

# NFPA 82

## Standard on Incinerators and Waste and Linen Handling Systems and Equipment 1994 Edition



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The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

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## **NFPA 82**

### **Standard on**

## **Incinerators and Waste and Linen Handling**

## **Systems and Equipment**

### **1994 Edition**

This edition of NFPA 82, *Standard on Incinerators and Waste and Linen Handling Systems and Equipment*, was prepared by the Technical Committee on Incinerators and Waste Handling Systems and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 15-18, 1993, in Phoenix, AZ. It was issued by the Standards Council on January 14, 1994, with an effective date of February 11, 1994, and supersedes all previous editions.

The 1994 edition of this document has been approved by the American National Standards Institute.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

### **Origin and Development of NFPA 82**

This standard was first adopted by the NFPA in 1948 on recommendation of the Committee on Field Practice. In 1953, a completely revised edition of the text on incinerators was prepared by a representative subcommittee and adopted by the NFPA on recommendation of the Committee on Building Construction. Responsibility for the subject of incinerators was turned over to the Committee on Chimneys and Heating Equipment in 1956. Revised editions were adopted in 1955, 1958, 1960, 1969, 1970, 1971, and 1972. The original 1948 text covered both rubbish handling and incinerators; the 1953, 1955, 1958, and 1960 revisions covered only incinerators. In the 1960 edition, incinerators and rubbish handling were covered by separate standards, NFPA 82, *Standard on Incinerators*, and NFPA 82A, *Standard for Rubbish Handling*, respectively, with NFPA 82A on rubbish handling remaining unchanged from the 1948 edition. In the 1969 edition, the subject of rubbish handling was included with incinerators, and NFPA 82A was discontinued as a separate standard. The 1977 edition was expanded to include linen handling systems, and the 1983 edition represented a partial revision, which was mainly editorial.

The 1990 edition contained minor revisions to Chapters 1 and 2, including a minor change to the Scope section. Chapters 3 and 4 were completely revised, and a new Appendix A was added to provide technical information to facilitate the selection of chimney materials for handling saturated and corrosive gases. The entire section on domestic incinerators was deleted from the 1990 edition.

Chapters 3 and 4 have been combined into one chapter (new Chapter 3) in the 1994 edition. Limited-combustible construction has been recognized by a new definition and by a new exception that allows limited-combustible construction for a gravity chute enclosure where a building is protected throughout by a supervised automatic sprinkler system. Also, new Chapters 4 and 7 have been added to address waste handling systems other than chute systems and waste processing equipment other than compactors.

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

NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

**Committee Scope:** This Committee shall have primary responsibility for documents on the fire-safe installation and use of incinerators, compactors, converters, other waste handling systems and laundry (linen) handling systems.

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NOTICE: An asterisk (\*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A.

Information on referenced publications can be found in Chapter 8 and Appendix B.

## Chapter 1 General

### 1-1 Scope.

**1-1.1** This standard covers requirements primarily concerned with reducing the fire hazards encompassing the installation and use of waste storage rooms, containers, handling systems, incinerators, and compactors. It also is concerned with linen and laundry handling systems.

**1-1.2** This standard does not include design criteria for the purpose of reducing air pollution. For such criteria, consult the authorities having jurisdiction.

### 1-2 Definitions.

NOTE: Other definitions relating to this standard are contained in NFPA 97, *Standard Glossary of Terms Relating to Chimneys, Vents, and Heat-Producing Appliances*.

**Approved.** Acceptable to the authority having jurisdiction.

NOTE: The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations that is in a position to determine compliance with appropriate standards for the current production of listed items.

**Authority Having Jurisdiction.** The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the

property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

**Chute Offset.** For the purpose of this standard, a single chute offset from plumb shall include a return of the chute to plumb.

**Combustible.** Material subject to increase in combustibility or flame spread rating beyond the limits established in the definition of Limited-Combustible.

**Labeled.** Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**Limited-Combustible.\*** As applied to a building construction material, other than interior finish, means a material not complying with the definition of noncombustible material that, in the form in which it is used, has a potential heat value not exceeding 3500 Btu/lb ( $8.14 \text{ m} \times 10^6 \text{ J/kg}$ ) and complies with one of the following paragraphs, (a) or (b).

(a) Materials having a structural base of noncombustible material with a surfacing not exceeding a thickness of  $\frac{1}{8}$  in. (0.3 cm) that has a flame spread rating not greater than 50.

(b) Materials, in the form and thickness used, other than as described in (a), having neither a flame spread rating greater than 25 nor evidence of continued progressive combustion, and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame spread rating greater than 25 nor evidence of continued progressive combustion.

Materials subject to increase in combustibility or flame spread rating beyond the limits herein established through the effects of age, moisture, or other atmospheric condition shall be considered combustible.

**Listed.** Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

**Noncombustible.** A material that, in the form in which it is used and under the conditions anticipated, will not aid combustion or add appreciable heat to an ambient fire. Materials, where tested in accordance with ASTM E136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, and conforming to the criteria contained in Section 7 of the referenced standard shall be considered as noncombustible.

**Shall.** Indicates a mandatory requirement.

### 1-3 Application of Standard.

**1-3.1** This standard shall be applied to new construction and new equipment, as determined by the authority having jurisdiction.

**1-3.2** This standard shall not require the alteration or replacement of existing construction or equipment currently in use, provided that the owner establishes appropriate administrative, maintenance, and training programs that provide equivalent safety.

**1-3.3** It is recognized that there are many different incineration technologies and designs. There also is a wide variation in the types of waste that can be incinerated, including solids, liquids, sludges, and fumes. This standard is not intended to cover or include all of the design and construction details for each incineration technology and application. However, all design, construction, control, and other features needed to reduce or minimize fire hazards shall be required for all new incineration facilities to satisfy the authority having jurisdiction.

**1-3.4** It is recognized that there are many different types of systems, equipment, and components utilized for handling or transporting waste. This standard is not intended to cover or include all of the design and construction details for each waste handling system and application. However, all design, construction, control, and other features needed to reduce or minimize fire hazards shall be required for such systems to satisfy the authority having jurisdiction and to comply with other applicable standards.

**1-3.5** Nothing in this standard is intended to prevent the use of new methods or devices, provided that sufficient technical data is submitted to the authority having jurisdiction to demonstrate that the proposed method or device is equivalent in quality, strength, fire endurance, effectiveness, durability, and safety to that prescribed by this standard.

## Chapter 2 Incinerators

### 2-1 General.

**2-1.1 Provision for Auxiliary Fuel.** Gas-burning installations shall be in accordance with the applicable provisions of NFPA 54, *National Fuel Gas Code*, and NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*. Oil-burning installations shall comply with NFPA 31, *Standard for the Installation of Oil-Burning Equipment*. Fuel burners of all incinerators shall be equipped with safety controls that will automatically shut off the fuel supply to the burner in the event the burner fails to ignite or its flame becomes extinguished or in the event of insufficient draft.

**2-1.2 Electrical Supply.** The electrical supply to an incinerator shall be installed in accordance with NFPA 70, *National Electrical Code®*.

### 2-1.3 Air for Combustion and Ventilation.

**2-1.3.1** Provision shall be made for an adequate supply of air for combustion and ventilation to enter the room in which an incinerator is located. Fans shall be permitted to be installed to deliver air to the incinerator room, provided they are in operation whenever the incinerator is in use.

**2-1.3.2** Rooms in which incinerators are installed shall be furnished air for combustion and ventilation by one of the following means:

(a) A screened or louvered ventilator opening or other suitable air intake; if communicating to other parts of the building, the opening shall be protected by an approved fire damper;

(b) A duct leading from the incinerator room to the outdoors;

(c) A duct leading to a boiler or furnace room cut off as prescribed in 2-2.7 and provided with sufficient air supply for both rooms.

**2-1.3.3** The opening or duct specified in 2-1.3.2 shall be sized so as to provide all air requirements, including those for waste combustion, auxiliary fuel combustion, room temperature control, and general area ventilation, where applicable.

**2-1.3.4** Air ducts extending to or from an incinerator room through other parts of a building shall be constructed and installed in accordance with NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*.

### 2-1.4 Spark Arresters.

**2-1.4.1** Spark arresters shall be installed on incinerator stacks:

*Exception No. 1: Where a wet scrubber or other emission control system or component is installed between the incinerator and stack such that fly ash cannot pass directly from the incinerator to the stack.*

*Exception No. 2: Where other acceptable design and control features are in place that prevent the entrainment of fly ash from the incinerator to the stack under all operating conditions.*

*Exception No. 3: Where the nature of the waste being incinerated will not result in fly ash emissions.*

**2-1.4.2** The net free area of the arrester shall be not less than four times the net free area of the outlet of the chimney flue it serves.

**2-1.4.3** Arresters shall have a vertical height of not less than 1.3 times the minimum diameter of the chimney flue or the minimum horizontal dimension of a rectangular chimney flue.

**2-1.4.4** Arresters, including bolts, rivets, screws, and supporting members, shall be made of heat- and corrosion-resistant materials.

**2-1.4.5** Openings shall not permit the passage of spheres having a diameter larger than 1/2 in. (13.7 mm) nor block the passage of spheres having a diameter of less than 3/8 in. (9.5 mm).

**2-1.4.6** Means shall be provided for securely attaching the spark arresters to chimneys to provide adequate support and prevent movement of the arrester.

**2-1.4.7** Spark screens shall be replaceable.

### 2-2 Commercial-Institutional Incinerators.

**2-2.1 Definition.** A commercial-institutional incinerator as used in this section refers to an incinerator predominantly designed for burning solid waste. The most

applicable systems under this definition include, but are not limited to, controlled air, rotary kiln, and multiple chamber-type incineration systems.

## 2-2.2 Design and Construction.

**2-2.2.1** The design and construction of the incinerator and all associated components shall be such that, in service, they will not crack, warp, or otherwise fail structurally so as to permit flame passage or emission of combustion gases or sparks into the building.

**2-2.2.2** Explosion relief shall be provided. The area of explosion relief shall be not less than 1 ft<sup>2</sup> (0.09 m<sup>2</sup>) of relief area for every 100 ft<sup>3</sup> (3 m<sup>3</sup>) of primary combustion chamber volume. Where the exhaust chimney will not serve the above purpose, a door or panel shall be provided and arranged to allow the door or panel to return to a closed position promptly after pressure has been released.

**2-2.2.2.1** Exhaust stack areas that typically are closed off with valving or stack caps for directing combustion-gas effluent to other process equipment, such as heat recovery boilers, cleanup equipment, or similar installations, shall not be used in the calculation of the explosion venting area specified in 2-2.2.2.

**2-2.2.2.2** Systems equipped with wet ash-type removal modules wherein a water seal exists between the outside and the incinerator chamber atmosphere and where this water seal does not exceed the equivalent of 6 in. water column (1.49 kPa) and, furthermore, where the interconnecting passageway between the internal ash port and external ash removal device is vertically oriented directly beneath the ash port without changes in direction shall be permitted to be considered to offer an explosion relief area for the minimum required area, based upon the following:

- (a) Internal dimensions of the ash port;
- (b) Smallest internal dimensions of the connecting and vertical passageway;
- (c) Normal projected area of the water surface interface.

**2-2.2.2.3** Wet ash systems wherein ash is expelled by mechanical devices necessitating a normal change in direction of ash flow, i.e., from vertical to horizontal, shall not be considered to provide an effective explosion relief area.

**2-2.2.2.4** All explosion relief devices shall be so oriented on the incinerator chamber so as not to be closer than 90 degrees in side elevation or plan view to the normal operator position.

**2-2.2.2.5** All explosion relief devices shall be placed in areas generally inaccessible to normal personnel activities and shall be properly guarded and posted with safety signs on all sides indicating the potential safety hazard of the vent area.

**2-2.2.3** Commercial-institutional incinerators shall be built in accordance with the following requirements:

(a) All combustion shall take place within the combustion chamber designed for combustion temperatures. Combustion shall not take place in breeching or chimneys unless they are designed as combustion chambers.

(b) Incinerators designed for positive pressures shall be gastight.

(c) The combustion chamber, inner walls, roofs, bridges, walls, and curtain walls shall be so constructed as to withstand the combustion temperatures involved and shall maintain their integrity under all operating conditions. Metal stays, lintels, or other supports shall not be exposed to the interior of the combustion chamber.

(d) An exterior masonry casing shall be reinforced with structural steel framework, and an exterior steel casing shall be reinforced with structural steel members such that the casing will withstand interior thrusts from arches and shall be capable of supporting all doors and burner equipment. The steel casing or framework shall be erected and set plumb before any brickwork is done. Cylindrical outer casings made of steel not less than 1/4 in. (6.4 mm) thick shall not be required to be reinforced. All incinerator structures shall be designed to comply with applicable building codes and shall give consideration to the most adverse condition of seismic, wind, dead, live, moving, concentrated, erection, and thermal loadings, corrosion allowance, or combinations thereof.

(e) Openings shall be provided so that all parts of the incinerator can be cleaned, including the ash pit, the combustion chamber, the passes of separation chambers, and the incinerator flue. Cleanouts shall be closed by tight-fitting doors or covers, securely latched or otherwise held in a closed position. Ash pit and combustion chamber closures and frames shall be of cast iron or equivalent, with the frames securely attached to the incinerator.

**2-2.2.4** No part of an incinerator shall be used as a wall, roof, or floor of a building.

**2-2.2.5** Incinerators shall be designed with internal insulation or refractory or shall be otherwise protected by location, guard rails, or shields such that all areas or surfaces normally accessible to personnel shall not exceed 160°F (71.1°C). External insulation over incinerator shells shall not be utilized in achieving this specified temperature, since severe thermal damage could result. Handles of operating doors shall not exceed a 40°F (4.4°C) rise for metallic and a 60°F (15.6°C) rise for nonmetallic.

**2-2.3 Placement.** Commercial-institutional incinerators shall be placed on properly designed foundations of masonry or reinforced concrete or on noncombustible material having a fire resistance rating of not less than 3 hours, provided such support is independent of the building construction and the load is transferred to the ground.

**2-2.3.1** All incinerator combustion chambers shall be elevated above concrete bearing surfaces through the use of pedestals, cradles, skids, or other means to provide a minimum of 4 in. (101.6 mm) clear air circulation space between the concrete bearing surface and the closest surface of the underside of the combustion chamber. Where this elevation is not practical, as in the case of large field-erected incinerators, other equivalent means shall be provided through the use of increased insulation, natural or forced circulation, or other methods acceptable to the authority having jurisdiction to protect the concrete bearing surfaces from thermal damage adequately.

## 2-2.4 Clearances.

**2-2.4.1** Commercial-institutional incinerators shall be installed to provide a clearance to combustible material of



not less than 36 in. (914 mm) at the sides and rear, not less than 48 in. (1220 mm) above, and not less than 8 ft (2.4 m) at the front of the incinerator.

*Exception:* For a commercial-institutional incinerator encased in brick, the clearance shall be permitted to be 36 in. (914 mm) above and 18 in. (457 mm) at the sides and rear.

**2-2.4.2** A clearance of not less than 12 in. (305 mm) shall be provided from the incinerator to the walls or ceilings of noncombustible construction.

*Exception:* A clearance of not less than 3 in. (76.2 mm) shall be permitted to be provided from commercial and industrial incinerators to walls or ceilings of noncombustible construction where it is not possible to place combustible material on the outer or upper side thereof.

**2-2.4.3** Incinerators that are listed specifically for installation at lesser clearances than specified in 2-2.4.1 and 2-2.4.2 shall be installed in accordance with the conditions of such listing, provided that, in any case, the clearances shall be sufficient to afford accessibility for firing, clean-out, and any necessary servicing as set forth in 2-2.4.4.

**2-2.4.4** Sufficient space shall be provided around the incinerator and its appurtenances to facilitate cleaning, repair, and servicing. Clearance shall be provided to allow the cleanout doors to be opened completely so that all parts of the combustion chamber, ash pit, separation chambers, etc., can be reached and so that implements used for this purpose can be freely manipulated. All dampers, gates, burners, valves, levers, etc., shall be accessible for repair and adjustment or replacement. No construction shall be located closer than 16 in. (406 mm) to any part of an incinerator.

*Exception:* Noncombustible structural members 2 ft (610 mm) wide or less, parallel to the incinerator, shall be permitted to be located as close as 6 in. (152 mm) to the incinerator, provided such members do not reduce accessibility to any moving parts of the incinerator.

## **2-2.5 Incinerator Charging.**

**2-2.5.1** A waste charging system and appropriate controls shall be provided that will prevent the direct discharge of flames, combustion gases, and heat from the incinerator during waste loading operations. This shall include a hopper/ram type mechanical loader or other approved system.

*Exception:* Incinerators that are loaded on a batch basis, during which the charging door is not open while waste combustion is taking place, shall not be required to have a mechanical charging system.

**2-2.5.2** The combustion chamber of a commercial-institutional-type incinerator shall not be charged through the floor immediately above such incinerator unless the charging chute is designed with dampering and controls that would prevent the direct passage of combustion products and radiant heat through the chute into the charging room.

**2-2.5.3** The charging hood and chute shall be constructed of not less than 12 U.S. gauge steel casing and shall be lined with not less than 4½ in. (114 mm) of fire-brick (ASTM C27 Type F, medium duty, or the equivalent). This charging hopper shall not exceed 6 ft (1.8 m) in

length, measured from the floor opening to the outside of the roof of the incinerator combustion chamber.

*Exception:* The charging hood and chute shall be permitted to exceed 6 ft (1.8 m) in length if approved means are provided to prevent the charging hood and chute from discharging gases resulting from combustion into the charging room.

**2-2.5.4** The charging opening shall be protected by a cover extending beyond the edges of the opening for at least 2 in. (51 mm) on all sides and lined with not less than 2½ in. (63.5 mm) of refractory material.

**2-2.5.5** The charging floor opening shall be located in a room with walls and floor and ceiling assemblies having a fire resistance rating of not less than 2 hours, with openings protected by approved self-closing or automatic-closing 3-hour fire doors suitable for Class A openings. Such doors shall be kept closed during the charging operation and at other times, except when delivering waste material to the room.

*Exception:* Where the room is protected by an approved system of automatic sprinklers, the walls and floor and ceiling assemblies shall be permitted to have a fire resistance rating of not less than 1 hour, and the door shall be permitted to be a 1½-hour fire door approved for Class B openings.

**2-2.6 Incinerator Residue Removal.** A system and appropriate approved measures shall be provided to adequately quench or fully contain, or both, ash residues removed from the incinerator during clean-out operations. These shall include such features as water sprays, a wet quench pit, or a special containment enclosure to enable ash clean-out with minimal exposure to ambient conditions.

## **2-2.7 Incinerator Rooms for Commercial-Institutional Incinerators.**

**2-2.7.1** Commercial-institutional incinerators shall be enclosed within a room separated from other parts of the building by wall, partition, floor, and floor-ceiling assemblies constructed of noncombustible material and having a fire resistance rating of not less than 2 hours and used for no other purpose.

*Exception:* Storage containers of waste material to be burned and building heating equipment shall be permitted to be located in the incinerator room.

**2-2.7.2** Door or other openings in rooms containing incinerators communicating with other areas of the building shall be protected by approved self-closing or automatic-closing 1½-hour fire doors suitable for Class B openings.

**2-2.7.3** Automatic sprinklers shall be provided in incinerator rooms in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

## **2-2.8\* Chimneys for Commercial-Institutional Incinerators.**

### **2-2.8.1 General.**

**2-2.8.1.1** The chimney for an incinerator shall serve the incinerator only, unless the chimney construction is acceptable for incinerator gases and the controls are suitable for the incinerator and the other device being served. The

chimney shall be designed and proportioned to provide adequate draft for proper operation of the incinerator.

**2-2.8.1.2** Chimneys shall be supported on properly designed foundations of masonry or reinforced portland or refractory cement concrete. They shall be so constructed as not to place excessive stress upon the roof of the combustion chamber. If incinerator walls are to support the chimney, the foundation and walls shall be built to support the load imposed.

*Exception: Masonry chimneys shall be permitted to be supported on noncombustible material having a fire resistance rating of not less than 3 hours where such supports are independent of the building construction and the load is transferred to the ground.*

**2-2.8.1.3** A factory-built chimney, if so listed, and a metal chimney also shall be permitted to be supported at intervals by the building structure, in which case expansion joints shall be provided at each support level. All joints shall be liquidtight or of a design such that liquid will drain to the interior of the chimney.

**2-2.8.1.4** Clean-out openings provided in chimneys shall be equipped with ferrous metal doors and frames arranged to remain tightly closed when not in use. A clearance of not less than 36 in. (914 mm) shall be provided between clean-out doors and combustible material.

**2-2.8.1.5** Drains shall be provided at the base of all chimneys to allow the removal of condensed flue products and shall be designed to avoid clogging.

**2-2.8.1.6** Breechings shall be designed or otherwise protected in an approved manner, such as by guard rails or shields, to protect personnel from accidental contact with surfaces that exceed 160°F (71.1°C). External insulation shall not be used on hot breechings.

**2-2.8.2 Listed Medium-Heat Chimneys.** Listed medium-heat appliance chimneys shall be permitted to be used and shall be installed in accordance with the conditions of the listing and the manufacturer's instructions.

### 2-2.8.3 Metal Chimneys.

**2-2.8.3.1** Where secondary combustion temperatures do not exceed 1800°F (982°C), metal chimneys shall be lined with 4½ in. (114 mm) of high-duty, spall-resistant firebrick (ASTM C27) laid in high-duty refractory mortar (ASTM C199). The lining shall start at the base of the chimney and extend continuously to the top. Equivalent linings of equivalent thickness, such as Class A or better alumina-silica base castable refractories or Class O or better insulating castable refractories, shall be permitted to be used. Equivalent thickness shall be that thickness capable of providing the same insulating and structural values to limit skin temperatures to those specified in 2-2.2.5 under all intended operating conditions.

**2-2.8.3.2** Where secondary combustion temperatures exceed 1800°F (982°C), metal chimneys shall be lined with 4½ in. (114 mm) of super-duty, spall-resistant refractory brick (ASTM C27) laid in refractory mortar. The refractory mortar shall be high-duty for temperatures up to 2730°F (1500°C) and super-duty or better for temperatures up to 2910°F (1600°C). The lining shall start at the base of the chimney and extend continuously to the top. Equivalent

linings of equivalent thickness, such as Class B or better alumina-silica base castable refractories (ASTM C27) in accordance with temperature requirements or Class P and Class Q insulating castable refractories (ASTM C27) in accordance with temperature requirements, shall be permitted to be used. Equivalent thickness shall be that thickness capable of providing the same insulating and structural values to limit skin temperatures to those specified in 2-2.2.5 under all intended operating conditions.

**2-2.8.3.3** Castable plastic refractories, or other refractories, shall be permitted to be used in metal chimneys in lieu of firebrick, provided such refractory is of equivalent heat and corrosion resistance. Liners made of these refractories shall be supported by anchors made of corrosion-resistant steel capable of supporting the refractory load at 1500°F (727°C). The insulating value shall be such that temperatures at the supports shall not exceed this temperature under all firing conditions.

**2-2.8.3.4** Metal chimneys shall be properly riveted or welded, securely supported, and constructed in accordance with good engineering practice.

**2-2.8.3.5** Metal chimneys shall be constructed of steel or cast iron. Sheet steel shall have a thickness not less than that indicated in Table 2-2.8.3.5.

**2-2.8.3.6** Metal chimneys shall be properly riveted, welded, or bolted, securely supported, and constructed in accordance with good engineering practice as necessary for the following conditions:

- Strength to resist stresses due to steady or gusting wind loads;
- Adequate anchoring, bracing, and inherent strength to withstand seismic and wind-induced vibrational stresses;
- Proper material thickness for durability, considering fuel analysis, gas temperature, and exposure;
- Security against leakage of flue gases under positive pressure;
- Allowance for thermal expansion of breeching and vertical sections.

**2-2.8.3.7** If a metal chimney extends through any story of a building above that in which the connected incinerator is located, it shall be enclosed in such upper stories within continuous walls that are constructed of noncombustible materials, such as masonry (*see Section 1-2*), and that extend from the ceiling of the incinerator room to or through the roof so as to retain the integrity of the fire separations as required by applicable building code provisions. The walls shall have a fire resistance rating of not less than 1 hour if

**Table 2-2.8.3.5 Minimum Thickness of Sheet Steel Chimneys**

Mfg. Std. Gage No.	Min. Thickness in. (mm)	Area in. <sup>2</sup> /m <sup>2</sup>	Equiv. Round Diam. in./mm
16	0.054 (1.37)	up to 154/0.0994	up to 14/356
14	0.069 (1.75)	155/0.0999 to 201/0.1296	over 14/356 to 16/406
12	0.098 (2.49)	202/0.1303 to 254/0.1638	over 16/406 to 18/457
10	0.128 (3.25)	Larger than 254/0.1638	over 18/457

NOTE: Regardless of minimums in this table, the thickness of sheet metal shall be adequate to meet the requirements of 2-2.8.3.6.

the building is less than 4 stories in height, or not less than 2 hours if the building is 4 or more stories in height, and shall conform to the following:

(a) The enclosure shall provide a space on all sides of the chimney sufficient to permit inspection and repair, but in no case shall the space be less than 12 in. (305 mm).

(b) The enclosing walls shall be without openings.

*Exception: Doorways equipped with approved self-closing 1½-hour fire doors approved for Class B openings shall be permitted to be installed at various floor levels for inspection purposes.*

## 2-2.8.4 Masonry Chimneys.

**2-2.8.4.1** Where secondary combustion temperatures do not exceed 1800°F (982°C), masonry chimneys shall be constructed of solid masonry units or reinforced concrete with walls not less than 8 in. (203 mm) thick. Such walls shall be lined with 4½-in. (114-mm) high-duty, spall-resistant firebrick (ASTM C27) laid in high-duty refractory mortar (ASTM C199). The lining shall start at the base of the chimney and extend continuously to the top.

**2-2.8.4.2** Where secondary combustion temperatures exceed 1800°F (982°C), masonry chimneys shall be constructed with double walls of solid masonry units or reinforced concrete. Each wall shall not be less than 8 in. (203 mm) thick with an air space of not less than 2 in. (51 mm) between them. The inside of the interior wall shall be lined with 4½-in. (114-mm) super-duty, spall-resistant firebrick laid in super-duty refractory mortar (ASTM C27). The lining shall start at the base of the chimney and extend continuously to the top.

**2-2.8.4.3** Masonry chimneys shall be proved airtight by a smoke test after erection and before being put into service.

## 2-2.9 Chimney Clearances.

**2-2.9.1** Listed chimneys shall be installed in accordance with the conditions of the manufacturer's instructions for clearances. Exposed portions of chimney or breechings that can be touched shall be so designed that maximum surface temperatures shall not exceed 70°F (39°C) above ambient temperature.

**2-2.9.2 Masonry Chimneys.** A clearance of not less than 4 in. (102 mm) shall be provided between the exterior surface of masonry chimneys and combustible material.

## 2-2.9.3 Exterior Metal Chimneys.

**2-2.9.3.1** Exterior metal chimneys shall have a clearance of not less than 24 in. (610 mm) from a wall of wood frame construction and from any combustible material.

**2-2.9.3.2** Exterior metal chimneys over 18 in. (457 mm) in diameter shall have a clearance of not less than 4 in. (102 mm), and those 18 in. (457 mm) or less in diameter shall have a clearance of not less than 2 in. (51 mm) from a building wall of other than wood frame construction.

**2-2.9.3.3** An exterior metal chimney shall be installed with a minimum clearance of 24 in. (610 mm) to any door or window or to any walkway, unless insulated or shielded in an approved manner to prevent a person from coming in contact with the chimney.

## 2-2.9.4 Interior Metal Chimneys.

**2-2.9.4.1** Within the same story of a building as that in which an incinerator is located, a metal chimney shall have a clearance of not less than 36 in. (914 mm) from a wall of wood frame construction and from any combustible material. Such interior metal chimneys over 18 in. (457 mm) in outside diameter shall have a clearance of not less than 4 in. (102 mm), and those 18 in. (457 mm) or less in outside diameter shall have a clearance of not less than 2 in. (51 mm) from a building wall of other than wood frame construction.

**2-2.9.4.2** If a metal chimney passes through a roof constructed of combustible material, it shall be guarded by a ventilating thimble of galvanized iron or approved corrosion-resistant metal, extending not less than 9 in. (229 mm) below and 9 in. (229 mm) above the roof construction, and shall be of a size to provide not less than 18 in. (457 mm) clearance on all sides of the chimney.

## 2-2.10 Low-Temperature Chimneys and Breeching.

Incinerator chimneys and breechings designed to handle saturated flue gases or flue gases with condensed acids shall be designed and constructed to be corrosion resistant and capable of handling aggressive flue acids under all operating conditions. Such materials can include fiberglass reinforced plastic (FRP), refractories, and mortars of special acid-resistant composition or specialized metals, such as Hastelloy or Inconel. See A-2-2.8 for further discussion.

## 2-2.11 Chimney Termination.

**2-2.11.1** Chimneys on incinerators where the secondary combustion chamber is designed to be operated at 1800°F (982°C) or less shall extend not less than 10 ft (3.1 m) higher than any portion of any building within 25 ft (7.5 m).

*Exception: Chimneys less than 10 ft (3.1 m) higher than other chimneys, vents, or open structural framing.*

**2-2.11.2** Chimneys on incinerators where the secondary combustion chamber is designed to be operated at over 1800°F (982°C) shall extend not less than 20 ft (6.2 m) higher than any portion of any building within 50 ft (15 m).

*Exception: Chimneys less than 10 ft (3.1 m) higher than other chimneys, vents, or open structural framing.*

**2-2.11.3** The terminus of the chimney flue for the incinerator shall be equipped with an approved spark arrester if the incinerator does not include effective means for arresting sparks and fly ash (see 2-1.4).

*Exception: Where the system complies with the conditions of 2-1.4.1.*

## 2-2.12 Chimney Connector or Breeching.

**2-2.12.1** A chimney connector or breeching connecting a commercial-institutional-type incinerator to a chimney shall be constructed of not lighter than 16 U.S. gauge steel if it is 12 in. (305 mm) or less in diameter or greatest cross-section dimension, and of not lighter than 12 U.S. gauge steel if it exceeds 12 in. (305 mm) in diameter or greatest cross-section dimension.

*Exception: Breechings that utilize listed medium-heat chimney sections, provided these sections are joined together with continuous welds, flanges, or couplings.*

**2-2.12.2** Chimney connectors or breeching up to 18 in. (457 mm) in diameter or greatest cross-section dimension shall be lined with not less than 2½-in. (63.5-mm) high-duty, spall-resistant refractory brick (ASTM C27).

**2-2.12.3** Chimney connectors or breeching over 18 in. (457 mm) in diameter or greatest cross-section dimension shall be lined with not less than 4½-in. (114-mm) of high-duty, spall-resistant refractory brick (ASTM C27).

**2-2.12.4** Castable plastic refractories, or other refractories, shall be permitted to be used in lieu of firebrick, provided such refractory is of equivalent heat and corrosion resistance. Liners made of these refractories shall be supported by anchors made of corrosion-resistant steel capable of supporting the refractory load at 1500°F (727°C). The insulating value shall be such that temperatures at the supports shall not exceed this temperature under all firing conditions.

**2-2.12.5** The net internal free area of the connector shall be not less than the free area of the flue collar of the incinerator.

**2-2.12.6** A chimney connector shall not be enclosed. The connector shall be readily accessible for inspection and replacement throughout its entire length.

**2-2.12.7** Chimney connectors or breechings of all commercial-institutional-type incinerators, including those of special design to produce low flue-gas temperatures, shall conform with 2-2.12.

NOTE: This requirement has been initiated to avoid the serious corrosion problems inherent with low-temperature incinerator flue gases. It also provides the high-temperature protection necessary when the special equipment is bypassed for any purpose, including power failure. In those cases where the bypass is such that the breeching also is bypassed, then the breeching need not be high-temperature protected, but it should be protected by an acid-resistant coating suitable for the operating conditions.

**2-2.12.8** If a gas washer or scrubber is used, or if other arrangements are such that the natural draft is insufficient for proper operation of the incinerator, a draft inducer shall be permitted to be used. In this event, the chimney shall be sized for natural-draft operation and a bypass installed around the gas washer or scrubber or other unit that requires the draft induction. Suitable, normally open dampers shall be installed in the bypass to allow venting of combustion products in the event of power failure.

**2-2.12.9** Expansion joints shall be provided as required.

**2-3 Outdoor Incinerators.** All outdoor incinerators shall conform with Chapters 2 and 3, depending upon use.

## Chapter 3 Waste and Linen Chutes and Transport Systems

**3-1 Definitions.** The three types of systems approved to handle waste and linen, each with separate fire safety criteria, are defined in 3-1.1 through 3-1.3.

**3-1.1 Gravity Waste or Linen Chutes.** An enclosed vertical passageway (riser) in a building, used for transferring trash or linen by gravity to a room at the bottom or to an interface to a compactor. A gravity chute also can be used

to interface with a pneumatic transport system. Access of chute intake doors might or might not be limited to the use of keys.

### 3-1.2 Full Pneumatic Waste or Linen Conveying Systems.

A closed system consisting of loading stations with inner doors and a fire-rated, normally locked, outer (intake) door; normally closed air damper above the topmost loading station; transport piping, both vertical and horizontal; waste or linen collector; fan with a fan damper; and a central process controller.

### 3-1.3 Gravity Pneumatic Waste or Linen Conveying Systems.

A system using a combination of the gravity waste or linen chutes defined in 3-1.1 and a pneumatic conveying system that receives the material from the chute by gravity. This system consists of gravity chutes; a material damper to interface between the chute and the transport piping; the transport pipe; waste or linen collector; fan with fan damper; and a central process controller.

## 3-2 Gravity Waste or Linen Chutes.

**3-2.1 General.** General access gravity chutes shall be permitted to be supplied with unlocked doors and shall be permitted to be available to all occupants at all times. A trash or linen gravity chute shall be permitted to be installed as a limited access gravity chute by installing a key in either the chute intake door or the entry door into the service room. Limited access waste chutes shall be installed so that they can be used only by authorized personnel. A gravity waste or linen chute also shall be permitted to be used to interface with a pneumatic transport system.

### 3-2.2 Construction.

**3-2.2.1 Chute Supports.** A steel or steel jacketed refractory chute supported at intervals by the building structure shall be provided with expansion joints between support levels. Other chutes shall be supported on a substantial noncombustible foundation.

**3-2.2.2 Chute Offsets.** Gravity metal chutes shall be constructed straight and plumb where allowed by the building configuration. Gravity metal chutes shall be permitted to be offset a maximum of 15 degrees from plumb with the approval of the authority having jurisdiction. Offsets shall be limited to a maximum of one offset for every two floors. A single offset shall be completed (returned to vertical) between floors. No access door shall be less than 4 ft (1.2 m) above an offset. (See Figure 3-2.2.2.)

**3-2.2.3 Standard Diameter of Waste and Linen Gravity Chutes.** Standard waste or linen gravity chutes shall be a minimum of 24 in. (610 mm) in diameter.

**3-2.2.4 Chute Venting.** A waste or linen chute shall extend (full size) at least 4 ft (1.2 m) above the roof of the building. The chute shall be open to the atmosphere.

**3-2.2.5 Masonry Waste Chutes.** Masonry waste chutes shall be constructed of clay or shale brickwork not less than 8 in. (203 mm) thick or of reinforced concrete not less than 6 in. (152 mm) thick. Such chutes shall be lined with low-duty refractory brick (ASTM C27) not less than 4½ in. (114 mm) thick. Equivalent construction with walls providing 2-hour fire resistance rating with equivalent structural features shall be acceptable.

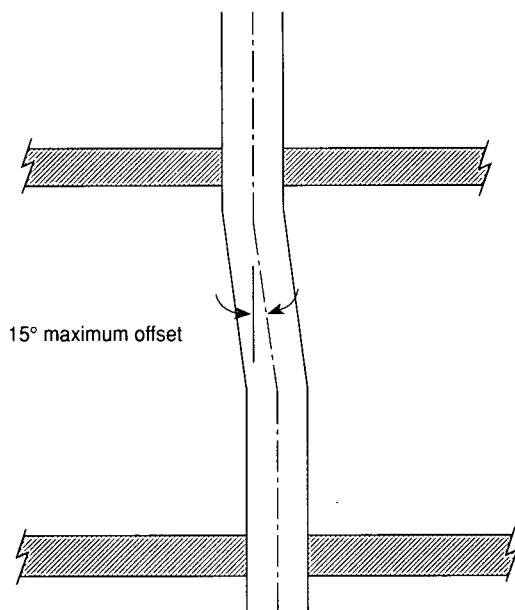


Figure 3-2.2.2 Gravity metal chute; maximum offset.

**3-2.2.6 Lined Metal Waste Chutes.** Metal waste chutes shall be permitted to be lined with low-duty refractory brick (ASTM C27) not less than  $2\frac{1}{2}$  in. (63.5 mm) thick or equivalent castable refractories. All unlined steel chutes shall be protected internally by automatic sprinklers. (See 3-2.5.1.)

**3-2.2.7 Chute Wall Thickness.** Metal waste or linen chutes shall be made of stainless steel, galvanized steel, or aluminum coated steel with no screws, rivets, or other projections on the interior surface of the chute. Laps or joints shall be designed so that the liquid will drain to the interior of the chute. The steel shall not be lighter than 16 U.S. gauge. Special waste chutes designed to handle dense or heavy material over  $10 \text{ lb/ft}^3$  ( $1500 \text{ kg/m}^3$ ) shall be made of steel not lighter than 14 U.S. gauge.

**3-2.2.8 Medium-Heat Chimneys.** Listed medium-heat appliance chimney sections shall be acceptable for use as trash chutes.

**3-2.2.9 Chute Discharge Doors.** Gravity chutes shall be constructed so that the base opening of the chute, or shaft, or both, shall be protected by an approved automatic-closing or self-closing 1-hour fire door suitable for a Class B opening.

**3-2.3 Chute Enclosure (Chase).** Vertical waste or linen chutes shall be enclosed in all stories above the storage or compacting room within a continuous enclosure constructed of noncombustible materials and extending from the ceiling of the storage or compacting room, to or through the roof, so as to retain the integrity of the fire separation. The walls of the enclosure, or the walls of the masonry chute, shall have a fire resistance rating of not less than 1 hour if the building is less than 4 stories in height and not less than 2 hours if the building is 4 or more stories in height.

*Exception No. 1: Masonry chutes conforming to 3-2.2.5, or those constructed of masonry walls having a fire resistance rating not less than specified in 3-2.3, shall not be required to be enclosed.*

*Exception No. 2: In buildings protected throughout by a supervised automatic sprinkler system, vertical chutes shall be permitted to be enclosed with limited-combustible materials.*

### 3-2.4 Service Openings.

**3-2.4.1 General Access Gravity Waste Chutes.** All service openings into a waste chute shall be provided with a self-closing, positive-latching, bottom-hinged, hopper-type frame and fire door assembly approved for Class B openings and having a fire resistance rating of not less than 1 hour. The door frame shall be fastened into the chute and the shaft wall. The design and installation shall be such that no part of the frame or door projects into the chute.

The area of each service opening shall be limited to one-third of the cross-sectional area of a square chute and 44 percent of the area of a round chute.

**3-2.4.2 Limited Access Gravity Chutes.** All service openings into a linen or waste chute shall be provided with a gasketed, self-closing, positive-latching frame and fire door assembly approved for Class B openings and having a rating of not less than 1 hour. The door frame shall be fastened into the chute and the shaft wall. The design and installation shall be such that no part of the frame or door projects into the chute. A key shall be required to open the door.

The area of each waste chute service opening shall be limited to two-thirds of the cross-sectional area of the chute. The area of each linen chute service opening shall not exceed the cross-sectional area of the chute.

**3-2.4.3 Service Openings Rooms.** Every service opening shall be in a room or compartment separated from other parts of the building by wall, partition, floor, and floor-ceiling assemblies having a fire resistance rating of not less than  $1\frac{1}{2}$  hours, with openings into such a room or compartment protected by approved self-closing fire doors suitable for class B openings.

**3-2.4.4 Service Opening Room Key.** If entrance to a limited access service opening is gained by key, the service opening door shall not require a key to be opened. One or the other shall be keyed. Keying shall be required only for limited access installations.

### 3-2.5 Chute Automatic Sprinklers.

**3-2.5.1 Gravity Chute.** Gravity chutes shall be protected internally by automatic sprinklers. This requires a sprinkler at or above the top service opening of the chute, and, in addition, a sprinkler shall be installed within the chute at alternate floor levels in buildings over two stories in height with a mandatory sprinkler located at the lowest service level. Sprinkler system installation shall comply with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

*Exception No. 1: Lined masonry chute that complies with 3-2.2.5.*

*Exception No. 2: Listed medium-heat chimney that complies with 3-2.2.8.*

*Exception No. 3: Lined metal chute that complies with 3-2.2.6.*

**3-2.5.2 Chute Sprinkler Head Protection.** Automatic sprinklers installed in gravity chute service openings shall be recessed out of the chute area through which the material travels.

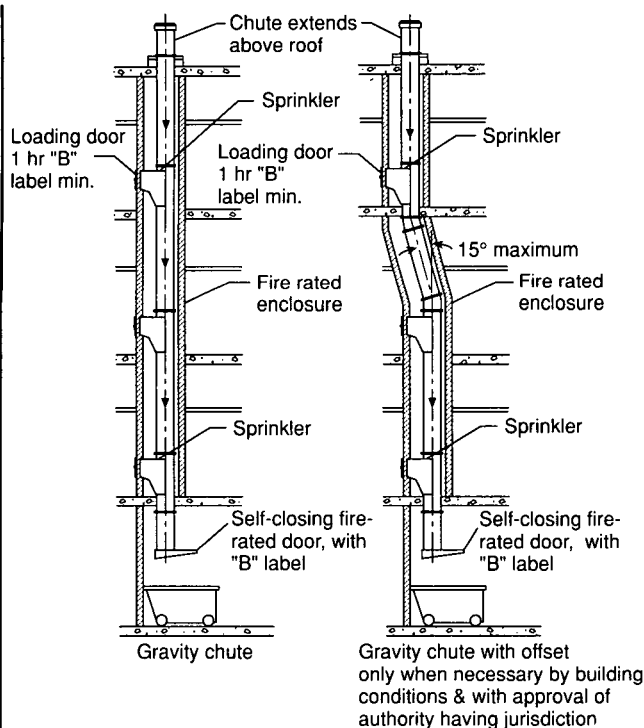


Figure 3-2.5.1 Gravity chute.

### 3-2.6 Chute Discharge Rooms.

**3-2.6.1 Chute Discharge Room Criteria.** Waste and linen chutes shall terminate or discharge directly into a room separated from other parts of the building by wall, partition, floor, and floor-ceiling assemblies having a minimum fire resistance rating not less than that specified for the chute. Openings to such rooms shall be protected by approved automatic-closing or self-closing 1½-hour fire doors suitable for Class B openings.

**3-2.6.2 Chute Room Automatic Sprinklers.** Automatic sprinklers shall be installed in chute terminal rooms.

**3-2.6.3 Chute to Incinerator Interface.** Trash gravity chutes shall not discharge directly into an incinerator.

### 3-3 Full Pneumatic Waste and Linen Conveying Systems.

**3-3.1 General.** A full pneumatic waste or linen transport system consists of full vacuum stations equipped with inner doors and a locked outer door; an air source at the top of the riser; an air inlet control damper; flanged riser piping; transport piping; collectors (receivers); and a fan and fan damper.

#### 3-3.2 Construction, Full Pneumatic Waste and Linen Systems.

**3-3.2.1 Full Pneumatic Waste or Linen Stations.** Full vacuum loading stations shall be a minimum of 20 in. (508 mm) in diameter, shall have an inner door that is under processor control, and shall not yield under system vacuum. The outer (loading) door shall be provided with a gasketed, self-closing, positive-latching fire door and frame assembly approved for Class B openings and shall have a fire resistance rating

of not less than 1½ hours. The door frame shall be fastened into the station and shall be flush with the rated shaft wall. Minimum outer door size shall be 18 in. × 18 in. (457.2 mm × 457.2 mm) and shall be side hinged. Full vacuum stations shall be constructed from a minimum of 14 gauge stainless or galvanized steel.

**3-3.2.2 Multi-bag Loading of Waste or Linen Systems.** During the multi-bag loading procedure, both the outer and inner doors shall be permitted to be open. Only one inner door shall be open at a time.

**3-3.2.3 Service Loading Rooms.** Every loading station door shall be in a room or compartment separated from other parts of the building by wall, partition, floor, and floor-ceiling assemblies having a fire resistance rating of not less than 1 hour, with openings into such a room or compartment protected by approved self-closing fire doors suitable for Class B openings.

**3-3.2.4 Full Pneumatic Riser Pipe.** Full pneumatic riser pipe shall have a minimum diameter of 20 in. (508 mm) and shall be constructed from 16 gauge (minimum) stainless steel, or galvanized or aluminum coated steel with no screws, rivets, or other projections on the interior surface of the pipe. To avoid vacuum leaks, riser pipe shall be flanged, gasketed, and bolted.

**3-3.2.5 Full Pneumatic Air Source.** A full pneumatic system requires a full diameter air source for conveying materials on a moving air stream. The air source shall be a roof-vent and curb, an all-weather elbow, or a louver through the side of the building.

**3-3.2.6 Full Vacuum Station Supports.** Full vacuum stations shall be supported at each floor by mounting plates or steel channel that will bridge the shaft opening. Stations shall be bolted to prevent movement under transport conditions. On floors where no station is installed, the riser pipe shall be supported at each floor.

**3-3.2.7 Full Pneumatic Riser Offsets.** Full pneumatic risers shall be permitted to be offset to fit building design requirements.

#### 3-3.3 Full Pneumatic Riser Enclosure (Chase).

**3-3.3.1 General.** Full pneumatic stations and vertical risers shall be mounted within a continuous enclosure constructed of materials that are noncombustible and that extend from floor to floor. The walls of the enclosure shall have a fire resistance rating of not less than 1 hour if the building is less than 4 stories in height and not less than 2 hours if the building is 4 or more stories in height. See 3-3.2.7 for offsets in full pneumatic riser piping.

**3-3.3.2 Full Pneumatic Loading Doors.** All full vacuum loading station outer doors shall be provided with a gasketed, self-closing, positive-latching fire door and frame assembly approved for Class B openings and shall have a fire resistance rating of not less than 1 hour. The door frame shall be installed onto the station and shall be set flush to the shaft wall. The width of the opening shall be permitted to be equivalent to the internal diameter of the chute, and the height shall be a maximum of one and a half times the diameter. Minimum door size for a waste or linen loading door shall be 18 in. × 18 in. (457.2 mm × 457.2 mm) and shall be side hinged.

### 3-3.4 Automatic Sprinklers, Full Pneumatic Systems.

Full pneumatic-type risers shall be protected internally by automatic sprinklers. A sprinkler shall be required at or above the top loading station and at alternate floor levels in buildings over two stories in height, with a mandatory sprinkler located at the lowest loading station. Sprinklers shall be recessed out of the station area through which the material travels. Sprinkler system installation shall comply with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

### 3-3.5 Transport Piping.

**3-3.5.1 Transport Piping Size and Thickness.** Transport piping shall have a minimum wall thickness of 16 U.S. gauge galvanized or stainless steel and shall be sized to fit the systems needs. Waste and linen transport systems shall be a minimum of 16 in. (406 mm) in diameter.

*Exception:* Where all materials entering the pneumatic-powered system are processed through a shredder, the transport pipe shall be permitted to be less than 16 in. (406 mm) in accordance with the authority having jurisdiction.

**3-3.5.2 Penetrating Fire-rated Walls.** Automatic fire dampers shall be installed at all points where the waste or linen transport system penetrates fire-resistive partitions or floor assemblies. [See Figure 3-3.5.2.] The system shall shut down automatically upon closing one of the fire dampers.

**3-3.5.3 Exiting from Two-hour Fire-rated Shafts.** Where the pneumatic transport pipe exits a 2-hour fire-rated shaft, the pipe wall thickness shall be increased to 11 U.S. gauge from within the shaft to 4 pipe diameters beyond the shaft wall. The 11-gauge pipe shall be supported at 3-ft (0.92-m) intervals.

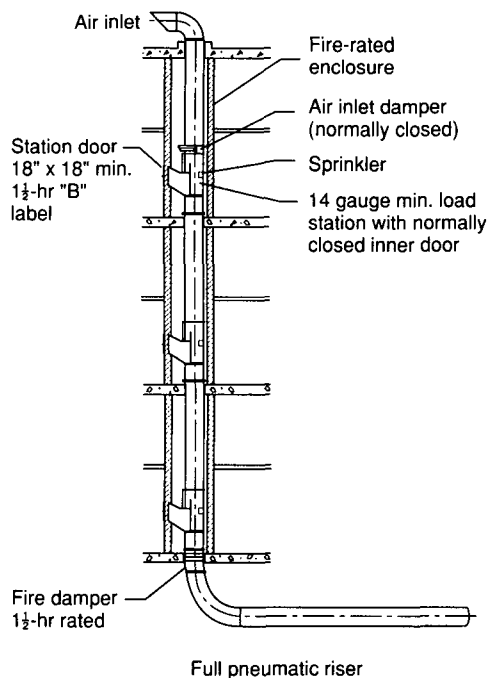


Figure 3-3.4 Full pneumatic system.

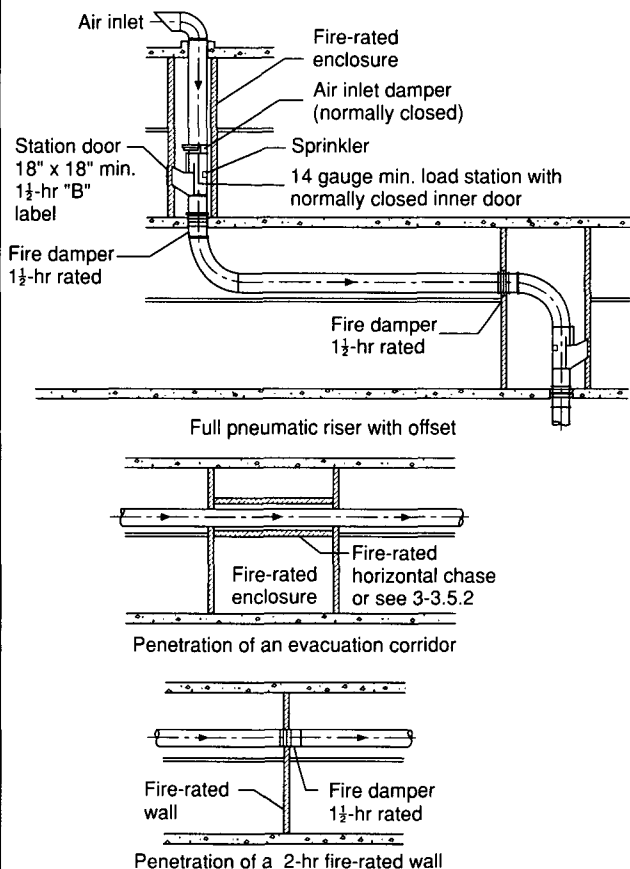


Figure 3-3.5.2 Full pneumatic system details.

**3-3.6 Full Pneumatic Collector Discharge Area.** The room or area where the collector discharges waste or linen shall be separated from the occupied part of the building by a 2-hour fire-rated wall. The room or area shall be protected by a sprinkler system. Sprinkler system installation shall comply with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

### 3-4 Gravity Pneumatic Trash or Linen Conveying System.

**3-4.1 General.** A gravity pneumatic transport system is a combination of a gravity chute and a horizontal pneumatic transport system. The gravity pneumatic system includes gravity chutes with a material discharge valve at the bottom, an air source at or near the bottom of the chute, air control dampers, horizontal piping with a pipe tee to connect to the chute, a collector, and a fan and fan damper.

#### 3-4.2 Construction.

**3-4.2.1 Gravity Chutes.** All the requirements of Section 3-2 shall apply to gravity pneumatic conveying systems. Where material is to be stored at the bottom of the chute and above the riser discharge damper (above the transport tee), automatic sprinklers shall be installed below the last service door on the chute. Where an open funnel is employed as an interface between the gravity chute storage

section and the transport discharge damper, a normally closed, specially designed 11 U.S. gauge, blade-type damper shall be installed at the bottom of the chute and above the funnel opening.

**3-4.2.2 Gravity Pneumatic Riser Discharge Damper.** At the point of entry into the transport piping tee, a material discharge damper shall be required to close off the transport piping when that riser is not being sequenced.

**3-4.2.3 Gravity Pneumatic Discharge Room Criteria.** Where a gravity pneumatic system has any opening in the connection between the chute and the transport pipe, the interface and the discharge damper shall be within a room separated from other parts of the building by a wall, partition, floor, and ceiling assemblies having a minimum fire resistance rating not less than that specified for the chute. Openings to such rooms shall be protected by approved automatic-closing or self-closing 1½-hour fire doors suitable for Class B openings.

**3-4.2.4 Automatic Sprinklers for the Gravity Pneumatic Discharge Room.** Automatic sprinklers shall be installed in chute terminal rooms.

### 3-4.3 Transport Piping.

**3-4.3.1 Piping Size and Thickness.** Transport piping shall have a minimum wall thickness of 16 U.S. gauge galvanized or stainless steel and shall be sized to fit the system's needs. Waste and linen transport systems shall be a minimum of 16 in. (406.4 mm) in diameter.

*Exception: Where all materials entering the pneumatic-powered system are processed through a shredder, the transport pipe shall be permitted to be less than 16 in. (406 mm) in accordance with the authority having jurisdiction.*

**3-4.3.2 Penetrating Fire-rated Walls.** Automatic fire dampers shall be installed at all points where the waste or linen transport system penetrates fire-resistive partitions or floor assemblies. The system shall shut down automatically upon closing of one of the fire dampers.

**3-4.3.3 Exiting from Two-hour Fire-rated Shafts.** Where the pneumatic transport pipe exits a 2-hour fire-rated shaft, the pipe wall thickness shall be increased to 11 U.S. gauge from within the shaft to 4 pipe diameters beyond the shaft wall. The 11-gauge pipe shall be supported at 3-ft (0.92-m) intervals.

**3-4.4 Gravity Pneumatic Collector Discharge Area.** The room or area where the collector discharges waste or linen shall be separated from the occupied part of the building by a 2-hour fire-rated wall. Where the room or area of collector discharge is within or abutting an occupied building, the room or area shall be protected by a sprinkler system. Sprinkler system installation shall comply with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

## Chapter 4 Other Waste Handling Systems

**4-1 Definition.** Waste handling systems and equipment, other than chute systems covered in Chapter 3, also shall comply with all of the basic requirements of this standard. Such systems and equipment include, but are not limited

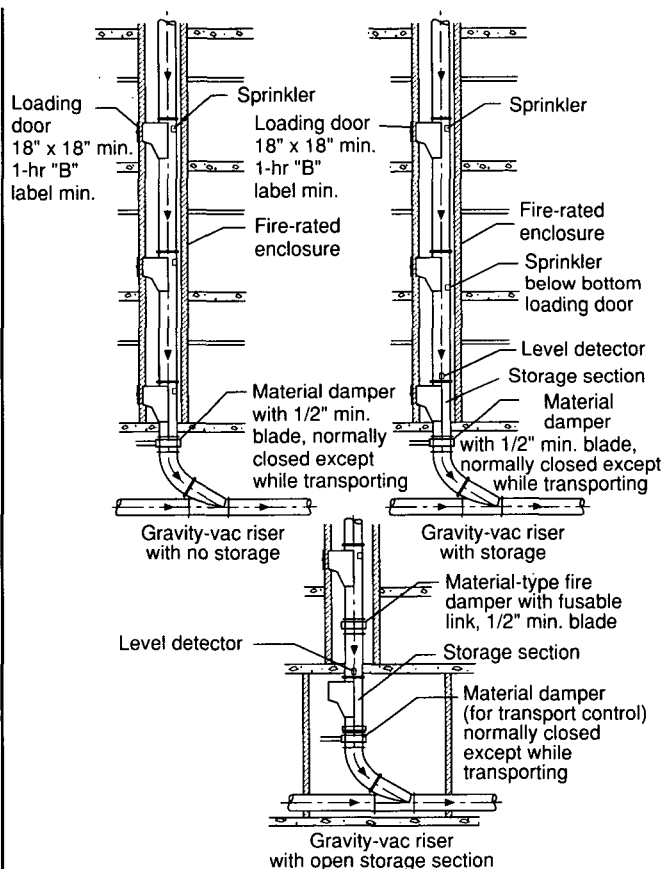


Figure 3-4 Gravity pneumatic system.

to, waste cart transport systems, skip hoists, cranes and grapples, and various types of conveyors, such as belt conveyors, pan conveyors, screw conveyors, vibratory conveyors, and drag conveyors.

**4-2 Waste Spillage Control.** Waste handling systems and equipment shall be designed and constructed to prevent or minimize waste spillage so as to prevent potential fire problems.

**4-3 Enclosure Requirements.** The building, rooms, or enclosures in which waste handling systems and equipment are located and used for either interim storage of waste materials or the direct movement of waste from storage areas to processing equipment, such as incinerators, or both, shall be shut off from other areas of the building by walls, floor, and ceiling assemblies having a fire resistance rating of not less than 2 hours. Openings to such rooms shall be protected by approved automatic-closing or self-closing fire doors suitable for Class B openings.

**4-4 Automatic Sprinklers.** Automatic sprinklers shall be provided in rooms where waste handling systems and equipment are used to transport waste from interim storage areas to waste processing equipment, such as incinerators. In locations or rooms where waste handling systems and equipment are used for interim storage of waste only, the rooms shall be sprinklered in accordance with requirements specified in Chapter 6.



## Chapter 5 Waste Compactors

### 5-1 General.

**5-1.1 Definition.** Waste compactors are devices using electro-mechanical-hydraulic means to reduce the volume of waste and to package it in the reduced condition.

**5-1.2 Classification.** The two types of compactors regulated by the provisions of this standard are as follows:

(a) Domestic compactors are designed for use in dwellings or individual dwelling units for compaction of family-developed waste.

(b) Commercial-industrial compactors used in multiple family or other classes of occupancies can be located indoors or outdoors. They can be chute-fed or hand-fed. Discharge of the compactor shall be permitted to be into metal-compaction containers or disposable packages.

### 5-2 Domestic Compactors.

**5-2.1** Domestic compactors shall be so designed that the unit can be opened manually in the event of electrical failure.

**5-2.2** The compacting chamber shall be so designed as to be enclosed on all sides, top, front, and bottom with steel construction that will contain fire in the event of waste ignition.

### 5-3 Commercial-Industrial Compactors.

**5-3.1** All chute-fed compactors shall have an automatic special fine water spray sprinkler with a minimum 1/2-in. (13-mm) orifice installed in the hopper of the compactor. This sprinkler shall be an ordinary temperature rated sprinkler. The sprinklers shall be supplied by a minimum 1-in. (25.4-mm) ferrous piping or 3/4-in. (19-mm) copper tubing line from the domestic cold water supply.

The sprinkler shall provide a suitable spray into the hopper. A cycling (on-off), self-actuating, snap-action, heat-actuated sprinkler shall be permitted to be used, or the sprinkler shall be permitted to be controlled by a temperature sensor operating a solenoid valve. Sprinkler water piping shall be protected from freezing in outdoor installations.

**5-3.2** Hand-fed compactors located within a building and not operated in conjunction with a chute shall not require installation of an automatic sprinkler in the hopper. Compactors larger than 2 yd<sup>3</sup> (1.52 m<sup>3</sup>) shall be enclosed in a fire-rated room in conformance with 5-3.4.

**5-3.3** Refuse compaction containers shall have an access door to the containers that can be opened without disconnecting the containers from the compactor or shall be provided with one 2 1/2-in. (63.5-mm) hose connection that fits standard fire-fighting equipment near the top of the container.

**5-3.4** Chute terminal, compacting, or storage rooms shall be separated from other parts of the building by wall, partition, floor, and floor-ceiling assemblies having a fire resistance rating of not less than 2 hours. Openings to such rooms shall be protected by approved automatic-closing or self-closing fire doors suitable for Class B openings.

## Chapter 6 Waste Storage Rooms

**6-1 Application.** Waste storage rooms in a building or structure shall comply with specified requirements for a waste storage room if they are used for storage or handling of waste that is loose, baled, or compacted or in containers with a combined total exceeding 1 yd<sup>3</sup> (0.765 m<sup>3</sup>) uncompact measure of waste.

**6-2 Fire Separation.** Waste storage rooms shall be separated from other parts of the building by walls and floor and ceiling assemblies having a fire resistance rating of not less than 2 hours. Openings to such rooms shall be protected by approved automatic-closing or self-closing fire doors suitable for Class B openings.

**6-3 Automatic Sprinklers.** Waste storage rooms shall be provided with automatic sprinklers installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

## Chapter 7 Other Waste Processing Equipment

**7-1 Definition.** Waste processing systems and equipment include those devices and processes used to change the physical form or characteristics of waste. In addition to compaction, as covered in Chapter 5, these include such devices as shredders, granulators, grinders, pulpers, and chippers.

**7-2 Fire Separation.** Rooms in which waste processing systems and equipment are located shall be separated from other parts of the building by wall, floor, and ceiling assemblies having a fire resistance rating of not less than 2 hours. Openings to such rooms shall be protected by automatic-closing or self-closing fire doors suitable for Class B openings.

**7-3 Explosion Protection.** Devices that granulate waste materials and that produce potentially explosive aerosols or combustible air mixtures shall be equipped with explosion protection devices or systems.

**7-4 Automatic Sprinklers.** Rooms in which waste processing equipment is located shall be installed with automatic sprinklers.

## Chapter 8 Referenced Publications

**8-1** The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**8-1.1 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1994 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 1992 edition.

NFPA 54, *National Fuel Gas Code*, 1992 edition.

NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*, 1992 edition.

NFPA 70, *National Electrical Code*, 1993 edition.

NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, 1993 edition.

### 8-1.2 Other Publications.

**8-1.2.1 ASTM Publications.** American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM C27-1984, *Standard Classification for Fireclay and High-Alumina Refractory Brick*.

ASTM C199-1984, *Standard Test Method for Pier Test for Refractory Mortars*.

ASTM E136-1993, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*.

## Appendix A Explanatory Material

*This Appendix is not a part of the requirements of this NFPA document, but is included for informational purposes only.*

**A-1-2 Limited-Combustible.** See NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, and NFPA 220, *Standard on Types of Building Construction*.

### A-2-2.8 Chimneys for Incinerators.

**General.** The changing composition of waste and regulations controlling temperatures and emissions have created very aggressive flue gases. Refractories that were suitable in the past can fail rapidly under existing conditions. There is no single material or family of materials suitable for ensuring fire safety under all conditions; therefore, no specific materials are identified in this appendix. Critical temperatures, aggressive chemical components, and conditions creating aggressive flue gases are identified. Selection of materials for chimney construction should be based on those capable of withstanding these conditions.

**Condensed Flue Acid Corrosives.** Hydrochloric acid is formed when chloride-bearing materials are oxidized. Hydrochloric acid is corrosive to all chimney linings and can destroy most metals in concentrations as low as 26 ppm in flue gases. Acid concentration in flue gases ranges from 26 ppm to as high as 2095 ppm.

The acid dew point is about 145°F (62.7°C).

Sulfuric acid is formed when sulfur is oxidized to SO<sub>2</sub>, which is further oxidized to SO<sub>3</sub>, which combines readily with water to form sulfuric acid, H<sub>2</sub>SO<sub>4</sub>. This flue acid is aggressive to most chimney linings.

The acid dew point depends on the SO<sub>3</sub> content of the flue gases. The maximum theoretical acid dew point is about 400°F (204.4°C). Acid concentration can be as high as 80 percent but will rapidly self-dilute to 35 percent.

Sulfurous acid is formed when SO<sub>2</sub> combines with water. It condenses as sulfurous acid, H<sub>2</sub>SO<sub>3</sub>, at the water dew points or about 130°F (54.4°C), but it is not as aggressive as sulfuric or hydrochloric acid and, therefore, does less damage.

Nitric acid is condensed in the water dew point area and also is not as aggressive to chimney materials as other flue acids. It pacifies the surface of stainless steel, reducing the corrosive effect of the other flue acids.

**Miscellaneous Flue Acids.** Other flue acids, formed by the halides, are very corrosive, but in lesser amounts than chlorides. Hydrochloric acid is, therefore, the controlling acid.

Other flue acids that condense at the water dew point are present; however, hydrochloric and sulfuric acids are the acids that cause the most corrosion in chimneys servicing incineration of general waste.

**Alkali Corrosives.** Alkalis are formed by the oxidation of metal oxides that are found in paints, ink, fillers, pigments, etc. The common alkalis are:

Soda (Na<sub>2</sub>O)

Potash (K<sub>2</sub>O)

Lithia (Li<sub>2</sub>O).

Increases in the quantities of plastics that are components of waste increase alkali in flue gases.

Alkalis form low-temperature melts that distress refractories, particularly those of low density. Distress due to alkali attack can be observed as glazing or dripping of the refractory if the temperature is high enough or, at lower temperatures, as a shelling or disintegration of the surface.

Alkali disruption begins at about 1600°F (871.1°C) and increases as temperatures approach 2000°F (1093.3°C).

**High Temperature Acid Corrosives.** Most common stainless steels show significant loss due to chloride or other halogen vapors in flue gases when temperatures exceed 600°F (315.8°C).

Flue temperatures over 1800°F (982.2°C) encourage reaction of hydrochloric vapors with calcium aluminate refractory binders. This reaction becomes more severe as temperatures approach and exceed 2200°F (1204.4°C).

**Free Chlorides and Alkalis.** Where free chlorides are present with alkalis, these compounds can condense within the lining forming expansive alkali chloride phases. The presence of these phases can result in cracking of the refractory.

**Chimney Systems below 200°F (93.3°C) Mid-flue Temperature Downstream of Scrubber.** Chimney systems that allow flue surfaces to fall below 200°F (93.3°C) are subject to corrosion by halogen acids, nitric acid, and others, with the prime corrosive acid being hydrochloric.

**Metal Linings Assuming HCl Content To Be 26 PPM or above in the Flue Gases.** Most common metals, such as Types 304, 304L, 316, 316L stainless steels, and nickel-based alloys, such as 800, 600, 618, and 671, have shown significant corrosion when subjected to flue gases containing 26 ppm hydrochloric acid and are not acceptable as flue liners.

Materials that exhibit essentially no corrosion attack when subjected to flue gases containing 26 ppm hydrochloric acid are as follows:

- Austenitic stainless steels: 904L, 254 SLX, 254 SMO, AL-6X, and 22-13-5
- Ferritic stainless steels: Ebrite 26-1, NuMonit, and 29-4C
- Nickel-based alloys: 690, 625, 825, and Hastelloys N, F, G, and C-276.

This data was obtained from Technology Development for Corrosion Resistant Condensing Heat Exchangers by Battelle, Columbus, OH.

**Refractory and Other Linings.** Refractory linings suitable for use downstream of scrubbers must resist all of the condensed flue acids at low temperatures and will become saturated and, therefore, must resist stresses of expanding

steam when temperatures elevate rapidly. They also must resist thermal shock when heated refractory suddenly is exposed to water.

Products suitable for this service should show evidence of no more than 3 percent weight loss when subjected to ASTM *Acid Resistance Testing* in boiling hydrochloric and sulfuric acids.

**Chimney Systems below 600°F (315.8°C) Mid-flue Temperature.** Chimney systems that allow flue surfaces in any portion of the system to fall below 600°F (315.8°C) can be subject to corrosion by sulfuric acid. These temperatures usually are associated with waste heat recovery boilers.

Lining suitable for this type of service should be dense, high in silica, and bonded with acid-resistant binders (calcium aluminate binders cannot pass the acid-resistant test unless co-bonded with potassium silicate). Material should withstand immersion in 5 percent sulfuric acid for 2000 hours at 70°F (21.1°C) with not more than 3 percent weight loss.

**Chimney Systems 600°F to 1500°F (315.8°C to 815.6°C).** These conditions existed prior to current regulations for incineration. This temperature range avoids condensed flue acid and problems with alkali. Refractories used in the past usually were lightweight with continuous service temperatures of 1800°F (982.2°C) with excursions to 2000°F (1093.3°C).

**Listed Medium-Heat Chimneys.** Listed medium-heat appliance chimneys may be used and should be installed in accordance with the conditions of the listing and the manufacturer's instructions.

**Chimney Systems 1500°F to 2200°F (815.6°C to 1204.4°C).** This temperature range requires more Al<sub>2</sub>O<sub>3</sub> and less SiO<sub>2</sub> in the chemical composition. The material

must meet the temperature limitations of the specific incinerator involved. It is subject to attack by both alkali and acid vapors, which becomes more severe as density is reduced; thus, high-density low-porosity material should be used.

## Appendix B Referenced Publications

**B-1** The following documents or portions thereof are referenced within this standard for informational purposes only and thus are not considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**B-1.1 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1994 edition.

NFPA 97, *Standard Glossary of Terms Relating to Chimneys, Vents, and Heat-Producing Appliances*, 1992 edition.

NFPA 220, *Standard on Types of Building Construction*, 1992 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 1993 edition.

### B-1.2 Other Publications.

**B-1.2.1 ASTM Publication.** American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM, *Acid Resistance Testing*.

**B-1.2.2** Technology Development for Corrosion Resistant Condensing Heat Exchangers by Battelle, Columbus, OH.

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# **The NFPA Codes and Standards Development Process**

Since 1896, one of the primary purposes of the NFPA has been to develop and update the standards covering all areas of fire safety.

## **Calls for Proposals**

The code adoption process takes place twice each year and begins with a call for proposals from the public to amend existing codes and standards or to develop the content of new fire safety documents.

## **Report on Proposals**

Upon receipt of public proposals, the technical committee members meet to review, consider, and act on the proposals. The public proposals – together with the committee action on each proposal and committee-generated proposals – are published in the NFPA's Report on Proposals (ROP). The ROP is then subject to public review and comment.

## **Report on Comments**

These public comments are considered and acted upon by the appropriate technical committees. All public comments – together with the committee action on each comment – are published as the Committee's supplementary report in the NFPA's Report on Comments (ROC).

The committee's report and supplementary report are then presented for adoption and open debate at either of NFPA's semi-annual meetings held throughout the United States and Canada.

## **Association Action**

The Association meeting may, subject to review and issuance by the NFPA Standards Council, (a) adopt a report as published, (b) adopt a report as amended, contingent upon subsequent approval by the committee, (c) return a report to committee for further study, and (d) return a portion of a report to committee.

## **Standards Council Action**

The Standards Council will make a judgement on whether or not to issue an NFPA document based upon the entire record before the Council, including the vote taken at the Association meeting on the technical committee's report.

## **Voting Procedures**

Voting at an NFPA Annual or Fall Meeting is restricted to members of record for 180 days prior to the opening of the first general session of the meeting, except that individuals who join the Association at an Annual or Fall Meeting are entitled to vote at the next Fall or Annual Meeting.

"Members" are defined by Article 3.2 of the Bylaws as individuals, firms, corporations, trade or professional associations, institutes, fire departments, fire brigades, and other public or private agencies desiring to advance the purposes of the Association. Each member shall have one vote in the affairs of the Association. Under Article 4.5 of the Bylaws, the vote of such a member shall be cast by that member individually or by an employee designated in writing by the member of record who has registered for the meeting. Such a designated person shall not be eligible to represent more than one voting privilege on each issue, nor cast more than one vote on each issue.

Any member who wishes to designate an employee to cast that member's vote at an Association meeting in place of that member must provide that employee with written authorization to represent the member at the meeting. The authorization must be on company letterhead signed by the member of record, with the membership number indicated, and the authorization must be recorded with the President of NFPA or his designee before the start of the opening general session of the Meeting. That employee, irrespective of his or her own personal membership status, shall be privileged to cast only one vote on each issue before the Association.

# **Sequence of Events Leading to Publication of an NFPA Committee Document**

Call for proposals to amend existing document or for recommendations on new document.



Committee meets to act on proposals, to develop its own proposals, and to prepare its report.



Committee votes on proposals by letter ballot. If two-thirds approve, report goes forward.  
Lacking two-thirds approval, report returns to committee.



Report is published for public review and comment. (Report on Proposals - ROP)



Committee meets to act on each public comment received.



Committee votes on comments by letter ballot. If two-thirds approve, supplementary report goes forward. Lacking two-thirds approval, supplementary report returns to committee.



Supplementary report is published for public review. (Report on Comments - ROC).



NFPA membership meets (Annual or Fall Meeting) and acts on committee report (ROP and ROC).



Committee votes on any amendments to report approved at NFPA Annual or Fall Meeting.



Complaints to Standards Council on Association action must be filed  
within 20 days of the NFPA Annual or Fall Meeting.



Standards Council decides, based on all evidence, whether or not to issue standard  
or to take other action, including hearing any complaints.



Appeals to Board of Directors on Standards Council action must be filed  
within 20 days of Council action.