ANSI/NFPA 650 An American National Standard December 8, 1983

NFPA 650 Pneumatic Conveying Systems for Handling Combustible Materials 1984

National Fire Protection Association Batterymarch Park, Quincy, MA 02269

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Policy Adopted by NFPA Board of Directors on December 3, 1982

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.

Statement on NFPA Procedures

This material has been developed under the published procedures of the National Fire Protection Association, which are designed to assure the appointment of technically competent Committees having balanced representation. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

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Standard for Pneumatic Conveying Systems for Handling Combustible Materials

NFPA 650-1984

1984 Edition of NFPA 650

This edition of NFPA 650, *Standard for Pneumatic Conveying Systems for Handling Combustible Materials*, was prepared by the Technical Committee on Fundamentals of Dust Explosion Prevention and Control, released by the Correlating Committee on Dust Explosion Hazards, and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 14-17, 1983 in Orlando, Florida. It was issued by the Standards Council on December 8, 1983, with an effective date of December 28, 1983, and supersedes all previous editions.

This edition of the standard has been submitted to the American National Standards Institute for approval as an American National Standard.

Origin and Development of NFPA 650

NFPA 650 had its origin as NFPA 66, *Standard for Pneumatic Conveying Systems for Handling Feed, Flour, Grain and Other Agricultural Dusts*. NFPA 66 was adopted as a tentative standard in 1963, and as a standard in 1964. Revised standards were adopted in 1970 and 1973. NFPA 650-1984, *Standard for Pneumatic Conveying Systems for Handling Combustible Materials*, in addition to being different in title from NFPA 66, differs in scope and represents a complete rewrite of NFPA 66. The rewrite makes the standard applicable to the pneumatic conveying of combustible materials, both agricultural and non-agricultural.

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

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

Contents

Standard for
Pneumatic Conveying Systems for Handling Combustible Materials

NFPA 650-1984

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 9 and Appendix B.

Chapter 1 General

1-1 Scope.

1-1.1 This standard shall apply to the pneumatic conveying of combustible materials.

1-1.2 This standard shall not apply to the pneumatic conveying of materials covered by:

NFPA 43A, *Code for the Storage of Liquid and Solid Oxidizing Materials*, Class 3 and 4 oxidizing materials only

NFPA 48, *Standard for the Storage, Handling, and Processing of Magnesium*

NFPA 61A, *Standard for Manufacturing and Handling Starch*

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

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

NFPA 61D, *Standard for the Prevention of Fire and Dust Explosions in the Milling of Agricultural Commodities for Human Consumption*

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

NFPA 85F, *Standard for the Installation and Operation of Pulverized Fuel Systems*

NFPA 482, *Guide for Fire and Explosion Prevention in Plants Producing and Handling Zirconium*

NFPA 495, *Code for the Manufacture, Transportation, Storage and Use of Explosive Materials*

NFPA 651, *Standard for the Manufacture of Aluminum or Magnesium Powder*

NFPA 653, *Standard for the Prevention of Dust Explosions in Coal Preparation Plants*

NFPA 664, *Standard for the Prevention of Fires and Explosions in Wood Processing and Wood Working Facilities*.

1-2 Purpose.

1-2.1 The purpose of this standard is to prescribe reasonable requirements for safety to life and property from fire and explosion and to minimize the resulting damage should a fire or explosion occur.

1-2.2 This standard is not intended to prevent the use of systems, methods or devices which provide equivalent protection from fire and explosion, providing that suitable data is available to demonstrate equivalency.

1-3 Retroactivity. This standard applies to facilities on which construction is begun subsequent to the date of publication of this standard. When major replacement or renovation of existing facilities is planned, provisions of this standard shall apply.

1-4 Definitions. For the purposes of this standard, the following terms shall have the meanings given below.

Approved. Acceptable to the "authority having jurisdiction."

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

Authority Having Jurisdiction. The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

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

Combustible Dust.* Any finely divided solid material 420 microns or smaller in diameter (material passing a U. S. No. 40 Standard Sieve) which presents a fire or explosion hazard.

Detachment. In the open air or in a separate building.

Duct. That part of a system which conveys air to or from primary and/or secondary air-material separators.

Header. That part of a system located between the air discharge of a primary or secondary air-material separator and the air intake of the prime air mover (blower or fan), which conveys the air discharge from only a single separator at any one time.

Hybrid Mixture. A combination of combustible dust and flammable gas or vapor which can be ignited.

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

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

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

Manifold. A header which simultaneously serves more than one air-material separator on a suction-type pneumatic system and which normally operates at a negative pressure.

Multiple Strand. The arrangement of several suction-type pneumatic systems served by a single manifold.

Pneumatic Conveying System. A system consisting of an enclosed tubing system in which a material is transported by a stream of air having a sufficiently high velocity to keep the conveyed material in motion. Noncombustible, nonreactive gases may be used in place of, or mixed with air.

Such systems are of two principal types or a combination of the two types.

(a) *Positive Pressure-Type.* Pressure-type systems transport material by utilizing air at greater than atmospheric pressure. Such systems basically consist of a blower drawing air through a filter; an air-lock feeder for introducing materials into the system; tubing or ducts; and a suitable air-material separator.

(b) *Negative Pressure-Type.* Negative pressure-type systems transport material by utilizing air at less than atmospheric pressure. These systems basically consist of a material and air intake; tubing or ducts; a suitable air-material separator; and a fan or blower.

Primary Air-Material Separator. A collector which removes the bulk of the product or material from the conveying air stream.

Secondary Air-Material Separator. A device for removing the residual dust or product remaining in the air stream after the primary air-material separator.

Tubing. The part of a system located between the point of infeed and the primary air-material separator, through which heavy concentrations of product are conveyed.

1-5 General Design.

1-5.1 All system components shall be conductive. Bonding and grounding shall be provided. (*See NFPA 77, Recommended Practice on Static Electricity.*)

1-5.2 All electrical equipment in and around the pneumatic system shall be designed and installed in accordance with NFPA 70, *National Electrical Code®*.

1-5.3 All systems shall be designed to be air-tight and dust-tight except at openings designed for intake and discharge of air and material.

1-5.4 Where more than one material is to be handled by a system, compatibility tests shall be run, and where incompatability is found, provisions shall be made for cleaning of the system prior to transport of a new material.

1-5.5 Equipment and bins shall be provided with explosion prevention or explosion protection in accordance with either 1-5.5.1, 1-5.5.2, or 1-5.5.3.

1-5.5.1 Explosion venting may be provided. (*See NFPA 68, Guide for Explosion Venting.*)

1-5.5.2 The container and system may be designed to contain the explosion pressure.

1-5.5.3 Explosion prevention systems in accordance with NFPA 69, *Standard on Explosion Prevention Systems*, may be installed.

1-5.6 Hybrid Mixtures.

1-5.6.1* Where inert gas is used, oxygen monitors shall be required and shall sound an alarm at a preset level.

1-5.6.2 When hybrid mixtures are transported, recycle of the gas stream to any work space shall not be permitted.

Chapter 2 Tubing, Headers, Manifolds, Ducts

2-1* Design.

2-1.1 Where a system or any part of a system operates as a positive pressure-type system and the blower discharge pressure is 15 psig (103 kPa) or greater, the system shall be designed in accordance with ASME *Unfired Pressure Vessel Code*, Division 8 or ANSI B31.3, *Chemical Plant and Petroleum Refinery Piping*.

2-1.2 Elbows.

2-1.2.1 All elbows shall be of air- and dust-tight construction.

2-1.2.2 Joints shall be butted squarely and air- and dust-tight.

2-1.3 All parts of a system located within buildings shall be permanently assembled with no temporary connec-

tions which may be left open and permit the escape of material from the system.

2-1.4 Connections between individual lengths, elbows, or other pneumatic equipment shall be air- and dust-tight.

2-1.5 Support.

2-1.5.1 All tubing, headers, manifold, and ducts shall be supported so as to avoid excessive stress or strain.

2-1.5.2 Supports shall be designed to include the weight of the system and the transported material.

2-1.5.3 Vertical runs through floors shall be securely fastened at each floor level.

2-1.5.4 Tubing or ducts which pass through fire barrier or fire walls shall be rigidly supported on both sides and the opening around the duct shall be sealed to the full thickness of the wall with a material of a fire resistance rating equivalent to that of the wall.

2-1.6 Sight Glasses.

2-1.6.1 Sight glasses, if installed, shall be of a material that is not readily damaged. Tubing shall be supported above and below each sight glass so that the sight glass does not carry any of the system weight and is not subject to stress or strain.

2-1.6.2 The electrical bonding of the system shall be continuous around all sight glasses. The strength of the sight glass and its mounting mechanism and its inside diameter shall be equal to the adjoining tube system.

2-1.6.3 Connections between the sight glass and tubing shall be butted squarely and sealed so as to be air-tight and dust-tight.

Chapter 3 Valves

3-1 Pressure Relief Valves. One or more relief valves for both positive pressure and negative pressure pneumatic systems shall be located, sized, and set to relieve at pressures designed to protect the system components. Valves to protect the blower package shall be installed on the clean air side of the system.

3-2 Multiple Direction Valves. Multiple direction valves shall be of air- and dust-tight construction and shall effect a positive diversion of the conveyed product. Diversion of the product in one direction shall mechanically and automatically seal all other directions from air and dust leakage.

3-3 Air Flow Control Valves.

3-3.1 Air flow control valves installed in multiple strand suction-type pneumatic systems shall be of air- and dust-tight construction and shall inject sufficient static resistance to allow air flow adjustment for system balancing purposes. Valves shall be sized to pass the total air flow of the system with dampers in the wide open position. Valves shall be so constructed as to totally shut off air flow in the system.

3-3.2 Valves shall have visible scales to indicate the position of control dampers.

3-3.3 Manually adjusted valves shall have a locking device to prevent movement of dampers once set.

Chapter 4 Air-Material Separators

4-1 General.

4-1.1 Air-material separators which are located outside and on top of structures shall be provided with lightning protection in accordance with NFPA 78, *Lightning Protection Code*.

4-1.2 Material discharge outlets from air-material separators shall be provided with a positive choke device.

4-1.3 Exhaust air from air-material separators shall be discharged outside of building.

Exception No. 1: Where provision is made to recycle transport air directly back into the pneumatic conveying system.

Exception No. 2: Where all ducts returning air to the building are equipped and protected as indicated in 4-1.4.

4-1.4 Return Air Ducts.

4-1.4.1 Ducts shall be equipped with a filter other than the primary or secondary air-material separator.

4-1.4.2 Filters shall have a 99.5 percent efficiency for particle sizes of 1.0 micron diameter, and greater.

4-2 Construction.

4-2.1 Air-material separators shall be constructed of noncombustible materials.

Exception: Filter media may be of combustible material.

4-2.2 Air-material separators shall be constructed so as to eliminate internal ledges or other points of dust accumulation. Hopper bottoms shall be sloped and the discharge conveying system shall be designed to handle maximum flow.

4-2.3 Cleanout doors or panels shall be provided for access to the interior.

4-2.4 Air-material separators shall be provided with explosion relief. (*See NFPA 68, Guide to Explosion Venting.*)

Exception: When protection is provided in accordance with 4-4.1, 4-4.2, or 4-4.3.

4-3 Location. Air-material separators shall be located outside of buildings.

Exception No. 1: Separators may be located inside of buildings if located adjacent to an exterior wall and vented to the outside through straight and short ducts, not exceeding 10 ft (3.05 m) in length, designed according to information contained in NFPA 68, Guide for Explosion Venting, and designed so that explosion pressures will not rupture the ductwork or the separator.

Exception No. 2: Separators protected in accordance with Section 4-4.

4-4* Protection.

4-4.1 Air-material separators may be equipped with an explosion suppression system. The explosion suppression system shall be designed and installed in accordance with NFPA 69, *Standard on Explosion Prevention Systems.*

4-4.2 Air-material separator systems may be designed to operate using an inert or oxygen deficient gas as a transfer medium provided that such systems are designed and installed in accordance with NFPA 69, *Standard on Explosion Prevention Systems.*

4-4.3 Air-material separators may be designed to withstand maximum peak explosion pressure.

Chapter 5 Feeding Methods

5-1 Hoppers. When material is introduced into the pneumatic system through a hopper and feeding device, such hopper shall be dust-tight and designed for pressure equalization.

5-2* Mechanical Devices. Mechanical feeding devices shall be equipped with a shear pin or overload detection device and alarm.

5-3 Drives. All drives used in connection with feeders, air locks, and other devices shall be direct connected.

Exception: Belt or other indirect type drives designed to have a sufficient service factor to stall the driving forces without slipping, and providing for the removal of static electric charges.

Chapter 6 Fans and Blowers

6-1 Design and Installation.

6-1.1 Fans and blowers shall be designed and installed in accordance with NFPA 91, *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying.*

6-1.2 Bearings or bearing housings shall be designed to prevent overheating, oil leakage and dust infiltration.

6-2 Maintenance.

6-2.1 Bearings shall be lubricated and checked for excessive wear on a periodic basis.

6-2.2 When the product has a tendency to stick to the rotor or housing, the rotor shall be cleaned periodically to maintain good balance, and the housing shall be cleaned periodically to minimize the possibility of ignition, especially when exposed to heated air.

6-2.3 The interior surfaces of fan housings shall be maintained free from rust. Aluminum paint shall not be used on interior steel surfaces which may be struck by foreign material because of potential heat of impact.

6-3 Operation.

6-3.1 Fans and blowers shall run at full speed before material is transported and after the material has ceased to be transported to clear the system of material.

6-3.2 Fans and blowers shall be checked periodically for excessive heat and vibration.

6-3.3 An interlock shall be provided to stop the material feed upon failure of the conveying system.

Chapter 7 Portable Conveying Units, Including Bulk Trucks

7-1 Engine and Motor Driven Equipment.

7-1.1 Engine and motor driven equipment used in confined hazardous areas shall be equipped with safety devices designed to reduce the potential fire hazard and electrical shock hazard.

7-1.2* Requirements for engine and motor driven equipment shall meet or exceed the requirements of the *Fire Safety Standard for Powered Industrial Trucks*, NFPA 505, for the following designations:

(a) Diesel powered units — Type DS.

(b) Electrical powered units — Type EE.

(c) Gasoline powered units — Type GS.

(d) Liquefied petroleum gas powered units — Type LPS.

(e) Dual powered units — Type GS/LPS.

7-1.3 Spark arrestors shall be used on the exhaust stacks of all diesel powered units.

7-1.4 Refueling shall be conducted outdoors.

7-1.5* Surface dust shall be removed from engine and motor driven equipment at regular intervals during operation.

7-1.5.1 Cleaning with compressed air shall not be conducted in Class II hazardous locations.

7-1.5.2 Spark arrestors shall be cleaned or replaced according to the manufacturer's recommendations.

7-1.6 Maintenance procedures shall comply with the manufacturer's instructions, especially with regard to replacement of insulation, covers, electrical enclosures, and parts of the electrical system designed to reduce chafing of insulation or termination failure.

7-2 Bonding and Grounding.

7-2.1 All equipment such as truck, tank or hopper, conveyor tube, motor, or compressors on a unit shall be electrically bonded and grounded.

7-2.2 Flexible tubing shall be electrically conductive. Connections from the transport vehicle to the receiving system shall be made on the outside of any building.

7-2.3 The operator shall ground the truck and bond the receiving tube to the truck and receiving equipment before starting the compressor. The compressor shall be at operating speed before transporting material.

7-2.4 Portable equipment electrical bonds shall be visually checked each time the equipment is used.

7-3 Dust Control.

7-3.1 The receiving bin or hopper shall have filtered open vents.

Exception: Filters may be omitted if the bin vent is piped back to the truck.

Chapter 8 Training and Inspection

8-1 Employee Training.

8-1.1 There shall be policies and requirements that provide for initial and continuing training for all employees. These shall include the development of operating procedures which are reviewed by the management at least once per year, and after every process change.

8-1.2 All employees shall be carefully and thoroughly instructed at scheduled intervals regarding the hazards of their working environment. Their reactions in cases of equipment or process failures may reduce the incidence of fires and prevent explosions.

8-2 Periodic Inspection.

8-2.1 A thorough systematic inspection for safe operation of items listed in 8-2.2 shall be made at regular intervals and shall be submitted to plant management for review.

8-2.2 The inspection shall include, but not be limited to, the following:

(a) fire and explosion protection and prevention equipment;

(b) dust control equipment;

(c) housekeeping;

(d)* electrical and mechanical equipment, relief valves, and interlocks;

(e) procedures.

8-2.3 Competent persons shall conduct such inspections and the record of their findings and recommendations shall be recorded in the principal plant office.

Chapter 9 Mandatory Referenced Publications

(See Appendix B for other referenced publications which are advisory and thus do not constitute part of the requirements of this document.)

9-1 This chapter lists publications referenced within this document which, in whole or in part, are part of the requirements of this document. The numbers in parentheses represent the paragraph numbers from other chapters of this standard which reference, in a mandatory way, the given publication.

9-1.1 NFPA Publications. The following publications are available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 69-1978, *Standard on Explosion Prevention Systems (1-5.5.3, 4-4.1, 4-4.2)*

NFPA 70-1984, *National Electrical Code (1-5.2)*

NFPA 78-1983, *Lightning Protection Code (4-1.1)*

NFPA 91-1983, *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying (6-1.1)*

NFPA 505-1982, *Fire Safety Standard for Powered Industrial Trucks (7-1.2)*

9-1.2 Other Publications.

ANSI B31.3-1976, *Chemical Plant and Petroleum Refinery Piping*, American National Standards Institute, Inc., 1450 Broadway, New York, NY 10018 (2-1.1)

ASME *Unfired Pressure Vessel Code*, Division 8, American Society of Mechanical Engineers, 345 East 47th St., New York, NY 10017 (2-1.1)

Appendix A

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

A-1-4 Combustible Dust. Any time a combustible dust is processed or handled, a potential for explosion exists. The degree of explosion hazard will vary depending on

the type of combustible dust and processing methods used.

A dust explosion has four requirements:

(a) A combustible dust,

(b) A dust dispersion in air or oxygen at or exceeding the minimum explosion concentration, and

(c) An ignition source such as a static, RF, or electric spark or arc; a glowing ember dust layer, hot surface or weld slag; a friction heated bearing, pulley, rotor, fan; a flame or other source.

(d) *Confinement.* Evaluation of the hazard of a combustible dust should be determined by the means of actual test data. All combustible dusts that may produce a dust explosion should be tested so as to determine the following data:

(1) Particle size distribution.

(2) Moisture content as received and dried.

(3) Minimum dust concentration to ignite.

(4) Minimum energy required for ignition (joules).

(5) Maximum rate of pressure rise at optimum concentration.

(6) Layer ignition temperature.

(7) Maximum explosion pressure, at optimum concentration.

(8) Electrical resistivity measurement.

(9) Dust cloud ignition temperature.

Optional Testing.

(10) Maximum permissible oxygen content to prevent ignition.

A-1-5.6.1 For oxygen concentration levels see NFPA 69, *Standard on Explosion Prevention Systems.*

A-2-1 Ducts should be equipped, where applicable, with an automatic spark detection and extinguishing system.

A-4-4 Air-material separators containing combustible component parts should be equipped with an automatic sprinkling device in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems,* or other special extinguishing system in accordance with NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems,* NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems,* or NFPA 12B, *Standard on Halon 1211 Fire Extinguishing Systems.*

A-5.2 Magnetic or other protective separating equipment should be provided to prevent entrance of ferrous materials into the pneumatic system. Removal of nonferrous material should be by screen or gravity separator or other device.

A-7-1.2 Refer to the following publications for further information:

UL 558, *Standard for Internal Combustion Engine Powered Industrial Trucks.*

UL 583, *Standard for Electric Battery Powered Industrial Trucks.*

(FM) *Approval Standard for Gasoline or Diesel Engine Powered Industrial Trucks, Types G, GS, D, or DS.*

(FM) *Approval Standard for Electrical Battery Powered Industrial Trucks, Types E and EE.*

(FM) *Approval Standard for LP-Gas Engine Powered Industrial Trucks, Types LP and LPS.*

ANSI B56.1, *Safety Standard for Powered Industrial Trucks.*

A-7-1.5 Cleaning should be done at 1-hour intervals during periods of steady operation and at the end of each work day.

A-8-2.2(d) Safety interlocks should be calibrated and tested at scheduled intervals in the manner in which they are intended to operate with written test records maintained and reviewed by management.

Appendix B Advisory Referenced Publications

B-1 This Appendix lists publications referenced in this document for advisory purposes and which therefore do not constitute part of the requirements. Some of the publications listed below additionally may be referenced in a mandatory way and thus constitute part of the requirements. In that case, the publications are listed also in Chapter 9. The numbers in parentheses represent the paragraph numbers from other parts of the standard which reference, in an advisory manner, the given publication.

B-1.1 NFPA Publications. The following publications are available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 12-1980, *Standard on Carbon Dioxide Extinguishing Systems (A-4-4.4)*

NFPA 12A-1980, *Standard on Halon 1301 Fire Extinguishing Systems (A-4-4.4)*

NFPA 12B-1980, *Standard on Halon 1211 Fire Extinguishing Systems (A-4-4.4)*

NFPA 13-1983, *Standard for the Installation of Sprinkler Systems (A-4-4.4)*

NFPA 43A-1980, *Code for the Storage of Liquid and Solid Oxidizing Materials (1-1.2)*

NFPA 48-1982, *Standard for the Storage, Handling, and Processing of Magnesium (1-1.2)*

NFPA 61A-1984, *Standard for Manufacturing and Handling Starch (1-1.2)*

NFPA 61B-1980, *Standard for the Prevention of Fires and Explosions in Grain Elevators and Facilities Handling Bulk Raw Agricultural Commodities (1-1.2)*

NFPA 61C-1984, *Standard for the Prevention of Fire and Dust Explosions in Feed Mills (1-1.2)*

NFPA 61D-1984, *Standard for the Prevention of Fire and Dust Explosions in the Milling of Agricultural Commodities for Human Consumption (1-1.2)*

NFPA 65-1980, *Standard for the Processing and Finishing of Aluminum (1-1.2)*

NFPA 68-1978, *Guide for Explosion Venting (1-5.5.1, 4-2.4, 4-3 Exception No. 1)*

NFPA 69-1978, *Standard on Explosion Prevention Systems (A-1-5.6.2)*

NFPA 77-1983, *Recommended Practice on Static Electricity (1-5.1)*

NFPA 85F-1982, *Standard for the Installation and Operation of Pulverized Fuel Systems (1-1.2)*

NFPA 482-1982, *Guide for Fire and Explosion Prevention in Plants Producing and Handling Zirconium (1-1.2)*

NFPA 495-1982, *Code for the Manufacture, Transportation, Storage and Use of Explosive Materials (1-1.2)*

NFPA 651-1980, *Standard for the Manufacture of Aluminum or Magnesium Powder (1-1.2)*

NFPA 653-1971, *Standard for the Prevention of Dust Explosions in Coal Preparation Plants (1-1.2)*

B-1.2 Other Publications.

ANSI B56.1, *Safety Standard for Powered Industrial Trucks*, American National Standards Institute, Inc., 1450 Broadway, New York, NY 10018. (A-7-1.2)

Approval Standard for Electrical Battery Powered Industrial Trucks, Types E and EE, Factory Mutual Research Corporation, Norwood, MA 02062. (A-7-1.2)

Approval Standard for Gasoline or Diesel Engine Powered Industrial Trucks, Types G, GS, D or DS, Factory Mutual Research Corp., Norwood, MA 02062. (A-7-1.2)

Approval Standard for LP-Gas Engine Powered Industrial Trucks, Types LP and LPS, Factory Mutual Research Corp., Norwood, MA 02062. (A-7-1.2)

UL 558, *Standard for Internal Combustion Engine Powered Industrial Trucks*, Underwriters Laboratories Inc., Northbrook, IL 60062. (A-7-1.2)

UL 583, *Standard for Electric Battery Powered Industrial Trucks*, Underwriters Laboratories Inc., Northbrook, IL 60062. (A-7-1.2)

Appendix C Schematics of Typical Pneumatic Conveying Installations

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

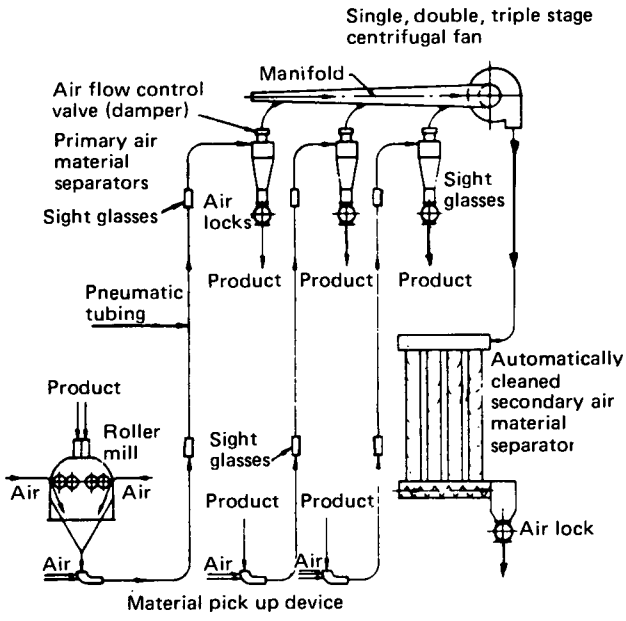

Figure C-1 Multiple strand system, NEGATIVE PRESSURE-TYPE, typical for cereal mills.

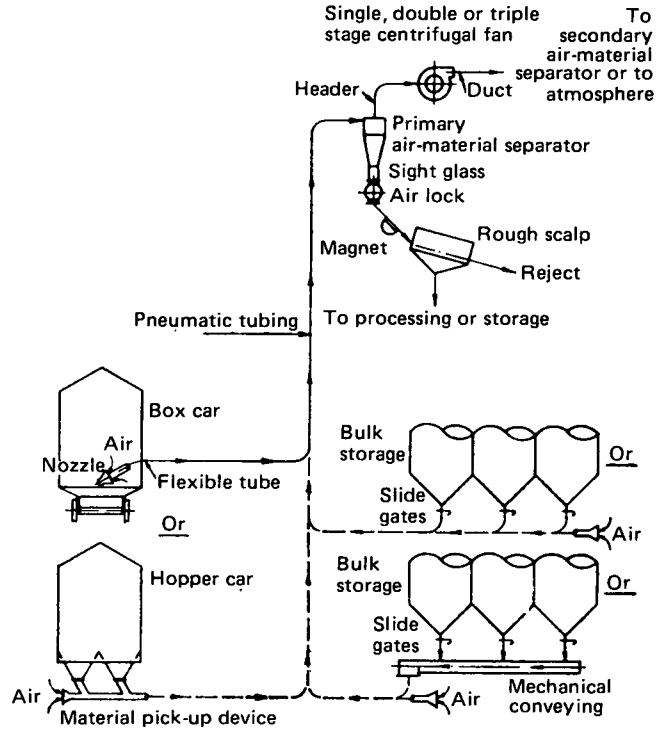

Figure C-2 Typical car unloader system, NEGATIVE PRESSURE-TYPE, low capacity.

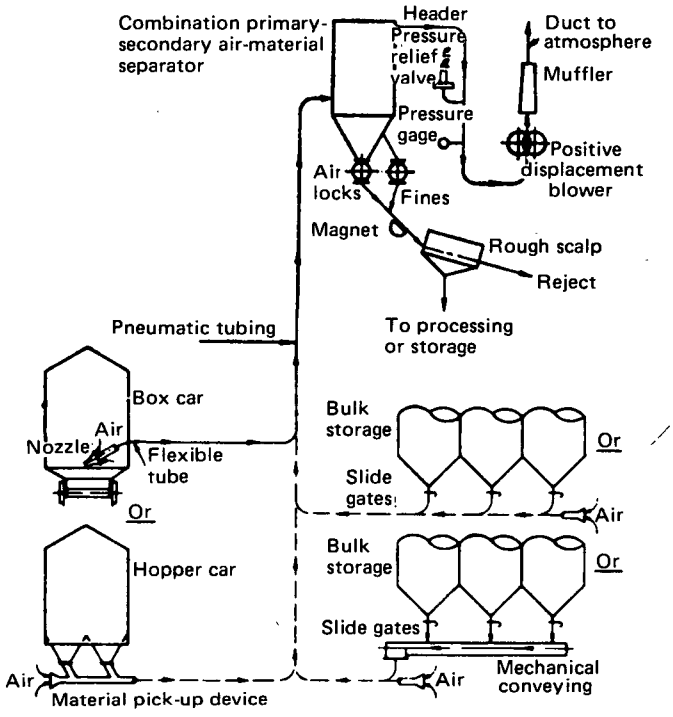

Figure C-3 Typical car unloader system, NEGATIVE PRESSURE-TYPE, high capacity.

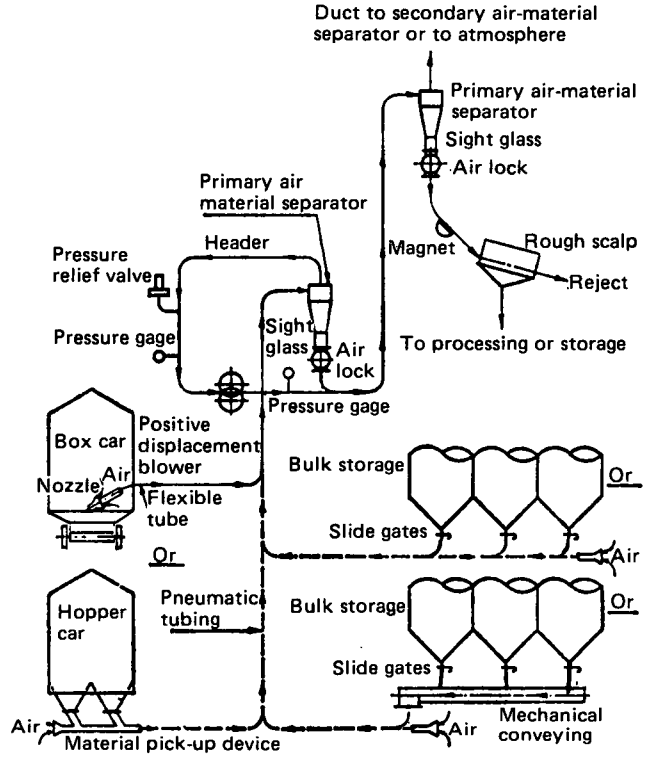

Figure C-4 Portable car unloader and transfer system, combination NEGATIVE PRESSURE-TYPE and POSITIVE PRESSURE-TYPE, high capacity.

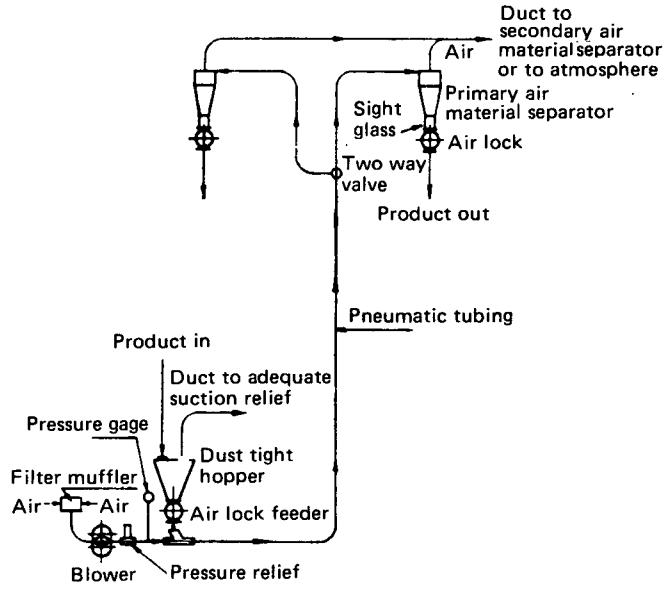

Figure C-5 Typical transfer system, POSITIVE PRESSURE-TYPE, high capacity.

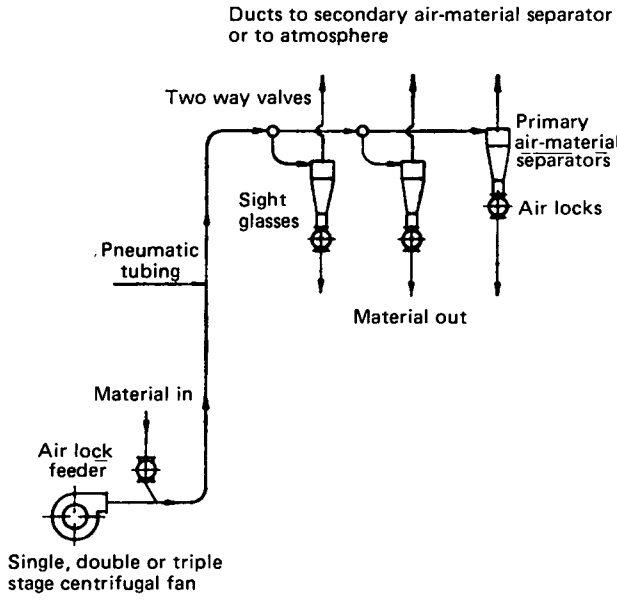

Figure C-6 Typical transfer system, POSITIVE PRESSURE-TYPE, low capacity.