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NFPA 91 Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying 1990 Edition

National Fire Protection Association 1 Batterymarch Park, Quincy, MA 02269-9101

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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 91

Standard for the Installation of

Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying

1990 Edition

This edition of NFPA 91, *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying*, was prepared by the Technical Committee on Blower 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 91

The National Fire Protection Association as early as 1899 recognized the hazards of blower and exhaust systems. Since 1900 the NFPA Committees on Blower Systems have given continuing attention to the subject. Following World War II, revisions and additions to the standard were recommended by the NFPA Committee on Blower Systems to cover various new developments in the protection of dust collecting systems and stock and refuse conveying systems, and were adopted by the NFPA at its Annual Meetings in 1946, 1947, 1948 and 1949. Editorially revised editions were published in 1959 and 1961. In 1972 Section 200 (Chapter 2) was expanded, and a new Section 500 (Chapter 5), covering systems involving plastic materials, was added. In the 1973 edition, Section 400 (Chapter 4) was completely revised. The 1983 edition was completely updated to conform with the NFPA Manual of Style and incorporated minor revisions in each chapter.

This 1990 edition includes minor revisions to Chapter 2 including a new Figure 2-8 and Table 2-8(b). Changes were made to recognize NFPA 45, *Standard on Fire Protection for Laboratories using Chemicals*, and to remove conflicts with that standard. These changes included moving Section 5-2 and Figures 5-2 through 5-5 to Appendix A.

Technical Committee on Blower Systems

Ralph E. Collins, *Chairman*
R. E. Collins Associates

Ray Hunter, Ray Hunter & Associates Inc.
Rep. AAF

Gerald Myers, Liberty Mutual Insurance Co.
Silvio R. Zuniga, Factory Mutual Research Corp.

Alternates

John H. Stratton, Sheet Metal & Air Conditioning Contractors Nat'l Assn.
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Richard L. Ortisi-Best, NFPA Staff Liaison

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.

Contents

NFPA 91

Standard for the Installation of

Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying

1990 Edition

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 6.

Chapter 1 Introduction

1-1* Scope. This standard is submitted as a guide for the proper installation and safeguarding of these systems, taking into consideration the purpose for which they are intended and the functions that they are designed to perform.

1-2 Purpose. The object of this standard is to eliminate or reduce the known fire and explosion hazards inherent in the operation of these systems and to prevent them from becoming the means of spreading fire.

1-3* Equivalency. 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.

1-4 Retroactivity. This standard is based on product and engineering practices recognized as being acceptable at the date of issue. Therefore, provisions of this standard are not intended to be applied retroactively.

1-5 Definitions.

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."

Blower. A fan used to force air under pressure into a space.

Exhauster. A fan used to withdraw air, gas, or solid materials (dust, refuse, and stock) from a space under suction.

Fan. An assembly comprising blades or runners and housings or casings, and being either a blower or exhauster.

Ducts. Pipes, channels, or other enclosures used for the purpose of conveying air, gas, dust, refuse, or other materials.

Fire Wall. A wall having adequate fire resistance and structural stability under fire conditions to accomplish the purpose of completely subdividing a building or completely separating adjoining buildings to restrict the spread of fire.

Noncombustible Material. A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Materials reported as noncombustible when tested in accordance with the *Standard Method of Test for Noncombustibility of Elementary Materials*, ASTM E-136 (1973), shall be considered noncombustible materials.

Shall. Indicates a mandatory requirement.

Chapter 2 General Requirements

2-1* General. These general requirements apply to systems for removal of flammable vapors (including paint spraying residue); corrosive fumes; and dust, stock, and refuse conveying; except as modified or amplified by the specific rules that follow (Chapters 3 and 4) or by NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, or other standards applying to specific industries or operations.

2-2 Design.

2-2.1 The design of any air moving equipment (AME) shall include adequate consideration of stock to be handled, its physical and chemical properties, and its hazard classification. Two or more materials to be handled by the same AME require further consideration by the designer to determine

if the mixture of two or more materials will be compatible, such as one dust with another dust, flammable vapor with a dust, or a dust with limited amounts of flammable vapors.

2-2.2 The design, construction, workmanship, and installation of the duct and system components that conform to the Industrial Ventilation – A Manual of Recommended Practices, published by the American Conference of Governmental Industrial Hygienists, are acceptable unless otherwise modified by this standard.

2-2.3 The engineer who designs the blower system shall coordinate the plans with the architect and structural engineer with respect to construction features.

2-3* Maintenance Responsibility.

2-3.1 An adequate maintenance program for all air moving equipment (AME) requires a periodic inspection over its entire length, from entrance to exhaust hood for duct system to point of discharge, including the roof area where air is discharged outdoors.

2-3.2 There shall be an adequate check of the entire AME, including each blower unit, its operating control panel, fume scrubbers, and especially any fire damper for proven tightness when closed, and all flexible connections to determine their tightness.

2-3.3 The responsibility for proper maintenance rests with each plant manager, who may assign the daily work to a person trained in this type of work. Such maintenance shall include the determination that a special protection for duct systems is fully operable and that plant automatic sprinkler protection is in service.

2-4 Approvals, Plans, and Specifications.

2-4.1 Before new equipment is installed or existing equipment remodeled, complete working plans and specifications shall be submitted for approval to the authority having jurisdiction. Plans shall be drawn to an indicated scale and show all essential details as to location, construction, ventilation duct work, volume of outside air at standard temperature and pressure introduced for safety ventilation, and control wiring diagrams. The plans shall include a list of all equipment giving manufacturer and type number and show the following data:

Name of owner and occupant

Location, including street address

Point of compass

Ceiling construction

Full height cross section

Location of fire walls

Location of partitions

Materials of duct construction

2-5 Power and Control.

2-5.1 All electrical equipment shall be installed in accordance with NFPA 70, *National Electrical Code®*.

2-5.2 Motors shall be located outside of rooms in which flammable vapors or flammable dust are being generated and removed, unless of the type approved for the particular conditions or hazard. Where necessary to install switches or other electrical apparatus in areas where explosive atmospheres might be created, only such equipment as is approved for the specific conditions shall be used. (*See Article 500 of the National Electrical Code.*)

2-5.3 Remote control of all blower or exhaust fans shall be provided in addition to any control located adjacent to the equipment.

2-6 Fans.

2-6.1* Fans shall be of noncombustible construction and of adequate capacity to properly perform the functions required.

2-6.2 Fans shall be so located and arranged as to afford ready access for repairing, cleaning, inspecting, and lubricating. They shall be placed on proper foundations or firmly secured to substantial supports.

2-6.3* Where flammable solid materials or vapors are passed through fans, the rotating element and the casing shall be constructed of compatible materials that are unlikely to cause ignition by friction or impact between the rotating elements and the casing.

2-6.4 Where there is a probability of solid foreign material passing through the fan, both the rotating element and the casing shall be constructed of materials that are unlikely to produce a spark upon impact with the foreign material.

2-6.5 Housings or casings shall be of substantial construction to prevent distortion and loss of alignment under operating conditions.

2-6.6 Blades or impellers and shafting shall be sufficiently strong and designed with adequate clearance to prevent contact with casings or prevent distortion under conditions of deposit loading or other factors.

2-6.7 Exposed openings into housings shall be protected with substantial metal screens or gratings to prevent accidents or the entry of foreign material.

2-6.8 Bearings shall be constructed in accordance with the best modern practice and shall be so proportioned, secured, and aligned as to prevent overheating. Bearings shall be accessible for lubrication and shall be well designed to prevent leakage of oil and minimize dust infiltration. They shall be located outside of casings and ducts unless proper shielding and dustproofing are provided.

2-7 Ducts.

2-7.1 Except as provided in Chapter 5, ducts shall be constructed entirely of sheet metal or other noncombustible material, shall be of adequate strength and rigidity to meet the conditions of service and installation requirements, and shall be properly protected where subject to mechanical injury. Minimum thickness for metal ducts is specified in 3-3.3, 4-3.1, and 4-3.2.

2-7.2 The entire duct system shall be self-contained. No rooms or portions of the building shall be used as an integral part of the system unless constructed of noncombustible material, and such design and arrangement shall be subject to the approval of the authority having jurisdiction.

2-7.3 All ducts shall be made reasonably tight throughout and shall have no openings other than those required for the proper operation and maintenance of the system.

2-7.4 All ducts, whether inside or outside of buildings, shall be thoroughly braced where required and substantially supported by metal hangers or brackets.

2-7.5 Where ducts are used for conveying explosive gases or dust, the supports shall be designed to afford strength and rigidity against disruption.

2-7.6 All laps in the piping shall be made in the direction of the air flow.

2-7.7 Changes in size of ducts shall be by means of a taper transformation piece, the included angle of the taper being not more than 30 degrees.

2-7.8 The passing of ducts through fire walls shall be avoided wherever possible (*see definition of fire wall, Section 1-5*). When ducts or the outlets from or inlets to them pass through fire walls, they shall be provided with automatic closing fire doors on both sides of the wall through which they pass. (*See Figures 2-1 and 2-2.*)

Exception: For smaller openings not exceeding 18 in. (457 mm) in diameter, 3/8-in. (9.5-mm) steel plates may be used in lieu of fire doors, or fire dampers listed by a recognized testing laboratory may be used in accordance with the conditions of their listing.

2-7.9 Actuation of fire doors shall be by fusible links or other approved thermal units, such units to be located on both sides of the fire wall.

2-7.10 Where ducts pass through fire or smoke rated barriers, the space around the duct shall be sealed with a listed or approved material to prevent the passage of flame and smoke.

2-7.11 Exhaust systems shall be designed with an adequate number of access panels for examining and cleaning of the duct system as well as for manual fire fighting. Hand holes for damper, sprinkler, or fusible link inspection or resetting and for residue clean-out purposes shall be equipped with tight fitting sliding or swinging doors provided with substantial latches, except in the case of vertical sliding doors held in place by gravity.

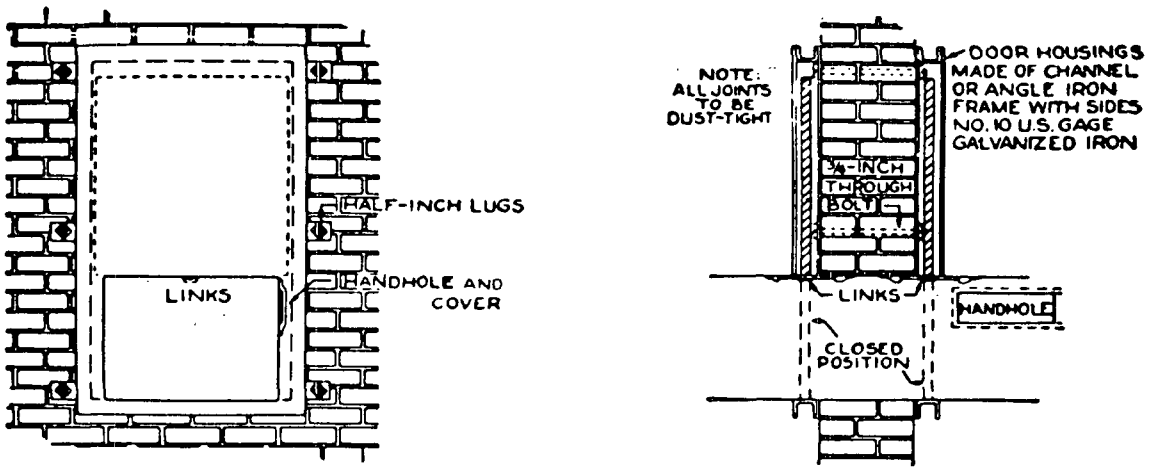


Figure 2-1 Suggested type of vertical fire door for duct passing through opening in fire wall.

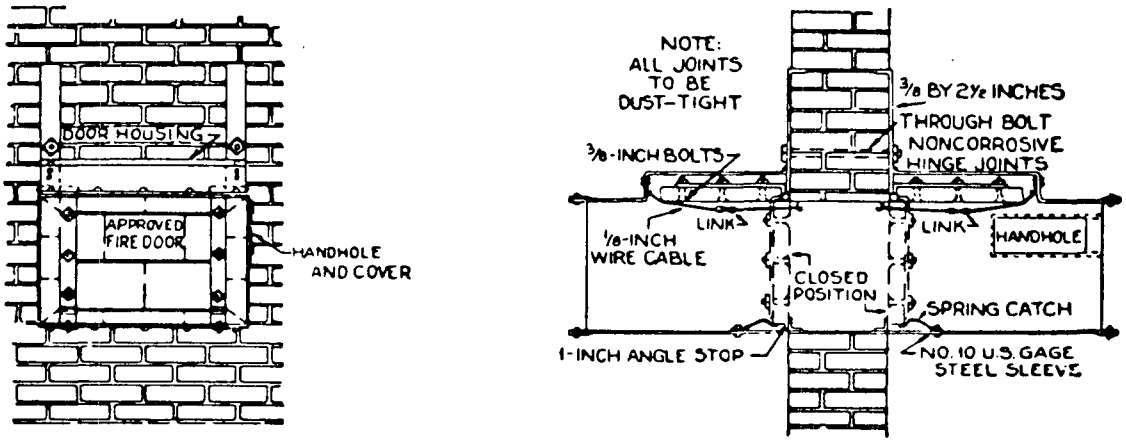


Figure 2-2 Suggested type of automatic hinged fire door for duct passing through opening in fire wall.

2-8 Duct Clearances.

2-8.1 All duct systems handling noncombustible materials and operating at approximately room temperature shall have a clearance of at least 6 in. (152 mm) from stored combustible materials, and not less than 1/2-in. (12.7-mm) clearance from combustible construction even though flameproofed, fire-retardant treated, or plastered.

2-8.2 Duct systems handling combustible material shall have a clearance of not less than 18 in. (457 mm) from combustible construction or any combustible material.

Exception No. 1: If a duct system is equipped with an approved automatic extinguishing system designed for the specific hazard, clearance may be as provided in 2-8.1.

Exception No. 2: Clearances from ducts to combustible material may be reduced if the combustible material is protected by an engineered protection system acceptable to the authority having jurisdiction, or by the use of materials or products listed for protection purposes, or in accordance with Table 2-8(b).

2-8.3 Duct systems operating at elevated temperatures [above 100°F (37.7°C)] shall have clearance from combustible building construction or any combustible material not less than shown in Table 2-8(a).

2-8.3.1 The clearance to combustible construction for ducts handling materials not in excess of 900°F (482°C) may be reduced provided the combustible construction is protected as described in Table 2-8(b).

2-8.3.2 Ducts handling materials at temperatures in excess of 900°F (482°C) shall be lined with refractory material or the equivalent.

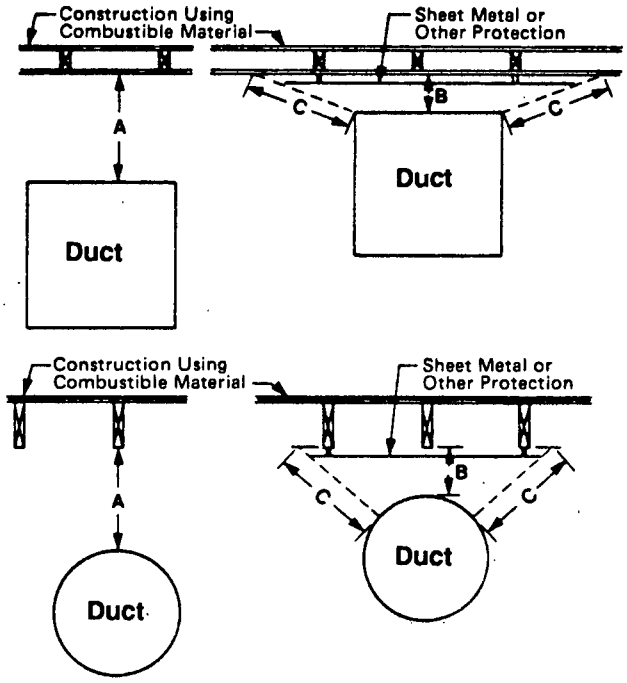
2-8.4 For clearance reduction systems using an air space between the combustible wall and the wall protector, adequate air circulation shall be provided by one of the following methods.

2-8.4.1 Adequate air circulation may be provided by leaving all edges of the wall protector open with at least a 1-in. (25.4-mm) air gap.

2-8.4.2 If the wall protector is mounted on a single flat wall away from corners, adequate air circulation may be provided by leaving only the bottom and top edges or only the side and top edges open with at least a 1-in. (25.4-mm) air gap.

2-8.4.3 Wall protectors that cover two walls in a corner shall be open at the bottom and top edges with at least a 1-in. (25.4-mm) air gap.

2-8.5 All clearances shall be measured from the outer surface of the combustible material to the nearest point on the surface of the duct, disregarding any intervening protection applied to the combustible material.



A equals the required clearance with no protection.
B equals the reduced clearance permitted.
The protection applied to the construction using combustible material shall extend far enough in each direction to make C equal to A.

Figure 2-8 Extent of protection required to reduce clearances from ducts.

Table 2-8(a) Clearances

Duct Gas Temperature	Largest Duct Dimension	Clearance
100°–600°F (38°–315°C) incl.	8 in. (203 mm) Over 8 in. (203 mm)	8 in. (203 mm) 12 in. (305 mm)
Over 600°–900°F (315–482°C) incl.	8 in. (203 mm) Over 8 in. 203 mm)	18 in. (457 mm) 24 in. (610 mm)
Over 900°F (482°C)	All ducts lined with refractories	24 in. (610 mm)

NOTE: Minimum clearance of 18 in. (457 mm) if material in the duct is a combustible material.

Table 2-8(b) Reduction of Duct Clearance with Specified Forms of Protection[1, 2, 3, 4, 5, 6, 7]

Clearance reduction applied to and covering all combustible surfaces within the distance specified as required clearance with no protection in Section 2-8 and Table 2-8(a).	Maximum allowable reduction in clearance (percent)[7]	
Form of Protection	**As Wall Protector**	**As Ceiling Protector**
(a) 3½ in. (90 mm) thick masonry wall without ventilated air space	33%	–
(b) ½ in. (13 mm) thick non-combustible insulation board over 1 in. (25 mm) glass fiber or mineral wool batts without ventilated air space.	50%	33%
(c) 0.024 in./0.61 mm (24 gage) sheet metal over 1 in. (25 mm) glass fiber or mineral wool batts reinforced with wire, or equivalent, on rear face with at least a 1 in. air gap.	66%	50%
(d) 3½ in. (90 mm) thick masonry wall with at least a 1 in. air gap.	66%	–
(e) 0.024 in./0.61 mm (24 gage) sheet metal with at least a 1 in. air gap.	66%	50%
(f) ½ in. (13 mm) thick noncombustible insulation board with at least a 1 in. air gap.	66%	50%
(g) 0.024 in./0.61 mm (24 gage) sheet metal with ventilated air space over 0.024 in./0.61 mm (24 gage) sheet metal with at least a 1 in. air gap.	66%	50%
(h) 1 in. (25 mm) glass fiber or mineral wool batts sandwiched between two sheets 0.024 in./0.61 mm (24 gage) sheet metal with at least a 1 in. air gap.	66%	50%

[1]Spacer and ties for protection materials shall be of noncombustible material. No spacers or ties shall be used directly behind the duct.

[2]With all clearance reduction systems using a ventilated air space, adequate air circulation shall be provided as described in 2-8.4. There shall be at least 1 in. (25 mm) between the clearance reduction system and combustible walls and ceilings for clearance reduction systems using a ventilated air space.

[3]Mineral wool batts (blanket or board) shall have a minimum density of 8 lb per ft^3 (128.7 kg/m^3) and have a minimum melting point of 1500°F (816°C).

[4]Insulation material used as part of clearance reduction system shall have a thermal conductivity of 1.0 (Btu-in.)/sq ft-hr-°F) or less. Insulation board shall be formed of noncombustible material.

[5]There shall be at least 1 in. (25 mm) between the duct and the protector. In no case shall the clearance between the duct and the wall surface be reduced below that allowed in the table.

[6]All clearances and thicknesses are minimum: larger clearances and thicknesses are acceptable.

[7]To calculate the minimum allowable clearance, the following formula may be used:
$C_{pr} = C_{wm} \times (1 - R/100)$.

2-9 Protection Against Static Electricity.

2-9.1 All metal parts of apparatus, used in systems for the removal of flammable gases or vapors, or systems used for conveying combustible or flammable dust, stock or refuse, considered in these requirements, including fans, ducts, etc., as well as shafting in connection therewith, shall be electrically bonded and grounded in an effective and approved manner. (*See NFPA 77, Recommended Practice on Static Electricity.*)

2-9.2 When metallic contact is broken at duct joints or at other points on the installation assembly, metallic straps, preferably of copper, shall be installed where necessary to afford effective bonding connections.

2-9.3 When systems are used for the handling of flammable gases or vapors or combustible or flammable dust, stock, or refuse, static electricity shall be removed from belts by grounded metal combs or other effective means. (*See recommendations of NFPA 77, Recommended Practice on Static Electricity.*)

2-10 Fire Extinguishing Apparatus, Manual or Automatic.

2-10.1* The provision of automatic or special extinguishing equipment for systems handling flammable vapors or combustible materials shall be subject to the authority having jurisdiction.

2-10.2 For specific recommendations, see Chapter 5 covering the particular type of materials being handled, as well as the applicable NFPA standards for the specific materials. (*See Section 2-1.*)

2-10.3* For installation of a particular type of fire protection system, see the applicable NFPA standard for that system. For other protection systems, the installation shall be subject to the authority having jurisdiction.

2-10.4 When a sprinkler system is installed, adequate means shall be provided to prevent water accumulation in the duct or flow of water back to a process subject to damage by water.

Chapter 3 Systems for Removal of Flammable Vapors

3-1 General.

3-1.1 Where systems of this class are installed, the following rules and the preceding general rules except as modified herein shall apply. (*See Section 2-1.*)

3-1.2* Due to the hazardous nature of the vapors to be removed, it is important that they be withdrawn from the rooms or equipment in which they are generated and taken to the outside of the building in the most direct manner possible.

3-1.3 Exhaust outlets to the atmosphere shall extend above or away from surrounding structures to prevent accumulation of combustible residues on such structures.

3-2 System Design.

3-2.1 In the design of any vapor removal system, control at the point of generation shall be provided wherever possible. Such systems shall consist of hoods or enclosures connected to suction ducts. They are more positive and require lower exhaust volumes than general ventilation through remote suction openings.

Exception: When flammable vapors are so generated that they cannot be readily picked up at the source, general ventilation through a system of suction ducts with inlets to the room or area may be employed. As suction inlets have but little directional effect beyond a few inches from the face of the inlet, such inlets should be located to best produce a sweeping or purging effect that will tend to avoid pockets in which vapors may accumulate. An air supply system properly located with reference to point of vapor generation and exhaust openings will be beneficial in vapor dilution and removal.

3-2.2 In addition to the requirements of 3-2.1, where heavier than air vapors or mixtures are handled, exhaust openings located near the floor line shall be required. Conversely, for vapors or mixtures lighter than air, exhaust system inlets shall be located near the top of the room, hood, or enclosure.

3-2.3 Outlets to the atmosphere shall be kept clear of and away from any combustible material.

3-3 Ducts.

3-3.1 Ducts installed under this classification shall be independent structures, and not built in the walls. Exhaust ducts shall lead to the outside of the building as directly as possible and never through intermediate rooms.

3-3.2 The installation of dampers, valves, and shutters in this type of system is not advisable. However, these devices may be necessary at outlets to afford weather protection when the system is shut down or where such devices are used for the final balancing of the exhaust system. In such cases the dampers shall be securely locked to prevent further manipulation or complete shutoff.

3-3.3 Ducts shall be so constructed as to provide structural strength and stability at least equivalent to sheet steel of not less than the following thicknesses:

In Greatest Dimension	
Up to 8 in. (203 mm) incl.	No. 24 U.S. gage
Over 8 in. (203 mm) to 18 in. (457 mm) incl.	No. 22 U.S. gage
Over 18 in. (457 mm) to 30 in. (762 mm) incl.	No. 20 U.S. gage
Over 30 in. (762 mm)	No. 18 U.S. gage

3-3.4 Material for duct lining shall be noncombustible.

3-3.5 No dissimilar matter shall be handled through one exhaust system when the intermingling or contact of one type of material with another would create a fire or explosion hazard in the duct system, collection unit, or airflow producing equipment. Operations generating sparks, such as from hot materials or grinding wheels, shall not be consolidated in the same exhaust system that handles flammable or explosive matter.

Chapter 4 Duct Systems for Moving, Conveying, or Transporting Stock, Vapor, or Dust

4-1 General.

4-1.1* The proper design and installation of ducts and system components are necessary for the moving, conveying, or transporting of stock, vapors, or dust. (*Also see Section 2-10.*)

4-1.2 Except as provided in Chapter 5, ducts shall be constructed entirely of metal or other noncombustible material and of adequate strength and rigidity to meet the conditions of service and installation requirements. The sheet metal duct system shall be properly protected where subject to mechanical damage.

4-1.3 All duct systems shall be installed in a permanent and workmanlike manner.

4-2 System Design.

4-2.1 In systems handling combustible materials or flammable vapors, the air moving equipment (AME) shall comply with Section 3-3 and be located on the clean air side of the collector.

4-2.2 Conveying systems for cotton and similar textile materials that are readily ignitable shall be designed so as not to create suction in machines producing the material.

4-2.3 Rooms or bins into which readily ignitable material is discharged by a collecting or conveying system shall be of noncombustible or fire-resistive construction. Such rooms or bins shall be provided with explosion vents in accordance with NFPA 68, *Guide for Venting of Deflagrations.*

4-2.4 The use of a trap at the junction of a hood or a branch duct shall be subject to the authority having jurisdiction and shall be so arranged that it cannot be filled completely with dust or stock.

4-2.5 Approved magnetic separators of the permanent magnetic or electromagnetic types shall be installed at those points where combustible materials that contain foreign ferrous particles enter the system. The separators shall be of sufficient size to ensure the removal of all ferrous materials passing over them.

4-3 Construction.

4-3.1 The materials, thickness, construction, and installation of ducts shall provide structural strength and durability in conformance with recognized good practice. Ducts shall be deemed as meeting the intent of this section if constructed and installed in accordance with:

(a) Industrial Ventilation – A Manual of Recommended Practices. (*See 2-2.2.*)

(b) The ASHRAE Handbook and Products Directory, 1979 Equipment.

(c) Round Industrial Duct Construction Standards (1977) and Rectangular Industrial Duct Construction Standards (1980), the Sheet Metal and Air Conditioning Contractors National Association.

4-3.2 Metal ducts shall be constructed of sheet steel of not less than the following gages (*see references in 4-3.1*):

Table 4-3.2

Diameter of Straight Ducts	U.S. Standard Gage for Steel Duct Class I	Class II	Class III
Up to 8 in. (203 mm)	24	22	20
Over 8 in. (203 mm) to 18 in. (457 mm)	22	20	18
Over 18 in. (457 mm) to 30 in. (762 mm)	20	18	16
Over 30 in. (762 mm)	18	16	14

Class I: Includes nonabrasive applications such as paint spray, woodworking, pharmaceutical and food products, and discharge ducts from dust collectors.

Class II: Includes nonabrasive materials in high concentrations (low pressure pneumatic conveying); moderately abrasive materials; and highly abrasive materials in light concentrations. Typical examples are conveying of chemicals and wood dusts; exhaust of foundry shakeouts and sand-handling systems; grain dusts; coal crushing, screening, and grinding; and buffing and polishing.

Class III: Includes all highly abrasive materials in moderate to heavy concentrations and moderately abrasive materials in heavy concentrations, such as low pressure conveying of tobacco, exhaust systems from sand and grit blasting, abrasive cleaning operations, rock and ore screening, crushing dryers and kilns, and fly ash from boiler stacks.

4-3.3 The main suction and discharge ducts shall be made as short as practicable.

4-3.4 Every duct shall be kept open and unobstructed throughout its length, and no screen shall be placed in it.

4-3.5 Additional branch ducts shall not be added to an existing system without redesigning the system. Branch ducts may not be disconnected nor unused portions of the system be blanked off without providing orifice plates to maintain required airflow.

4-3.6 When flexible duct section is necessary, it shall be a type that will not restrict the airflow, will be as short as possible, and number of flexible sections shall be kept to a minimum.

4-4 System Details.

4-4.1 Acceptable longitudinal seams of ducts are continuous welded, lapped and riveted, or spot welded on 3 in. (76 mm) centers maximum.

Exception: Double-lock seams may be used on Class I ducts.

4-4.2 Lapped girth joints of ducts shall be made with the inner lap in direction of airflow, with 1 in. (25.4 mm) lap for diameters 19 in. (483 mm) or less and with 1¼ in. (32 mm) laps for diameters over 19 in. (483 mm).

4-4.3 Hoods shall be free of sharp edges or burrs and reinforced to provide necessary stiffness.

4-4.4 Equipment vibration shall be considered as discussed in reference documents in 4-3.1.

4-4.5 Transitions in mains and submains are to be tapered; the taper shall be 5 in. (127 mm) long for 1 in. (25.4 mm) change in diameter.

4-4.6 Access openings or cleanouts shall be provided as necessary for proper maintenance of equipment near each elbow, change of direction of more than 15 degrees, or duct junction in horizontal sections, except for systems with noncorrosive gases and vapors containing no particulate matter.

4-4.7 Where blast gates are used for adjustment of the system, they shall be located near the connection of the branch to the main. A means of locking the blast gates after adjustments have been made shall be provided. Butterfly dampers shall not be permitted.

4-4.8 When transporting stock or dust, rectangular ducts may be used only when clearance prevents the use of round ducts. Rectangular ducts shall be made as nearly square as possible. Construction details are to be equal to round duct construction whose diameter equals the longest side.

Chapter 5 Plastic Systems for Removal of Nonflammable Corrosive Fumes and Vapors

5-1 General.

5-1.1* Duct systems of plastic material may be used to handle only nonflammable corrosive fumes and vapors when conventional metal duct systems will not be adequate. The choice of the material type is the responsibility of the design engineer, but contained herein are minimum standards of materials, construction, and workmanship deemed necessary to ensure minimum fire hazard in the operation of these systems. All chemical-resistant plastics have heat limitations that must be considered when designing a system.

5-1.2 Environments containing oxidizers classed by NFPA 43A, *Code for the Storage of Liquid and Solid Oxidizing Materials*, as Class 2, 3, or 4, or Class 1 oxidizers that can deposit residue in the duct shall not be handled in plastic ducts.

5-1.3 The plastic shall have a flame spread rating of 25 or less as measured in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

5-1.4 Plastic duct material used in multistory buildings or that runs through concealed spaces other than fire-rated vertical shafts shall have a smoke developed rating of 50 or less, unless the duct system is protected externally by an approved automatic sprinkler system.

5-2 Installation.

5-2.1 The ducts shall lead to the outside as directly as practicable. They shall not penetrate fire walls or fire rated floors. When penetrating a fire rated shaft wall or fire partition, the opening shall be protected by a fire damper, protected against corrosion from the agent being conveyed.

5-2.2 Manifold systems shall be limited to 50,000 cfm (23.6 cubic meters per second) capacity, except when special process engineering considerations necessitate larger manifolded systems. Such systems shall be designed by a registered professional engineer.

5-2.3 Flexible Connections. Vibration isolation between duct work and air moving equipment can be accomplished by flexible connections at the inlet and discharge of the equipment. Corrosion resistance, smoke developed rating, and flame spread rating of these connections shall be at least equal to that of the material of the duct system.

5-2.4 All hoods and air moving equipment surfaces that are part of the system shall have flame spread rating at least equal to the material of the duct system. Design and workmanship shall meet all physical requirements and shall conform to the general sections of this standard.

5-2.5 Hangers and Supports. Duct work shall be supported in accordance with the engineer's specifications and recommendations. In locations where hangers are exposed to corrosive atmosphere adjacent to hoods, tanks, or other process equipment, hanger material and hardware shall be Type 316 stainless steel or equal. In locations where hangers are not subject to corrosive fumes, other steel with rust protection shall be provided. Hangers and supports shall be securely fastened to the building or structure to avoid vibration. Care shall be taken in supporting the ductwork to avoid creating conditions of stress on the material in the finished installation.

5-3* Fire Protection.

5-3.1 Automatic protection shall be provided at the duct intake, hood, canopy, and the immediate areas thereof to quickly extinguish source fires. (*See NFPA Standards 11, 11A, 12, 12A, 12B, 13, 15, 17, 17A.*)

5-3.2 Sensing elements provided at these aforementioned sources shall be arranged to shut down the blower system. This automatic shutdown may be waived if fire control can be improved through continued operation.

5-4 Identification. Plastic duct components shall be identified as to the manufacturer, type of material, flame spread rating, and smoke-developed rating.

5-5 Maintenance Responsibility. After a system is installed and turned over to the owner or operator, it is important that the system is maintained in good operating condition. This responsibility entails periodic inspection of all components at least twice each year. Inspections shall include at least the following parts of the system:

Hood face velocity for all types of hoods

Clean filters in filter boxes

Proper function of fume scrubbers

Proper operation of air moving equipment, including greasing of bearings and replacement of worn belts on drives

Fan discharge stack

Gravity-operated back draft dampers

Motor-operated close off dampers

Manual balancing dampers

Flexible connections at inlet and discharge of air moving equipment

Fire dampers

Access doors

Duct and equipment hangers and supports.

5-6 Reinforced Thermosetting Plastic Duct

5-6.1* The generic term "reinforced thermosetting plastic duct" can refer to many plastic materials. In commercial practice, reinforced thermosetting plastic duct construction is largely confined to glass-fiber reinforced thermosetting polyester, fabricated to the Department of Commerce voluntary Standard PS-15-69.

5-6.2 System Design.

5-6.2.1 The construction, workmanship, and assembly of the duct and hoods shall conform to the Department of Commerce Standard PS-15-69. Other related methods, such as filament winding, may be considered acceptable provided they are shown to afford the same overall strength and chemical resistance that would be obtained with a contact molded laminate meeting the specified thickness of PS-15-69.

5-6.2.2 The mechanical properties of all laminates shall conform to Table 5-6.2.2 taken from PS-15-69.

Table 5-6.2.2
Requirements for Properties of Reinforced-Polyester Laminates

Property at 73.4°F (23°C)	Thickness [in. (mm)] 1/8 to 3/16 (3.2 mm to 4.8 mm) psi	1/4 (6.5 mm) psi	5/16 (8 mm) psi	3/8 and up (9.6 mm) psi
Ultimate tensile strength-minimum	9,000	12,000	13,500	15,000
Flexible strength-minimum	16,000	19,000	20,000	22,000
Flexural modulus of elasticity (tangent)-minimum	700,000	800,000	900,000	1,000,000

For SI Units: 1 psi = 6.89 kPa

5-6.2.3 The size of round duct shall be determined by the inside diameter in inches (mm). Unless otherwise specified, the tolerance shall be ± 1/16 in. (1.6 mm) for ducting up to and including 6 in. (152 mm) diameter, and ± 1/8 in. (3.2 mm) or ± 1 percent, whichever is greater, for ducting exceeding 6 in. (152 mm).

5-6.2.4 The size of rectangular ducting shall be determined by the inside dimensions. The tolerances shall be ± 3/16 in. (4.8 mm) for dimensions up to 18 in. (457 mm) and under; ± 1 percent for dimensions over 18 in. (457 mm).

5-6.2.5 The minimum thickness of round, contact molded duct shall be in accordance with Table 5-6.2.5 taken from PS-15-69. For rectangular ducting, the minimum thickness shall be specified as in Table 5-6.2.5, substituting the longer side for the diameter.

5-6.2.6 The maximum deflection of a side on a rectangular duct shall not exceed 1 percent of the width of the side under operating conditions. Ribs or other special construction shall be used to meet the deflection requirement.

5-6.2.7 Other design details, such as fittings, flanges, methods of joining, etc., are to conform to PS-15-69.

5-6.2.8 For cleanouts and other general requirements see Chapter 2.

5-7 Thermoplastics.

5-7.1 Thermoplastic materials are a separate group of plastics from the thermosets outlined in Section 5-6. Thermoplastics have in common a number of chemical, physical, and mechanical properties that make them suitable to application on exhaust systems conveying corrosive agents.

5-7.2 Materials used in the fabrication of the system components shall conform to ASTM-D-1784-81 under cell classifications 12454-B (for Type I Grade I), 12454-C (for Type I Grade II) and 23447-B (for Type IV). Base product standards are as follows:

Laminated Sheet	ASTM D-1927-81
Pressure Rated	ASTM D-1785-82
Extruded Pipe and Duct	ASTM D-2241-82

5-7.3 System Design.

5-7.3.1 Round Duct Work.

5-7.3.1.1 Round duct work can be fabricated from sheet material by heating the material to a pliable state and forming it over cylindrical mandrels. After forming the duct section, the longitudinal seam must be welded. Round duct also is available as an extruded, seamless tube starting at 6-in. (152 mm) diameter in 1-in. (25.4-mm) increments through 12-in. (305-mm) diameter, as well as 14-in. (356-mm) diameter and 16-in. (406-mm) diameter. Minimum wall thickness for round duct shall be in accordance with the following table:

Inside Duct Diameter	Minimum Wall Thickness
Up to 18 in. (457 mm)	1/8 in. (3.2 mm)
19 to 30 in. (483 mm to 762 mm)	3/16 in. (4.8 mm)
31 to 54 in. (787 mm to 1372 mm)	1/4 in. (6.5 mm)
55 to 72 in. (1397 mm to 1829 mm)	1/4 in. (6.5 mm) with 2 in. (51 mm) wide girth straps on 4 ft (1.22 m) centers.

Table 5-6.2.5
Reinforced-Polyester Round Duct Dimensions
(For SI Units: 1 ft = .3048 m; 1 in. = 25.4 mm)

I.D. inches	Wall Thickness (Min.) inches	Allowable Vacuum[2] inches of water	Allowable Pressure[1] inches of water	Flange Diameter (O.D.) inches	Flange Thickness inches	Bolt Circle Diameter inches	Bolt Hole Diameter inches	No. of Bolt Holes
2	0.125	405	750	6 3/8	1/4	5	7/16	4
3	0.125	405	500	7 3/8	1/4	6	7/16	4
4	0.125	210	410	8 3/8	1/4	7	7/16	4
6	0.125	64	350	10 3/8	1/4	9	7/16	8
8	0.125	30	180	12 3/8	1/4	11	7/16	8
10	0.125	16	340	14 3/8	3/8	13	7/16	12
12	0.125	9	280	16 3/8	3/8	15	7/16	12
14	0.125	7	220	18 3/8	3/8	17	7/16	12
16	0.125	6	290	20 3/8	1/2	19	7/16	16
18	0.125	5	240	22 3/8	1/2	21	7/16	16
20	0.125	5	190	24 3/8	1/2	23	7/16	20
24	0.187	9	140	28 3/8	1/2	27	7/16	20
30	0.187	7	100	34 3/8	1/2	33	7/16	28
36	0.187	5	70	40 3/8	1/2	39	7/16	32
42	0.250	10	120	46 3/8	5/8	45	7/16	36
48	0.250	9	100	54 3/8	5/8	52	9/16	44
54	0.250	7	80	60 3/8	5/8	58	9/16	44
60	0.250	6	60	66 3/8	5/8	64	9/16	52

[1] Based on 10 ft (3.04 mm) lengths between stiffener rings for vacuum service. These ratings are suitable for use up to 180° F (82.2° C) in pressure service and ambient atmospheric temperatures on vacuum service. For ratings at higher temperatures consult the manufacturer.

5-7.3.1.2 Elbows and bevels shall have a minimum centerline radius of 1 1/2 times the duct diameter whenever possible. Elbows shall have at least five sections, and bevels shall be pieced accordingly. Molded, vacuum-formed, or die-formed elbows and bevels with a centerline radius of 1 1/2 times the duct diameter also are acceptable. Transition fittings in mains and submains are to have a taper of 5 in. (127 mm) in length for each 1-in. (25.4-mm) change in diameter wherever possible. Branch ducts shall tee into the main at the large end of the transition at an angle not exceeding 45 degrees. Branch tees shall not be placed directly opposite each other.

5-7.3.2 Rectangular Duct Work.

5-7.3.2.1 Rectangular duct sections shall be uniform throughout their length with formed corner construction for maximum strength. Welded corner seams are to be avoided unless some special condition necessitates welded corner construction. Rectangular ducts shall have minimum wall thickness in accordance with the following table:

Longer Side	Minimum Wall Thickness
Up to 18 in. (457 mm)	1/8 in. (3.2 mm)
19 to 30 in. (483 mm to 762 mm)	3/16 in. (4.8 mm)
31 to 48 in. (787 mm to 1219 mm)	1/4 in. (6.5 mm)
49 to 60 in. (1244 mm to 1524 mm)	1/4 in. (6.5 mm) with angle or T-bar reinforcing on 4-ft (1.22-m) centers.
61 in. (1549 mm) and up	1/4 in. (6.5 mm) with angle or T-bar reinforcing on 2-ft (0.61-m) centers

5-7.3.2.2 Elbows and bevels can be either formed corner construction or welded corner seams. Whenever possible, elbows are to have a centerline radius equal to 1 1/2 times the depth of the duct. Where space limitation or other conditions necessitate the use of square backed and square throated elbows, turning vanes shall be installed to minimize the system static pressure. Transitions shall be formed corner construction wherever possible. Branch ducts shall tie into mains close to the large end of transitions at an angle not exceeding 45 degrees. Branch tees shall not be positioned directly opposite one another on a main or submain.

5-7.3.3 Welding. Welding shall be done by the hot gas fusion method utilizing filler rod of the same base materials being joined. Welding shall be performed by workmen adequately trained in the art of thermoplastic welding based on ASTM D-1789-65, and by the American Welding Society, 2501 N.W. 7th Street, Miami, FL 33125, in their *Welding Handbook*, Section 38, Sixth Edition, Chapter 56.

5-7.3.4 System Components Connections. Component parts of the system shall be connected together in such a manner that the system will be approximately equal in strength and rigidity to each individual section, or as recommended by the engineer.

Chapter 6 Referenced Publications

6-1 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.

6-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 11-1988, *Standard for Low Expansion Foam and Combined Agent Systems*

NFPA 11A-1988, *Standard for Medium-and High-Expansion Foam Systems*

NFPA 12-1989, *Standard on Carbon Dioxide Extinguishing Systems*

NFPA 12A-1989, *Standard on Halon 1301 Fire Extinguishing Systems*

NFPA 12B-1985, *Standard on Halon 1211 Fire Extinguishing Systems*

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

NFPA 15-1985, *Standard for Water Spray Fixed Systems for Fire Protection*

NFPA 17-1990, *Standard for Dry Chemical Extinguishing Systems*

NFPA 17A-1990, *Standard for Wet Chemical Extinguishing Systems*

NFPA 43A-1980, *Code for the Storage of Liquid and Solid Oxidizing Materials*

NFPA 45-1986, *Standard on Fire Protection for Laboratories Using Chemicals*

NFPA 68-1988, *Guide for Venting of Deflagrations*

NFPA 70-1990, *National Electrical Code*

NFPA 77-1988, *Recommended Practice on Static Electricity*

NFPA 255-1984, *Standard Method of Test of Surface Burning Characteristics of Building Materials*

6-1.2 Other Publications.

6-1.2.1 ACGIH Publication. American Conference of Governmental Industrial Hygienists, Bldg. D-5, 6500 Glenway Ave. B, Cincinnati, OH 45211.

Industrial Ventilation — A Manual of Recommended Practices

6-1.2.2 ASHRAE Publication. American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1791 Tullie Circle, N.E., Atlanta, GA 30329.

Handbook and Product Directory 1979 Equipment

6-1.2.3 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D-1784-81, *Specification for DOD Adopted Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds*

ASTM D-1785-89, *Specification for DOD Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120*

ASTM D-1789-65, *Test Method For Welding Performance of Poly (Vinyl Chloride) Structures*

ASTM D-1927-81, *Specifications for Rigid Poly (Vinyl Chloride) Plastic Sheet*

ASTM D-2241-89, *Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)*

ASTM E-136-82, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*

6-1.2.4 AWS Publication. American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, FL 33135.

Welding Handbook, Sixth Edition

6-1.2.5 SMACNA Publications. Sheet Metal and Air-Conditioning Contractors National Association, P.O. Box 70, Merrifield, VA 22116

Round Industrial Duct Construction Standards, 1977

Rectangular Industrial Duct Construction Standards, 1980

6-1.2.6 U.S. Government Publication.

Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

PS-15-69 U.S. Dept. of Commerce—NBS Voluntary Product Standard *Custom Contact—Molded Reinforced Polyester Chemical-Resistant Process Equipment.*

Appendix A

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

The following notes, bearing the same number as the text of this standard to which they apply, contain useful explanatory material and references to standards.

A-1-1 The design and installation of systems coming within the scope of this standard should be in the hands of competent engineers, and their maintenance and operation should be in charge of reliable and experienced persons.

A-1-3 In the standards for specific industries or operations there will be found special requirements not embodied in this standard or modifications of certain of these requirements.

A-2-1 The following NFPA standards contain information on the application of blower and exhaust systems to specific industries or operations.

NFPA 30, *Flammable and Combustible Liquids Code*

NFPA 32, *Drycleaning Plants*

NFPA 33, *Spray Application Using Flammable and Combustible Materials*

NFPA 34, *Dipping and Coating Processes Using Flammable or Combustible Liquids*

NFPA 35, *Manufacture of Organic Coatings*

NFPA 36, *Solvent Extraction Plants*

NFPA 40E, *Storage of Pyroxylin Plastic*

NFPA 45, *Fire Protection for Laboratories Using Chemicals*

NFPA 46, *Recommended Safe Practice for Storage of Forest Products*

NFPA 61A, *Prevention of Fire and Dust Explosions in Facilities Manufacturing and Handling Starch*

NFPA 61B, *Prevention of Fires and Explosions in Grain Elevators and Facilities Handling Bulk Raw Agricultural Commodities*

NFPA 61C, *Prevention of Fire and Dust Explosion in Feed Mills*

NFPA 65, *Processing and Finishing of Aluminum*

NFPA 68, *Guide for Venting of Deflagrations*

NFPA 81, *Fur Storage, Fumigation, and Cleaning*

NFPA 85A, *Prevention of Furnace Explosions in Fuel Oil-and Natural Gas-Fired Single Burner Boiler-Furnaces*

NFPA 88B, *Repair Garages*

NFPA 96, *Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment*

NFPA 120, *Coal Preparation Plants*

NFPA 303, *Fire Protection Standard for Marinas and Boatyards*

NFPA 409, *Aircraft Hangars*

NFPA 480, *Storage, Handling, and Processing of Magnesium*

NFPA 481, *Production, Processing, Handling, and Storage of Titanium*

NFPA 651, *Manufacture of Aluminum and Magnesium Powder*

NFPA 654, *Prevention of Fire and Dust Explosions in Chemical, Dye, Pharmaceutical, and Plastics Industries*

NFPA 655, *Prevention of Sulfur Fires and Explosions*

NFPA 664, *Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities*

NFPA 801, *Protection Practice for Facilities Handling Radioactive Materials*

A-2-3 Since each system differs, duct work should be examined periodically until a cleaning schedule can be established and followed.

A-2-6.1 Excess capacity is undesirable as a producer of unnecessary drafts and should be avoided except where justified by the contemplated extension of operations.

A-2-6.3 See *Air Movement and Control Association Standard 99-0401-82* for informative material regarding fan construction.

A-2-10.1 In systems used for the removal of flammable vapors or gases that may result in the condensation of combustible residues within the duct, the installation of an approved fixed pipe system for the application of water, dry chemical, or inert gas is recommended, as conditions warrant.

A-2-10.3 Such systems may be automatically or manually controlled, as required by the authority having jurisdiction. (*See NFPA 11, Low Expansion Foam and Combined Agent Systems; NFPA 11A, Medium- and High-Expansion Foam Systems; NFPA 12, Carbon Dioxide Fire Extinguishing Systems; NFPA 12A, Halon 1301 Fire Extinguishing Systems; NFPA 12B, Halon 1211 Fire Extinguishing Systems; NFPA 13, Installation of Sprinkler Systems; NFPA 15, Water Spray Fixed Systems for Fire Protection; NFPA 17, Dry Chemical Extinguishing Systems; and NFPA 69, Explosion Prevention Systems.*)

A-3-1.2 Processes generating such flammable vapor should be located along an outside wall of the building to facilitate efficient vapor removal. No ducts or other portions of any vapor removal system should extend into stories or rooms of a building other than those from which the vapor is being removed.

A-4-1.1 Where practical, inert gas may be used to create safe atmospheres within the system, especially those handling exceedingly fine particle stock. (*See NFPA 69, Explosion Prevention Systems.*)

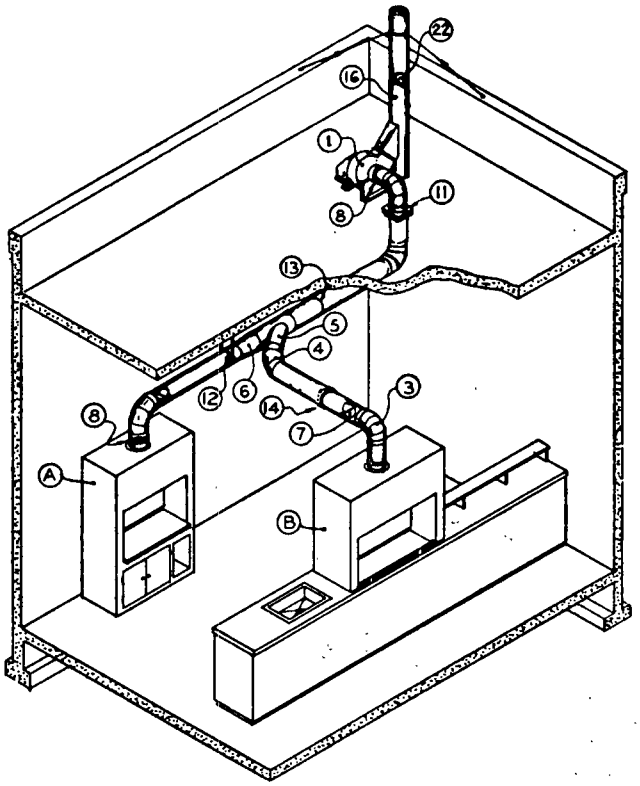
A-5-1.1 System Components. In order to avoid misunderstandings caused by different terminology in various parts of the country and within the air handling industry, the following components of a typical industrial exhaust system are described by diagrammatical reference to the numbered and lettered components listed below, shown in Figures A-5-1.1(a), A-5-1.1(b), A-5-1.1(c), and A-5-1.1(d).

I. Equipment
- A. Cabinet-type fume hood
- B. Bench-type fume hood
- C. Filter box for special or high efficiency filters
- D. Shaft
- E. Horizontal-type fume scrubber
- F. Vertical-type fume scrubber
- G. Service pit or trench

II. System Components
1. Air moving equipment (centrifugal type exhaust fan)
2. Horizontal duct section
3. 90° Elbow
4. Elbow (less than 90°)
5. Lateral entry
6. Transition
7. Manual balancing damper
8. Flexible connection
9. Fire damper (where required)
10. Access door
11. Counterflashing
12. Duct hanger
13. Circumferential girth joint (butt welded)
14. Bell end duct seam
15. Weather cap
16. Fan discharge stack
17. Flanged duct connection
18. Open face tank exhaust hood (updraft)
19. Slotted face tank exhaust hood (updraft)
20. Open face tank exhaust hood (downdraft)
21. Round to rectangular (or square) transitional fitting
22. Gravity operated back draft damper

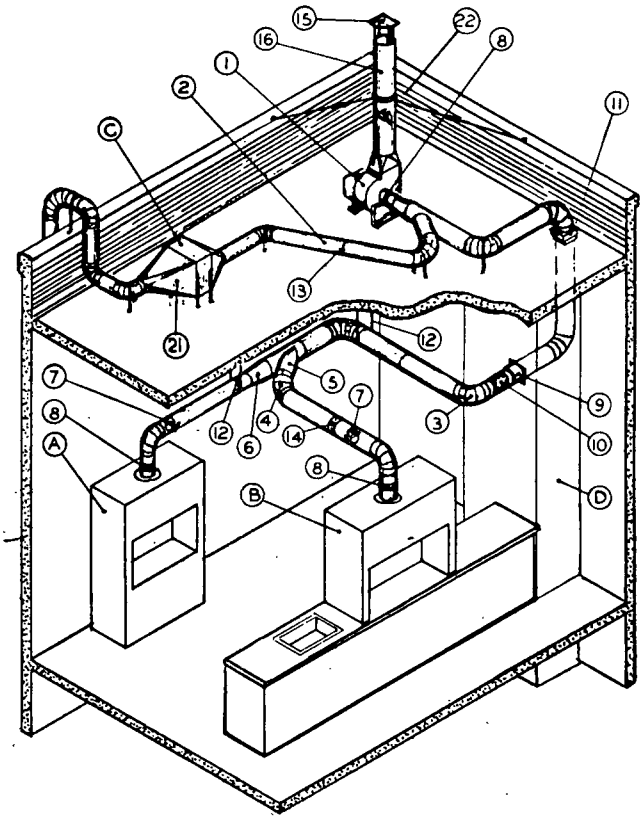
A-5-3 Under some circumstances, the authority having jurisdiction may require protection within plastic duct systems.

A-5-6.1 For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order by catalog No. C13.20 2:15-69.



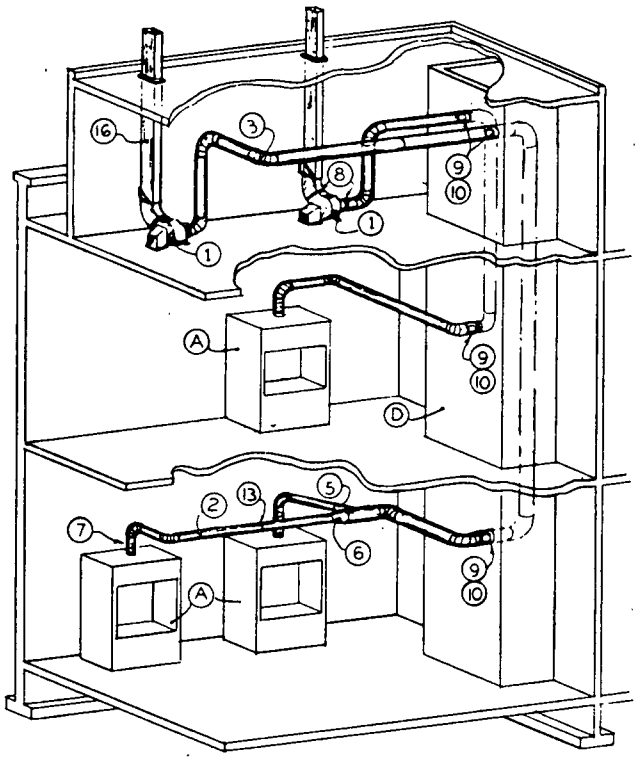
See Legend in Section A-5-1.1

Figure A-5-1.1(a) Rooftop exhaust system for one-story building.



See Legend in Section A-5-1.1

Figure A-5-1.1(b) Exhaust system with filter box for multistory building.



See Legend in Section A-5-1.1

Figure A-5-1.1(c) Internal exhaust system for multistory building.

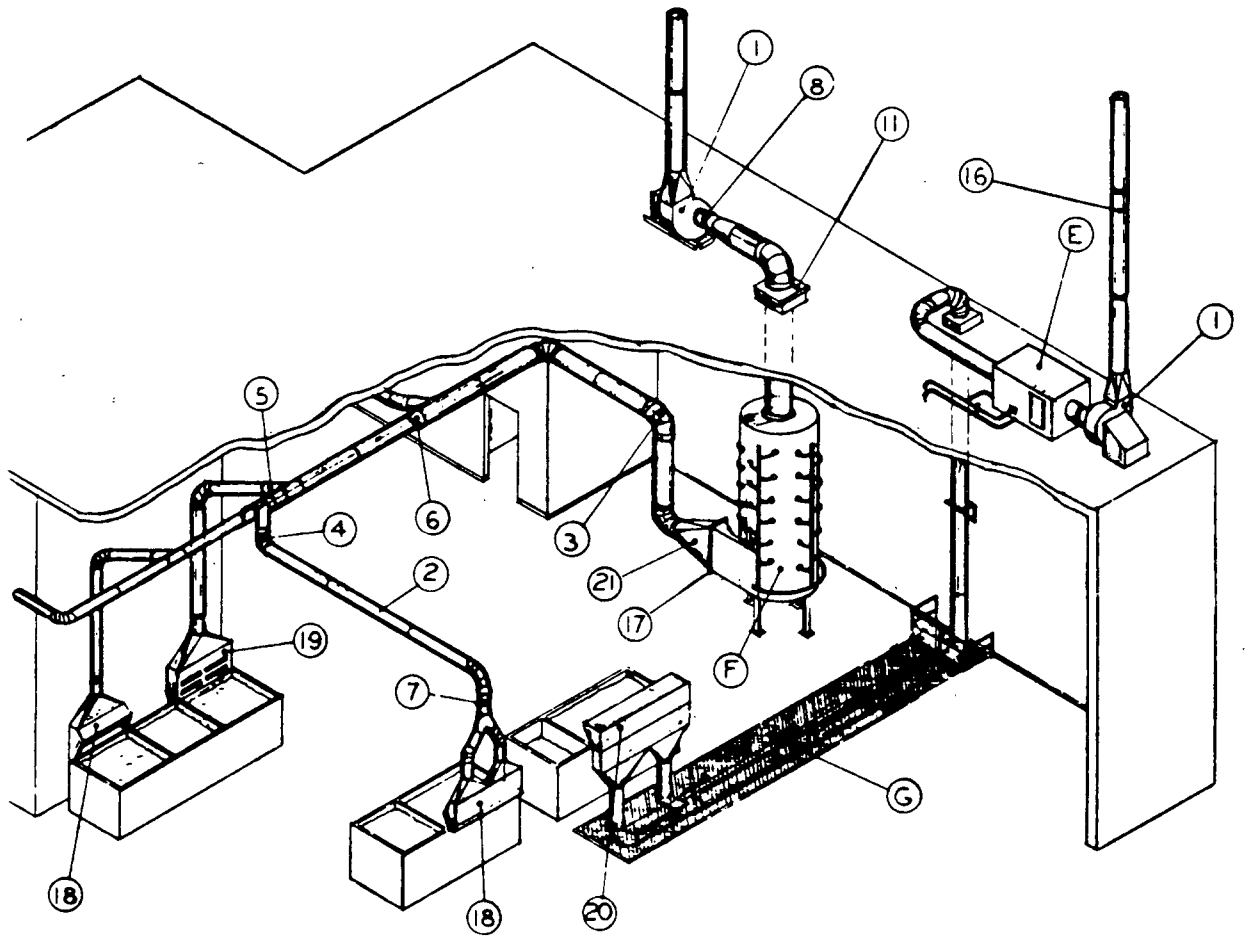


Figure A-5-1.1(d) Exhaust system for one-story building.

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 30-1987, *Flammable and Combustible Liquids Code*

NFPA 32-1990, *Standard for Drycleaning Plants*

NFPA 34-1989, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*

NFPA 35-1987, *Standard for the Manufacture of Organic Coatings*

NFPA 36-1988, *Standard for Solvent Extraction Plants*

NFPA 40E-1986, *Code for the Storage of Pyroxylin Plastic*

NFPA 45-1986, *Standard on Fire Protection for Laboratories Using Chemicals*

NFPA 46-1990, *Recommended Safe Practice for Storage of Forest Products*

NFPA 61A-1989, *Standard for the Prevention of Fire and Dust Explosions in Facilities Manufacturing and Handling Starch*

NFPA 61B-1989, *Standard for the Prevention of Fires and Explosions in Grain Elevators and Facilities Handling Bulk Raw Agricultural Commodities*

NFPA 61C-1989, *Standard for the Prevention of Fire and Dust Explosions in Feed Mills*

NFPA 65-1987, *Standard for the Processing and Finishing of Aluminum*

NFPA 69-1986, *Standard on Explosion Prevention Systems*

NFPA 81-1986, *Standard for Fur Storage, Fumigation, and Cleaning*

NFPA 85A-1987, *Standard for Prevention of Furnace Explosions in Fuel Oil- and Natural Gas-Fired Single Burner Boiler-Furnaces*

NFPA 88B-1985, *Standard for Repair Garages*

NFPA 120-1988, *Standard for Coal Preparation Plants*

NFPA 303-1986, *Fire Protection Standard for Marinas and Boatyards*

NFPA 409-1985, *Standard on Aircraft Hangars*

NFPA 480-1987, *Standard for the Storage, Handling, and Processing of Magnesium*

NFPA 481-1987, *Standard for the Production, Processing, Handling, and Storage of Titanium*

NFPA 651-1987, *Standard for the Manufacture of Aluminum and Magnesium Powder*

NFPA 654-1988, *Standard for Prevention of Dust Explosions in the Chemical, Dye, Pharmaceutical, and Plastics Industries*

NFPA 655-1988, *Standard for Prevention of Sulfur Fires and Explosions*

NFPA 664-1987, *Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities*

NFPA 801-1986, *Recommended Fire Protection Practice for Facilities Handling Radioactive Materials*

B-1.2 Other Publication.

Air Movement and Control Association, 30 W. University Drive, Arlington Heights, IL 60004

99-0401-82, *Classifications for Spark Resistant Construction*

Index