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91

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Construction

Standard

for the Installation of

BLOWER AND EXHAUST SYSTEMS

for

Dust, Stock and Vapor Removal or Conveying

May

1961

Fifty Cents*

NATIONAL FIRE PROTECTION ASSOCIATION

International

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*See inside front cover for quantity discounts

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National Fire Protection Association
International

The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection. Its membership includes national and regional societies and associations (list on outside back cover) and over eighteen thousand individuals, corporations, and organizations. Anyone interested may become a member; the annual dues are $15.00. Full membership information is available on request.

This is one of a large number of publications on fire safety issued by the Association. All NFPA standards and recommended practices, including this text, are prepared by the technical committees of the NFPA and adopted at an Annual Meeting of the Association. They are intended to prescribe reasonable measures for minimizing losses of life and property by fire.

This text and most other NFPA standards and recommended practices are published in the **National Fire Codes**, a compilation of NFPA's official technical material, issued in seven clothbound volumes. Full information on the availability of these Codes and other NFPA publications can be secured from the Association.

Official NFPA Definitions

SHALL is intended to indicate requirements.

SHOULD is intended to indicate recommendations, or that which is advised but not required.

APPROVED refers to approval by the authority having jurisdiction.

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters. One foot = 0.3048 meters. One inch = 25.40 millimeters. One pound per square inch = 0.06805 atmospheres = 2.307 feet of water.

Approved Equipment

The National Fire Protection Association does not "approve" individual items of fire protection equipment, materials or services. The suitability of devices and materials for installation under NFPA standards is indicated by the listing of nationally recognized testing laboratories, whose findings are customarily used as a guide to approval by agencies applying these standards. Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada, the Factory Mutual Laboratories and the American Gas Association (gas equipment) test devices and materials for use in accordance with the appropriate standards, and publish lists which are available on request.

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6–11 copies: 10%	24– 47: 20%
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BLOWER AND EXHAUST SYSTEMS.

NFPA No. 91—1961

This 1961 edition was adopted by the National Fire Protection Association on May 19, 1961, on recommendation of the Committee on Blower Systems. It supersedes the editions of 1949 and 1959.

This edition does not contain Section 500, Ventilation of Restaurant Type Cooking Equipment, which was assigned to the NFPA Committee on Chimneys and Heating Equipment in 1955 and has since been revised and published as NFPA No. 96, Ventilation of Restaurant Cooking Equipment.

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 standards 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. An editorially revised edition was published in 1959.

STANDARD FOR THE INSTALLATION OF BLOWER AND EXHAUST SYSTEMS FOR DUST, STOCK AND VAPOR REMOVAL OR CONVEYING.

NFPA No. 91—1961

CONTENTS.

100. Introduction.

101. 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. 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.

102. 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.

103. 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.

Definitions

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.

200. General Requirements.

201. These general requirements apply to systems for removal of flammable vapors (including paint spraying residue); dust, stock, and refuse conveying; except as modified or amplified by the specific rules which follow (Secs. 300 and 400) or by the standards applying to specific industries or operations.

NOTE: The following NFPA standards contain information on the application of blower and exhaust systems to specific industries or operations. These standards will be generally found available for distribution from the same sources that distribute the Standards for Blower and Exhaust Systems. The number designations are those used by the National Fire Protection Association, the National Board of Fire Underwriters and the Canadian Underwriters' Association. The abbreviations after the titles indicate the publication sources. Where two or more sources are indicated, the texts are identical from each source, except for cover and introductory matter.

NFPA — Published by the National Fire Protection Association in pamphlet form and available from them at 60 Batterymarch Street, Boston.

NBFU — Published by the National Board of Fire Underwriters in pamphlet form and available from them at 85 John Street, New York 38; 222 West Adams Street, Chicago 6; or 465 California St., San Francisco 4.

CUA — Published by the Canadian Underwriters' Association in pamphlet form and available from them at 460 St. John Street, Montreal, Quebec.

NFC I, II, III, IV, V, VI or VII — Published by the National Fire Protection Association in the National Fire Codes volume indicated. These codes, republished annually, are available from the National Fire Protection Association, 60 Batterymarch Street, Boston.

30. Flammable Liquids Code (NFPA, NBFU, CUA, NFC I)
32. Dry Cleaning Plants (NFPA, NBFU, CUA, NFC I)
33. Spray Finishing (NFPA, NBFU, CUA, NFC I)
34. Dip Tanks (NFPA, NBFU, NFC I)
35. Lacquer Manufacturing Plants (NFC I)
36. Solvent Extraction Plants (NFPA, NFC I)
42. Pyroxylin Plastics in Factories (NFPA, NBFU, NFC II)
47. Retail Lumberyards (NFPA, NBFU, NFC II)
48. Storage, Handling and Processing of Magnesium (NFPA, NBFU, NFC II)
60. Pulverized Fuel Systems (NFPA, NBFU, NFC II)
61A. Starch Factories (NFPA, NFC II)

61B. Terminal Grain Elevators (NFPA, NBFU, NFC II)
61C. Flour and Feed Mills (NFPA, NBFU, NFC II)
62. Pulverizing Systems for Sugar and Cocoa (NFPA, NFC II)
63. Prevention of Dust Explosions in Industrial Plants (NFPA, NBFU, NFC II)
64. Country Grain Elevators (NFPA, NBFU, NFC II)
65. Processing and Finishing of Aluminum (NFPA, NFC II)
68. Guide for Explosion Venting (NFPA, NFC II)
81. Fur Storage, Fumigation and Cleaning (NFPA, NBFU, NFC II)
83. Transit Operations (NFPA, NBFU, NFC VI)
86. Class A Ovens and Furnaces (NFPA, NBFU, NFC I)
88. Garages (NFPA, NFC III)
96. Ventilation of Restaurant Cooking Equipment (NFPA, NFC III)
303. Marinas and Boatyards (NFPA, NFC VI)
307. Operation of Marine Terminals (NFPA, NBFU, NFC VI)
409. Aircraft Hangars (NFPA, NBFU, NFC VI)
481. Production, Processing, Handling and Storage of Titanium (NFPA, NFC II)
651. Manufacture of Aluminum Bronze Powder or Dust (NFPA, NFC II)
652. Plants Producing or Handling Magnesium Powder (NFPA, NFC II)
653. Coal Preparation Plants (NFPA, NFC II)
654. Prevention of Dust Explosions in Plastics Industry (NFPA, NFC II)
655. Prevention of Sulfur Dust Explosions and Fires (NFPA, NFC II)
657. Confectionery Manufacturing Plants (NFPA, NFC II)
661. Suction and Venting in Grain Elevators (NFPA, NFC II)
664. Woodworking and Wood Flour Manufacturing Plants (NFPA, NFC II)
801. Laboratories Handling Radioactive Materials (NFPA, NFC II)

210. Power and Control.

211. All electrical equipment shall be installed in accordance with the National Electrical Code.

212. 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 obtaining shall be used. See Art. 500 of the National Electrical Code.

213. Remote control of all blower or exhaust fans shall be provided, in addition to any control located close to the equipment.

220. Fans.

221. Fans shall be of noncombustible construction and of adequate capacity to properly perform the functions required. Excess capacity is undesirable as a producer of unnecessary drafts and should be avoided except where justified by the contemplated extension of operations.

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

223. When flammable solid materials or vapors are passed through the fans, the rotating element shall be of non-ferrous or non-sparking material, or the casing shall consist of or be lined with such material. Where there is a possibility of solid foreign material passing through the fan that would produce a spark, both the rotating element and the casing shall be constructed as required above.

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

225. 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.

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

227. 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 is provided.

230. Ducts.

231. Ducts shall be constructed entirely of sheet metal or other noncombustible material, and 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 thicknesses for metal ducts are specified in Arts. 323, 421 and 422.

232. The entire duct system should 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.

233. 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.

234. All ducts, whether inside or outside of buildings, shall be thoroughly braced where required and substantially supported by metal hangers or brackets. Where ducts are used for conveying explosive gases or dust, the supports shall be designed to afford strength and rigidity against disruption. All laps in the piping should be made in the direction of the air flow.

235. 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°.

236. The passing of ducts through fire walls should be avoided wherever possible (see definition of fire wall, Section 100). When ducts or the outlets from or inlets to them pass through fire walls, they should be provided with auto-

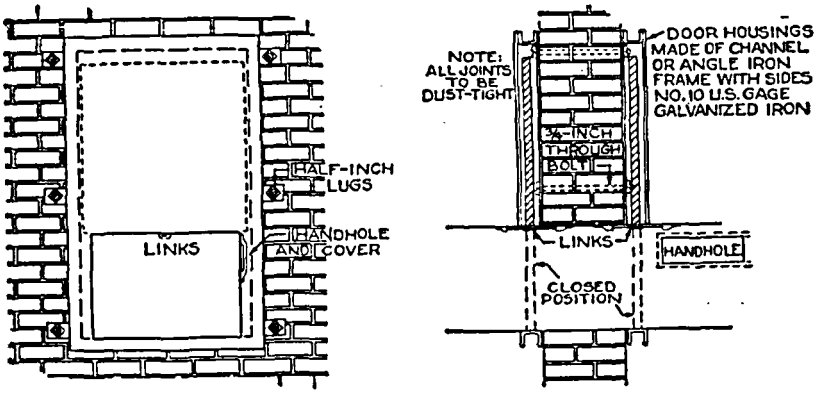

Fig. 1. Suggested type of vertical fire door for duct passing through opening in fire wall.

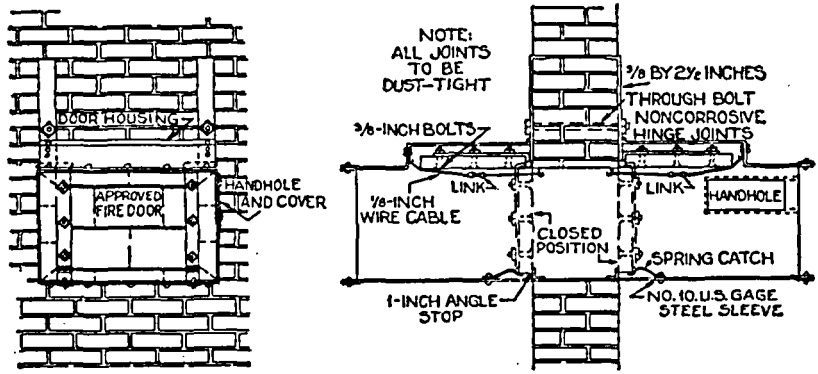

Fig. 2. Suggested type of automatic hinged fire door for duct passing through opening in fire wall.

matic closing fire doors on both sides of the wall through which they pass. (See Figures 1 and 2.)

Such fire doors shall be approved for the protection of openings in fire walls (Class A openings) except that for small openings not exceeding 18 inches in diameter, ⅜-inch steel plates may be used in lieu of fire doors, or fire dampers listed by a nationally recognized testing laboratory may be used in accordance with the conditions of their listing.

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

238. Where ducts pass through walls, floors or partitions the space around the duct shall be sealed with rope asbestos, mineral wool or other noncombustible material to prevent the passage of flame and smoke.

239. 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.

240. Duct Clearances.

241. All duct systems handling noncombustible materials and operating at approximately room temperature shall have a clearance of at least 6 inches from stored combustible materials, and not less than ½-inch clearance from combustible construction even though flameproofed, fire-retardant treated or plastered, except as noted in paragraphs 242 and 427.

242. Duct systems handling combustible material shall have a clearance of not less than 18 inches from combustible construction or any combustible material. The clearance to combustible construction may be reduced, provided the combustible construction is protected as described in Table I. If a duct system is equipped with adequate automatic sprinklers, clearance may be as provided in paragraph 241.

243. Duct systems operating at elevated temperatures (above 100°F) shall have clearance from combustible build-

ing construction or any combustible material not less than shown in table below:

Duct Gas Temperature	Largest Duct Dimension	Clearance
Up to 600° F. incl.	8 in.	8 in.
	Over 8 in.	12 in.
Over 600°-900° F. incl.	8 in.	18 in.
	Over 8 in.	24 in.
Over 900° F.	All ducts lined with refractories	24 in.

NOTE.—Where experience indicates that fires in duct systems are a fairly common occurrence or there is a likelihood that fires will occur, because of the very nature of the occupancy using such duct systems, a greater clearance may be required as is the case of NFPA No. 33, Spray Finishing Using Flammable Materials; and NFPA No. 96, Ventilation of Restaurant Cooking Equipment, where a clearance of 18 inches between ducts and unprotected combustible material is required.

Ducts handling materials at temperatures in excess of 900°F shall be lined with refractory material or the equivalent.

The clearance to combustible construction for ducts handling materials not in excess of 900°F may be reduced provided the combustible construction is protected as described in Table I.

TABLE I

Clearances, Inches, with Specified Forms of Protection*

Type of Protection Applied to the Combustible Material. Thicknesses are Minimum	Where the Required Clearance with No Protection is: 8 in.	12 in.	18 in.	24 in.
a) ¼-in. asbestos millboard spaced out 1 in.†	3	6	12	18
b) 28-gauge sheet metal on ¼-in. asbestos millboard	3	6	12	16
c) 28-gauge sheet metal spaced out 1 in.†	2	4	9	12
d) 28-gauge sheet metal on ⅛-in. asbestos millboard spaced out 1 in.†	2	4	9	12

*All clearances shall be measured from the surface of the duct to combustible material disregarding any intervening protection applied to the combustible material.

†Spacers shall be of noncombustible material.

250. Protection Against Static Electricity.

251. 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 No. 77M, Static Electricity.)

252. 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.

253. 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 the NFPA Committee on Static Electricity.*)

260. Fire Extinguishing Apparatus, Manual and Automatic.

261. The provision of automatic or special extinguishing equipment for systems handling flammable vapors or combustible materials should be subject to the approval of the authority having jurisdiction. Details of such systems are set forth in following sections covering specific materials being handled.

300. Systems for Removal of Flammable Vapors. (Including Paint Spraying Residue.)

301. Where systems of this class are installed, the following rules and the preceding general rules except as modified herein shall apply:

NOTE.—See paragraph 201.

*Part of standard affecting static electricity in dusty industries included in dust explosion codes in National Fire Codes, Volume II. Complete NFPA No. 77M, Static Electricity, available in separate pamphlet form.

302. 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. 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. Exhaust outlets to atmosphere should extend above or away from surrounding structures to prevent accumulation of combustible residues on such structures.

310. System Design.

311. In the design of any vapor removal system, control at the point of generation should be provided wherever possible. Such systems will 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.

312. 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.

313. Where heavier than air vapors or mixtures are handled, exhaust openings located near the floor line will be more effective. This is particularly true when exhaust system is not in operation and its stack effect is utilized to remove any residual material. Conversely for vapors or mixtures lighter than air, exhaust system inlets should be located near the top of room, hood, or enclosure.

314. Outlets to atmosphere shall be kept clear of and away from any combustible material.

320. Ducts.

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

322. The installation of dampers, valves and shutters in this type of system is not ordinarily advisable, except where 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.

323. 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. incl.	No. 24 U. S. gauge
Over 8 in. to 18 in. incl.	No. 22 U. S. gauge
Over 18 in. to 30 in. incl.	No. 20 U. S. gauge
Over 30 in.	No. 18 U. S. gauge

324. Material for duct lining should have a fire hazard classification of 0 when tested in accordance with the Method of Test of Surface Burning Characteristics of Building Materials, NFPA No. 255 or UL 723.

325. 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 air flow 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.

330. Fire Extinguishing Apparatus, Automatic or Manual.

331. In systems used for the removal of flammable vapors or gases, the installation of an approved fixed pipe system for the application of water, dry chemical, or inert gas is recommended, as conditions warrant. Such systems

may be automatically or manually controlled, as required by the authority having jurisdiction. (See Standard for the Installation of Sprinkler Systems, NFPA No. 13, Standard for Water Spray Systems, NFPA No. 15, Standard for Carbon Dioxide Fire Extinguishing Systems, NFPA No. 12, Standard for Dry Chemical Extinguishing Systems, NFPA No. 17, and Standard for Inerting for Fire and Explosion Prevention No. 69.*)

400. Dust Collecting Systems; Stock and Refuse Conveying Systems.

401. Where systems of this class are installed, the following rules and the preceding general rules except as modified herein shall apply: (See paragraph 201.)

402. These systems consist of suction ducts and inlets, airflow producing equipment, feeders, discharge ducts and outlets, collecting equipment, vaults and other receptacles, designed to collect by air or gas, powdered, ground or finely divided material.

410. General.

411. Systems collecting highly flammable or explosive dust preferably should be so arranged that the fan is on the clean air side of the collector.

412. Conveying systems for cotton and similar textile materials which are readily ignitable shall be arranged so as not to create suction in machines producing the material.

413. Rooms or bins into which readily ignitable material is discharged by a collecting or conveying system should be of noncombustible material. Such rooms or bins shall be provided with vents, preferably leading to outside the building.

414. Dust collecting systems from grinding and other machines which may produce sparks shall not be combined with collecting systems handling linty or other readily flammable dusts.

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*Published in pamphlet form by the National Fire Protection Association and in National Fire Codes, Volumes II and IV.

415. The use of a trap at the junction of a hood or a branch duct may be permitted by the authority having jurisdiction provided it is not permitted to fill up with dust.

416. Approved magnetic separators of the permanent magnet or electromagnetic types should be installed at those points where combustible materials which may contain ferrous particles enter the system. The separators shall be of sufficient size to insure the removal of all ferrous materials passing over them.

417. Readily ignitable materials should not pass through the fan unless the fan is constructed and installed in accordance with Section 220. Systems handling these materials should be operated entirely under suction with suitable equipment for removing the stock from the air stream before it reaches the fan.

418. Where practical inert gas should be used to create safe atmospheres within the system or parts of the system, especially those handling exceedingly fine stock. (See Inerting for Fire and Explosion Prevention, NFPA No. 69 published in the National Fire Codes, Volume II and in pamphlet form.)

420. Ducts.

421. Metal ducts shall be constructed of sheet steel of not less than the following gauges.

Diameter of duct, inches	U. S. Standard Gauge	
	Non-Abrasive Materials	Abrasive Dusts
Up to 8 inclusive	24	20
Over 8 to 18 inclusive	22	18
Over 18 to 30 inclusive	20	16
Over 30	18	14

Buried ducts may be of concrete or ceramic materials, cast iron, or cement-asbestos and shall also comply with Section 231.

422. All sheet metal elbows and bends shall be made from material at least two (2) gauges heavier than is required for straight duct-work of the same diameter except that for No. 14 gauge and heavier, the elbows and straight duct-work may be of the same gauge.

423. Round sheet metal elbows should be of at least five-piece construction for ducts six (6) inches in diameter or less and of seven-piece construction for larger ducts, with a throat radius equal to one-half (½) to two (2) times the duct diameter unless space prohibits the use of such long bends. In place of long radius elbows specified above, rectangular elbows, venturi-shaped elbows or other bends of equivalent low-resistance design may be used.

424. The main suction duct should receive only one branch in a section of uniform area, whenever space permits, and in no case shall it receive more than two branches in such a section.

425. The inlet of the fan or exhaust should be at least 20 per cent greater in area than the sum of the areas of all of the branch ducts, and such increase shall be carried proportionately throughout the entire length of the main suction duct, i.e., the area of the main duct at any point shall be at least 20 per cent greater than the combined areas of the branch ducts entering it between such point and the tail end, or dead end of the system.

426. Every branch duct should connect with the main duct at top or side at an angle not exceeding forty-five (45) degrees, inclined in the direction of the air flow.

427. The main suction and discharge ducts should be made as short as practicable. To provide access for sweeping and cleaning, ducts should not be less than 6 inches above the floor at every point, and not closer than 6 inches at any ceiling.

428. Every duct shall be kept open and unobstructed throughout its length, and no screen shall be placed in it. The use of a trap may be permitted by the authority having jurisdiction.

429. Main ducts of systems handling materials which form an explosive mixture with air should be run on the outside of the building where practicable with ducts from each operation and each floor passing out directly through the wall and discharging into the main duct. All ducts shall be adequately supported.

430. Additional branch ducts should not be added to an existing system without redesigning the system. Branch ducts should not be disconnected nor unused portions of a

system be blanked off without providing orifice plates to maintain required airflow.

440. Separating and Collecting Equipment.

441. This includes cyclones, condensers, cloth screen and stocking arrestors, centrifugal collectors and other devices used for the purpose of separating solid material from the air stream in which it is carried and hoppers, bins, silos and vaults for collecting the solid material so separated.

442. Separating and collecting equipment should be designed and constructed to withstand anticipated explosion pressures, due consideration being given the reduction in pressure afforded by adequate explosion relief vents.

443. Separating or collecting equipment should be outside the building when conditions permit, and so located as to constitute a minimum hazard to adjacent structures. Their construction shall be of steel or steel enclosed. Supports shall be of steel, masonry or concrete and the structure securely anchored to resist anticipated wind pressures. It is recommended that clean-out doors be provided. Separating or collecting equipment should be located at a safe distance from combustible construction or unprotected openings into buildings.

444. All collectors which must be located indoors and cannot be constructed of sufficient strength to resist maximum calculated explosion pressure should be located close to exterior walls to facilitate explosion relief venting.

445. Discharge ducts shall not come in contact with nor expose combustible material and should terminate above the roofs if within 10 ft. of building of combustible construction or unprotected openings.

446. Delivery ducts from cyclone collectors should not convey refuse directly into the fireboxes of boilers, furnaces (including Dutch ovens), refuse burners, incinerators, etc.

447. Delivery of stock from separator, cyclone or other collection equipment to storage receptacles should be accomplished by means of gravity through tightly fitted ducts.

448. Where refuse is to be used as fuel, the discharge system from the storage receptacle or intermediate feed bin should be so designed that either by means of a choke feeder