial Trucks.

5112. Industrial trucks using gas or liquid fuel shall be refueled outside of the storage building at a location designated for that purpose.

52. Building Service Equipment.

521. Electrical equipment shall be installed in accordance with the provisions of the National Electrical Code, NFPA No. 70.

522. Heating, air-conditioning, lighting and other service equipment, should be installed in accordance with applicable NFPA Codes, Standards, Recommended Practices, and Manuals.

523. Refrigeration systems, if used, shall conform to the recommendations of Safety Code for Mechanical Refrigeration,* ASHRAE 15-63, ANSI B9.1-1964.

CHAPTER 6. BUILDING MAINTENANCE AND OPERATIONS

61. Building Operations Other Than Storage.

611. The use of welding, cutting, soldering, or brazing torches in the storage areas introduces a severe fire hazard. The use of mechanical fastenings and mechanical saws or cutting wheels is recommended. When welding or cutting operations are absolutely necessary, the precautions contained in NFPA No. 51B, Cutting and Welding Processes, shall be followed.

612. Welding, soldering, brazing, and cutting may be performed on rack or building components which cannot be removed, provided no storage is located below and within 25 feet of the working area, and flameproof tarpaulins enclose this section. During any of these operations the sprinkler system shall be in service. Extinguishers suitable for Class A fires with a minimum rating of 2A and charged inside hose lines shall be located in the working area. A fire watch shall be maintained during these operations and for at least 30 minutes additional.

613. Fumigation operations shall comply with the Fumigation Standard, NFPA No. 57.

62. Waste Disposal.

621. Approved type containers for rubbish and other waste materials shall be provided as required. Containers shall be emptied and contents removed from the premises or otherwise safely disposed of at frequent intervals. (See Standard on Incinerators and Rubbish Handling, NFPA No. 82.)

*The Safety Code for Mechanical Refrigeration is published by the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 345 East 47th Street, New York, N.Y. 10017, and may also be purchased from American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

63. Smoking.

631. Smoking shall be strictly prohibited, except in locations prominently designated as smoking areas, and "No Smoking" signs shall be posted in prohibited areas.

64. Maintenance and Inspection.

641. Fire walls, fire doors, and floors shall be maintained in good repair at all times.

642. Periodic inspections should be made of all fire protection equipment in conjunction with regular inspection of the premises. Unsatisfactory conditions should be immediately reported and necessary corrective measures taken promptly. Employees assigned to inspection shall also check such features as general order and neatness, portable fire extinguishers, electrical equipment, industrial truck equipment, and other sources of hazard in the storage area.

643. The sprinkler system and the water supplies shall be checked and maintained in accordance with Care and Maintenance of Sprinkler Systems, NFPA No. 13A.

APPENDIX A

Provisions contained herein are for information only.

A21. Consideration should be given to subdividing large area warehouses in order to reduce the amount of merchandise that would be affected by a single fire.

A211. It is desirable to provide walls or partitions to separate the storage area from mercantile, manufacturing or other occupancies to prevent the possibility of transmission of fire or smoke between the two occupancies.

A221. Smoke removal is important to manual fire fighting and its associated materials handling. Fire fighters and plant emergency organizations should realize the great danger of locating fire by shutting off sprinklers once opened by heat from fire. Shutting off sprinklers to locate fire could cause a disaster. Venting, use of smoke masks, and removal of material are safer ways.

Provision may be made for removal of smoke from the building through one of the following methods:

(a) Manual or automatic roof vents, hatches, monitors, or peripheral eaveline windows.

(b) Access doors in exterior walls to allow introduction of fire department smoke ejection equipment.

(c) Mechanical exhaust systems.

A311. Where commodities of different commodity classifications are stored in the same building, the protection should be adequate for the most hazardous material. Proper protection may be also obtained by piling the more hazardous material only as high as can be properly protected by the sprinkler system. (See Section 42.) In certain cases, it may be desirable to provide walls or partitions to enclose the most hazardous material and design the sprinkler system in the enclosure to meet the requirements of Section 42.

A312. Commodities that are particularly susceptible to water damage should be stored on skids, dunnage, pallets, or elevated platforms in order to maintain at least 4 inches clearance from the floor.

A33. Main and cross aisles should be located opposite window or door openings in exterior walls. This is of particular importance in windowless buildings or where exterior openings are few.

A34. Idle Pallet Storage.

Idle pallet storage introduces a severe fire condition. Stacking idle pallets in piles is the best arrangement of combustibles to promote rapid spread of fire, heat release and complete combustion. After pallets are used for a short time in warehouses, they dry out and edges become frayed and splintered. In this condition, they are subject to easy ignition from a small ignition source. Again, high piling increases considerably both the challenge to sprinklers and the probability of involving a large number of pallets when fire occurs.

A fire in stacks of idle wooden pallets is one of the greatest challenges to sprinklers. The undersides of the boards of the pallets create a dry area on which a fire can grow and expand to other dry or partially wet areas. This process of jumping to other dry, closely located, parallel combustible surfaces continues until the fire bursts through the top of the stack. Once this happens, very little water is able to reach the base of the fire. The only practical method of stopping a fire in a large concentration of pallets with ceiling sprinklers, is a great amount of prewetting. In high stacks, this cannot be done without abnormally high water supplies.

A412. As an example of the use of curves, Fig. 412, a warehouse containing cereal storage on pallets 20- high would be a Class III commodity. Using the Class III curve in Fig. 412.- any point on the curve can be selected. If 165° heads are to be used on a wet pipe system, the sprinkler system could be designed to provide a density of .25 gpm over an area of 2500 square feet. This requires a water supply of 625 gpm at the proper pressure to supply the area and density selected. To this water supply must be added the quantity required for hose streams in Section 424. Total water supply would then be 1125 gpm for a duration of at least 90 minutes.

A42. Recommended water supplies contemplate successful sprinklers operation. Because of the small but still significant number of uncontrolled fires in sprinklered properties because of various reasons there should be an adequate water supply available for Fire Department use.

A423. Wet systems are recommended for storage warehouses except where it is impractical to provide heat. If a dry system is to be used in the previous example, a density of .25 can still be used but the area of application must be increased to 3,250 sq. ft. This means the water supply for sprinklers should be 812 gpm.

A441. At windowless warehouses and where windows are scant, hydrants should be located at or in the vicinity of entrances.