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NFPA 82 Incinerators, Waste and Linen Handling Systems and Equipment 1990 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, Waste and Linen Handling Systems and Equipment

1990 Edition

This edition of NFPA 82, *Standard on Incinerators, 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 13-15, 1989 in Seattle, WA. It was issued by the Standards Council on January 12, 1990, with an effective date of February 5, 1990, and supersedes all previous editions.

The 1990 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. 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 treated as separate standards, Nos. 82 and 82A respectively, No. 82A on Rubbish Handling being unchanged from the 1948 edition. In the 1969 edition, the subject Rubbish Handling was included with incinerators and Standard No. 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, with those revisions mainly editorial.

This 1990 edition contains minor revisions to Chapters 1 and 2, including a small 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.

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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.

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NFPA 82

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Chapter 1 General

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

Information on referenced publications can be found in Chapter 7 and Appendix B.

1-1 Scope.

1-1.1 This standard represents basic 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, or 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 97M, *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 or 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 which is in a position to determine compliance with appropriate standards for the current production of listed items.

Authority Having Jurisdiction. The "authority having jurisdiction" is 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, 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 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."

Combustible Material. Combustible material, as pertaining to this standard, means material made of or surfaced with wood, compressed paper, plant fibers, or other material that will ignite and burn. Such material shall be considered as combustible even though flameproofed, fire-retardant treated, or plastered.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization 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.

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.

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 It 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 give 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 as needed to reduce or minimize fire hazards are required for all new incineration facilities, to the satisfaction of the authority having jurisdiction.

1-3.4 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 applicable provisions of NFPA 54, *National Fuel Gas Code*, and NFPA 58, *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 may be installed to deliver air to the incinerator room, provided they are in operation whenever the incinerator is in use.

2-1.3.2 If a residential-type of incinerator is installed in an open area, such as an undivided basement without storm windows and without unusually tight-fitting doors, in buildings of conventional construction, adequate air supply usually may be obtained through normal air infiltration. If the incinerator is located in a confined space or an area separated by tight-fitting partitions and doors, adequate air shall be provided by means of an opening communicating with other areas of the building having adequate infiltration or with the outdoors. See NFPA 31, *Standard for the Installation of Oil Burning Equipment*.

2-1.3.3 Rooms in which incinerators other than residential types 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 2-2.9 or 2-3.6 and provided with sufficient air supply for both rooms.

2-1.3.4 The opening or duct specified in 2-1.3.3 shall have a free area of not less than 1 sq in. (6.5 cm^2) per 4,000 Btu (1.17 kW) per hour incinerator burning rate based on heat value of waste and auxiliary fuel, if all air is from the outdoors; and 1 sq in. (6.5 cm^2) per 1,000 Btu (293 W) per hour incinerator burning rate if all air is from inside buildings. See NFPA 54, *National Fuel Gas Code*.

2-1.3.5 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 unless the following are present:

(a) A wet scrubber or other emission control system or component is installed between the incinerator and stack, such that flyash cannot pass directly from the incinerator to the stack.

(b) Other acceptable design and control features are in place that would prevent the entrainment of flyash from the incinerator to the stack under all operating conditions.

(c) The nature of the waste being incinerated will not result in flyash 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 rectangular chimney flue.

2-1.4.4 Arresters, including bolts, rivets, screws, and supporting members, shall be made of stainless steel (ASTM A167,[1] Type 316, or ASTM A478, Type 316, or the equivalent).

2-1.4.5 Openings shall not permit the passage of spheres having a diameter larger than 1/2 inch (13.7 mm), nor block the passage of spheres having a diameter of less than 3/8 inch (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 Means shall be provided to replace spark screens.

2-2 Commercial-Institutional Incinerators.

2-2.1 Definition. A commercial-institutional incinerator as defined in this section refers to an incinerator predominantly designed for burning solid waste. The most applicable systems included under this definition include, but are not limited to, controlled air incineration 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 sq ft (.09 m^2) of relief area for every 100 cu ft (3 m^3) 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.

2-2.2.3 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.

[1] The full title and date of all ASTM standards referenced in this standard appear in Chapter 7.

(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 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 need not be reinforced.

(e) Insulation or other approved means shall be provided to meet the temperature limitation of 2-2.2.5.

(f) 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 so designed that the temperature rise above ambient [75°F ± 5° (24°C ± 3°)] of any portion of the incinerator casing accessible to an operator shall not exceed 70°F (39°C). Handles of operating doors shall not exceed a 40°F (22°C) rise for metallic and 60°F (33°C) rise for nonmetallic.

Exception: Doors, inspection points, burners, flues, and areas immediately adjacent thereto need not comply with 2-2.2.5.

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.

2-2.4 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, and 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 above may be 36 in. (914 mm) and at the sides and rear it may be 18 in. (457 mm).

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

Exception: A clearance of not less than 3 in. (76.2 mm) may 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, cleanout, 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 completely opened so that all parts of the combustion chamber, ash pit, separation chambers, etc., may be reached and so 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 m) wide or less, parallel to the incinerator, may 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, whereby the charging door is not opened 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 may 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 US gage steel casing, lined with not less than 4 1/2 in. (114 mm) of firebrick (ASTM C27 Type F, medium duty, or the equivalent). Such 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 may 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 2 1/2 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: When the room is protected by an approved system of automatic sprinklers, the walls and floor and ceiling assemblies may have a fire resistance rating of not less than 1 hour, and the door may 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 and/or fully contain ash residues removed from the incinerator during clean-out operations. This 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 may 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, a short length of hand hose connected to a suitable water supply, and a suitable floor drain shall be provided in the incinerator room.

2-2.8* Chimneys for Commercial-Institutional Incinerators.

2-2.8.1 General.

2-2.8.1.1 The chimney flue for an incinerator shall serve the incinerator only, unless the chimney flue construction is acceptable for incinerator gases and the controls are suitable for the incinerator and other device being served. It 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 may 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 may be supported additionally 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 Cleanout 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 cleanout 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.

2-2.8.2 Listed Medium-Heat Chimneys. Listed medium-heat appliance chimneys may 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, may 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 2-3.2.5 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 Q Insulating Castable Refractories (ASTM C27) in accordance with temperature requirements, may 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 2-3.2.5 under all intended operating conditions.

2-2.8.3.3 Castable plastic refractories, or other refractories, may 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 2-3.7.3.5.

Table 2-2.8.3.5 Minimum Thickness of Sheet Steel Chimneys

Mfgr. Std. Gage No.	Min. Thickness in. (mm)	Area $in.^2/m^2$	Equiv. Round Diam. in./mm
16	.054 (1.37)	up to 154/.0994	up to 14/356
14	.069 (1.75)	155/.0999 to 201/.1296	over 14/356 to 16/406
12	.098 (2.49)	202/.1303 to 254/.1638	over 16/406 to 18/457
10	.128 (3.25)	Larger than 254/.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.

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:

(a) Strength to resist stresses due to steady or gusting wind loads.

(b) Adequate anchoring, bracing, and inherent strength to withstand seismic and wind-induced vibrational stresses.

(c) Proper material thickness for durability considering fuel analysis, gas temperature, and exposure.

(d) Security against leakage of flue gases under positive pressure.

(e) 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 constructed of materials that are noncombustible, such as masonry (*see Section 1-2*), and extending 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 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, 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 it 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 may 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 to be not 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 as to 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 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 any approved manner to avoid burning a person who might touch 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 the 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 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 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 corrosive resistant and capable of handling aggressive flue acids under all operating conditions. Such materials may include fiberglass reinforced plastic (FRP), refractoires, and mortars of special acid resistant composition or specialized metals, such as Hastelloy or Inconel. See Appendix A-2.3.8 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: Such portions do not include 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: Such portions do not include 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*), unless the system complies with the conditions listed under 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 US gage steel if it is 12 in. (305 mm) or less in diameter or greatest cross-section dimension, and of not lighter than 12 US gage steel if it exceeds 12 in. (305 mm) in diameter or greatest cross-section dimension.

Exception: Breechings also may utilize listed medium-heat chimney sections if 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, may 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 throughout its entire length shall be readily accessible for inspection and replacement.

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 2-2.11.[1]

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 may 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.

[1] 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 by-passed 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 shall be protected by an acid-resistant coating suitable for the operating conditions.

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 Chutes and Handling Systems[1]

3-1 Definitions. There are five types of waste chute systems, each with separate fire safety criteria.

3-1.1 General Access Gravity Type. A waste chute of this type is an enclosed vertical passageway in a building to a storage or compacting room where the waste is transferred by gravity only. All occupants of the building are free to use the chute at any time.

3-1.2 Limited Access Gravity Type. A waste chute of this type is an enclosed vertical passageway in a building to a storage or compacting room where the waste is transferred by gravity only. Authorized personnel only use the chute, gaining entry by key to a locked chute door or service opening room door.

3-1.3 Pneumatic Waste Handling Systems. A waste handling system of this type is a vertical, horizontal, or inclined duct having sufficient mechanically applied air-flow to convey refuse without clogging to point of disposition.

3-1.4 Multi-Loading Pneumatic Waste Handling Systems. A negative pressure waste handling system of this type shall consist of an automatic or self-closing, positive-latching inlet door, interlocked so that only one door in the chute can be opened at the same time and not when the material damper is opened.

3-1.5 Gravity-Pneumatic Waste Handling System. A system using a combination of the types defined in 3-1.1 or 3-1.2 and feeding into a pneumatic waste handling system.

3-2 Construction.

3-2.1 General.

3-2.1.1 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 upon a substantial noncombustible foundation having a fire resistance rating of at least 3 hours.

3-2.1.2 Gravity chutes shall be constructed straight and plumb with no offsets. A minimum clearance of 24 in. (610 mm) shall be maintained from the outside edge of the discharge of the chute to any wall. All chute interiors shall be smooth and without projections.

Exception: When connected to a compactor or other device for processing waste, clearance on two sides may be 4 in. (102 mm).

3-2.1.3 Listed medium-heat appliance chimney sections shall be acceptable for use as waste chutes.

[1] Waste chutes, conveyors, or other handling systems usually are employed where there is a relatively large area on each floor from which waste is collected. The collected waste is brought to the opening in the chute. The chute then conveys the waste to its disposition point.

3-2.1.4 Vertical waste chutes shall be enclosed in all stories above the storage or compacting room within a continuous enclosure constructed of materials that are noncombustible, 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 as required by applicable building code provisions. 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. (*For pneumatic waste handling systems with horizontal runs, see 3-2.4.*)

Exception: Masonry chutes conforming to 3-2.2 or constructed of masonry walls having a fire resistance rating not less than specified above are not required to be enclosed.

3-2.1.5 The size of a waste chute shall be in accordance with the following:

(a) *Gravity-type Chutes.* The size of the chute shall not be less than 22 1/2 by 22 1/2 in. (571 mm by 571 mm) or 24 in. (610 mm) in diameter, inside measurement.

(b) *Pneumatic Waste Handling Systems and Multi-Loading Pneumatic Waste Handling Systems.* The size of the duct shall not be less than 16 in. (406 mm) inside measurement.

Exception: When all materials entering the pneumatic-powered chute are processed through a shredder, the chute may be less than 16 in. (406 mm) in accordance with the authority having jurisdiction.

3-2.1.6 A waste 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 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 4 1/2 in. (114 mm) thick. Equivalent construction with walls providing 2-hour fire resistance rating with equivalent structual features shall be acceptable.

3-2.3 Metal Waste Chutes.

3-2.3.1 Metal chutes may be lined with low-duty refractory brick (ASTM C27) not less than 2 1/2 in. (63.5 mm) thick or equivalent castable refractories. Unlined steel chutes shall be protected internally by automatic sprinklers (*see 3-4.1*).

3-2.3.2 Metal waste chutes shall be made of stainless steel or galvanized or aluminum-coated steel with no screws, rivets, or other projections on the interior surface of the chute. Laps or joints shall be of a design so that the liquid will drain to the interior of the chute. The steel shall not be lighter than as indicated below:

(a) Chutes handling general household or office wastes shall be made of steel not lighter than 16 US gage.

(b) Chutes handling other than general waste, or dense-heavy waste material over 10 lb/cu ft (1500 kg/m^3), shall be made of steel not lighter than 14 US gage.

3-2.4 Pneumatic Waste and Multi-Loading Pneumatic Waste Handling Systems.

3-2.4.1 The minimum air velocity in pneumatic waste handling systems shall be not less than 3500 ft per minute (1150 m/min).

3-2.4.2 Each riser on pneumatic waste handling systems shall be equipped with dampers that are open to the atmosphere except when automatically closed to permit a conveying operation in another riser. Immediately after completion of the conveying cycle, all riser dampers shall open automatically.

3-2.4.3 Each riser with more than one inlet door or multi-loading pneumatic waste handling system shall be equipped with a damper that normally is closed to the atmosphere except during discharging of the chute.

3-2.4.4 Metal thickness shall be not lighter than 14 US gage steel for material conveying lines, but in all cases shall be of sufficient thickness to retain its design shape under all operating conditions. Steel shall be galvanized, aluminized, or stainless to avoid corrosion.

3-2.4.5 Automatic fire dampers shall be installed at all points where the waste handling system penetrates fire-resistive partitions or floor assemblies (*see Figure 3-2.4.5*). The system shall shut down automatically upon closing of one of the fire dampers.

Exception: When the waste handling system penetration of the floor assembly is enclosed by a fire-rated shaft both above and below the floor penetration, a fire damper is not required.

3-3 Chute Terminal Rooms.

3-3.1 Room Criteria. Waste chutes, pneumatic waste handling systems, or multi-loading pneumatic waste handling systems shall terminate or discharge directly into a room separate from other parts of the building by wall, partition, floor, and floor-ceiling assemblies having a minimum fire-resistive rating not less than that specified for the chute. Openings to such room shall be protected by approved automatic or self-closing 1 1/2 hour fire doors suitable for Class B openings.

3-3.2 Automatic Sprinklers. Automatic sprinklers shall be installed in chute terminal rooms.[1] Hand hose of adequate length to reach all portions of the room shall be provided. The hose can be utilized for cleaning purposes.

3-3.3 Discharge. Waste chutes or conveying systems shall not discharge directly into an incinerator.

3-3.4 Automatic Feeding or Stoking Systems. Systems for the automatic transfer of waste materials from a waste-chute terminal room to an incinerator or other means of automatic feeding or stoking incinerators shall not be installed unless special permission of the authority having jurisdiction has been obtained.[2]

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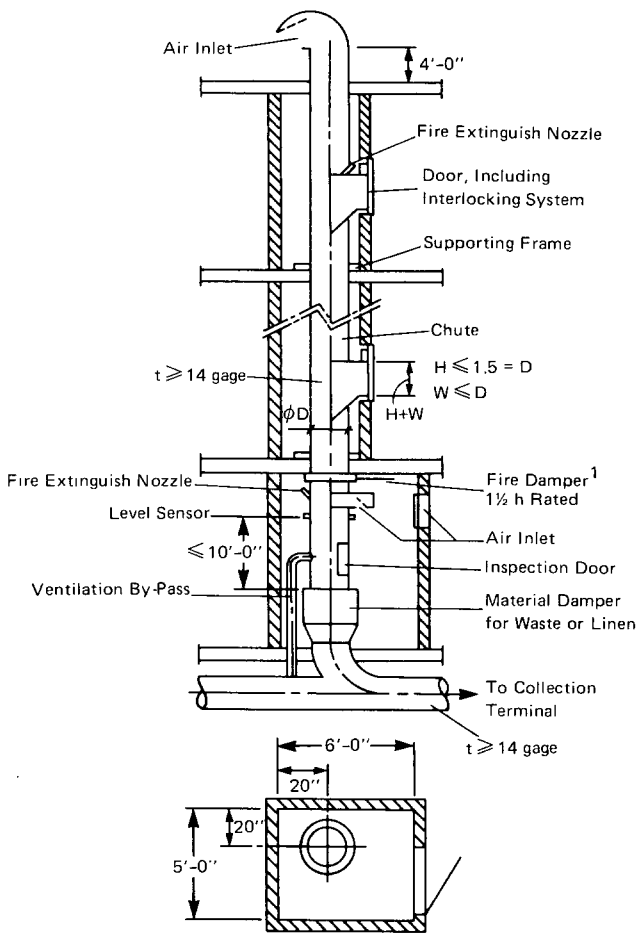
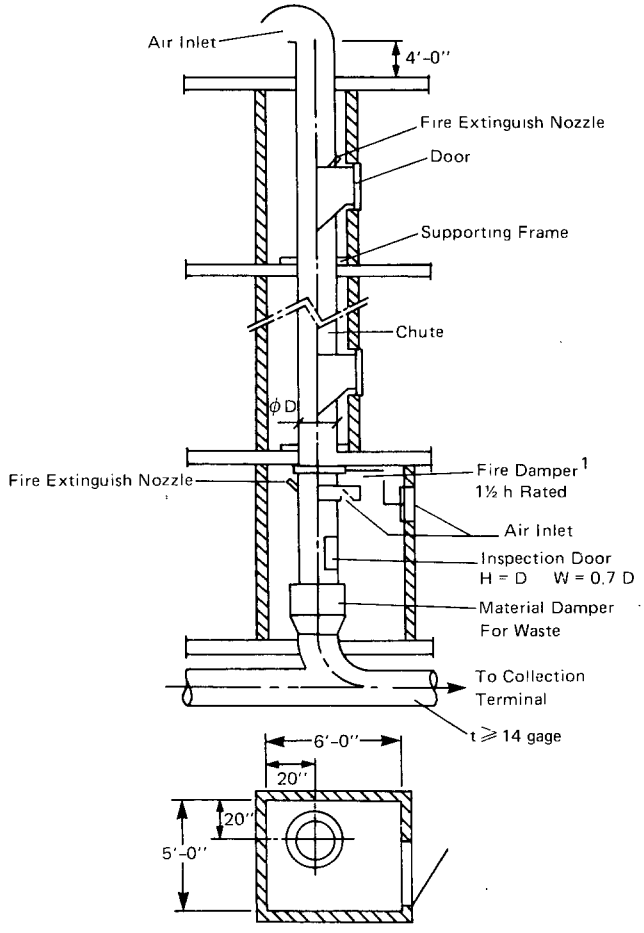
[1] Fires of the nature likely to occur at chute terminals generally are difficult to control by ordinary means due to the large amount of smoke involved and consequent difficulty of access by the fire department. Automatic extingushment of such fires in the incipient stage is, therefore, of primary importance.

[2] There are many situations in which arrangements are made for handling refuse mechanically and automatic stoking of incerators that would not introduce an unreasonable hazard. In such cases, the authority having jurisdiction may permit such an arrangement, taking into consideration the whole layout, its relation to the rest of the building, the presence or absence of complete sprinkler protection, the continuity and competence of the personal supervision attending the operation, ventilation, access for fire fighting, and similar factors. See also NFPA 91, *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying.*



Note 1: Fire damper not required when fire-rated enclosure provided above and below floor penetration. See 3-2.4.5 and Exception.

Figure 3-2.4.5(a) Multi-loading waste handling system.



Note 1: Fire damper not required when fire-rated enclosure provided above and below floor penetration. See 3-2.4.5 and Exception.

Figure 3-2.4.5(b) Gravity pneumatic waste handing system.

3-3.5 Waste Collection. All waste from pneumatic or multi-loading pneumatic waste handling systems must be discharged and collected in a completely sealed collector or fed into a completely sealed collector/compactor/container unit. The collector must be furnished with a sprinkler head. Waste from collector must be conveyed to incinerator by improved manner.

3-4 Automatic Sprinklers.

3-4.1 Unlined Metal Chutes. Unlined metal gravity-type 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 2 stories in height with a mandatory sprinkler located at the lowest service level. See NFPA 13, *Standard for the Installation of Sprinkler Systems*.

3-4.2 Masonry Waste Chutes. Masonry waste chutes conforming to 3-2.2 or 3-2.1.3 shall not require automatic sprinklers.

3-4.3 Sprinkler Head Protection. Automatic sprinklers installed in gravity waste chutes or waste handling systems shall be positioned out of the area through which waste travels. The installation shall be so designed to avoid collection of waste.

3-5 Service Openings.

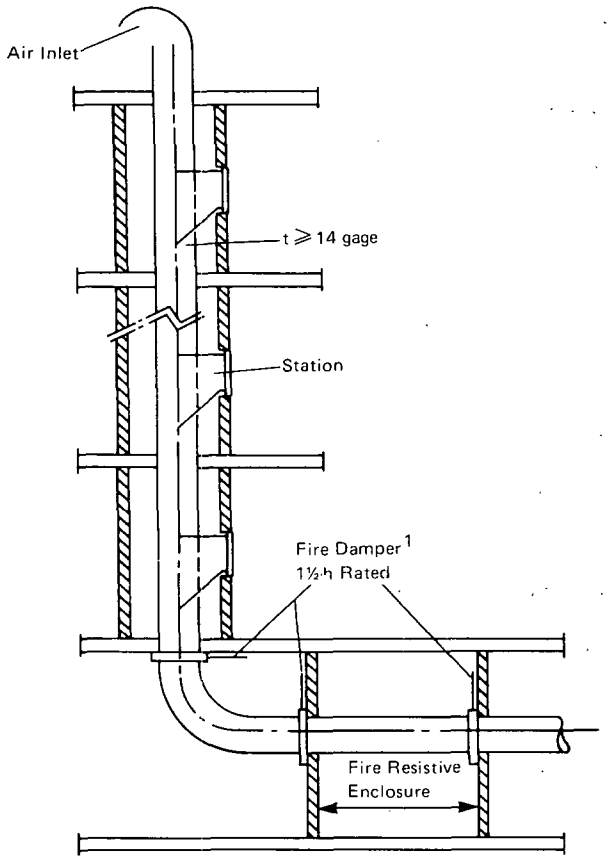
3-5.1 General Access Gravity-type Waste Chutes.

3-5.1.1 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 will project into the chute.

3-5.1.2 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.

3-5.2 Limited Access Gravity-type Waste Chutes.

3-5.2.1 All service openings into a waste chute shall be provided with a gasketed, self-closing, positive-latching frame and fire door assembly approved for Class B openings and



Note 1: Fire damper not required when fire-rated enclosure provided above and below floor penetartion. See 3-2.4.5 and Exception.

Figure 3-2.4.5(c) Pneumatic waste handing system.

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 will project into the chute. A key shall be required to open the door.

3-5.2.2 The area of each service opening shall be limited to two-thirds of the cross-sectional area of the chute.

3-5.3 Pneumatic Waste Handling Systems.

3-5.3.1 The service opening size of pneumatic waste handling systems shall be designed to provide proper entrance into the system. The width of the opening may be equivalent to the internal diameter of the chute and the height maximum 1.5 times the diameter.

3-5.3.2 Pneumatic waste handling systems shall be provided with a service opening consisting of two doors, including an automatic or self-closing, positive-latching outer door, front panel, and frame assembly, approved for Class B openings and having a fire resistance rating of not less than 1 hour. The door frame shall be built firmly into the duct and wall. The system service opening shall be equipped with a second or inner door designed to remain closed at all times under full system pressure unless released by the system control circuit to allow the material placed inside the outer door to enter the duct, provided the outer door is closed. However, the door need not be closed for systems designed for multiple bag loading. Only one inner service door shall be open during each conveying cycle.

3-5.4 Multi-Loading Pneumatic Waste Handling Systems.

3-5.4.1 The service opening size of multi-loading pneumatic waste handling systems shall be designed to provide proper entrance into the system. The width of the opening may be equivalent to the internal diameter of the chute and the height maximum 1.5 times the diameter.

3-5.4.2 Multi-loading pneumatic waste handling systems shall be provided with a service opening consisting of an automatic or self-closing, positive-latching door front panel and frame assembly approved for Class B openings and having a fire resistance rating of not less than 1 hour. The door frame shall be built firmly into the duct and wall. The door shall be interlocked so that only one door in the chute can be opened at the same time and not when discharging the chute.

3-5.4.3 The material damper shall be airtight and shall convey waste from the vertical chute to the horizontal duct. The horizontal duct shall not be less than 4 in. (102 mm) in diameter compared to the vertical chute. A level indicator above the material damper shall lock the chute doors when activated. The material damper shall be protected by automatic sprinkler and inspection openings. The inspection openings shall not be less than ⅔ of the cross section of the chute diameter. The height shall be equivalent to the chute diameter.

3-5.5 Combined Gravity-Pneumatic Waste Handling Systems.

3-5.5.1 Each section of a gravity-pneumatic system shall conform to the requirements for the individual type of system.

3-5.5.2 The storage area above the metering valve in a gravity-pneumatic system shall be protected by automatic sprinklers.

3-6 Service Opening Rooms.

3-6.1 Every service opening shall be enclosed 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 to such room or compartment protected by approved self-closing fire doors suitable for Class B openings.

3-6.2 If entrance to a limited access service opening room is gained by a key, the service opening door need not require a key to be opened. One or the other shall be keyed.

Chapter 4 Linen (Laundry) Chutes or Conveyors

4-1 General.

4-1.1 Definition. Linen chutes or handling systems are chutes or systems used to transport soiled laundry from the floor or area of collection to a laundry or designated areas.

4-1.2 Classification. There are four types of linen (laundry) handling systems involving conveyance through a tube or cylinder.

4-1.2.1 Gravity-type Linen Chutes. A gravity-type linen chute is an enclosed vertical passageway in a building where the linen is transferred by gravity to a chute terminal room or collecting facility or a pneumatic system.

4-1.2.2 Pneumatic Linen Handling Systems. A pneumatic linen handling system is a vertical, horizontal, or inclined duct having sufficient mechanically applied air flow to convey linen without clogging to a laundry or collecting facility.

4-1.2.3 Multi-Loading Pneumatic Linen Handling Systems. A linen handling system of this type shall consist of an automatic or self-closing, positive-latching inlet door, interlocked so that only one door in the chute can be opened at the same time and not when the material damper is opened.

4-1.2.4 Gravity-Pneumatic Linen Handling System. A gravity-pneumatic linen handling system is a system using a combination of the types defined in 4-1.2.1.

4-2 Construction.

4-2.1 General.

4-2.1.1 Linen chutes supported at intervals by the building structure shall be provided with expansion joints between support levels.

4-2.1.2 A 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.

4-2.1.3 Vertical linen chutes shall be enclosed on all stories above the collection or laundry facility within a continuous enclosure constructed of materials that are noncombustible, and extending from the ceiling of the collection or laundry room to or through the roof so as to retain the integrity of the fire separations as required by the applicable building code provisions. 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.

Exception: Masonry chutes conforming to 3-2.2 or constructed of masonry walls having a fire resistance rating not less than specified above shall not be required to be enclosed.

4-2.1.4 Metal linen chutes or handling systems shall be made of stainless steel or galvanized or aluminum-coated steel with no screws, rivets, or other projections on the interior surface of the chute. Laps or joints shall be of a design so that liquid will drain to the interior of the chute.

4-2.2 Gravity-type Linen Chutes.

4-2.2.1 The portion of a gravity linen chute located not more than 6 stories below the roof of a building shall be made of steel not lighter than 18 US gage, and any other portions shall be made of steel not lighter than 16 US gage.

4-2.2.2 Gravity linen chutes shall be constructed straight and plumb with no offsets.

4-2.3 Pneumatic Linen and Multi-Loading Pneumatic Linen Handling Systems.

4-2.3.1 Metal thickness shall not be lighter than 14 gage steel for material conveying lines, but in all cases shall be of sufficient thickness to retain its design shape under all operating conditions. Steel shall be galvanized, aluminized, or stainless to avoid corrosion.

4-2.3.2 The minimum air velocity in a pneumatic linen handling system shall not be less than 2,400 ft per minute (800 m/min).

4-2.3.3 Each riser on pneumatic linen handling systems shall be equipped that dampers that are open to the atmosphere except when automatically closed to permit conveying operation in another riser. Immediately after completion of the conveying cycle, all riser dampers shall be opened.

4-2.3.4 Each riser with more than one inlet door on multi-loading pneumatic linen handling systems shall be equipped with a damper that is normally closed to the atmosphere except during discharging of the chute.

4-2.3.5 Automatic fire dampers shall be installed at all points where the linen handling system penetrates fire-resistive partitions or floor assemblies (*see Figure 3-2.4.5*). The system shall shut down automatically upon closing of one of the fire dampers.

Exception: When the linen handling system penetration of the floor assembly is enclosed by a fire-rated shaft both above and below the floor penetration, a fire damper is not required.

4-3 Chute Terminal Rooms.

4-3.1 Linen (laundry) chutes or pneumatic linen handling systems 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-resistive rating not less than that specified for the chute. Openings to such rooms shall be protected by approved automatic or self-closing 1½ hour fire doors suitable for Class B openings.

4-3.2 Automatic sprinklers shall be installed in chute terminal rooms. Hand hose of adequate length to reach all portions of the room shall be provided. The hose can be utilized for cleaning purposes.

4-4 Automatic Sprinklers.

4-4.1 Metal Gravity-type Chutes. Metal gravity-type 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 2 stories in height with a mandatory sprinkler located at the lowest service level. See NFPA 13, *Standard for the Installation of Sprinkler Systems*.

4-4.2 Chute Terminal Rooms. The room or area into which a chute or linen handling system discharges shall be protected with automatic sprinklers.

4-4.3 Sprinkler Head Protection. Automatic sprinklers installed in linen chutes or linen handling systems shall be positioned out of the area through which linen travels. The installation shall be so designed to avoid collection of dust or lint.

4-5 Service Openings.

4-5.1 Gravity-type Linen Chutes.

4-5.1.1 All service openings into a linen 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 firmly built into the chute, and the design and installation shall be such that no part of the frame or door will project into the chute. A key shall be required to open the door.

4-5.1.2 The area of each service opening shall not exceed the cross-sectional area of the chute.

4-5.2 Pneumatic Linen and Multi-Loading Pneumatic Linen Handling Systems.

4-5.2.1 The service opening of pneumatic linen handling systems shall be designed to provide proper entrance into the system. It may be equivalent to the cross-sectional area of the duct or greater. The maximum door width shall not be greater than the duct diameter.

4-5.2.2 Pneumatic linen handling systems shall be provided with a service opening consisting of two doors, including an automatic or self-closing, positive-latching outer door, front panel, and frame assembly, approved for Class B openings and having a fire rating of not less than 1 hour. The door frame shall be built firmly into the duct and wall. The system service opening shall be equipped with a second or inner door designed to remain closed at all times under full system pressure unless released by the system control circuit to allow the material placed inside the outer door to enter the duct provided the outer door is closed. However, the door need not be closed for systems designed for multiple bag loading. Only one inner service door shall be open during each cycle.

4-5.2.3 Multi-loading pneumatic linen handling systems shall be provided with a service opening consisting of an automatic or self-closing, positive-latching door front panel and frame assembly approved for Class B openings and having a fire resistance rating of not less than 1 hour. The door frame shall be built firmly into the duct and wall. The door shall be interlocked so that only one door in the chute can be open at the same time and not when discharging the chute.

4-5.2.4 The material damper shall be airtight and shall convey linen waste from the vertical chute to the horizontal duct. The horizontal duct shall not be less than 4 in. (102 mm) in diameter compared to the vertical chute. A level indicator above the material damper shall lock the chute doors when activated. The material damper shall be protected by automatic sprinkler and inspection openings. The inspection openings shall not be less than $^2/_3$ of the cross section of the chute diameter. The height shall be equivalent to the chute diameter.

4-5.3 Combination Gravity-Pneumatic Linen Handling Systems.

4-5.3.1 Each section of a gravity-pneumatic system shall conform to the requirements for the individual type of system.

4-5.3.2 The storage area above the metering valve in a gravity-pneumatic system shall be protected by automatic sprinklers.

4-6 Service Opening Rooms.

4-6.1 Every service opening shall be enclosed 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 to such room or compartment protected by approved self-closing fire doors suitable for Class B openings.

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:

5-1.2.1 Domestic compactors are designed for use in dwellings or individual dwelling units for compaction of family-developed waste.

5-1.2.2 Commercial-industrial compactors used in multiple family or other classes of occupancies may be located indoors or outdoors. They can be chute-fed or hand-fed. Discharge of the compactor may 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 head with a minimum $^1/_2$-in. (13-mm) orifice installed in the hopper of the compactor. This sprinkler shall be an ordinary temperature rating 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 head shall provide a suitable spray into the hopper. An on-off, self-actuating, snap-action, heat-actuated sprinkler may be used, or the sprinkler may 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 do not require installation of an automatic sprinkler in the hopper. Compactors larger than 2 cu yd (1.52 m^3) 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. hose connection fitting 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- or self-closing fire doors suitable for Class B openings.

Chapter 6 Waste Storage Rooms

6-1 Waste storage rooms in a building or structure shall comply with specified requirements for a waste storage room if it is used for the keeping, storage, or handling of waste that is loose, baled, or compacted or in containers in an amount exceeding 3 cu yd (2.29 m^3) (uncompacted measure).

6-2 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- or self-closing fire doors suitable for Class B openings.

6-3 Waste storage rooms shall be provided with automatic sprinklers installed in accordance with NFPA 13, *Standard for the Installation of Automatic Sprinkler Systems*. These sprinklers may be supplied from the domestic water supply. Hand hose of adequate length to reach all portions of the room shall be provided.

Chapter 7 Referenced Publications

7-1 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.

7-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 13-1989, *Standard for the Installation of Sprinkler Systems*

NFPA 30-1987, *Flammable and Combustible Liquids Code*

NFPA 31-1987, *Standard for the Installation of Oil Burning Equipment*

NFPA 54-1988, *National Fuel Gas Code*

NFPA 58-1989, *Storage and Handling of Liquefied Petroleum Gases*

NFPA 70-1990, *National Electrical Code*

NFPA 86-1990, *Standard for Ovens and Furnaces*

NFPA 90A-1989, *Standard for the Installation of Air Conditioning and Ventilating systems*

NFPA 211-1988, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances.*

7-1.2 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM A167-1988, *Specifications for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip*

ASTM A478-1982, *Specifications for Chromium-Nickel Stainless and Heat-Resisting Steel Weaving Wire*

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

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

Appendix A

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

A-2-2.8 Chimneys for Incinerators.

General.

The changing composition of waste and regulations controlling temperatures and emissions has created very aggressive flue gases. Refractories suitable in the past can fail rapidly under existing conditions. There are no single materials or family of materials suitable for ensuring firesafety under all conditions; therefore, no specific materials will be identified. Critical temperatures, aggressive chemical components, and conditions creating aggressive flue gases will be identified. Selection of materials for chimney construction should be based on materials capable of withstanding these conditions.

The 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 when as low as 26 ppm in the 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_2, which is further oxidized to SO_3, which combines readily with water to form sulfuric acid, H_2SO_4. This flue acid is aggressive to most chimney linings.

The acid dew point depends upon the SO_3 content of the flue gases. The maximum theoretical acid dew point is about 400°F (204.4°C). Acid concentration can be up to 80 percent but rapidly self-dilute to 35 percent.

Sulfurous acid is formed when SO_2 combines with water. It condenses as sulfurous acid, H_2SO_3, at the water dew points or about 130°F (54.4°C) but it is not as aggressive as sulfuric or hydrochloric and is, therefore, overshadowed by them.

Nitric acid is condensed in the water dew point area and also is not as aggressive to chimney materials as other flue acids. With stainless steel it pacifies the surface, 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 item.

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

The 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_2O)
potash (K_2O)
lithia (Li_2O)

Increases in plastics that are components of waste increase alkalis in flue gases.

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

Alkali disruption begins at about 1600°F and increases as temperatures approach 2000°F.

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.

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

Free Chlorides and Alkalis – When free chlorides are present with alkalis, these compounds may 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 Mid-Flue Temperature Downstream of Scrubber.

Chimney systems that allow flue surfaces to fall below 200°F will be 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 Fue Gases – Most common metals such as Type 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 exhibited essentially no corrosion attack when subject to flue gases containing 26 ppm hydrochloric acid:

- 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

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

Refractory and Other Linings – Refractory linings suitable downstream of scrubbers must resist all of the condensed flue acids at low temperatures, and will become saturated and must, therefore, resist stresses of expanding steam when temperatures are elevated rapidly. They also must resist thermal shock when heated refractory suddenly is exposed to water.

Products suitable for this service should show 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 Mid-Flue Temperature.

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

Lining suitable for this type service shall 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 shall withstand immersion in 5 percent sulfuric acid for 2000 hours at 70°F with not more than 3 percent weight loss.

Chimney Systems 600°F to 1500°F.

These are the conditions that existed prior to current regulations concerning incineration. This range avoids condensed flue acid and problems with alkali. Refractories used in the past usually were lightweight with continuous service temperatures of 1800°F with excursions to 2000°F.

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 manufacturers instructions.

Chimney Systems 1500°F to 2200°F.

This temperature range requires more Al_2O_3 and less SiO_2 in the chemical composition. The material will be required to meet the temperature limitations of the specific incinerator involved. It will be subject to attack by both alkali and acid vapors, which becomes more severe as density is reduced; thus, high-density low-porosity material is desirable.

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 91-1990, *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying*

NFPA 97M-1988, *Standard Glossary of Terms Relating to Chimneys, Vents, and Heat Producing Appliances.*

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