NFPA

496

ANSI / NFPA 496
An American
National
Standard
December 2, 1981

PURGED AND PRESSURIZED ENCLOSURES FOR ELECTRICAL EQUIPMENT 1982

1.5M-1-82-FP

Printed in U.S.A.

NATIONAL FIRE PROTECTION ASSOCIATION, INC.
Batterymarch Park, Quincy, MA 02269

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Standard for

Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (Classified) Locations

NFPA 496-1982

1982 Edition of NFPA 496

This edition of NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (Classified) Locations*, was prepared by the Technical Committee on Electrical Equipment in Chemical Atmospheres, released by the Correlating Committee on Chemicals and Explosives, and acted on by the National Fire Protection Association, Inc., on November 17, 1981, at its Fall Meeting in Toronto, Ontario, Canada. It was issued by the Standards Council on December 9, 1981 with an effective date of December 29, 1981 and supersedes all previous editions.

The 1982 edition of this standard 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 496

This standard was developed in two parts by the Technical Committee on Electrical Equipment in Chemical Atmospheres. The first part, addressing purged enclosures for electrical equipment in Class I Hazardous (Classified) Locations, was adopted as a tentative standard at the 1966 NFPA Annual Meeting and as an official standard at the 1967 NFPA Annual Meeting. The second part, addressing pressurized enclosures for electrical equipment in Class II Hazardous (Classified) Locations was tentatively adopted at the 1970 NFPA Annual Meeting and officially adopted at the 1971 NFPA Annual Meeting.

In 1974, the Technical Committee on Electrical Equipment in Chemical Atmospheres presented a complete revision of the entire standard. In 1980, the Committee began another complete revision. This work culminated in the 1982 edition.

The NFPA Technical Committee on Electrical Equipment in Chemical Atmospheres wishes to gratefully acknowledge the efforts of the Instrument Society of America, through its Committee SP12, in the development of the basic requirements for purged and pressurized enclosures. These efforts resulted in the publishing of ISA S12.4, "Instrument Purging for Reduction of Hazardous Area Classification." ISA S12.4 was the basis for NFPA 496.

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Standard for

Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (Classified) Locations

NFPA 496-1982

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 Appendix C.

Chapter 1 General

1-1 Scope.

1-1.1* This standard shall apply to purged enclosures for electrical equipment located in areas classified as hazardous by Article 500 of NFPA 70, *National Electrical Code®*.

1-1.2 This standard shall apply to such enclosures when located in Class I or Class II hazardous (classified) locations.

1-1.3 This standard shall not apply to enclosures in which a flammable material is introduced, such as gas chromatographs or gas analyzers.

1-2 Purpose. This standard is intended to provide information for the design of purged and pressurized enclosures and the necessary associated safety measures for the purpose of eliminating or reducing the hazardous (classified) location classification within such enclosures. By this means, electrical equipment which is not otherwise acceptable for hazardous (classified) locations may be utilized in accordance with NFPA 70, *National Electrical Code*.

1-3 Applicability.

1-3.1 Chapters 2, 3, and 4 of this standard shall apply to instrument enclosures, small electrical enclosures, control rooms, motors, motor controllers, electrical switchgear, and similar equipment located in areas where flammable gases or vapors may be present in air in concentrations sufficient for the locations to be classified as hazardous.

1-3.2 Chapters 5, 6, and 7 of this standard shall apply to instrument enclosures, small electrical enclosures, control rooms, motors, motor controllers, electrical switchgear, and similar equipment located in areas where combustible dusts may be present in quantities sufficient for the locations to be classified as hazardous.

1-4* Degree of Hazard. There are two degrees of hazard for both Class I and Class II locations:

(a) Division 1, or normally hazardous;

(b) Division 2, or hazardous only under abnormal conditions.

1-5* Definitions. For the purpose of this standard, the following terms shall have the meanings given below.

Class I, Division 1. A location (1) in which ignitible concentrations of flammable gases or vapors exist under normal operating conditions; or (2) in which ignitible concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or (3) in which breakdown or faulty operation of equipment or processes might release ignitible concentrations of flammable gases or vapors and might also cause simultaneous failure of electrical equipment. [*See Article 500-4(b) of NFPA 70, National Electrical Code.*]

Class I, Division 2. A location (1) in which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or (2) in which ignitible concentrations of gases or vapors are normally prevented by positive mechanical ventilation and which might become hazardous through failure or abnormal operation of the ventilating equipment; or (3) that is adjacent to a Class I, Division 1 location and to which ignitible concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided. Electrical conduits and their associated enclosures separated from process fluids by a single seal or barrier shall be classed as a Division 2 location if the outside of the conduit and enclosures is a nonhazardous (classified) location. [*See Article 500-4(b) of NFPA 70, National Electrical Code.*]

Class II, Division 1. A location (1) in which combustible dust is present in the air under normal operating conditions in quantities sufficient to produce explosive or ignitible mixtures; or (2) where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitible mixtures to be produced and might also provide a source of ignition through simultaneous failure of electrical equipment, operation of protection devices, or from other causes; or (3) in which combustible dusts of an electrically conductive nature may be present. [*See Article 500-5(a) of NFPA 70, National Electrical Code.*]

Class II, Division 2. A location (1) in which combustible dust will not normally be in suspension in the air in quantities sufficient to produce explosive or ignitible mixtures and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus; or (2) in which dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment and dust accumulations resulting therefrom may be ignitible by abnormal operation or failure of electrical equipment or other apparatus. [*See Article 500-5(b) of NFPA 70, National Electrical Code.*]

Pressurization. The process of supplying an enclosure with clean air or an inert gas with or without continuous flow at sufficient pressure to prevent the entrance of combustible dusts.

Purging. The process of supplying an enclosure with clean air or an inert gas at sufficient flow and positive pressure to reduce to an acceptably safe level the concentration of any flammable gas or vapor initially present and to maintain this safe level by positive pressure with or without continuous flow.

Type X Purging. Reduces the classification within an enclosure from Division 1 to nonhazardous.

Type Y Purging. Reduces the classification within an enclosure from Division 1 to Division 2.

Type Z Purging. Reduces the classification within an enclosure from Division 2 to nonhazardous.

Chapter 2 Purged Instrument and Other Small Enclosures in Class I Locations

2-1 Scope. Chapter 2 shall apply to enclosures with gross internal volume not exceeding 0.3 cu m (10 cu ft).

2-2 General Requirements.

2-2.1 The enclosure shall be constructed of noncombustible material that is not likely to be damaged under the conditions to which it is likely to be subjected.

2-2.1.1 Precautions shall be taken to protect the enclosure from excessive pressure of the purge supply.

2-2.1.2 Excess pressure relieving devices, when required to protect in case of control failure, shall be designed to prevent escape of sparks or burning material to a hazardous area when they function.

2-2.2 Any window in a purged enclosure shall be tempered glass at least 6.3 mm (¼ in.) thick, shatterproof glass, or other shatterproof material.

2-2.3 If hazardous gases or vapors have accumulated within the enclosure, either because the enclosure has been opened or because the purge system has failed, the enclosure shall be purged.

2-2.3.1 Once the enclosure has been purged of hazardous concentrations, positive pressure shall be maintained within the enclosure. No specific flowrate need be maintained.

2-2.4* Compartments within the main enclosure or adjacent enclosures connected to the main enclosure shall be considered separately and protection shall be provided by one of the following methods:

(a) The compartment shall be vented to the main enclosure by nonrestricted top and bottom vents, common to the main enclosure. Each vent shall provide not less than 6.5 sq cm (1.0 sq in.) of vent area for each 6560 cu cm (400 cu in.), with a minimum vent size of 0.64 cm (¼ in.) diameter.

(b) The compartment shall be separately purged.

(c) The equipment in the compartment shall be protected by other means.

2-2.5 To warn of the possible entrance of hazardous concentrations of flammable gas or vapor in the event of opening of the enclosure or failure of the purge system, suitable devices, such as indicators, alarms, or interlocks, shall be provided.

2-2.6 The purge supply shall be essentially free of dust or liquid which could plug small openings. It shall contain no more than trace amounts of flammable gas or vapor.

2-2.6.1* Air of normal instrument quality shall be considered acceptable for purging, as shall other suitable supplies, such as inert gas.

2-2.6.2 If compressed air is used, the compressor suction line shall be designed to prevent leaks which might permit hazardous gases or vapors to be drawn into the compressor.

2-2.6.3 If compressed air is used, the compressor intake shall be located in a nonhazardous area.

2-2.6.4* If the compressor suction line passes through a hazardous area, it shall be constructed of noncombustible material, designed to prevent leakage of hazardous gases or vapors into the system, and protected against mechanical damage and corrosion.

2-2.7 When double purging is used (e.g., a room purged to a Division 2 classification and containing a device with open contacts protected by purging), the two purge systems shall be independent of each other or automatic shutdown of the device upon failure of one of the systems shall be provided.

2-3* Specific Requirements for Type Z Purging.

2-3.1* Equipment shall not be energized until at least four enclosure volumes of purge gas have passed through the enclosure while maintaining an internal pressure of at least 25 Pa (0.1 in. water).

Exception: Equipment may be energized immediately if a pressure of at least 25 Pa (0.1 in. water) exists and the atmosphere within the enclosure is known to be nonhazardous.

2-3.2* Under normal operating conditions, neither the temperature of the external surface of the enclosure nor that of the purge gas leaving the enclosure shall exceed 80 percent of the autoignition temperature of the flammable vapor or gas involved as determined by the method of *Test for Autogenous Ignition*

Temperatures of Petroleum Products, ASTM D2155, or the *Standard Method for Determining the Autoignition Temperature of Liquid Chemicals*, ASTM E659.

Exception: Temperature limits may be exceeded if it can be shown by test that excessively hot components will not ignite the vapor or gas involved.

2-3.3* A visual or audible alarm shall be provided to indicate failure of the purge system. Safety interlocks need not be provided. (*See Figure 2-3.3.*)

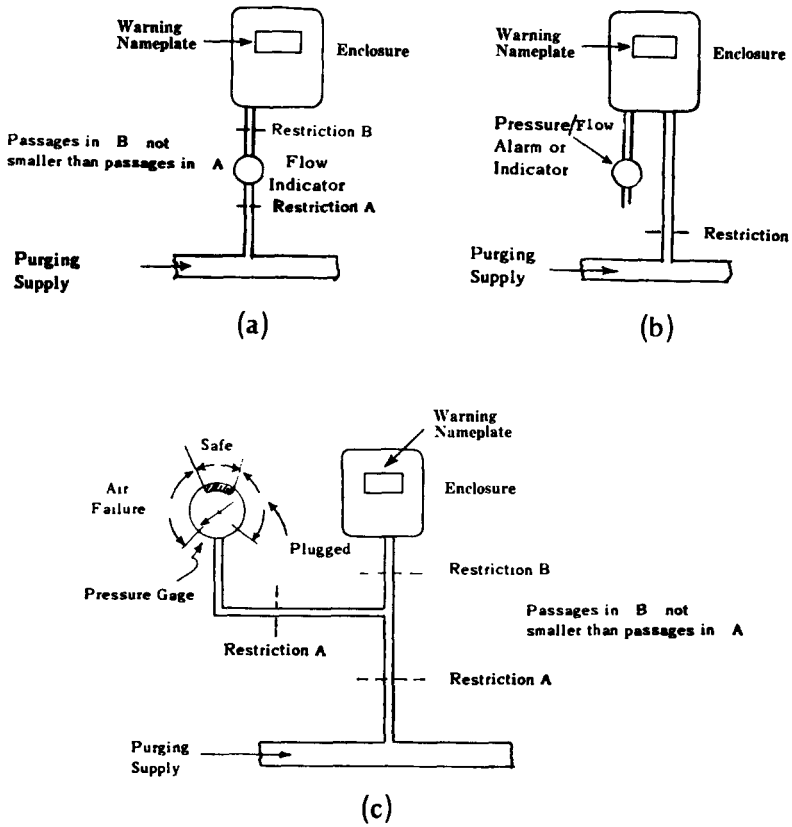

Figure 2-3.3 Acceptable installations for Types Y and Z purging

2-3.3.1 The alarm shall be located so that it is readily seen or heard.

2-3.3.2 The alarm device may be mechanical, pneumatic, or electric.

2-3.3.3 Electrical alarm devices shall be suitable for the location in which they are installed.

2-3.3.4 If the alarm device is pneumatic, any restriction between it and the enclosure shall have passages no smaller than the smallest passage before the pneumatic device in order to avoid plugging. (*See Figure 2-3.3.*)

2-3.3.5 If a pneumatic indicator is used, no valve shall be permitted between the indicator and the enclosure.

2-3.3.6 The pressure or flow device shall be capable of indicating or actuating an alarm when the purge pressure or flow is inadequate to maintain the required static pressure.

2-3.4 A warning nameplate shall be mounted on the enclosure in a prominent location so that it is visible before the enclosure can be opened. The nameplate shall contain the following, or an equivalent, statement:

"Enclosure shall not be opened unless the area is known to be nonhazardous or unless all devices within have been deenergized. Power shall not be restored after enclosure has been opened until enclosure has been purged for _____ minutes."

2-3.4.1 The manufacturer shall recommend purge conditions and flow rate necessary to pass at least four enclosure volumes of purge gas in the time period specified on the label.

2-3.5 The maximum surface temperature of any component within the enclosure shall not exceed 80 percent of the autoignition temperature of the flammable vapor or gas involved, as determined by the procedures referenced in 2-3.2.

Exception: Temperature limits may be exceeded if it can be shown by test that the excessively hot component will not ignite the vapor or gas involved.

2-3.5.1 If a component has not been tested and its surface temperature exceeds the limit stated in 2-3.5, then:

(a) The warning nameplate shall contain a statement that such conditions exist and that the enclosure shall be deenergized for _____ minutes (time period specified to be sufficient to permit the component to cool to a safe temperature) before the enclosure is opened unless the area is demonstrated to be nonhazardous at the time; or

(b) The component shall be separately housed so that the surface temperature of the housing is below the stated temperature limit. This housing shall be purged or sealed and shall be provided with a warning nameplate stating that its cover shall not be removed for _____ minutes after deenergizing unless the area is demonstrated to be nonhazardous at the time. (Time period specified to be sufficient to permit the component to cool to a safe temperature.)

2-4* Specific Requirements for Type Y Purging.

2-4.1 All requirements in 2-3.1 through 2-3.5 shall be complied with.

2-4.2 Equipment and devices within the enclosure shall conform to the requirements for Division 2 locations as follows:

2-4.2.1* Make-and-break or sliding contacts shall be either immersed in oil, enclosed within a chamber hermetically sealed against entrance of gases or vapors, or in circuits which, under normal conditions, do not release sufficient energy to ignite the specific hazardous atmosphere involved.

2-4.2.2* The maximum surface temperature of any component within the enclosure shall not exceed 80 percent of the autoignition temperature of the flammable vapor or gas involved, as determined by the procedures referenced in 2-3.2.

Exception No. 1: Temperature limits may be exceeded if it can be shown by test that the excessively hot component will not ignite the vapor or gas involved.

Exception No. 2: Temperature limits may be exceeded if the excessively hot component is enclosed in a chamber hermetically sealed against entrance of gases or vapors.

2-4.2.3 When line voltage wiring enters the enclosure, precautions shall be taken to ensure that a fault (e.g., a short circuit) between the line voltage wiring and the enclosure cannot burn through the enclosure or otherwise raise the external surface temperature of the enclosure to greater than 80 percent of the autoignition temperature of the gas or vapor involved. Such precautions may include overcurrent protection for such wiring in conjunction with enclosure thickness and material. (*See Appendix B.*)

2-4.3 If the requirements of 2-4.2 are met, it shall be acceptable to locate the equipment in a Division 2 location in a general purpose enclosure without purging.

2-5* Specific Requirements for Type X Purging.

2-5.1 A timing device shall be used to prevent energizing of electrical equipment within the enclosure until at least four volumes of purge gas (ten volumes for motors) have passed through the enclosure while maintaining an internal pressure of at least 25 Pa (0.1 in. water).

2-5.1.1 The timing device shall be suitable for the location in which it is installed.

2-5.1.2 Purge conditions and flowrate shall be calculated to determine the conditions to pass four enclosure volumes in the stated time.

2-5.2 The enclosure shall be maintained under a positive pressure of not less than 25 Pa (0.1 in. water) when the equipment is energized.

2-5.3 A device shall be incorporated to remove power automatically from all circuits within the enclosure not suitable for Division 1 upon failure of the purge system. (*See 2-5.6.*)

2-5.4* If the enclosure can be readily opened without the use of a key or tools, an interlock shall be provided to immediately deenergize all circuits within the enclosure that are not suitable for Division 1 locations when the enclosure is opened.

2-5.4.1 The interlock, even though located within the enclosure, shall be suitable for Class I, Division 1 locations.

2-5.5* The maximum surface temperature of any component within the enclosure shall not exceed 80 percent of the autoignition temperature of the flammable vapor or gas involved, as determined by the procedures referenced in 2-3.2.

Exception No. 1: Temperature limits may be exceeded if it can be shown by test that the excessively hot component will not ignite the vapor or gas involved.

Exception No. 2: Temperature limits may be exceeded if the excessively hot component is enclosed in a chamber hermetically sealed against entrance of gases or vapors.

2-5.5.1 Equipment such as motors, transformers and other equipment which may be overloaded shall be provided with appropriate devices to detect any increase in temperature beyond design limits of the equipment and to automatically deenergize the equipment, upon detection of such increase.

2-5.5.2 When line voltage wiring enters the enclosure, precautions shall be taken to ensure that a fault (e.g., a short circuit) between the line voltage wiring and the enclosure cannot burn through the enclosure or otherwise raise the external surface temperature of the enclosure to greater than 80 percent of the autoignition temperature of the gas or vapor involved. Such precautions may include overcurrent protection for such wiring in conjunction with enclosure thickness and material. (*See Appendix B.*)

2-5.6 The electrical disconnect provided to remove power upon failure of the purge system shall be either flow or pressure actuated. (*See Figure 2-5.6.*)

2-5.6.1 The electrical disconnect shall be suitable for use in the location in which it is installed.

2-5.6.2 To avoid plugging when a pneumatic device is used, any restrictions between the device and the enclosure shall have passages no smaller than the smallest passage before the device. No valve between the pneumatic device and the enclosure shall be permitted.

2-5.6.3 The pressure or flow device shall be capable of removing power when the purge pressure or flow is inadequate to maintain a static pressure within the enclosure of at least 25 Pa (0.1 in. of water).

2-5.6.4 If a pressure gage is used, as shown in Figure 2-5.6(c), it shall be arranged to remove power if pressure exceeds or falls below a predetermined safe range.

2-5.7 A warning nameplate shall be affixed to the enclosure in a prominent location so that it is visible before the enclosure can be opened. The nameplate shall contain the following, or an equivalent, statement:

"Enclosures shall not be opened or any cover removed unless the area is known to be nonhazardous or unless all devices within have been deenergized. Power shall not be restored after the enclosure has been opened until the enclosure has been purged for _____ minutes."

2-5.7.1 The manufacturer shall recommend purge conditions and flow rate necessary to pass at least four enclosure volumes of purge gas in the time period specified on the label.

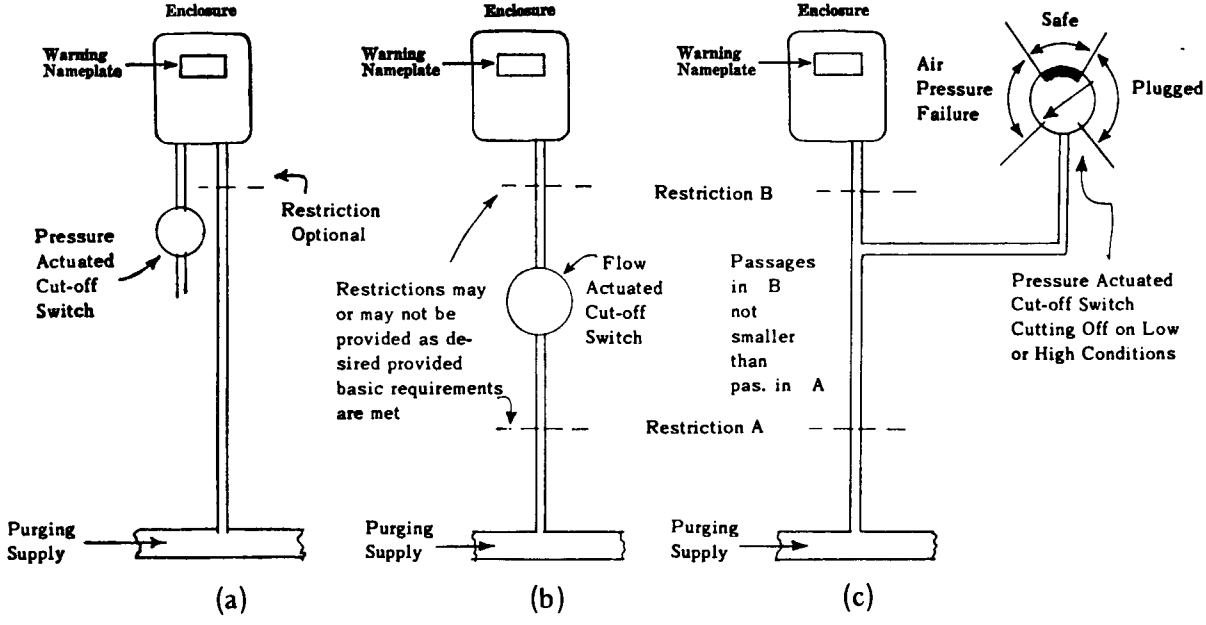

Figure 2-5.6 Acceptable installations for Type X purging

Chapter 3 Purged Control Rooms in Class I Locations

3-1 General.

3-1.1* These requirements shall apply to buildings or portions of buildings commonly referred to as control rooms.

3-1.2* If the control room is in a classified location, it shall be designed to prevent the entry of flammable vapors or gases, or flammable liquids.

3-2 Considerations Relating to Positive Pressure Ventilation.

3-2.1 The following factors shall be considered in designing a control room suitable for safe operation in a hazardous (classified) location:

(a) The number of people to be housed;

(b) The type of equipment to be housed;

(c) The location of the control room relative to process units, including location of relief valves, vent stacks, emergency relief systems, and prevailing wind.

3-2.2* The source of air for purging control rooms shall be free of hazardous concentrations of flammable vapors and gases, contaminants and any other foreign matter.

3-2.2.1* The source of air shall be determined from the nature of the process and the physical layout.

3-2.2.2 Any ducts shall be constructed of noncombustible materials. The fan suction line shall be free of leaks and given suitable protection from mechanical damage and corrosion to prevent hazardous concentrations of flammable gases or vapors from being drawn into the purge system.

3-2.2.3 The purge system shall be designed to provide positive pressure for all areas of the control room.

3-3 Requirements for Positive Pressure Air Systems.

3-3.1* The positive pressure air system shall be capable of:

(a) Maintaining a pressure of at least 25 Pa (0.1 in. of water) in the control room with all openings closed;

(b) Providing a minimum outward velocity of 0.305 m/sec (60 fpm) through all openings capable of being opened. A drop in pressure below the 25 Pa (0.1 in. of water) specified in 3-3.1 (a) is permissible while meeting the requirements of 3-3.1(b).

3-3.1.1 The positive pressure air system may include heating, ventilation, and air conditioning equipment, as well as any auxiliary equipment necessary to comply with 3-3.1.

3-3.2 If there is an air consuming device in the control room, sufficient air shall be supplied to accommodate its needs as well as the needs of the positive pressure air system. Alternatively, the air supply to such a device shall be taken from a separate source.

3-3.3 If Type X purging is required, all power to the control room shall be interrupted upon failure of the positive pressure air system. The effect of such immediate interruption of power on processes shall be considered.

3-3.4 Immediate interruption of power upon air system failure shall not be required for Types Y and Z purging.

3-3.5* Failure of the positive pressure air system shall be detected at the discharge end of the fan and shall be signaled by a visible or audible alarm at a constantly attended location.

3-3.6 Provisions shall be made to energize the control room safely after an air system interruption. Such provisions include checking the atmosphere in the control room with a flammable vapor detector to determine that the atmosphere is safe.

3-3.7* The switch, electrical disconnect, and motor for the air system fan shall be suitable for the area as it would be classified in the absence of positive pressure ventilation.

3-3.8 The electrical power for the positive pressure air system shall be taken off the main power line ahead of any service disconnects to the control room.

Chapter 4 Purged Power Equipment Enclosures in Class I Locations

4-1 Scope.

4-1.1 This chapter shall apply to equipment enclosures which exceed 0.3 cu m (10 cu ft) in volume, but which are not control rooms.

4-1.2 For the purpose of this chapter, electrical power equipment is divided into two groups:

(a) Purged Equipment. Equipment, such as switchgear and motor controllers, which does not require airflow for heat dissipation, but which requires pressurization to prevent entrance of flammable gases or vapors.

(b) Ventilated Equipment. Equipment, such as motors, which requires airflow for heat dissipation, as well as to prevent entrance of flammable gases or vapors.

4-2 Requirements for Purged Equipment.

4-2.1 Enclosures shall be of substantial noncombustible construction and shall be reasonably tight. Gaskets shall be permitted.

4-2.2 The source of air shall be free of hazardous concentrations of flammable vapor or gas, contaminants, and any other foreign matter.

4-2.3 Piping for air or inert gas (if used) shall be protected against mechanical damage.

4-2.4 Regardless of the type of purging (i.e., X, Y, or Z), at least ten enclosure volumes of purge gas shall be passed through the enclosure while maintaining an internal pressure of 25 Pa (0.1 in. of water) before the enclosure is energized. This pressure shall be maintained continuously.

Exception: In the cases of Type Y and Z purging, power may be turned on immediately if a pressure of at least 25 Pa (0.1 in. water) exists and the atmosphere within the enclosure is known to be nonhazardous.

4-2.5 For Type Z purgings, the temperature of the external surface of the enclosure or the egress air shall not, under normal operating conditions, exceed 80 percent of the autoignition temperature of the vapor or gas involved as determined by the procedures referenced in 2-3.2.

Exception: Temperature limits may be exceeded if it can be shown by test that excessively hot components will not ignite the vapor or gas involved.

4-2.6 For Type X purging, power to the equipment shall be immediately removed upon loss of pressurization, unless immediate loss of power would result in a more hazardous condition.

4-2.6.1 In cases where immediate power removal is not provided, both audible and visual signals to warn of loss of pressurization shall be provided at a constantly attended location. Such alarm devices shall be suitable for the area in which they are installed.

4-2.7 For Types Y and Z purging, loss of pressurization shall energize an audible or visual alarm at a constantly attended location. Removal of power shall not be required for failure of Types Y or Z purging.

4-2.8 A warning nameplate shall be mounted on the enclosure in a prominent location so that it is visible before the enclosure can be opened. The nameplate shall contain the following, or an equivalent, statement:

"Enclosure shall not be opened unless the area is known to be nonhazardous or unless all devices within have been deenergized. Power shall not be restored after enclosure has been opened until enclosure has been purged for _____ minutes."

4-2.8.1 The manufacturer shall recommend purge conditions and flow rate necessary to pass at least 10 enclosure volumes of purge gas in the time period specified on the label.

4-2.9 The maximum surface temperature of any component within the enclosure shall not exceed 80 percent of the autoignition temperature of the flammable vapor or gas involved, as determined by the procedures referenced in 2-3.2.

Exception: Temperature limits may be exceeded if it can be shown by test that the excessively hot component will not ignite the vapor or gas involved.

4-2.9.1 If a component has not been tested and its surface temperature exceeds the limit stated in 4-2.9 then:

(a) The warning nameplate shall contain a statement that such conditions exist and that the enclosure shall be deenergized for _____ minutes (time period specified to be sufficient to permit the component to cool to a safe temperature) before the enclosure is opened unless the area is demonstrated to be nonhazardous at the time; or

(b) The component shall be separately housed so that the surface temperature of the housing is below the stated limit. This housing shall be purged or sealed and shall be provided with a warning nameplate stating that its cover shall not be removed for _____ minutes after deenergizing unless the area is demonstrated to be nonhazardous at the time. (Time period specified to be sufficient to permit the component to cool to a safe temperature.)

4-2.9.2 For Type X purging, equipment such as motors, transformers and other equipment which may be overloaded shall be provided with appropriate devices to detect any increase in temperature of the equipment beyond its design limits and to deenergize the equipment automatically, upon detection of such increase.

4-3 Requirements for Ventilated Equipment.

4-3.1 The enclosure shall be of substantial noncombustible construction with necessary openings limited to minimum practical size and kept as airtight as possible.

4-3.2 The enclosure shall be purged by at least ten air changes before the electrical equipment is energized. The auxiliary air equipment shall be suitable for the location.

4-3.3 The enclosure shall be constantly maintained at a pressure of at least 25 Pa (0.1 in. of water) above the surrounding atmosphere during operation of the equipment.

4-3.4* The source of air for ventilation shall be free of hazardous concentrations of flammable gases or vapors, contaminants, and any other foreign matter.

4-3.5 Air discharge from the enclosure shall be to an area classified as nonhazardous or Division 2.

4-3.6 Airflow through the enclosure shall be as uniform as possible so as to avoid air pockets.

4-3.7* The flow of air shall be sufficient to keep the equipment adequately cooled, depending on operating and design requirements.

4-3.8 For equipment in Division 2 locations, the maximum temperature of any surface exposed to the atmosphere shall not exceed 80 percent of the autoignition temperature of the flammable vapor or gas involved, as determined by the procedures referenced in 2-3.2.

Exception: Temperature limits may be exceeded if it can be shown by test that excessively hot components will not ignite the vapor or gas involved.

4-3.9 The electrical circuits of the equipment within the enclosure shall be interlocked with the ventilating equipment so that:

(a) The equipment cannot be energized until the purge cycle has been completed; and

(b) The equipment will be automatically deenergized when the equipment stops.

Exception: If automatic deenergizing of equipment would result in unsafe conditions, it shall be acceptable to provide both audible and visual alarms at a constantly attended location, in lieu of compliance with 4-3.9 (b).

Chapter 5 Pressurized Instrument and Other Small Enclosures in Class II Locations

5-1 Scope. Chapter 5 shall apply to enclosures with a gross internal volume not exceeding 0.3 cu m (10 cu ft).

5-2 General Requirements.

5-2.1 The enclosure shall be reasonably tight and shall be constructed of noncombustible material that is not likely to be damaged under the conditions to which it is likely to be subjected.

5-2.1.1 Precautions shall be taken to protect the enclosure from excessive internal pressure.

5-2.1.2 Excess pressure relieving devices, when required to protect in case of control failure, shall be designed to prevent escape of sparks or burning material to a hazardous area when they function.

5-2.2 Any window in a pressurized enclosure shall be tempered glass at least 6.3 mm (¼ in.) thick, shatterproof glass, or other shatterproof material.

5-2.3 If combustible dust has accumulated within the enclosure, the enclosure shall be opened and the dust removed before pressurization.

5-2.4 Compartments within the main enclosure or adjacent enclosures connected to the main enclosure may be collectively pressurized to prevent the entrance of dust if there is adequate communication to maintain the specified pressure at all points.

5-2.5 Suitable indicators, pressure switches, or interlocks shall be provided to safeguard the installation if the enclosure is opened or if the pressurizing system fails.

5-2.6 The pressurizing supply shall be essentially free of dust and liquids which can plug small openings. It shall contain no more than trace amounts of flammable gases or vapors.

5-2.6.1 Air of normal instrument quality shall be considered acceptable for pressurizing, as shall other suitable supplies such as inert gas. (*See A-2-2.6.1.*)

5-2.6.2 If compressed air is used, the compressor suction line shall be designed to prevent leaks which might permit hazardous gases, vapors, or dusts from being drawn into the compressor.

5-2.6.3 If compressed air is used, the compressor intake shall be located in a nonhazardous area.

5-2.6.4* If the compressor suction line passes through a hazardous area, it shall be constructed of noncombustible material, designed to prevent leakage of hazardous gases, vapors, or dusts into the system and shall be protected against mechanical damage and corrosion.

5-3* Specific Requirements for Pressurizing.

5-3.1 Before the equipment in the enclosure is energized, the interior of the enclosure shall be free of dust. If combustible dusts have collected within the enclosure, it shall be opened and the dust removed before pressurization.

5-3.2* The enclosure shall be maintained under a positive pressure dependent on the specific particle density of the dust as long as equipment in the enclosure is energized. The positive pressure shall comply with the following:

Specific Particle Density		Pressure	
lbs per cu ft	*kg per cu m*	*in. H_2O*	*Pa*
≤ 130	≤ 2083	≥ 0.1	≥ 25
> 130	> 2083	≥ 0.5	≥ 125

5-3.3* In Class II, Division 1 locations, a door switch shall be provided on the enclosure arranged to deenergize all circuits within the enclosure which are not suitable for Division 1 if the enclosure can be readily opened without the use of a key or tools. No door switch is required for Division 2 locations.

5-3.4* A warning nameplate shall be mounted on the enclosure in a prominent location so that it is visible before the enclosure can be opened. The nameplate shall contain the following, or an equivalent, statement:

"Enclosure shall not be opened unless the area is known to be nonhazardous or unless all devices within the enclosure have been deenergized. Power shall not be restored after the enclosure has been opened until combustible dusts have been removed and the enclosure repressurized."

5-3.5* Under normal operating conditions, neither the temperature of the external surface of the enclosure nor that of the gas leaving the enclosure shall exceed 80 percent of the layer ignition temperature of the combustible dust involved, and in all cases shall be at least 25°C (77°F) below such temperature.

5-3.5.1 If the ignition temperature of the dust is not known, maximum surface temperatures shall not exceed those stated in Table 502-1 of NFPA 70, *National Electrical Code*.

5-3.5.2* Equipment installed in Class II locations shall be able to function at full rating without developing surface temperatures high enough to cause excessive dehydration or gradual carbonization of any organic dust deposits that may occur.

5-3.6 When line voltage wiring enters the enclosure, precautions shall be taken to insure that a fault (e.g., a short circuit) between the line voltage wiring and the enclosure cannot burn through the enclosure or otherwise raise the external surface temperature above 80 percent of, and at least 25°C (77°F) below, the layer ignition temperature of the dust involved. Such precautions may include over-current protection for such wiring in conjunction with enclosure thickness and material. (*See Appendix B.*)

5-3.7* Any internal component having a surface temperature approaching the layer ignition temperature of the combustible dust involved shall be protected in accordance with 5-3.7.1.

5-3.7.1 If any internal component has a maximum surface temperature greater than that indicated in 5-3.5, the component shall be enclosed within a chamber hermetically sealed or suitably gasketed against the entrance of combustible dusts and of a size which will limit its exterior surface temperature to those specified in 5-3.5.

Exception No. 1: If the chamber containing the component is not sealed or gasketed, a warning nameplate shall be mounted on the outside of the enclosure stating that such conditions exist and that power shall be removed for _____ minutes (time period specified to be sufficient to permit unit to cool to a safe limit) before the door is opened unless the area is known to be nonhazardous at the time.

Exception No. 2: If the chamber containing the component is not sealed or gasketed, the component shall be separately housed so that the surface temperature of the housing is below safe limits. The housing shall be pressurized or sealed and provided with a warning nameplate stating that its cover shall not be removed for _____ minutes (time period specified to be sufficient to permit unit to cool to a safe limit) unless the area is known to be nonhazardous at the time.

5-3.7.2 Equipment such as motors and transformers that may be overloaded and that is exposed directly to the dusty atmosphere shall be provided with appropriate devices to detect any increase in temperature beyond design limits and to deenergize the equipment automatically.

Exception: If immediate interruption of power would result in a condition more hazardous than that created by failure to remove the power, audible and visible alarms shall be provided at a constantly attended location in lieu of compliance with 5-3.7.2.

5-3.8 An alarm or indicator shall be provided to indicate failure of the pressurizing system. It shall be acceptable for the device to be mechanical, pneumatic, or electric and the alarm may be audible or visible.

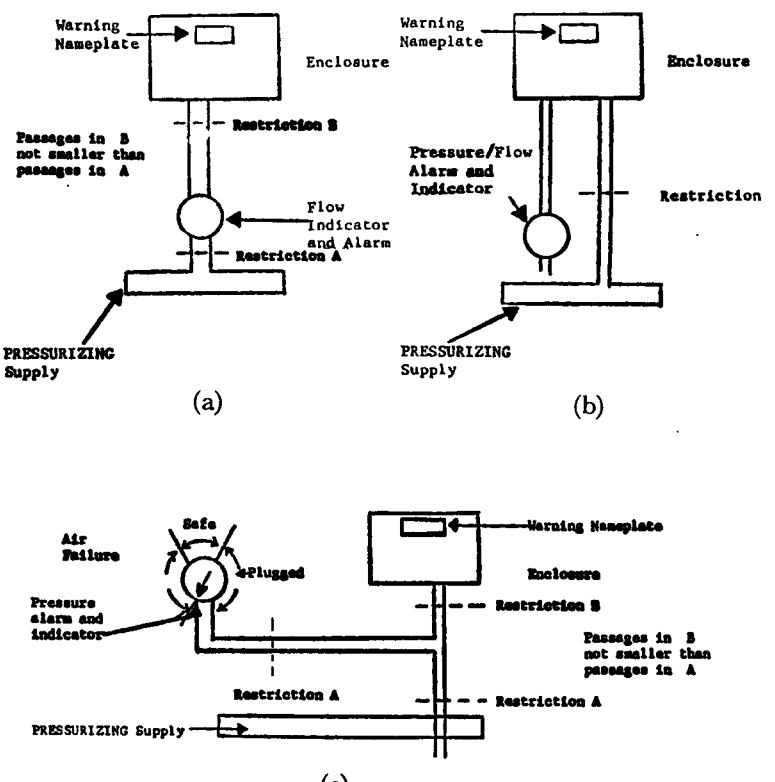

Figure 5-3.8 Acceptable installations for pressurizing

5-3.8.1 To avoid plugging when a pneumatic device is used, any restrictions between the pneumatic device and the enclosure shall have passages no smaller than the smallest passage before the pneumatic device.

5-3.8.2 If a pneumatic indicator is used, no valve shall be permitted between the device and the enclosure.

5-3.8.3 The pressure or flow device shall be capable of indicating or actuating an alarm when the pressure or flow of the purge gas is inadequate to maintain the static pressure specified in 5-3.2. (*See Figure 5-3.8.*)

5-3.8.4 The device shown in Figure 5-3.8(c), shall also be capable of indicating or actuating an alarm if pressure exceeds a predetermined safe range (which indicates plugging of Restriction B).

Chapter 6 Pressurized Control Rooms in Class II Locations

6-1 General.

6-1.1 These requirements apply to buildings or portions of buildings commonly referred to as control rooms. (*See A-3.1.1.*)

6-1.2 If the control room is in a Class II location, it shall be designed to prevent the entry of combustible dusts. To prevent the entry of combustible dusts, it shall be acceptable to use positive pressure ventilation from a source of clean air and the equipment in the building need not be housed in special enclosures for safe operation.

6-2 Considerations Relating to Positive Pressure Ventilation.

6-2.1 The following factors shall be considered in designing a control room suitable for safe operation in a hazardous (classified) location:

(a) The number of people to be housed;

(b) The type of equipment to be housed;

(c) The location of the control room relative to process units and potential sources of dust, such as bucket elevator legs, belt conveyors, and vent stacks.

6-2.2* The source of air for pressurizing control rooms shall be free of hazardous concentrations of flammable vapors and gases, combustible dusts, contaminants and any other foreign matter.

6-2.2.1* The source of air shall be determined from the nature of the process and the physical layout.

6-2.2.2 Any ducts shall be constructed of noncombustible materials. The fan suction line shall be free of leaks and given suitable protection from mechanical damage and corrosion to prevent hazardous concentrations of combustible dusts from being drawn into the pressurizing system.

6-2.2.3 The pressurizing system shall be designed to provide positive pressure ventilation for all areas of the control room.

6-3 Requirements for Positive Pressure Air Systems.

6-3.1 The positive pressure air system shall be capable of:

(a) Maintaining a pressure of at least 25 Pa (0.1 in. of water) in the control room with all openings closed;

(b) Providing a minimum outward velocity of 0.305 m/sec (60 fpm) through all openings capable of being opened.

A drop in pressure below the 25 Pa (0.1 in. of water) specified in 6-3.1 (a) is permissible while meeting the requirements of 6-3.1(b). (*See A-3-3.1.*)

6-3.1.1 The positive pressure air system may include heating, ventilating, and air conditioning equipment, as well as any auxiliary equipment necessary to comply with 6-3.1.

6-3.2 If there is an air-consuming device in the control room, sufficient air shall be supplied to accommodate its needs as well as the needs of the positive pressure air system. Alternatively, the air supply to such a device shall be taken from a separate source.

6-3.3 Failure of the positive pressure air system shall be detected at the discharge end of the fan and shall be signaled by a visual or audible alarm at a constantly attended location. Prompt measures shall be taken to restore pressurization. (*See A-3-3.5.*)

6-3.4 After an interruption of the positive pressure air system, a visual inspection shall be made to determine that the control room is safe from the hazard of combustible dust.

Chapter 7 Pressurized Power Equipment Enclosures in Class II Locations

7-1 Scope.

7-1.1 This chapter shall apply to equipment enclosures which exceed 0.3 cu m (10 cu ft) in volume but which are not control rooms.

7-1.2 For the purpose of this chapter, electrical power equipment is divided into two groups:

(a) Pressurized Equipment. Equipment which does not require air flow for heat dissipation, but which requires pressurization to prevent entrance of combustible dusts.

(b) Ventilated Equipment. Equipment, such as motors, which requires air flow for heat dissipation, as well as to prevent entrance of combustible dusts.

7-2 Requirements for Pressurized Equipment.

7-2.1 The enclosure shall be of substantial noncombustible construction and shall be reasonably tight. Gaskets shall be permitted.

7-2.1.1 Precautions shall be taken to protect the enclosure from excessive pressure of the pressurization system.

7-2.1.2 Excess pressure relief devices, where required to protect in case of failure of pressure control, shall be designed to prevent escape of sparks or burning material to a hazardous area when they function.

7-2.2 The source of air shall be free of hazardous concentrations of flammable gases, vapors, combustible dusts, contaminants and any other foreign matter.

7-2.3 Piping for air or inert gas (if used) shall be protected against mechanical damage.

7-2.4 Combustible dust shall be removed from the enclosure before the equipment is energized.

7-2.5 The enclosure shall be maintained under a positive pressure dependent on the specific particle density of the dust as long as the equipment in the enclosure is energized. The positive pressure shall comply with the following:

Specific Particle Density		Pressure	
lbs per cu ft	*kg per cu m*	*in. H_2O*	*Pa*
≤ 130	≤ 2083	≥ 0.1	≥ 25
> 130	> 2083	≥ 0.5	≥ 125

7-2.5.1 It shall be acceptable to energize the equipment in the enclosure immediately if the pressure specified in 7-2.5 exists and the atmosphere in the enclosure is not visibly dusty.

7-2.6 Under normal operating conditions, neither the temperature of the external surface of the enclosure nor that of the gas leaving the enclosure shall exceed 80 percent of the layer ignition temperature of the combustible dust involved, and in all cases shall be at least 25 °C (77 °F) below such temperature. (*See A-5-3.5.*)

7-2.6.1 If the ignition temperature of the dust is not known, maximum surface temperatures shall not exceed those stated in Table 502-1 of NFPA 70, *National Electrical Code*.

7-2.6.2 Equipment installed in Class II locations shall be able to function at full rating without developing surface temperatures high enough to cause excessive dehydration or gradual carbonization of any organic dust deposits that may occur. (*See A-5-3.5.2.*)

7-2.7* Loss of pressurization shall energize an audible and visual alarm at a constantly attended location. Immediate removal of power shall not be required.

7-2.8 A warning nameplate shall be mounted on the enclosure in a prominent location so that it is visible before the enclosure can be opened. The nameplate shall contain the following, or an equivalent, statement:

"Enclosure shall not be opened unless the area is known to be nonhazardous or unless all devices within the enclosure have been deenergized. Power shall not be restored after the enclosure has been opened until combustible dusts have been removed and the enclosure repressurized."

7-2.9 Equipment that may be overloaded, such as motors and transformers, and which may be exposed directly to the dusty atmosphere shall be provided with suitable devices to detect any increase in temperature beyond the design limits of the equipment and to deenergize the equipment automatically.

Exception: If immediate interruption of power would result in a condition more hazardous than that created by failure to remove the power, audible and visible alarms shall be provided at a constantly attended location, in lieu of compliance with 7-2.9.

7-2.10 If any internal component has a maximum surface temperature exceeding the limits stated in 7-2.6, the component shall be enclosed within a chamber hermetically sealed or suitably gasketed against the entrance of combustible dusts and of a size which will limit its exterior surface temperature to those stated in 7-2.6.

Exception No. 1: If the chamber containing the component is not sealed or gasketed, a warning nameplate shall be mounted on the outside of the enclosure stating that such conditions exist and that power shall be removed for _____ minutes (time period specified to be sufficient to permit unit to cool to a safe limit) before the door is opened unless the area is known to be nonhazardous at the time.

Exception No. 2: If the chamber containing the component is not sealed or gasketed, the component shall be separately housed so that the surface temperature of the housing is below safe limits. The housing shall be pressurized or sealed and provided with a warning nameplate stating that its cover shall not be removed for _____ minutes (time period specified to be sufficient to permit unit to cool to a safe limit) unless the area is known to be nonhazardous at the time.

7-3 Requirements for Ventilated Equipment.

7-3.1 The enclosure shall be of substantial noncombustible construction with necessary openings limited to minimum practical size and kept as airtight as possible.

7-3.2 Combustible dust shall be removed from the enclosure before the equipment is energized and ventilated.

7-3.3 The source of air for ventilation shall be free of hazardous concentrations of flammable vapors, gases, combustible dusts, contaminants and any other foreign matter. (*See A-6-2.2.*)

7-3.4 Air discharge from the enclosure shall be to an area classified nonhazardous or Division 2. (*See A-6-2.2.*)

7-3.5 The flow of air shall be as uniform as possible within the enclosure so as to avoid air pockets.

7-3.6 The flow of air shall be sufficient to keep the equipment adequately cooled, depending on operating and design requirements. (*See A-4-3.7.*)

7-3.7 The enclosure shall be constantly maintained at a pressure of at least 25 Pa (0.1 in. of water) above the surrounding atmosphere during operation of the equipment, unless the surrounding atmosphere is known to be nonhazardous.

7-3.8 The maximum temperature limits of 7-2.6 shall apply.

7-3.9 The electrical circuits of the equipment within the enclosure shall be interlocked with the ventilating equipment, so that the circuits will be automatically deenergized if the ventilating equipment fails.

Exception: If deenergizing the circuits would result in a condition more hazardous than that created by failure to deenergize, audible and visual alarms shall be provided at a constantly attended location, in lieu of compliance with 7-3.9.