NFPA® 496

Standard for Purged and Pressurized Enclosures for Electrical Equipment

2024 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA® 496

Standard for

Purged and Pressurized Enclosures for Electrical Equipment

2024 Edition

This edition of NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, was prepared by the Technical Committee on Electrical Equipment in Chemical Atmospheres. It was issued by the Standards Council on April 23, 2023, with an effective date of May 13, 2023, and supersedes all previous editions.

This edition of NFPA 496 was approved as an American National Standard on May 13, 2023.

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.

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

In 1983, the technical committee recognized the need for specific requirements applicable to process control analyzers that have internal sources of a flammable or combustible material, such as a direct connection to the process stream. Two chapters were added to address analyzer enclosures and analyzer rooms or buildings. Additional changes were also made to certain existing portions of the text specifically to address problems in the interpretation of the existing text. The 1986 edition of NFPA 496 was the result of that effort.

In 1987, the technical committee recognized a need for editorial revisions to the figures in Chapter 2 as well as some minor editorial changes in Chapters 2 and 9 and Appendix A. The 1989 edition was the result of that effort.

Beginning in 1990, an ad hoc committee consisting of members of the Technical Committee on Electrical Equipment in Chemical Atmospheres started a major rewrite of the document to develop a more comprehensive standard and to reduce redundancy in the text. Definitions were added for further clarity, and references to Class III were deleted, since the standard did not cover that application and could create some confusion. The term *purging* was replaced with *pressurizing*, and *protective gas* was introduced as a new term. The requirements based on gross internal volume were deleted and replaced with general and specific requirements for all pressurized enclosures used in Class I and Class II locations. The result of the rewrite was the 1993 edition.

In 1997, the technical committee entered NFPA 496 into the revision cycle to update the requirements. The standard was updated to include definitions and references to Article 505 in *NFPA 70®*, *National Electrical Code®*, which deals with Class I, Zone 1, and Zone 2 locations. It also was changed to provide an exception for control rooms, where doors and other openings used solely for equipment relocation are permitted to be excluded from the calculation for outward air velocity from the central room.

In 2001, the Technical Committee on Electrical Equipment in Chemical Atmospheres entered NFPA 496 into the May 2003 revision cycle. The 2003 edition was significantly revised and reorganized for conformance with the 2000 *Manual of Style for NFPA Technical Committee Documents*. Additionally, technical changes included revision of the term *alarm* to clarify its function with

protected enclosures, and a revision that permits the use of a means other than a timing device to ensure that electrical equipment within a protected enclosure is not energized until the specified amount of protective gas has passed through the enclosure.

The 2008 edition was the culmination of a revision cycle that began with the document being entered into cycle in January 2006. NFPA 496 contains requirements on a protection technique for electrical and electronic equipment recognized by *NFPA 70, National Electrical Code*, for installations in hazardous (classified) locations. To ensure correlation with revisions occurring in the 2008 *NEC*, the Technical Committee on Electrical Equipment in Chemical Atmospheres requested and was granted permission by the NFPA Standards Council to enter into a three-year (Fall 2007) revision cycle. Significant revisions to the 2008 edition included the following: (1) a new requirement to mark purged and pressurized enclosures with an asphyxiation hazard warning where the protective gas is other than air and (2) deletion of 6.2.5, Table 6.2.5, and A.6.2.5 on Class II temperatures because the temperature class ratings for equipment in 4.5.3 correlate with the current temperature rating requirements for new equipment in Class I and Class II locations contained in 500.8(D)(1) and 500.8(D)(2) of the *NEC*.

The 2013 edition was revised to ensure correlation with the 2011 edition of *NFPA 70, National Electrical Code*. The definition of *energized* and *identified* were extracted from *NFPA 70*. Equipment was required to be identified for use in a classified area, and the requirements for determining the suitability of identified equipment were clarified. The definitions of *Type X, Type Y*, and *Type Z pressurizing* were clarified to more clearly define their usage.

The 2017 edition was revised to no longer include unenforceable language such as *near*, *close to*, and *significant portion*. Such terms cannot be quantified in the design or evaluation of an installation designed to the standard.

The 2021 edition included revisions mostly in the annexes. To correlate with ANSI/ISA-12.04.04-2012, Pressurized Enclosures, the Annex A sections for 4.3.1 were updated to clarify that components completing the enclosure are subject to the same considerations as the enclosure itself. Methods were provided to prevent the enclosure from excessive protective gas pressure as well as to prevent the discharge of ignition-capable particles to a Division 1 location.

In 4.4.5, requirements for alarms on pressurizing system bypasses and safety measures to prevent their accidental opening were added, because pressurization systems with this function were available. Guidance, including a possible test, to confirm that enclosures do not contain trapped flammable gases was provided in A.5.2.3. Annex section A.5.2.6 was revised to indicate that internal components in or through enclosure walls might not be properly protected by purge/pressurization. Annex section A.5.2.6.1 was added for internal components with a small internal volume that might not require protection.

Throughout the standard for the 2021 edition, area electrical classifications were revised to correlate with the *NEC*® electrical classification, and French translations of required markings were added.

For the 2024 edition, annex section A.4.5.5 has been added to clarify that power to a protective gas supply must be activated regardless of whether there is power to a protected enclosure and the equipment within the enclosure. The definition for *hazardous (classified) locations* has also been added from the *NEC*®.

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Committee Scope: This Committee shall have primary responsibility for documents on (1) developing data on the properties of chemicals enabling proper selection of electrical equipment for use in atmospheres containing flammable gases, vapors or dusts; (2) making recommendations for the prevention of fires and explosions through the use of continuously purged, pressurized, explosion-proof, or dust-ignition-proof electrical equipment where installed in such chemical atmospheres.

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Standard for

Purged and Pressurized Enclosures for Electrical Equipment

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex B.

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard applies to purging and pressurizing for the following:

(1) Electrical equipment located in areas classified as hazardous by Article 500 or Article 505 of *NFPA 70*®
(2) Electrical equipment containing sources of flammable vapors or gases and located in either classified or unclassified areas
(3) Control rooms or buildings located in areas classified as hazardous by Article 500 or Article 505 of *NFPA 70*
(4) Analyzer rooms containing sources of flammable vapors or gases and located in areas classified as hazardous by Article 500 or Article 505 of *NFPA 70*

1.1.2* This standard does not apply to electrical equipment located in any of the following:

(1) Areas classified as Zone 0
(2) Areas classified as Class III
(3) Areas where flammable liquids might be splashed or spilled on the electrical equipment

1.2 Purpose. This standard provides information on the methods for purging and pressurizing enclosures to prevent ignition of a flammable atmosphere that could be introduced into the enclosure by a surrounding external atmosphere or by an internal source. By these means, electrical equipment that is not otherwise acceptable for a flammable atmosphere can be utilized in accordance with Article 500 or Article 505 of *NFPA 70*.

1.3 Application.

1.3.1 Chapters 4, 5, and 6 of this standard apply to electrical instrument and process control equipment, motors, motor controllers, electrical switchgear, and similar equipment that is installed in hazardous (classified) locations and that does not contain an internal source of flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor.

1.3.2 Chapter 7 of this standard applies to control rooms that are located in hazardous (classified) locations and that do not contain an internal source of flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor.

1.3.3* Chapter 8 of this standard applies to electrical instruments, process control equipment, and similar enclosed equipment that contains an internal source of flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor.

1.3.4 Chapter 9 of this standard applies to analyzer rooms and buildings.

1.4 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.4.1 Where required by the authority having jurisdiction, technical documentation shall be submitted to demonstrate equivalency.

1.4.2 The system, method, or device requires approval for the intended purpose by the authority having jurisdiction.

1.5 Units of Measurement.

1.5.1 SI Units. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI).

1.5.2 Compliance. Compliance with the numbers shown in either the SI system or the inch-pound system constitutes compliance with this standard.

1.6 Mandatory Rules, Permissive Rules, and Explanatory Material.

1.6.1 Mandatory Rules. Mandatory rules of this standard are those that identify actions that are specifically required or prohibited and are characterized by the use of the terms *shall* or *shall not*.

1.6.2 Permissive Rules. Permissive rules of this standard are those that identify actions that are allowed but not required, are normally used to describe options or alternative methods, and are characterized by the use of the terms *shall be permitted* or *shall not be required*.

1.6.3 Explanatory Material. Explanatory material is located in Annex A. The information contained in Annex A is explanatory only and is not enforceable as part of this standard.

Chapter 2 Referenced Publications

2.1* General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 70®, National Electrical Code®, 2023 edition.

2.3 Other Publications.

2.3.1 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 60079-29-1, *Explosive Atmospheres — Part 29-1: Gas detectors — Performance requirements of detectors for flammable gases*, 2019.

2.3.2 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2020.

2.4 References for Extracts in Mandatory Sections.

NFPA 70®, National Electrical Code®, 2023 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

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

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3 General Definitions.

3.3.1* Alarm. A piece of equipment that generates a visual or audible signal that is intended to attract attention.

3.3.2 Analyzer Room or Building. A specific room or building containing analyzers, with one or more of the analyzers piped to the process.

3.3.3* Autoignition Temperature (AIT). The minimum temperature required to initiate or cause self-sustained combustion of a solid, liquid, or gas independently of the heating or heated element.

3.3.4 Bypass Function. A mode for pressurization systems to maintain power on the protected equipment to allow for maintenance and service of the equipment without maintaining pressurization.

3.3.5 Enclosure Volume (Other Than Rotating Electric Machinery). The volume of the empty enclosure without internal equipment.

3.3.6 Enclosure Volume (Rotating Electric Machinery). The enclosure volume for motors, generators, and other rotating electric machinery is the volume within the enclosure minus the volume of the rotor, stator, and field coils.

3.3.7 Ignition-Capable Equipment. Equipment that, under normal operation, produces sparks, hot surfaces, or a flame that can ignite a specific flammable atmosphere.

3.3.8 Indicator. A piece of equipment that shows flows or pressure and is monitored periodically, consistent with the requirement of the application.

3.3.9 Power Switching Equipment. Equipment that switches greater than 2500 VA per contact.

3.3.10 Pressurization. The process of supplying an enclosure with a protective gas with or without continuous flow at sufficient pressure to prevent the entrance of a flammable gas or vapor, a combustible dust, or an ignitible fiber.

3.3.10.1 ***Type X Pressurizing.*** Enables use of equipment suitable for unclassified locations within the protected enclosure where the equipment would otherwise be required to be suitable for Division 1 or Zone 1 locations.

3.3.10.2 ***Type Y Pressurizing.*** Enables use of equipment suitable for Division 2 or Zone 2 locations within the protected enclosure where the equipment would otherwise be required to be suitable for Division 1 or Zone 1 locations.

3.3.10.3 ***Type Z Pressurizing.*** Enables use of equipment suitable for unclassified locations within the protected enclosure where the equipment would otherwise be required to be suitable for Division 2 or Zone 2 locations.

3.3.11* Pressurizing System. A grouping of components used to pressurize and monitor a protected enclosure.

3.3.12 Protected Enclosure. An enclosure pressurized by a protective gas.

3.3.13 Protected Equipment. The electrical equipment internal to the protected enclosure.

3.3.14 Protective Gas. The gas used to maintain pressurization or to dilute a flammable gas or vapor.

3.3.15 Protective Gas Supply. The compressor, blower, or compressed gas container that provides the protective gas at a positive pressure, including inlet pipes or ducts, pressure regulators, outlet pipes or ducts, and any supply valves that are not adjacent to the pressurized enclosure.

3.3.16 Purging. The process of supplying an enclosure with a protective gas at a sufficient flow and positive pressure to reduce the concentration of any flammable gas or vapor initially present to an acceptable level.

3.3.17* Specific Particle Density. The density of individual dust particles, as opposed to the bulk density of the material.

3.3.18* Ventilated Equipment. Equipment that requires airflow for heat dissipation in addition to pressurization to prevent entrance of flammable gases, vapors, or dusts.

3.4 NEC Extracted Definitions.

3.4.1 Class I, Division 1. A Class I, Division 1 location is a location: (1) In which ignitible concentrations of flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors can exist under normal operating conditions, or (2) In which ignitible concentrations of such flammable gases, flammable liquid–produced vapors, or combustible liquids above their flash points might 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, flammable liquid–produced vapors, or combustible liquid–produced vapors and might also cause simultaneous failure of electrical equipment in such a way as to directly cause the electrical equipment to become a source of ignition. [**70:**500.5(B)(1)]

3.4.2 Class I, Division 2. A Class I, Division 2 location is a location: (1) In which volatile flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors 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 flammable gases, flammable liquid–produced vapors, or combustible liquid–produced 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 flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors above their flash points 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. [**70:**500.5(B)(2)]

3.4.3 Class II, Division 1. A Class II, Division 1 location is a location: (1) In which combustible dust is 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 electric equipment, through operation of protection devices, or from other causes, or (3) In which Group E combustible dusts may be present in quantities sufficient to be hazardous in normal or abnormal operating conditions. [**70:**500.5(C)(1)]

3.4.4 Class II, Division 2. A Class II, Division 2 location is a location: (1) In which combustible dust due to abnormal operations may be present in the air in quantities sufficient to produce explosive or ignitible mixtures; or (2) Where combustible dust accumulations are present but are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but could as a result of infrequent malfunctioning of handling or processing equipment become suspended in the air; or (3) In which combustible dust accumulations on, in, or in the vicinity of the electrical equipment could be sufficient to interfere with the safe dissipation of heat from electrical equipment, or could be ignitible by abnormal operation or failure of electrical equipment. [**70:**500.5(C)(2)]

3.4.5 Zone 0. A Zone 0 location is a location in which one of the following conditions exists: (1) Ignitible concentrations of flammable gases or vapors are present continuously, or (2) Ignitible concentrations of flammable gases or vapors are present for long periods of time. [**70:**505.5(B)(1)]

3.4.6 Zone 1. A Zone 1 location is a location: (1) In which ignitible concentrations of flammable gases or vapors are likely to exist under normal operating conditions; or (2) In which ignitible concentrations of flammable gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or (3) In which equipment is operated or processes are carried on, of such a nature that equipment breakdown or faulty operations could result in the release of ignitible concentrations of flammable gases or vapors and also cause simultaneous failure of electrical equipment in a mode to cause the electrical equipment to become a source of ignition; or (4) That is adjacent to a Zone 0 location from which ignitible concentrations of vapors could be communicated, unless communication is prevented by adequate positive pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided. [**70:**505.5(B)(2)]

3.4.7 Zone 2. A Zone 2 location is a location: (1) In which ignitible concentrations of flammable gases or vapors are not likely to occur in normal operation and, if they do occur, will exist only for a short period; or (2) In which volatile flammable

liquids, flammable gases, or flammable vapors are handled, processed, or used but in which the liquids, gases, or vapors normally are confined within closed containers of closed systems from which they can escape, only as a result of accidental rupture or breakdown of the containers or system, or as a result of the abnormal operation of the equipment with which the liquids or gases are handled, processed, or used; or (3) In which ignitible concentrations of flammable gases or vapors normally are prevented by positive mechanical ventilation but which may become hazardous as a result of failure or abnormal operation of the ventilation equipment; or (4) That is adjacent to a Zone 1 location, from which ignitible concentrations of flammable gases or vapors could 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. [**70:**505.5(B)(3)]

Δ **3.4.8 Energized.** Electrically connected to, or is, a source of voltage. [**70,** 2023]

3.4.9 Identified (as applied to equipment). Recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular code requirement. [**70,** 2023]

N **3.4.10 Locations.**

N **3.4.10.1** ***Hazardous (Classified) Locations.*** Locations where fire or explosion hazards might exist due to flammable gases, flammable liquid–produced vapors, combustible liquid–produced vapors, combustible dusts, combustible fiber/flyings, or ignitible fibers/flyings. [**70,** 2023]

N **3.4.10.2** ***Unclassified Locations.*** Locations determined to be neither Class I, Division 1; Class I, Division 2; Zone 0; Zone 1; Zone 2; Class II, Division 1; Class II, Division 2; Class III, Division 1; Class III, Division 2; Zone 20; Zone 21; Zone 22; nor any combination thereof. [**70,** 2023]

Chapter 4 General Requirements for Pressurized Enclosures

4.1 Applicability. This chapter contains the general requirements for pressurized enclosures containing electrical equipment.

4.2 Suitability of Identified Equipment. Suitability of identified equipment shall be determined by one of the following:

(1) Equipment listing or labeling
(2) Evidence of equipment evaluation from a qualified testing laboratory or inspection agency concerned with product evaluation
(3) Evidence acceptable to the authority having jurisdiction such as a manufacturer's self-evaluation or an owner's engineering judgment

[**70:**500.8(A)]

4.3 Enclosure.

4.3.1* The protected enclosure, including windows and other components through the enclosure walls that complete the enclosure, shall be constructed of material that is not likely to be damaged under the conditions to which it might be subjected.

4.3.1.1* Precautions shall be taken to protect the enclosure from excessive pressure of the protective gas supply.

4.3.1.2* Where required to protect the enclosure in the case of a control failure, excess-pressure-relieving devices shall be designed to prevent the discharge of ignition-capable particles to a Division 1 location.

4.3.2* Normal discharge of the protective gas from a designated enclosure outlet shall be to an unclassified location, unless the discharge meets the conditions specified in 4.3.2.1 or 4.3.2.2.

4.3.2.1 Discharge to a Division 2 or Zone 2 location shall be permitted if the equipment does not create ignition-capable particles during normal operation.

4.3.2.2* Discharge to a Division 1 or Division 2 location or to a Zone 1 or Zone 2 location shall be permitted if the outlet is designed to prevent the discharge of ignition-capable particles during normal operation.

4.3.3* In Division 1 and Zone 1 locations, where the conduit or raceway entry into a pressurized enclosure is not pressurized as part of the approved protection system, an explosionproof conduit seal shall be installed as close as practicable to, but not more than 450 mm (18 in.) from, the pressurized enclosure.

4.3.4 In Division 2 and Zone 2 locations, an explosionproof conduit seal shall not be required at the pressurized enclosure.

4.4 Pressurizing System.

4.4.1* The protected enclosure shall be constantly maintained at a positive pressure of at least 25 Pa (0.1 in. of water) above the surrounding atmosphere during operation of the protected equipment.

4.4.2 Where the protective gas supply is used to supply other than Type X pressurized equipment, an alarm shall be provided to indicate failure of the protective gas supply to maintain the required pressure.

4.4.3 All pressurizing system components energized in the absence of the protective gas shall be identified for the classification that would exist in the absence of the pressurizing system.

4.4.4 Installation, operating, and maintenance instructions shall be provided for the pressurizing system.

4.4.5 If the pressurizing system is equipped with a bypass function, the bypass function shall have an alarm and shall require a tool, password, or similar protection to be actuated.

4.5 Protective Gas System.

4.5.1* The protective gas shall be essentially free of contaminants or foreign matter and shall contain no more than trace amounts of flammable vapor or gas.

4.5.1.1 All protective gas supplies shall be designed to minimize chances for contamination.

4.5.1.2* Air of normal instrument quality, nitrogen, or other nonflammable gas shall be permitted as a protective gas.

4.5.2 Piping for the protective gas shall be protected against mechanical damage.

4.5.3 Where compressed air is used, the compressor intake shall be located in an unclassified location.

4.5.4* Where the compressor intake line passes through a classified location, it shall be constructed of noncombustible

material, designed to prevent leakage of flammable gases, vapors, or dusts into the protective gas, and protected against mechanical damage and corrosion.

4.5.5* Where applicable, electrical power for the protective gas supply source shall be supplied by either of the following options:

(1) Power is supplied before any device provided to de-energize power to the protected enclosure upon failure of the protective gas supply to maintain positive pressure.
(2) Power is supplied by a separate power source.

4.5.6 Where "double pressurization" (e.g., a Division 1 enclosed area pressurized to a Division 2 classification that contains ignition-capable equipment also protected by pressurization) is used, the protective gas supplies shall be independent.

4.6* Determination of Temperature Marking.

4.6.1* The temperature class (T Code) marked on the enclosure shall represent under normal conditions, the highest of the following:

(1) The hottest enclosure external surface temperature
(2) The hottest internal component surface temperature, except as permitted in 4.6.1.1
(3) The temperature of the protective gas leaving the enclosure

4.6.1.1 The surface temperature of the internal components shall be permitted to exceed the marked temperature class (T Code) in accordance with any one of the following conditions:

(1) The enclosure is marked as required in 4.12.4 with the time period sufficient to permit the component to cool to the marked temperature class (T Code).
(2) The small component has been shown to be incapable of igniting a test gas associated with a lower temperature class (T Code) or will not ignite the flammable vapor, gas, or dust involved.
(3) The component is separately housed so that the surface temperature of the housing is below the marked temperature class (T Code), and the housing complies with the following:
    (a) The housing shall be pressurized or sealed.
    (b) Where the housing can be readily opened, the housing shall be marked as required in 4.12.4.

4.6.2 Marking the actual temperature in degrees Celsius in place of the temperature class (T Code) shall be permitted.

4.6.3 Temperature class (T Codes) shall be as shown in Table 4.6.3.

4.7* Ventilated Equipment. The flow of protective gas shall keep the equipment adequately cooled.

4.8* Power Switching Equipment. Enclosures containing power switching equipment shall be of substantially noncombustible construction and shall be reasonably tight. Gaskets shall be permitted.

4.9* Type Z Pressurizing.

4.9.1 Detection shall be provided to indicate failure to maintain positive pressure within a protected enclosure.

Table 4.6.3 Temperature Class (T Codes)

Maximum Surface Temperature °C	Temperature Class (T Code)
450	T1
300	T2
280	T2A
260	T2B
230	T2C
215	T2D
200	T3
180	T3A
165	T3B
160	T3C
135	T4
120	T4A
100	T5
85	T6

Note: For applications in accordance with Article 505 of *NFPA 70*, temperature classes with suffixes do not apply.

4.9.1.1* Failure to maintain the positive pressure within a protected enclosure shall be communicated by an alarm or an indicator.

4.9.1.2 It shall not be required to de-energize the protected equipment upon detection of the failure to maintain positive pressure within a protected enclosure.

4.9.2 Any protected enclosure that can be isolated from the protective gas supply shall be equipped with an alarm, except as permitted in 4.9.2.1.

4.9.2.1 The protected enclosure shall be permitted to be equipped with an indicator where the isolation is done with a valve(s) that complies with the following:

(1) The valve(s) is immediately adjacent to the protected enclosure.
(2) The valve(s) is intended for use only during servicing of the protected enclosure.
(3) The valve(s) is marked as required in 4.12.5.

4.9.3 Where an alarm is used, the following shall apply:

(1) The alarm shall be located at a constantly attended location.
(2) The alarm actuator shall take its signal from the protected enclosure and shall not be installed between the enclosure and the protective gas supply.
(3) The alarm actuator shall be mechanical, pneumatic, or electrical.
(4) Electrical alarm actuators shall be identified for a Division 2 or Zone 2 location as applicable.
(5) No valves shall be permitted between the alarm actuator and the enclosure.
(6) The alarm shall be permitted to satisfy the requirement in 4.4.2 to provide an alarm on the protected gas supply.

4.9.4 Where an indicator is used, the following shall apply:

(1) The indicator shall be located for convenient viewing.
(2) The indicator shall not be installed between the enclosure and the protective gas supply.
(3) The indicator shall indicate either pressure or flow.

(4) No valves shall be permitted between the indicator and the enclosure.
(5) The protective gas supply shall have an alarm that is located at a constantly attended location to fulfill the requirement in 4.4.2.

4.10* Type Y Pressurizing.

4.10.1 All of the requirements in Section 4.9 shall apply.

4.10.2 Equipment within a protected enclosure shall be approved for Division 2 or Zone 2 locations.

4.10.3 Electrical alarm actuators shall be identified for a Division 1 or Zone 1 location as applicable.

4.10.4 Ventilated equipment that would develop temperatures higher than the marked temperature class (T Code) upon failure of the ventilation shall be automatically de-energized when the flow of protective gas stops.

4.11* Type X Pressurizing.

4.11.1* Except as permitted in 4.11.1.1, a device shall be provided to automatically de-energize all circuits and equipment within the protected enclosure that are not identified for Division 1 or Zone 1 upon failure of the protective gas supply to maintain positive pressure, in accordance with the following:

(1) The device provided to de-energize power upon failure of the protective gas supply to maintain positive pressure shall be actuated by flow or pressure sensors.
(2) The flow or pressure sensor shall be identified for the location in which it is installed.
(3) No valves shall be permitted between the flow or pressure sensor and the protected enclosure.
(4) The sensor shall take its signal from the protected enclosure and shall not be installed between the enclosure and the protective gas supply.

4.11.1.1 Power shall be permitted to be continued for a short period if immediate loss of power would result in a more hazardous condition, and if both audible and visual alarms are provided at a constantly attended location.

4.11.2* Except as permitted in 4.11.2.1, equipment that can be overloaded shall be provided with devices to detect any increase in temperature of the equipment beyond its design limits and shall de-energize the equipment automatically.

4.11.2.1 Power to the circuits shall be permitted to be continued for a short period if immediate loss of power would result in a more hazardous condition, and if both audible and visual alarms are provided at a constantly attended location.

4.11.3 Except as permitted in 4.11.3.1, the flow of protective gas shall provide sufficient cooling for ventilated equipment, even during overload conditions, or the equipment subject to overloading shall be provided with devices to detect any increase in temperature beyond its design limits and to de-energize that equipment automatically.

4.11.3.1 Power to the circuits shall be permitted to be continued for a short period if immediate loss of power would result in a more hazardous condition, and if both audible and visual alarms are provided at a constantly attended location.

4.12 Markings.

4.12.1 A permanent marking shall be placed in a prominent location on the protected enclosure so that it is visible before the enclosure can be opened.

4.12.2* Except as permitted in 4.12.2.1 and 4.12.2.2, the marking required by 4.12.1 shall include the information specified as follows:

(1) The following statement or an equivalent statement: **WARNING — PRESSURIZED ENCLOSURE — This enclosure must not be opened unless the area atmosphere is known to be below the ignitible concentration of combustible materials or unless all devices within have been de-energized.**
(2) The external area classification for the protected enclosure
(3) The pressurization type (e.g., Type X, Type Y, or Type Z)
(4) The temperature class (T Code) or the operating temperature in degrees Celsius as determined in Section 4.6

4.12.2.1 The temperature class (T Code) or operating temperature marking shall not be required where the highest temperature does not exceed 100°C.

4.12.2.2 For equipment marked for use in a specific gas or dust atmosphere, the temperature class (T Code) or operating temperature marking shall not be required where the highest temperature does not exceed 80 percent of the autoignition temperature (in degrees Celsius) of the flammable vapor, gas, or dust involved. If the dust involved is an organic dust that might dehydrate or carbonize, the higher temperature shall not be permitted to exceed the lower of either 80 percent of the layer/cloud ignition temperature or 165°C.

4.12.3 The additional markings specified in Sections 5.3 and 6.3 shall also be included in the permanent marking described in 4.12.2.

4.12.4* Where 4.6.1.1(1) or 4.6.1.1(2) is used, the following or equivalent statement shall appear in a permanent marking:

WARNING:
HIGH-TEMPERATURE INTERNAL PARTS
This enclosure must not be opened unless the area atmosphere is known to be below the ignitible concentration of combustible materials or unless all equipment within has been de-energized for ____ minutes.

4.12.5* Where 4.9.2.1 is used, the following or equivalent statement shall appear in a permanent marking:

WARNING:
PROTECTIVE GAS SUPPLY VALVE
This valve must be kept open unless the area atmosphere is known to be below the ignitible concentration of combustible materials or unless all equipment within the protected enclosure is de-energized.

4.12.6* In addition to the marking required by 4.12.1, a permanent label or marking with the following or equivalent statement shall be provided on the exterior of enclosures where the protective gas is other than air:

WARNING: Protective gas release poses potential for asphyxiation.

Chapter 5 Pressurized Enclosures for Class I, or Zone 1, or Zone 2

5.1 Applicability. This chapter applies to enclosures containing electrical equipment that are located in Class I, or Zone 1, or Zone 2 locations, and in conjunction with the requirements of Chapter 8, to enclosures located in unclassified locations that contain an internal source of flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor.

5.2 General Requirements.

5.2.1 The requirements of Chapter 4 shall be met.

5.2.2 When the enclosure has been opened or if the protective gas supply has failed to maintain the required positive pressure, the enclosure shall be purged.

5.2.3* Airflow through the enclosure during purging shall be designed to avoid air pockets.

5.2.4 Once the enclosure has been purged of flammable concentrations, only positive pressure shall be required to be maintained within the enclosure.

5.2.5 A specific flow rate shall not be required for the positive pressure required by 5.2.4.

5.2.6* Compartments within the main enclosure or adjacent enclosures connected to the main enclosure shall be considered separately, and protection shall be provided by any of the following methods:

(1) The internal compartment shall be vented to the main enclosure by nonrestricted top and bottom vents that are common to the main enclosure. Each vent shall provide not less than 6.5 cm^2 (1.0 $in.^2$) of vent area for each 6560 cm^3 (400 $in.^3$) of internal compartment volume.
(2) The internal compartment or adjacent enclosure shall be purged in series or shall be purged separately.
(3) Where internal compartments or adjacent enclosures are connected in series, the pressure or flow sensor shall be located at the downstream end of the series of compartments or enclosures.
(4)* The equipment in the internal compartment or adjacent enclosure shall be protected by other means (e.g., explosionproof, intrinsic safety, hermetic sealing, nonincendive, or encapsulation).

5.2.6.1* Internal components with a free internal volume of less than 20 cm^3 (1.22 $in.^3$) shall not be required to be considered as internal compartments requiring protection, provided that the total volume of all such components is not a significant portion of the protected enclosure volume, such that the release of the contents of all such internal components into the protected enclosure would not create an atmosphere exceeding 50 percent of the LFL.

5.2.6.2* It shall not be required to include components considered to be environmentally sealed in the percent of volume analysis.

5.3 Markings.

5.3.1 Except as permitted in 5.3.1.1, a permanent marking containing the start-up conditions shall be on the protected enclosure in a prominent location.

5.3.1.1 Start-up conditions shall be permitted to alternatively be marked on an adjacent pressurizing system if referenced on the protected enclosure.

5.3.2* The marking shall contain the following, or an equivalent, statement:

WARNING:
Power must not be restored after enclosure has been opened until enclosure has been purged for ____ minutes at a flow rate of _____.

5.3.3 The minimum pressure shall be permitted to be used in place of the flow rate where the pressure is a positive indication of the correct flow.

5.4* Additional Requirements for Type Y or Type Z Pressurizing. The protected equipment shall be energized only under the conditions specified in 5.4.1 or 5.4.2.

5.4.1 Protected equipment, other than as described in 5.4.1.1, shall not be energized until at least four enclosure volumes of the protective gas have passed through the enclosure while maintaining an internal pressure of at least 25 Pa (0.1 in. of water).

5.4.1.1 Motors, generators, and other rotating electric machinery shall not be energized until ten volumes of the protective gas have passed through the enclosure while maintaining an internal pressure of at least 25 Pa (0.1 in. of water).

5.4.2 Protected equipment shall be permitted to be energized immediately where a pressure of at least 25 Pa (0.1 in. of water) exists, and the atmosphere within the enclosure is known to be below the ignitible concentration of the combustible material.

5.5 Additional Requirements for Type X Pressurizing.

5.5.1 Protected equipment, other than as described in 5.5.1.1, shall not be energized until at least four enclosure volumes of the protective gas have passed through the enclosure while maintaining an internal pressure of at least 25 Pa (0.1 in. of water).

5.5.1.1 Motors, generators, and other rotating electric machinery shall not be energized until ten volumes of the protective gas have passed through the enclosure while maintaining an internal pressure of at least 25 Pa (0.1 in. of water).

5.5.2* If the enclosure can be readily opened without the use of a key or tools, an interlock shall be provided to immediately de-energize all circuits within the enclosure that are not approved for the location when the enclosure is opened.

5.5.2.1 The interlock, even though located within the enclosure, shall be approved for external area classification.

5.5.2.2 Protected enclosures that contain hot parts requiring a cooldown period shall be designed to require the use of a key or tool for opening.

Chapter 6 Pressurized Enclosures for Class II

6.1 Applicability. This chapter applies to enclosures containing electrical equipment that are located in Class II locations.

6.2 General Requirements.

6.2.1 The requirements of Chapter 4 for each type of pressurizing shall be met, except as modified in this chapter.

6.2.2* Where combustible dust has accumulated within the protected enclosure, the protected enclosure shall be opened and the dust removed before pressurizing.

6.2.3 Adjacent enclosures connected to the main enclosure shall be permitted to be collectively pressurized to prevent the entrance of dust if there is communication to maintain the specified pressure at all points.

6.2.4* The protected enclosure shall be constantly maintained at a pressure above the surrounding atmosphere, depending on the specific particle density during operation of the protected equipment, and shall not be less than that specified in Table 6.2.4.

Table 6.2.4 Minimum Enclosure Pressure Versus Dust Density

Specific Particle Density			Minimum Enclosure Pressure	
kg/m^3	lb/ft^3	Specific Gravity	Pa	in. of water
<2083	<130	<2.083	25	0.1
>2083	>130	>2.083	125	0.5

6.3 Markings. Start-up conditions shall be permanently marked in a prominent location on the protected enclosure.

6.4* Marking Information. The marking required by Section 6.3 shall contain the following, or an equivalent, statement:

WARNING: Power must not be restored after the enclosure has been opened until combustible dusts have been removed and the enclosure repressurized.

6.5* Additional Requirements for Type X Pressurizing. An alarm, provided at a constantly attended location, shall be permitted to be used in place of the device specified in 4.11.1 if the enclosure is tightly sealed to prevent the entrance of dust.

6.6 Additional Requirements for Ventilated Equipment. The discharge of protective gas shall not create a combustible atmosphere by disturbing layers of dusts.

Chapter 7 Pressurized Control Rooms

7.1* Applicability. This chapter applies to buildings or portions of buildings commonly referred to as control rooms that do not contain an internal source of flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor.

7.2 Protective Gas.

7.2.1 The protective gas shall be air.

7.2.2* The air shall be essentially free of contaminants or foreign matter and shall contain no more than trace amounts of flammable vapor or gas.

7.2.3* The source of air shall be both of the following:

(1) Determined from the nature of the process and the physical layout
(2) From an unclassified location

7.2.4 Any ducts shall be constructed of noncombustible materials.

7.2.5 The fan suction line shall be free of leaks and shall be given protection from mechanical damage and corrosion to prevent ignitible concentrations of flammable gases, vapors, or dusts from being drawn into the control room.

7.3 Considerations Relating to Positive Pressure Ventilation.

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

(1) The number of people to be housed
(2) The type of equipment to be housed
(3) The location of the control room relative to the direction of the prevailing wind and to the location of process units (e.g., relief valves, vent stacks, and emergency relief systems)

7.3.2* If the control room is in a classified location, it shall be designed to minimize the entry of flammable vapors, gases, liquids, or dusts.

7.4 Requirements for Positive Pressure Air Systems.

7.4.1* Except as permitted in 7.4.1.1 and 7.4.1.2, the positive pressure air system shall meet the following requirements:

(1) A pressure of at least 25 Pa (0.1 in. of water) in the control room shall be maintained, with all openings closed.
(2) A minimum outward velocity of 0.305 m/sec (60 ft/min) shall be provided through all openings capable of being opened. The velocity shall be measured with all openings simultaneously open, and a drop in pressure below the 25 Pa (0.1 in. of water) specified in 7.4.1(1) shall be permitted while meeting this requirement.

7.4.1.1 Doorways or other openings that are used solely for infrequent movement of equipment in or out of pressurized control rooms or analyzer rooms shall be permitted to remain closed where all of the following conditions are met:

(1) The control room is under management control.
(2) The doors are marked to restrict use.
(3) The doors are not used for egress.
(4) The doors are secured in the closed position.
(5) An airlock meets the following requirements:
    (a) Ignitible vapor hazards shall be addressed by one of the following:
        i. Ventilation with a continuous flow of clean air equivalent to at least 6 volumes of the airlock per hour
        ii. Gas detectors installed within the airlock arranged to alarm at 25 percent of the limiting value
    (b)* Each door of the airlock shall be fitted with a device to indicate when both doors are not closed.

(c) All electrical equipment within the airlock shall be suitable for the hazardous area classification of the area without pressurization required external to the room.
(d) Warning signs shall be viewable upon entry or egress that indicate that one door must be closed before the other is open.
(e) The airliock shall be marked with the following: "WARNING – Verify other door is closed before opening this door."

7.4.1.2 Gland or bulkhead plates or other similar covers that cannot be removed without the use of a key or tool shall be permitted to remain closed.

7.4.2 The positive pressure air system shall be permitted to include heating, ventilation, and air conditioning equipment, as well as any auxiliary equipment necessary to comply with 7.4.1.

7.4.3* Where there is not a separate air supply source to an air-consuming device in the control room, air shall be supplied to accommodate its needs as well as the needs of the positive pressure air system.

7.4.4 The positive pressure air system shall be designed to provide the required pressure and flow rate for all areas of the control room.

7.4.5 For Type X pressurizing, except as permitted in 7.4.5.1, a cutoff switch shall be incorporated to de-energize power automatically from all circuits within the control room, not approved for the external area classification, upon failure of the positive pressure air system.

7.4.5.1 Power to the circuits shall be permitted to be continued for a short period of time if immediate loss of power would result in a more hazardous condition.

7.4.6 For Type Y and Type Z pressurizing, power to the control room shall not be required to be de-energized upon failure of the positive pressure air system.

7.4.7* Failure of the positive pressure air system shall be detected at the discharge end of the fan and shall activate an alarm at a constantly attended location.

7.4.8* The following provisions shall be made to energize the control room safely after interruption of the positive pressure air system:

(1) Checking the atmosphere in the control room with a flammable vapor detector *(see UL 60079-29-1, Explosive atmospheres — Part 29-1: Gas detectors — Performance requirements of detectors for flammable gases)* to determine that the atmosphere contains less than the ignitible concentration of gases or vapors
(2) Removing accumulations of combustible dust

7.4.9 The switch, electrical disconnect, and motor for the air system fan shall be approved for the external area classification.

7.4.10 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 or shall be supplied from a separate power source.

Chapter 8 Pressurized Enclosures Having an Internal Source of Flammable Gas or Vapor

8.1* Applicability. This chapter applies to instruments and other enclosures that contain an internal source of flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor.

8.2* General Requirements.

8.2.1 The requirements of Chapters 4, 5, and 6 shall apply, except as modified in this chapter.

8.2.2* For the purpose of this chapter, every protected enclosure shall be considered to have a "normal" per 8.2.2.1 and an "abnormal" per 8.2.2.2 condition, and the electrical equipment in the enclosure is assumed to be operating correctly in both conditions.

8.2.2.1 "Normal" shall mean the anticipated release of flammable gas or vapor within the enclosure when the system that supplies the flammable gas or vapor is operating properly and shall be defined as one of the following:

(1) None — There is no release of flammable gas or vapor, or the release of flammable gas or vapor is documented to reflect that it is of such a low level that, without ventilation and/or purge, the concentration is not capable of reaching 25 percent of the lower flammable limit.
(2) Limited — The release of flammable gas or vapor is limited to an amount that can be diluted by the pressurizing system to a concentration less than 25 percent of the lower flammable limit; limited release of a liquid is not permitted.

8.2.2.2 "Abnormal" shall mean the anticipated release of flammable gas or vapor within the enclosure when the system that supplies the flammable gas or vapor is either leaking or is otherwise operating abnormally, and shall be defined as one of the following:

(1) Limited — The release of flammable gas or vapor is limited to an amount that can be diluted by the pressurizing system to a concentration less than 25 percent of the lower flammable limit.
(2) Unlimited — The release of flammable gas or vapor is of such magnitude that it cannot be diluted by the pressurizing system to a concentration less than 25 percent of the lower flammable limit.

8.2.2.3 Precautions shall be taken if the abnormal condition release can be great enough to adversely affect an external area classification.

8.2.3* Pressurizing requirements shall be established according to Table 8.2.3.

8.2.4 Protected enclosures containing an open flame shall comply with 8.2.4.1 and 8.2.4.2.

8.2.4.1 Protected enclosures containing an open flame shall be considered to have equipment suitable for unclassified locations for the purposes of determining the pressurizing requirement according to Table 8.2.3.

8.2.4.2 Open flames within a protected enclosure shall be automatically extinguished upon failure of the pressurization system, regardless of the type of pressurizing.

Δ Table 8.2.3 Pressurizing Requirements for Enclosures Subject to Internal Release

(1) External Area Classification	(2) Classified or Unclassified Location for Which Internal Equipment Is Suitable	(3) Pressurizing Requirements for Limited Release Under Abnormal Conditions		(4) Additional Requirements for Unlimited Release Under Abnormal Conditions
		No Release Under Normal Conditions	Limited Release Under Normal Conditions	
Class I, Division 1 (Zone 1)	Class I, Division 1 (Zone 1)	None	None	None
	Class I, Division 2 (Zone 2)	Y	Y	None
	Unclassified	X	X	Inert*
Class I, Division 2 (Zone 2)	Class I, Division 1 (Zone 1)	None	None	None
	Class I, Division 2 (Zone 2)	None	Z	None
	Unclassified	Z	X	Inert*
Class II	Class I, Division 1 (Zone 1)	None	None	None
	Class I, Division 2 (Zone 2)	None	Z	None
	Unclassified	Z	X	Inert*
None	Class I, Division 1 (Zone 1)	None	None	None†
	Class I, Division 2 (Zone 2)	None	Z	None†
	Unclassified	Z	X	Inert*

Note: To determine the pressurizing requirements according to Table 8.2.3:
(1) Find the external area classification in column (1).
(2) Find the internal equipment type in column (2).
(3) Determine the pressurizing requirement for limited release under abnormal conditions by using the appropriate normal condition in column (3).
(4) Determine any additional requirements from column (4) if the abnormal condition is unlimited release.
* See A.8.2.3.
† See 8.2.2.3.

8.3 Specific Requirements.

8.3.1* Where a release of flammable gas or vapor within an enclosure can occur either in normal operation or under abnormal conditions, protection shall be provided by one of the following:

(1) Diluting with air to maintain the concentration of flammable gas, vapor, or mixture to less than 25 percent of its lower flammable limit, based on the lowest value of the lower flammable limit of any individual flammable gas or vapor entering the enclosure
(2) Diluting or pressurizing with inert gas to reduce the oxygen content in the enclosure to a level of not more than 5 percent by volume or to 50 percent of the minimum concentration of oxygen required to form a flammable mixture, whichever is lower

8.3.2 Where the protected enclosure is located in a hazardous (classified) location, the pressurizing system shall also prevent entrance of the external atmosphere by providing a minimum internal pressure of 25 Pa (0.1 in. of water).

8.3.3 The locations and sizes of gas or vapor outlets in the protected enclosure shall be designed to allow effective removal of both the flammable gas or vapor and the protective gas.

8.3.4* Where an inert protective gas is used, the outlets shall be permitted to be closed after purging to prevent undue loss of inert protective gas, provided that this does not constitute further danger.

8.3.5 In applications where flammable mixtures are permitted to be piped into the enclosure through the flammable gas or vapor system, precautions shall be taken to prevent propagation of an explosion back to the process equipment.

8.3.6 The flow rate of protective gas shall be sufficient to maintain the requirements of 8.3.1 and to ensure adequate mixing, so that the release of a flammable gas or vapor is limited.

8.3.7* To achieve proper pressurization with air, caution shall be required to ensure the air pressure used within the enclosure does not exceed the pressure of the flammable gas or vapor system supplying the enclosure.

8.3.8 Precautions shall be taken to protect the enclosure from excessive pressure of the protective gas supply.

Chapter 9 Pressurized Analyzer Rooms Containing a Source of Flammable Gas, Vapor, or Liquid

9.1 Applicability. This chapter applies to analyzer rooms and buildings containing electrical equipment that have process streams of flammable liquid, vapor, or compressed flammable gas piped into the equipment.

9.2 General.

9.2.1 For the purpose of this chapter, every pressurized analyzer room containing a source of flammable gas, vapor, or liquid shall be considered to have one of the following types of anticipated releases:

(1) None — There is no release of flammable gas or vapor, or the release of flammable gas or vapor is documented to reflect that it is of such a low level that, without ventilation and/or purge, the concentration is not capable of reaching 25 percent of the lower flammable limit.
(2) Limited — The release of flammable gas or vapor is limited to an amount that can be diluted by the pressurizing system to a concentration less than 25 percent of the lower flammable limit.
(3) Unlimited — The release of flammable gas or vapor is of such a magnitude that it cannot be diluted by the pressurizing system to a concentration less than 25 percent of the lower flammable limit.

9.2.2 The magnitude of the anticipated release within the analyzer room shall be "none" or "limited" based on the largest single failure.

9.2.3 Where the analyzer room is in a hazardous (classified) location, it shall be designed to prevent the entry of flammable gases and vapors, flammable liquids, and combustible dusts.

9.2.4 The requirements of Chapter 7 for control rooms shall apply except as modified in this chapter.

9.2.5* Analyzer rooms shall be separated from control rooms by distance or by a wall impermeable to vapors.

9.2.6 Flow of air through the room shall ensure adequate air distribution.

9.2.7* Flammable vapors shall be removed as close to their source as is practical.

9.2.8* The following shall apply where personnel can enter an analyzer room that is purged with inert gases:

(1) Administrative controls combined with training and safe entry procedures shall be established.
(2) Warning signs advising of the hazard of inert gas shall be posted.
(3)* Inert gas shall not be used for purging an entire analyzer room where personnel shall be permitted to enter.

9.3 Specific Requirements.

9.3.1 Flow-Limiting Devices.

9.3.1.1 To prevent an unlimited release in the analyzer room, process streams shall have orifices or other flow-limiting devices on the inlets and on the outlet if the outlet can constitute a source of uncontrolled leakage from the process.

9.3.1.2 Orifices or other flow-limiting devices shall be located outside and within 3.05 m (10 ft) of the wall of the building or room.

9.3.2* Where flammable vapor, gas, or liquid is discharged from an enclosure, it shall not create a hazard within the analyzer house or to the surroundings.

9.3.3* Sample conditioning equipment shall be suitable for the area electrical classification.

9.3.4 Process piping within the analyzer room shall be minimized.

9.3.5 Means for emergency isolation of the process from the analyzers shall be provided outside the analyzer building.

9.3.6 False ceilings and floors shall not be used in analyzer rooms.

9.3.7* Ventilation fans shall be constructed to minimize the possibility of sparking.

9.3.8 Except as permitted in 9.3.8.1, the following shall be required in the event of pressurizing failure:

(1) An audible and visual alarm shall be activated at a constantly attended location.
(2)* Electrical power to ignition-capable equipment within the analyzer room shall be automatically shut down.
(3) Open flames shall be automatically extinguished.
(4) Power shall not be restored until the analyzer room is below ignitible concentration of the combustible material.

9.3.8.1 Automatic shutdown shall not be required under any of the following conditions:

(1) The anticipated release is "none," the analyzer room is unclassified, and the area outside the analyzer room is unclassified.
(2) The anticipated release is "none," the analyzer room is unclassified, and the area outside the analyzer room is classified Class I, Division 2 or Zone 2.
(3) The anticipated release is "limited," and the analyzer room is classified as Class I, Division 2 or Zone 2.
(4) The analyzer room is classified as Class I, Division 1 or Zone 1.

9.3.9 Where gas or vapor mixtures within the flammable range are piped to the analyzer room, precautions shall be taken to prevent propagation of an explosion back to the process equipment.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1.2 Electrical equipment should be located in an area having as low a degree of hazard classification as is practical. Where there is probability of flammable liquid exposure, additional means should be taken to avoid ingress.

A.1.3.3 The flammable gas or vapor is piped internally to the enclosure so that process parameters can be measured. The source of release could be fittings or vents. It is not intended that fumes or vapors from components within the electrical equipment be considered (e.g., from decomposing insulation).

Examples of "similar enclosed equipment" include, but are not limited to, gas chromatographs and gas analyzers.

A.2.1 Editions of the referenced documents are the editions used in preparation of this document. It is important that the authority having jurisdiction (AHJ) be aware that later editions might exist. Compliance with later editions should be considered when the requirements of the most current edition of the referenced documents have changed.

Δ **A.3.2.1 Approved.** 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 that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA standards in a broad manner because 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, or 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 or her 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.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations 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.

A.3.3.1 Alarm. An alarm is intended to alert the user that the pressurizing system should be immediately repaired or that the electrical equipment protected by the failed pressurizing system should be removed from service.

A.3.3.3 Autoignition Temperature (AIT). The autoignition temperature of a flammable gas or vapor is listed in NFPA 497.

Normally, the minimum ignition temperature of a layer of a specific dust is lower than the minimum ignition temperature of a cloud of that dust. Since this is not universally true, the lower of the two minimum ignition temperatures is listed in NFPA 499.

A.3.3.11 Pressurizing System. The pressurizing system can include components such as the alarm actuator, indicator, cutoff switch, or components of the protective gas supply. The components can be mounted in a separate enclosure/panel or be included within the protected enclosure.

A.3.3.17 Specific Particle Density. Specific particle density (sometimes referred to as the true density) is the mass per unit volume or, more commonly, weight per unit volume and is expressed as kilograms per cubic meter (pounds per cubic foot). It refers only to the material making up the particle. *Bulk density* is obtained by placing granular or powdered material in a specified volume and calculating the density. Bulk density includes the void space between the particles created because of the irregular particle shape. As an example, the specific particle density of sulfur is about 2083 kg/m^3 (130 lb/ft^3) while the bulk density of pulverized sulfur dust is about 801 kg/m^3 (50 lb/ft^3).

A.3.3.18 Ventilated Equipment. Examples of this type of equipment include, but are not limited to, motors and motor control centers.

A.4.3.1 The intent of this requirement is to ensure that all parts of the enclosure are constructed to prevent damage that would invalidate the integrity of the type of protection used. While it might be obvious that this applies to the walls of the enclosure and any windows, it also applies to anything that is integrated into the walls of the enclosure that would "complete" the enclosure such as HMI screens, buttons, keypads, pilot lights, and so forth. The integrity might affect not only the purge/pressurization function of the system, but also other protection methods used.

A.4.3.1.1 Various methods can be used to protect an enclosure from excessive pressure of the protective gas supply. Examples include, but are not limited to, the following:

(1) Restricting inlet orifice size relative to the normal discharge
(2) Limiting supply pressure to less than the design enclosure strength, using a relief device set to vent below the enclosure design rating or an inherently low pressure source, such as a blower
(3) Using multiple fasteners on doors and enclosure walls to increase enclosure strength
(4) Using two-position fasteners to allow the enclosure to vent before the door can be fully opened
(5) Using vents or pressure-relieving devices on the enclosure
(6) Proof testing the enclosure to ensure that the measured internal pressure does not exceed the specified maximum operating pressure, and the enclosure shows no signs of permanent damage that would invalidate the integrity of the enclosure

This proof test can be very dangerous. Confirm that proper protection and safeguards are in place prior to testing to protect personnel and property.

A.4.3.1.2 Examples of methods that can be used to prevent the discharge of ignition-capable particles include the following:

(1) Providing the vent with a hub so that it can be used with pipes or ducts that exhaust to an unclassified location
(2) Providing suitable baffles to deflect any particles away from the vent
(3) Providing the vent with a substantially noncombustible screen or filter

(See A.4.8 for additional details on substantially noncombustible materials.)

A.4.3.2 During brief periods of purging, the area around the vent might contain a concentration of flammables that requires caution.

A.4.3.2.2 See A.4.3.1.2 for examples of methods that can be used to prevent the discharge of ignition-capable particles.

A.4.3.3 Pressurized raceways do not need to be sealed if they have been properly designed as part of pressurized systems with the required alarms or indicators. The exception is not meant to allow the user to install the equipment and ignore proper installation of classified location wiring. The exception allows the same raceway to be used for electrical wiring and the protective gas. The design must consider the restriction of protective gas flow when conductors are installed in the raceway.

A.4.4.1 The reason for requiring that a positive pressure be maintained is to prevent flammable vapors or gases from being forced into the enclosure by external air currents.

A.4.5.1 Air filtration might be desirable.

A.4.5.1.2 Ordinary plant compressed air is usually not suitable for purge or pressurizing systems, due to contaminants that might cause equipment to malfunction.

A.4.5.4 The compressor suction line should not pass through any area having a hazardous atmosphere, unless it is not practical to do otherwise.

N **A.4.5.5** It is essential that power to the protective gas supply be activated regardless of whether there is power to the protected enclosure and the equipment within the enclosure.

A.4.6 The temperature class (T Code) is based on the ambient temperature surrounding the pressurized equipment not exceeding 40°C (104°F). The maximum ambient temperature rating of the equipment must not be exceeded.

A.4.6.1 Because a high-temperature source of ignition is not immediately removed by de-energizing the equipment, additional precautions are necessary for hot components. If the external temperature of the enclosure is greater than the autoignition temperature (in degrees Celsius) of the gas or vapor, it is obvious that purging will not prevent an explosion. Thus, it is essential that excess surface temperature be prevented, unless it has been specifically shown to be safe by a qualified testing laboratory. Dust that is carbonized or excessively dry is highly susceptible to spontaneous ignition. Sources of internal temperatures above the autoignition temperature (in degrees Celsius) of the gas or vapor involved, such as vacuum tube filaments, are hermetically sealed to prevent them from contacting the atmosphere that might become hazardous. However, it is essential that the surface of the glass envelope does not exceed the 80 percent limit, unless shown by test to be safe.

The ignition temperature of gases and vapors that is listed in reference documents such as NFPA 497 is determined under conditions where a significant volume of gas is at the same temperature. The condition specified in 4.6.1.1(2) indicates that when ignition is attempted with a small component, convection effects and partial oxidation at the surface of the component decrease the rate of heat transfer to the gas. Therefore, the component must be at a temperature much higher than the quoted ignition temperature to ignite the flammable mixture. Typical transistors, resistors, and similar small components must have a surface temperature of 220°C to 300°C (428°F to 572°F) to ignite diethyl ether, whose ignition temperature is 160°C (320°F). Similar values have been measured in ignition tests of carbon disulfide, whose ignition temperature is 100°C (212°F).

A.4.7 Airflow required for cooling could be more than that required for purging.

A.4.8 Enclosures containing power switching equipment are more likely to produce ignition-capable particles. It is necessary to have an enclosure through which these particles cannot burn or escape from openings other than the vents. Examples of enclosures that are tight enough include IP40 or higher (as described in ANSI/IEC 60529, *American National Standard for Degrees of Protection Provided by Enclosures*) Type 3, 3S, 4, 4X, 6, 6P, 12, and 13 [as described in ANSI/NEMA 250, *Enclosures for Electric Equipment (1000 Volts Maximum)*; UL 50, *Enclosures for Electrical Equipment, Non-Environmental Considerations*; UL 50E, *Enclosures for Electrical Equipment, Environmental Considerations*; CSA C22.2 NO. 94.1, *Enclosures for electrical equipment, nonenvironmental considerations*; and CSA C22.2 NO. 94.2, *Enclosures for electrical equipment, environmental considerations]*. Other techniques can be used to ensure that ignition-capable particles are contained in the enclosure. Nonmetallic enclosure flammability ratings of 94 V-0 or 94 5V are considered as substantially noncombustible. *(See UL 94, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, for descriptions of flammability ratings.)*

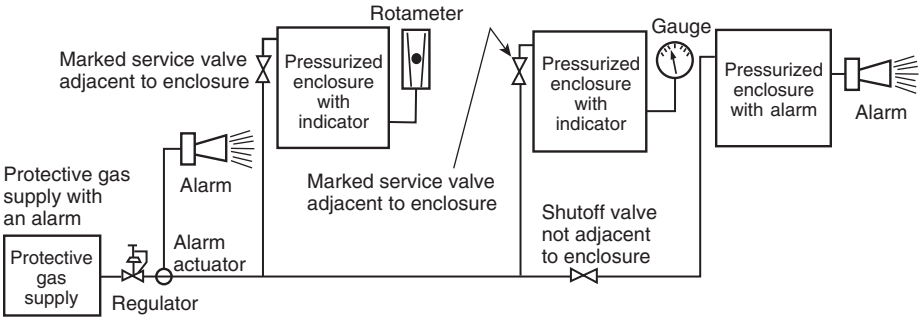
A.4.9 Type Z permits the use of general purpose equipment within the enclosure (except for safeguards as identified in this practice). It does not reduce the classification within an enclosure from Division 2 to unclassified. With Type Z pressurizing, a hazard is created only if the pressurizing system fails simultaneously with the area outside of the enclosure becoming ignitible due to the release of normally contained flammable liquids or gases, or combustible dust. For this reason, it is not considered essential to remove power from the equipment upon failure of the pressurizing system.

Alarm and indicator configurations for Type Y and Type Z pressurizing are shown in Figure A.4.9.

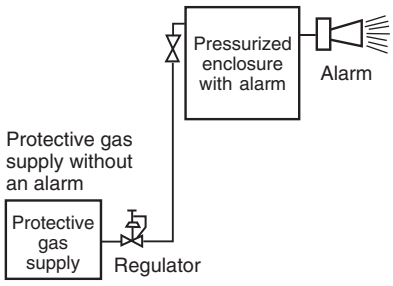
A.4.9.1.1 An alarm is preferred, but an indicator is acceptable if the protected enclosure is much less likely to fail than the protective gas supply. Excessive leakage from the protected enclosure is only likely during servicing, at which time the indicator will assist the maintenance personnel in determining when the enclosure is adequately sealed to maintain pressure.

A.4.10 Type Y pressurizing does not reduce the classification within an enclosure from Division 1 to Division 2. Equipment and devices within the enclosure must be suitable for Division 2 (except for safeguards as identified in this practice). This requires that the enclosure does not contain an ignition source. Thus, a hazard is created within the enclosure only upon simultaneous failure of the pressurizing system and of the equipment within the enclosure. For this reason, it is not considered essential to remove power from the equipment upon the failure of the pressurizing system.

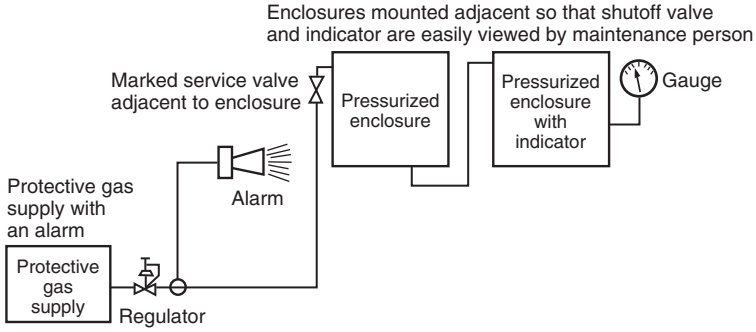
A.4.11 Type X permits the use of general purpose equipment within the enclosure (except for safeguards as identified in this practice). It does not reduce the classification within an enclosure from Division 1 to unclassified. Because the probability of a hazardous atmosphere external to the enclosure is high and the enclosure normally contains a source of ignition, it is essential that any interruption of the pressurizing results in de-energizing of the equipment. Also, it is essential that the enclosure be tight enough to prevent escape of molten metal particles or sparks. Examples of enclosures that are tight enough include IP40 or higher (as described in ANSI/IEC



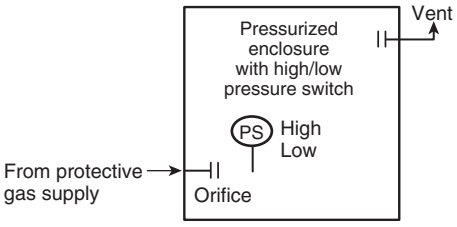
Example 1: Shows indicators can be used if protective gas supply has an alarm and the shutoff valve is adjacent to the enclosure.



Example 2: Shows enclosure alarm can also fulfill requirement for protective gas supply alarm.



Example 3: Shows multiple enclosures can be series purged.



Example 4: Shows enclosure with internal fail-safe, high/low pressure switch arranged to alarm in an attended location that can fulfill Chapter 4 requirements.

FIGURE A.4.9 Typical Alarm and Indicator Configurations for Type Y and Type Z Pressurizing. Purge outlet devices that could be provided are not shown for clarity.

60529, *American National Standard for Degrees of Protection Provided by Enclosures*); Type 3, 3S, 4, 4X, 6, 6P, 12, and 13 [as described in ANSI/NEMA 250, *Enclosures for Electric Equipment (1000 Volts Maximum);* UL 50, *Enclosures for Electrical Equipment, Non-Environmental Considerations;* UL50E, *Enclosures for Electrical Equipment, Environmental Considerations;* CSA C22.2 NO. 94.1, *Enclosures for electrical equipment, nonenvironmental considerations;* and CSA C22.2 NO. 94.2, *Enclosures for electrical equipment, environmental considerations].*

A.4.11.1 Power to the circuits can be continued for a short period where the Division 1 location only has a flammable concentration on an intermittent basis, and where entrance of the external atmosphere would be slow because the protected enclosure is tightly sealed. Where flammable concentrations occur frequently or enclosure failure can be catastrophic, Type Y pressurizing should be used if it is necessary to continue operating the process to prevent a more hazardous condition.

A.4.11.2 Examples of this type of equipment include, but are not limited to, motors or transformers. Overload conditions need only be a concern where the motor load or the transformer load is not determined by the product but by external variable loading in the actual application.

A.4.12.2 Canada has a dual language warning requirement. The French warning statement is as follows:

AVERTISSEMENT ENVELOPPE PRESSURISÉE Cette enceinte ne doit pas être ouverte à moins que l'atmosphère de la zone ne soit connue sous la concentration inflammable de matériaux combustibles ou que tous les dispositifs à l'intérieur aient été mis hors tension.

A.4.12.4 Canada has a dual language warning requirement. The French warning statement is as follows:

AVERTISSEMENT: PIECES INTERIEURES HAUTE TEMPERATURE Cette enceinte ne doit pas être ouverte à moins que l'atmosphère de la zone ne soit inférieure à la concentration inflammable des matériaux combustibles ou que tout l'équipement à l'intérieur ait été mis hors tension pendant _____minutes.

A.4.12.5 Canada has a dual language warning requirement. The French warning statement is as follows:

AVERTISSEMENT: SOUPAPE D'ALIMENTATION DE GAZ PROTECTEUR Cette soupape doit rester ouverte à moins que l'atmosphère de la zone ne soit inférieure à la concentration inflammable de matériaux combustibles ou que tout l'équipement à l'intérieur de l'enceinte protégée soit mise hors tension.

A.4.12.6 Canada has a dual language warning requirement. The French warning statement is as follows:

AVERTISSEMENT: La libération du gaz protecteur peut causer une asphyxie.

A.5.2.3 The design criteria are such that during a purging sequence, areas within the enclosure should be designed to avoid air pockets that are not completely purged. The risk associated with air pockets is the potential for a volume of gas to be trapped in the enclosure. This design criteria can sometimes be difficult to assess based on a visual inspection, especially on complex designs. One method of testing to confirm that air pockets have been avoided is detailed as follows (other test methods are possible):

(1) Small-bore tubes used to provide a method of sampling are placed in all locations where there is concern flammable gas will not be purged.
(2) The enclosure is filled with test gas to a concentration of not less than 70 percent by volume at any sampling point. Depending on the flammable gas(es) of concern, two tests should be run; one with a lighter-than-air gas (such as helium) and a second with a heavier-than-air gas (such as argon or carbon dioxide). If necessary, operational openings in the pressurized enclosure can be closed to enable the enclosure to be filled, but these would be reopened to operational condition when the protective gas supply is turned on for the purging test.
(3) As soon as the enclosure is filled with test gas, the test gas supply should be turned off and the protective gas supply turned on at the minimum purge flow rate for the minimum purge time as specified by the manufacturer. At the end of the purge time, the samples taken from all locations provided by the small-bore tubes should indicate safe concentrations of flammables based on the purge gas used, typically the following:
    (a) A concentration of 1 percent by volume for the helium or 0.25 percent by volume for the argon or carbon dioxide
    (b) A concentration equivalent to 25 percent of the most onerous LFL where two tests are performed to cover a range of flammable gases
    (c) A concentration equivalent to 25 percent of the LFL where one specific flammable gas is covered

If the protective gas is something other than air (i.e., inert gas), the concentration of oxygen should not exceed 2 percent by volume.

A.5.2.6 In order for any internal or adjacent enclosure to be automatically purged as the main enclosure is purged, adequate vents are provided to permit air circulation between the two enclosures. The area required to provide adequate venting will depend on the volume of the internal or adjacent enclosure. It is considered that meeting this requirement will prevent the formation of unpurged pockets of gas or vapor within the enclosure. This does not imply that internal or adjacent enclosures not meeting these requirements are prohibited, but that such enclosures must be provided with their own purge systems.

It should be understood that components that are mounted to or through the main enclosure wall could create an internal or adjacent enclosure within which ignition sources could exist. These need to be properly handled according to 5.2.6 and all others that apply if an adjacent or internal enclosure is present

For example, a pilot light that could not be fully purged and pressurized from the main enclosure because of its construction would create an adjacent enclosure that would need to be properly handled according to 5.2.6.

A.5.2.6(4) Cathode ray tubes (CRTs) are hermetically sealed components.

A.5.2.6.1 This less-stringent requirement applies only to internal components. For ignition-capable components mounted through the enclosure walls completing the enclosure, 5.2.6.1 does not apply.

Any ignition in this type of component that would normally be limited in its influence to the surrounding atmosphere because it is completely surrounded by a purged/pressurized area would not be the case for components that are mounted through the enclosure wall.

A.5.2.6.2 Examples of components that are environmentally sealed include, but are not limited to, transistors, microcircuits, and capacitors.

A.5.3.2 Canada has a dual language warning requirement. The French warning statement is as follows:

AVERTISSEMENT: Une fois l'enceinte ouverte, l'alimentation ne doit pas être rétablie jusqu'à ce que l'enceinte ait été purgée pendant _____ minutes à un débit de _____.

A.5.4 Any time the enclosure has been opened or the pressurizing system has failed, the possibility exists that an ignitible mixture has accumulated in the enclosure. For enclosures that are effectively subdivided by internal parts, a greater purge volume might be necessary.

A.5.5.2 It is essential that any door access that can be opened by untrained personnel be protected with interlock switches. Consistent with the practice that has been established with explosionproof enclosures, it is considered that the commonly displayed warning nameplate is adequate protection for an enclosure that requires the use of a tool to be opened.

A.6.2.2 Cleaning should be done using a method that will not create a dust cloud (e.g., vacuuming or brushing). Use of compressed air should be avoided. Protected enclosures should normally be kept closed whether the equipment is in operation or not.

A.6.2.4 The density of 2083 kg/m^3 (130 lb/ft^3) is slightly greater than that of sulfur dust, which was one of the dusts used in performing the tests on which the values in Table 6.2.4 are based. The pressures in the table are based on the assumption that the maximum crack width exposed to falling dust is 0.4 mm ($\frac{1}{64}$ in.). The ability of a dust to enter an opening due to the force of gravity against an outward velocity of gas is directly proportional to its specific particle density.

A.6.4 Canada has a dual language warning requirement. The French warning statement is as follows:

AVERTISSEMENT: Une fois l'enceinte ouverte l'alimentation ne doit pas être jusqu'à ce que les poussières combustibles aient été enlevées et que l'enceinte ait été repressurisée.

A.6.5 A hazard is created within an enclosure only after the pressure has failed and enough dust to be ignitible penetrates into the enclosure. This takes an appreciable length of time with any tightly sealed enclosure. Because of this, it is not always considered essential to remove the power from the equipment automatically upon failure of the pressurizing. It is necessary only to provide an adequate warning so that operations will not continue indefinitely without pressurizing.