

NFPA No.

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PURGED AND PRESSURIZED ENCLOSURES FOR ELECTRICAL EQUIPMENT 1974



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NATIONAL FIRE PROTECTION ASSOCIATION

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Standard for
Purged and Pressurized Enclosures for
Electrical Equipment in Hazardous Locations

NFPA No. 496 — 1974

1974 Edition of No. 496

The 1974 edition is a complete revision of the preceding (1972) edition.

Origin and Development of No. 496

This text was developed by the Sectional Committee on Electrical Equipment in Chemical Atmospheres of the NFPA Committee on Chemicals and Explosives. It was processed in accordance with NFPA Regulations Governing Technical Committees. Part A was adopted as a Tentative Standard at the 1966 NFPA Annual Meeting, and, with amendments, was adopted as an Official Standard at the 1967 Annual Meeting.

Part B was tentatively adopted in 1970 and officially adopted in 1971. The 1971 edition of this standard was approved by the American National Standards Institute under date of January 18, 1972 and designated ANSI C106.1. The 1974 edition is being submitted for similar approval. The ANSI designation and date of approval will be printed on the front cover of copies of this edition printed after approval has been received.

Amendments were adopted in 1972 and 1974.

Amendments Adopted in 1974

A complete revision including removal of all recommendations from the body of the standard to Appendix A, use of a new numbering system and other editorial changes to bring the standard into compliance with the Manual of Style for NFPA Codes and Standards.

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Those desiring an interpretation shall supply the Chairman with five identical copies of a statement in which shall appear specific reference to a single problem, paragraph, or section. Such a statement shall be on the business stationery of the inquirer and shall be duly signed.

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Requests for interpretations should be addressed to the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

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Standard for
Purged and Pressurized Enclosures for
Electrical Equipment in Hazardous Locations

NFPA No. 496 — 1974

**PART A. PURGED ENCLOSURES FOR ELECTRICAL
EQUIPMENT IN CLASS I HAZARDOUS LOCATIONS**

Chapter 1 General Provisions

1-1 Object and Scope.

1-1.1* The object of Part A of this Standard is to provide information for the design of purged enclosures for the purpose of eliminating or reducing within the enclosure a Class I hazardous location classification, as defined in Article 500 of the *National Electrical Code, NFPA No. 70 — 1974*. By this means, equipment which is not otherwise acceptable for hazardous locations may be utilized in accordance with the *National Electrical Code*.

1-2 Equipment and Locations Covered.

1-2.1 Part A of this Standard applies to instruments, control rooms, motors, motor controllers, switchgear, and similar equipment.

1-2.2 Part A of this Standard applies to locations where flammable gases or vapors may be present in air in concentrations sufficient for the locations to be classified as hazardous.

*An asterisk beside a number indicates that Appendix A contains related information.

Appendix A

Appendix A is not a part of this Standard. It is included for information purposes only.

A1-1.1 Electrical equipment should be located in the area having as low a degree of hazard classification as practicable.

1-3 Degree of Hazard.

1-3.1 There are two degrees of hazard: 1, normally hazardous (Division 1), and 2, hazardous only under abnormal conditions (Division 2).

1-3.2 The degree of hazard may be safely reduced (Division 1 to Division 2), or may be eliminated (Division 1 or Division 2 to nonhazardous) by purging, provided the installations are properly designed, installed, and maintained.

1-4 Definitions.

Division 1 Locations are those (1) in which hazardous concentrations of flammable gases or vapors exist continuously, intermittently, or periodically under normal operating conditions; (2) in which hazardous 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 which might release hazardous concentrations of flammable gases or vapors might also cause simultaneous failure of electrical equipment.

Division 2 Locations are those (1) in which volatile flammable liquids or flammable gases are handled, processed or used, but in which the hazardous 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; (2) in which hazardous concentrations of gases or vapors are normally prevented by positive mechanical ventilation, but which might become hazardous through failure or abnormal operation of the ventilating equipment; or (3) which are adjacent to Division 1 locations, and to which hazardous 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.

Purging is 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 gases or vapors 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

2-1 Scope.

2-1.1 Chapter 2 applies to enclosures with a gross internal volume not exceeding 10 cubic feet. For larger enclosures see Chapters 3 and 4.

2-2 General Requirements.

2-2.1 The enclosure shall be of such noncombustible material and construction that is not likely to be broken under conditions to which it is likely to be subjected.

2-2.2 Any window in a purged enclosure shall be tempered glass at least $\frac{1}{4}$ inch thick, shatterproof glass or other shatterproof material.

2-2.3 If hazardous vapors or gases have collected within the enclosure, either because the enclosure has been opened or the purge has failed, then 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.

NOTE: It is not obligatory to maintain any given flow rate.

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 three methods:

Appendix A (Continued)

A2-2.4 In order for any internal or adjacent enclosure to be automatically purged as the main enclosure is purged, adequate vents must be provided to permit air circulation between it and the main enclosure. The area required to provide adequate venting will obviously depend upon the internal or adjacent enclosure. It is considered that meeting this requirement will prevent the formation of unpurged pockets of gas within the enclosure. It is not intended to imply that internal or adjacent enclosures not meeting these venting requirements are prohibited but that such enclosures must be provided with their own purging gas connections.

1. The compartment shall be vented to the main enclosure by nonrestricted top and bottom vents, common to the purged main enclosure, having a minimum size for each vent of one square inch per 400 cubic inches of the volume of the internal or adjacent enclosure.

2. The compartment shall be separately purged, or

3. The equipment in the compartment shall be protected by other approved means.

2-2.5 To exclude the entrance of flammable vapors or gases in the event that the enclosure is opened or the purging system fails, suitable devices such as indicators or interlocks shall be provided.

2-2.6 The purging supply shall be essentially free of dust and liquids, which can plug small openings. It shall contain no more than trace amounts of flammable vapors or gases.

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

NOTE: Ordinary plant compressed air is usually not suitable.

2-2.6.2 The compressor suction line shall be designed to prevent leaks which might permit hazardous vapors to be drawn into the compressor.

2-2.6.3 If 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 leaks of hazardous vapor into the system, and suitably protected against mechanical damage and corrosion.

2-2.7 When double purging is used, i.e., a room ventilated to make it Division 2 and containing a device with open contacts protected by purging, the two sources of air shall be independent or automatic shutdown shall be provided.

2-3 Specific Requirements for Type Z Purging.

NOTE: Type Z purging reduces the classification within an enclosure from Division 2 to nonhazardous. A hazard is created under Type Z conditions only if the purge should fail at the same time the area which is normally nonhazardous becomes hazardous. Because of this, it is not considered essential to remove power from the equipment upon failure of the purge

Appendix A (continued)

A2-2.6.4 The compressor suction line should preferably not pass through any area having hazardous atmospheres.

but only that adequate warning must be provided to prevent continuing operation without purge protection.

2-3.1* Power shall not be turned on until at least four enclosure volumes of purge gas have passed through the enclosure while maintaining an internal enclosure pressure of at least 0.1 inch of water.

Exception: Power may be turned on immediately if a pressure of at least 0.1 inch of water exists and if the atmosphere within the enclosure is known to be nonhazardous.

2-3.2* The enclosure shall be maintained under a positive pressure of not less than 0.1 inch of water when the power is on.

2-3.3* Under normal operation the external enclosure temperature or the temperature of the egress air shall not exceed 80 percent of the ignition temperature (°C) of the vapor or gas involved as determined by Method of Test for Autogenous Ignition Temperatures of Petroleum Products, ASTM D2155-66. (See B1 in Appendix B.)

Exception: Temperature limits of the gases or vapors involved may be exceeded if a qualified testing laboratory has determined that the excessively hot components will not ignite the specific gases or vapors involved.

2-3.4 A visual or audible alarm to indicate purge system failure shall be provided. Safety interlocks shall not be required.

2-3.4.1 The alarm shall be so located that it can be readily seen or heard.

Appendix A (continued)

A2-3.1 Any time the enclosure has been opened or the purging gas removed, there exists the possibility that explosive gases or vapors have accumulated within the enclosure. For enclosures effectively divided by internal parts into two or more separate spaces a greater purge volume may be advisable.

A2-3.2 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 velocities.

A2-3.3 In the event that an external enclosure temperature in excess of the ignition temperature of the gas or vapor involved existed, it is obvious the purging cannot prevent an explosion; therefore, it is essential that excessive surface temperature be prevented, except when it has been specifically shown to be safe by a qualified testing laboratory.

2-3.4.2 It shall be acceptable for the visible or audible alarm device to be mechanical, pneumatic, or electric.

2-3.4.3 If the alarm device is electrical it shall be suitable for use in the location in which it is installed.

2-3.4.4 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.

2-3.4.5 If a pneumatic indicator is used, no valve between the device and the enclosure shall be permitted.

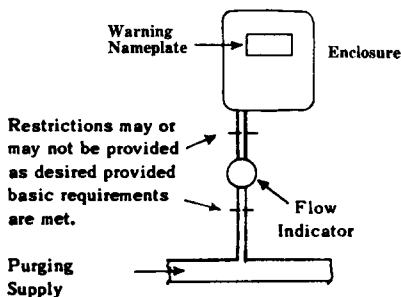


Figure 2-3a

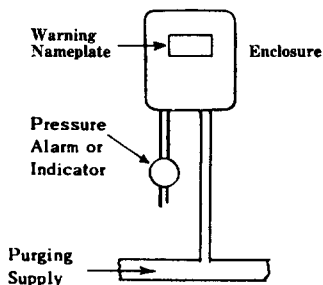


Figure 2-3b

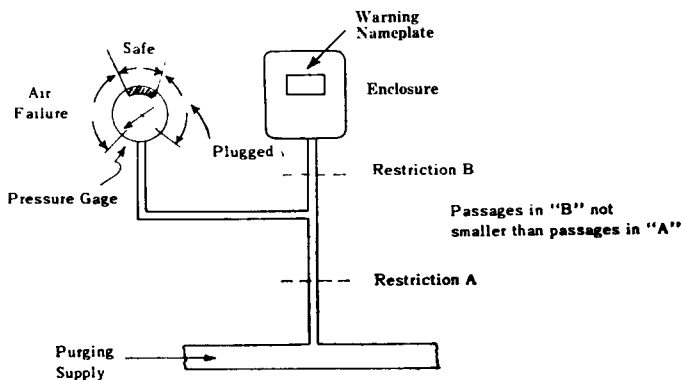


Figure 2-3c

Acceptable installations for Types Y and Z purging

2-3.4.6 The pressure or flow device shall be capable of indicating (or actuating an alarm) when the purging pressure or flow is inadequate to maintain a static pressure within the enclosure of at least 0.1 inch of water.

2-3.5 A warning nameplate shall be mounted on the enclosure. The nameplate shall be mounted in a prominent location and be visible before the enclosure is opened. It shall contain the following or equivalent statement:

Enclosures shall not be opened unless area is known to be nonhazardous or unless the power has been removed from all devices within the enclosure. Power shall not be restored after enclosure has been opened until enclosure has been purged for X minutes.

2-3.5.1 The manufacturer shall recommend purge conditions and flow rate necessary to pass at least four enclosure volumes in the stated time X.

2-3.6 The maximum operating temperature of any internal surface exposed to the atmosphere within the enclosure shall not exceed 80 percent of the ignition temperature (°C) of the gases or vapors involved, as determined by ASTM D2155-66 (*See B1 in Appendix B.*) except that:

Exception: Temperature limits of the gases or vapors involved may be exceeded if a qualified testing laboratory has determined that the excessively hot components will not ignite the specific gases or vapors involved.

2-3.6.1 If the device has not been tested by a qualified testing laboratory and any temperature exists over 80 percent of the ignition temperature of the gases or vapors involved, then

(a) The warning nameplate shall contain a statement that such conditions exist and that power shall be removed for X minutes (period to be determined and specified by the manufacturer to be sufficient to permit unit to cool to safe limit) before the door is opened unless the area is demonstrated to be nonhazardous at the time, or:

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

2-4 Specific Requirements for Type Y Purging.

NOTE: Type Y purging reduces the classification within an enclosure from Division 1 to Division 2. The equipment that can be included within the enclosure under Type Y conditions must be suitable for Division 2. This requires that it does not normally contain a source of ignition. Thus, a hazard is created within the enclosure only upon failure of the purging system simultaneously with a failure of the internal equipment causing it to produce a source of ignition. Therefore, it is not considered essential that on failure of the purging system the power be automatically removed from the equipment but that a warning be provided to prevent continuing operation without purge protection.

2-4.1 All requirements in 2-3.1 to and including 2-3.5 shall be met.

2-4.2 Equipment 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, or enclosed within a chamber hermetically sealed against the entrance of gases or vapors, or in circuits which under normal conditions do not release sufficient energy to ignite a specific hazardous atmosphere mixture.

2-4.2.2* The maximum operating temperature of any surface exposed to the atmosphere within the enclosure shall not exceed 80 percent of the ignition temperature ($^{\circ}\text{C}$) of the gases or vapors involved, as determined by ASTM D2155-66. (*See B1 in Appendix B.*)

Exception No. 1: Temperature limits of the gases or vapors involved may be exceeded if a qualified testing laboratory has determined that the excessively hot components will not ignite the specific gases or vapors involved.

Exception No. 2: Temperature limits of the gases or vapors involved may be exceeded if the surface having this temperature is enclosed within a chamber hermetically sealed against the entrance of gases or vapors.

Appendix A (continued)

A2-4.2.1 Examples of contacts normally operating at energy levels that would not cause ignition are: slide-wire and switching contacts in thermocouple circuits, resistance thermometer, strain gauge and pH electrode.

A2-4.2.2 Internal temperatures above the ignition temperature of the gas or vapor involved, such as vacuum tube filaments, are hermetically sealed to prevent them from normally coming in contact with the atmosphere that may become hazardous. It is essential that in such enclosures the surface of the glass envelope that does come in contact with the atmosphere not have a temperature in excess of 80 percent of the ignition temperature of the gas or vapor involved, unless specifically shown to be safe by a qualified testing laboratory.

2-4.3 If the conditions specified under 2-4.2 are met, it shall be acceptable to locate the equipment in a general purpose enclosure without purging.

2-5 Specific Requirements for Type X Purging.

NOTE: Type X purging reduces the classification within an enclosure from Division 1 to nonhazardous. Because the probability of a hazardous concentration of gas or vapor external to the enclosure is high and the enclosure normally contains a source of ignition, it is essential that any disruption of the purging will result in the removal of power from the equipment. Also, it is essential that the enclosure be tight enough to prevent escape of molten metal particles or sparks.

2-5.1 A timing device shall be incorporated to prevent power from being applied until after the elapse of a time sufficient to permit at least four enclosure volumes of purge gas (ten for motors) to have passed through the enclosure while maintaining an internal pressure of at least 0.1 inch of water.

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

2-5.1.2 The manufacturer shall recommend purge conditions and flow rate necessary to pass four enclosure volumes in a stated time.

2-5.2 The enclosure shall be maintained under a positive pressure of not less than 0.1 inch of water when the power is on.

2-5.3 A device shall be incorporated to remove potential automatically from all circuits within the enclosure not suitable for Division 1 upon failure of the purging supply.

NOTE: See Section 2-5.6 for requirements for cutoff switches.

2-5.4* A door switch shall be provided to remove potential automatically from all circuits within the enclosure not suitable for Division 1 if the enclosure can be readily opened without the use of a key or tools.

Appendix A (Continued)

A2-5.4 It is considered essential that any door or other opening which can be opened by untrained people without tools be protected with door interlock switches. Consistent with the practice which has been established with explosionproof enclosures, it is considered that the commonly displayed warning nameplate is adequate protection for the enclosure that can only be opened by the use of suitable tools.

2-5.4.1 The door switch, even though located within the enclosure, shall be suitable for Division 1 locations.

2-5.5* The maximum operating temperature of any surface exposed to the atmosphere within the enclosure shall not exceed 80 percent of the ignition temperature (°C) of the gases or vapors involved, as determined by ASTM D2155-66. (*See B1 in Appendix B.*)

Exception No. 1: Temperature limits of gases or vapors involved may be exceeded if a qualified testing laboratory has determined that the excessively hot components will not ignite the specific gases or vapors involved.

Exception No. 2: Temperature limits of gases or vapors involved may be exceeded if the surface having this temperature is enclosed within a chamber hermetically sealed against the 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 of the equipment beyond design limits and to de-energize the equipment automatically.

2-5.6 The power cutoff switch provided to remove power upon failure of the purging system shall be either flow or pressure actuated.

2-5.6.1 It 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.

2-5.6.3 If a pneumatic device is used, no valve between the device and the enclosure shall be permitted.

2-5.6.4 The pressure or flow device of Figure 2-5a and Figure 2-5b shall be capable of cutting off power when the purging pressure or flow is inadequate to maintain a static pressure within the enclosure of at least 0.1 inch of water.

Appendix A (Continued)

A2-5.5 Because the source of ignition caused by high temperature is not immediately removed by cutting off power to the equipment, it is considered essential that no surface temperature approaching the ignition temperature of the gas or vapor involved should be permitted to come in contact with the internal enclosure atmosphere, unless specifically shown to be safe by a qualified testing laboratory.

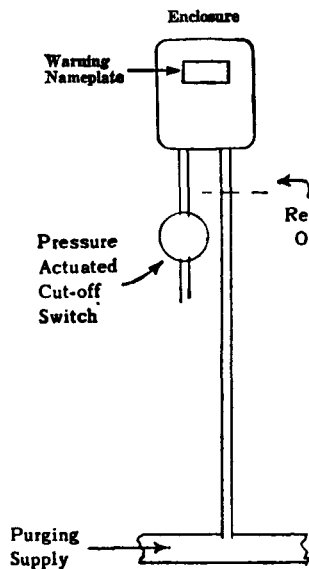


Figure 2-5a

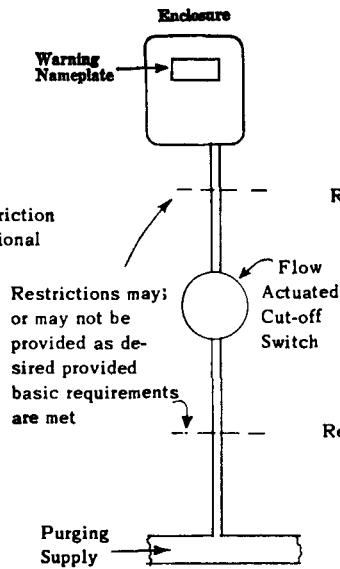


Figure 2-5b

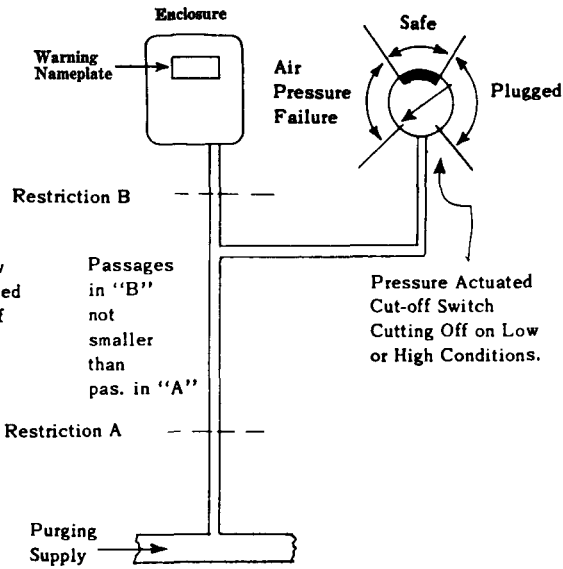


Figure 2-5c

Acceptable installations, for Type X purging

2-5.6.5 The pressure device of Figure 2-5c shall be capable of cutting off power if pressure exceeds or falls below a predetermined safe range.

2-5.7 A warning nameplate shall be mounted on the instrument in a prominent location and be visible before the enclosure is opened. It shall contain the following or an equivalent statement: Enclosure shall not be opened or any cover removed unless area is known to be nonhazardous or unless the power has been removed from all devices within the enclosure. Power shall not be restored after enclosure has been opened until enclosure has been purged for X minutes.

2-5.7.1 The manufacturer shall recommend purge conditions and flow rate necessary to pass at least four enclosure volumes in the stated time X.

Chapter 3 Purged Control Rooms

3-1 General.

3-1.1* These requirements apply to buildings or portions of buildings, commonly referred to as control rooms, when located close to areas which may contain flammable atmospheres.

3-1.2* If the control room is located in a hazardous area, it shall be designed to prevent the entry of flammable liquids and flammable atmospheres.

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 hazardous atmospheres.

The number of people to be housed.

The type of equipment to be housed.

The location of the control room in relation to the process units, including the location of relief valves and vent stacks, and the direction of the prevailing wind.

Appendix A (Continued)

A3-1.1 Control rooms commonly house one or more of the following facilities:

Process control instruments and panels.

Data processing equipment.

Communications equipment.

Electrical lighting and electrical power equipment and controls.

Emergency power-producing equipment to serve lighting and control devices.

Lunch, restroom and locker facilities for operating personnel.

Offices for process supervisors and technical personnel.

Maintenance facilities for calibration and repair of process instruments and control devices.

Heating and ventilating equipment.

In the process which can create hazardous atmospheres, the control room may serve as a separated location for devices capable of releasing sufficient electrical or thermal energy to cause ignition.

A3-1.2 To prevent the entrance of flammable liquids may require differences in elevation and/or the use of dikes, etc. To prevent the entry of flammable atmospheres positive pressure ventilation from a source of clean *air* may be used and the equipment in the building need not be housed in special enclosures for safe operation.

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 Ducting shall be constructed of noncombustible material. The fan suction line shall be free of leaks and given suitable protection from mechanical damage and corrosion to prevent hazardous concentrations of flammables from being admitted to the control room.

3-2.3.3* The air system shall be designed to provide positive-pressure ventilation for all areas of the room.

3-3 Requirements for Positive Pressure Air Systems.

3-3.1* The positive pressure air system shall:

(a) be capable of maintaining a pressure of at least 0.1 inch of water in the control room with all openings closed, and

(b) be capable of providing a minimum outward velocity of 60 feet per minute through all openings. All doors and windows capable of being opened shall be considered as open, and an allowance for other openings shall be included.

3-3.1.1 It shall be acceptable for the positive pressure air system to include heating, ventilating and air conditioning equipment plus any auxiliary equipment found necessary to comply with the above.

Appendix A (Continued)

A3-2.2 Air filtering may be desirable.

A3-2.2.1 Ordinarily air can be taken from an area to one side of a process area where there is a minimum chance of flammable vapors being found. The elevation of the fan suction depends on the density of the flammable gases or vapors under handling temperatures and adverse atmospheric conditions. For a control room in the center of a process, ducting may be necessary.

A3-2.2.3 Monitoring devices such as gas analyzers or similar devices may be needed to detect flammable vapors and gases and give suitable warning.

A3-3.1 A minimum number of doors should be provided so that positive pressures can be maintained, while at the same time the number of doors should be adequate for safe exit.

3-3.2 If there is an air-consuming device in the control room, sufficient air shall be supplied to handle its needs plus the needs of the positive pressure air system requirements or the air shall be taken from a separate source.

3-3.3 If Type X purging is required, all power to the control room shall be automatically shut down upon air system failure.

NOTE: Cutting off power to the control room may shut down the process, and this fact shall be considered.

3-3.4 For Types Y and Z purging, shutdown of power to the control room shall not be required.

3-3.5* The positive pressure air system failure shall be sensed by the discharge pressure of air from the fan and be signaled by a visible or audible alarm.

3-3.5.1 The visual or audible alarm shall be so located that it can be readily noticed and action can be taken.

3-3.6 Provisions shall be made to energize the control room safely after an air system interruption. Such provisions are:

3-3.6.1 Check with a flammable vapor indicator to determine when it is safe to energize the control room.

3-3.6.2* Provide a switch, motor and disconnect for the fan suitable for the area as it would be classified in the absence of positive pressure ventilation.

3-3.6.3 The electrical power for the air system fan shall be taken off the power line ahead of any disconnects that must be energized to return power to the control room.

Appendix A (Continued)

A3-3.5 Velocity pressure switches, static pressure sensing devices and plenum chambers with orifices to provide sufficient pressure to be sensed have been used. Electrical interlocks on the fan motors are not adequate in the event the fan belt slips, the fan impeller becomes loose on the shaft or if the fan rotation is backwards.

A3-3.6.2 An enforced purge wherein an interlock system requires proof of purging for a set period of time prior to energization should be considered if warranted by the conditions.

Chapter 4. Purged Power Equipment Enclosures

4-1 Scope.

4-1.1 Chapter 4 applies to equipment enclosures exceeding 10 cubic feet in volume but not control rooms. For enclosures with a volume of 10 cubic feet or less see Chapter 2; for control rooms see Chapter 3.

4-1.2 For purposes of purging, electrical power equipment can be divided into two groups:

4-1.2.1 Purged Equipment. Equipment, such as switch-gear and motor controllers, which does not require air flow for heat dissipation, but which requires pressurization to prevent entrance of flammable gases or vapors.

4-1.2.2 Ventilated Equipment. Equipment, such as motors, which requires air flow for heat dissipation.

4-2 Requirements for Purged Equipment.

4-2.1 The enclosure shall be of substantial noncombustible construction and reasonably tight. Gaskets shall be permissible.

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

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

4-2.4 Whether the type of purging is X, Y or Z, before power is turned on at least ten enclosure volumes of purge gas shall have passed through the enclosure while internal enclosure pressure of 0.1 inch of water or more is maintained. This pressure shall be maintained continuously.

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

4-2.5 Under normal operating conditions the external enclosure temperature or the temperature of the egress air shall not exceed 80 percent of the ignition temperature (°C) of the vapor or gas involved as determined by ASTM D2155-66. (See B1 in Appendix B.)

Exception: Temperature limits of the gases or vapors involved may be exceeded if a qualified testing laboratory has determined that the excessively hot components will not ignite the specific gases or vapors involved.

4-2.6 In the case of loss of pressurization, power to the equipment shall be removed immediately in the case of X purging, unless immediate interruption of power would result in a condition more hazardous than that created by failure to remove the power immediately. In this case an audible as well as visual alarm suitable for the area shall be energized. In the cases of Y and Z purging, loss of pressurization shall energize an audible as well as a visual alarm. Removal of power shall not be required in the cases of Y and Z purging failures.

4-2.6.1 The visual or audible alarm shall be so located that it can be readily noticed and action can be taken.

4-2.7 A warning nameplate shall be mounted on the enclosure in a prominent location and be visible before the enclosure is opened. It shall contain the following or an equivalent statement:

Enclosure shall not be opened unless area is known to be non-hazardous or unless the power has been removed from all devices within the enclosure. Power shall not be retored after enclosure has been opened until enclosure has been purged for X minutes.

NOTE: There should be a flow rate to pass at least ten enclosure volumes in the stated time X.

4-2.8 The maximum operating temperature of any internal surface exposed to the atmosphere within the enclosure shall not exceed 80 percent of the ignition temperature (°C) of the gases or vapors involved, as determined by ASTM D2155-66. (See B1 in Appendix B.)

Exception No. 1: Temperature limits of the gases or vapors involved may be exceeded if a qualified testing laboratory has determined that the excessively hot components will not ignite the specific gases or vapors involved.

Exception No. 2. Temperature limits of the gases or vapors involved may be exceeded if the warning nameplate contains a statement that such conditions exist and that power shall be removed for X minutes (period to be determined and specified by the manufacturer to be sufficient to permit unit to cool to safe limit) before the door is opened unless the area is demonstrated to be nonhazardous at the time.

Exception No. 3. Temperature limits of the gases or vapors involved may be exceeded if the hot component is separately housed so that the surface temperature of its housing is below safe limits. This housing shall be purged or

sealed and provided with a warning nameplate stating that its cover shall not be removed for X minutes (period to be determined and specified by the manufacturer to be sufficient to permit unit to cool to safe limit) unless the area is demonstrated to be nonhazardous at the time.

4-2.8.1 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 design limits and to de-energize the equipment automatically.

4-3 Requirements for Ventilated Equipment.

4-3.1 The enclosure shall be 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 (10) 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 0.1 inch 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 vapors and gases, contaminants and any other foreign matter.

NOTE: Air filtering may be desirable.

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

4-3.6 The flow of air shall be as uniform as possible within the enclosure so as to avoid, or at least minimize, air pockets.

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

NOTE: The air required for cooling will be more than that required for purging.

4-3.8 The maximum operating temperature of any surface exposed to the atmosphere shall not exceed 80 percent of the ignition temperature (°C) of the gases or vapors involved, as determined by ASTM D2155-66. (See B1 in Appendix B.)

Exception: Temperature limits of the gases or vapors involved may be exceeded if a qualified testing laboratory has determined that the excessively hot components will not ignite the specific gases or vapors involved.

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

(a) The equipment cannot be energized until the purging cycle has been completed.

(b) The equipment will automatically shut down when the ventilating equipment stops.

Exception: If shutting down the equipment can produce unsafe conditions, an audible as well as visible signal shall be energized so that corrective steps can be taken.

PART B. PRESSURIZED ENCLOSURES FOR ELECTRICAL EQUIPMENT IN CLASS II HAZARDOUS LOCATIONS

Chapter 5 General Provisions

5-1 Object and Scope.

5-1.1 The object of Part B of this Standard is to provide information for the design of pressurized enclosures for the purpose of eliminating within the enclosure a Class II hazardous location classification, as defined in Article 500 of the National Electrical Code, NFPA No. 70 — 1974. By this means, equipment which is not otherwise acceptable for hazardous locations may be utilized in accordance with the National Electrical Code.

5-2 Equipment and Locations Covered.

5-2.1 Part B of this Standard applies to control rooms and enclosures for instruments, motors, motor controllers, switchgear, and similar equipment.

5-2.2 Part B of this Standard applies to locations which are hazardous because of the presence of combustible dust.

5-3 Definitions.

Class II, Division 1. Locations (1) in which combustible dust is or may be in suspension in the air continuously, intermittently, or periodically under normal operating conditions, in quantities sufficient to produce explosive or ignitable mixtures, (2) where mechanical failure or abnormal operation of machinery or equipment might cause such mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electrical equipment, operation of protective devices, or from other causes, or (3) in which dusts of an electrically conducting nature may be present.

NOTE: Combustible dusts which are electrically nonconducting include dusts produced in the handling and processing of grain and grain products, pulverized sugar and cocoa, dried egg and milk powders, pulverized spices, starch and pastes, potato and wood flour, oil meal from beans and seed, dried hay, and other organic materials which may produce combustible dusts when processed or handled. Electrically conducting nonmetallic dusts include dusts from pulverized coal, coke and charcoal. Dusts containing magnesium or aluminum are particularly hazardous and every precaution must be taken to avoid ignition and explosion.

Class II, Division 2. Locations in which combustible dust will not normally be in suspension in the air, or will not be likely to be thrown into suspension by the normal operation of equipment or apparatus, in quantities sufficient to produce explosive or ignitable mixtures, but (1) where deposits or accumulations of such dust may be sufficient to interfere with the safe dissipation of heat from electrical equipment or apparatus, or (2) where such deposits or accumulations of dust on, in, or in the vicinity of electrical equipment might be ignited by arcs, sparks or burning material from such equipment.

Pressurization for the purposes of this Standard is 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 hazardous dusts.

NOTE: An atmosphere made hazardous by dust inside an enclosure cannot be reduced to a safe level by supplying a flow of clean air in the same manner as gases or vapors. The enclosure must be opened and the dust removed. Visual inspection can be used to determine if the dust has been removed. Positive pressure will prevent entrance of a dust into a clean enclosure.

5-4 Degree of Hazard.

5-4.1* In both Division 1 and Division 2 locations, the hazard can be eliminated by pressurization to prevent the entrance of combustible dusts, provided the installations are properly designed, installed and maintained.

Appendix A (Continued)

A5-4.1 Electrical equipment should be located in the area having as low a degree of hazard classification as practicable.

Chapter 6. Pressurized Instrument and Other Small Enclosures

6-1 Scope.

6-1.1 Chapter 6 applies to enclosures with a gross internal volume not exceeding 10 cubic feet. For larger enclosures see Chapters 7 and 8.

6-2 General Requirements.

6-2.1 The enclosure shall be reasonably tight and of such non-combustible material and construction that is not likely to be broken under conditions to which it is likely to be subjected.

6-2.1.1 Precautions shall be taken to protect the enclosure from excessive pressure of the pressurizing supply.

6-2.1.2 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 relieve.

6-2.2 Any window in a pressurized enclosure shall be tempered glass at least $\frac{1}{4}$ -inch thick, shatterproof glass or other shatter-proof material.

6-2.3 If combustible dusts have collected within the enclosure, the enclosure shall be opened and the dust removed; then the enclosure shall be pressurized.

6-2.4 Subdivisions 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.

6-2.5 Suitable precautions such as indicators, pressure switches, and interlocks shall be provided to safeguard the installation if the enclosure is opened or if the pressurizing system fails.

6-2.6 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.

6-2.6.1 Air of normal instrument quality shall be acceptable as shall other suitable supplies such as inert gas.

NOTE: Ordinary plant compressed air is usually not suitable due to contaminants which may cause equipment to malfunction.

6-2.6.2 The compressor intake shall be located in a non-hazardous area.

6-2.6.3* If the compressor suction line passes through a hazardous area, it shall be of noncombustible material suitably protected against mechanical damage and corrosion.

6-2.6.4 The compressor suction line shall be designed to prevent leaks which might permit hazardous vapors or dusts to be drawn into the compressor.

6-3 Specific Requirements for Pressurizing.

NOTE: A hazard is created within an enclosure only after the pressure has failed and enough dust to be explosive penetrates into the enclosure. This takes an appreciable time with any normally tight enclosure. Because of this, it is not always considered essential to remove the power from the equipment automatically upon failure of the pressurization. It is necessary only to provide an adequate warning so that operations will not continue indefinitely without pressure protection. It is essential that the enclosure be tight enough to prevent escape of sparks or burning material.

6-3.1 Before the power is turned on, the interior of the enclosure shall be free of dust.

6-3.1.1 If combustible dusts have collected within the enclosure, it shall be opened and the dust removed before pressurizing.

6-3.2* The enclosure shall be maintained under a positive pressure dependent on the specific particle density of the dust in accordance with the following table, when the power is on:

Specific Particle Density (Pounds per Cubic Foot)	Pressure (Inches of Water)
130 or less	Not Less than 0.1
Greater than 130	Not Less than 0.5

Appendix A (Continued)

A6-2.6.3 The compressor suction line should preferably not pass through any area having hazardous atmospheres.

A6-3.2 The density of 130 pounds per cubic foot is slightly greater than that of sulfur dust, which was one of the dusts used in performing the tests on which the values in the table are based. The pressures in the table are based on the assumption that the maximum crack width exposed to falling dust is 1/64 inch wide. The ability of a dust to enter an opening due to the force of gravity against an outward velocity of gas is directly dependent on its specific particle density.

6-3.3* In Division 1 locations, a door switch shall be provided to remove power automatically from all circuits within the enclosure not suitable for Division 1 if the enclosure can be readily opened without the use of a key or tools. In Division 2 locations, no door switch is required as it is not necessary to remove the power to the enclosure automatically if the door is opened.

6-3.4 A warning nameplate shall be mounted on the enclosure. The nameplate shall be mounted in a prominent location and be visible before the enclosure is opened. It shall state:

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

Exception: If there is not space on the enclosure to print this statement in type large enough to be legible, equivalent wording, such as the following may be used:

De-energize before opening unless area is known to be nonhazardous. Remove dust and repressurize before restoring power.

6-3.5 Under normal operation, the external enclosure temperature or the temperature of the egress air shall not exceed 80 percent of, and in all cases shall be at least 50° C below, the ignition temperature (°C) of the dust when in the form of a layer. The ignition temperature of the dust layer is determined by the procedure described in the U. S. Bureau of Mines Report of Investigation 5624. (See B2 in Appendix B.) 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.

In general, maximum surface temperatures under actual operating conditions shall not exceed 165°C (329°F) for equipment which is not subject to overloading, and 120°C (248°F) for equipment such as motors, power transformers, etc., which may be overloaded.

NOTE: Dust which is carbonized or is excessively dry is highly susceptible to spontaneous ignition.

Appendix A (Continued)

A6-3.3 Consistent with the practice which has been established with explosion-proof enclosures, it is considered that the commonly displayed warning nameplate is adequate protection for the enclosure that requires the use of a tool to be opened.

6-3.6* Any internal component having a surface temperature approaching the ignition temperature of the combustible dust involved shall be protected in accordance with 6—3.6.1.

6-3.6.1 If any internal component has a maximum surface temperature greater than that indicated in 6-3.5, the surface having this temperature 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 6-3.5.

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 and it shall contain a statement that such conditions exist and that power shall be removed for — minutes (period to be determined and specified by the manufacturer to be sufficient to permit unit to cool to safe limit) before the door is opened unless the area is known to be nonhazardous at the time or:

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

6-3.6.2 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 of the equipment beyond design limits and to de-energize 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 as well as visible alarms suitable for the area shall be energized.

6-3.7 An alarm or indication of pressurized system failure shall be provided. It shall be acceptable for the device to be mechanical, pneumatic or electric, and the signal may be audible or visual.

6-3.7.1 If electrical, the alarm device shall be suitable for use in the location in which it is installed.

Appendix A (Continued)

A6-3.6 Because source of ignition caused by high temperature is not immediately removed by cutting power to the equipment, additional precautions are necessary for hot components.

6-3.7.2 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.

6-3.7.3 If a pneumatic indicator is used, no valve between the device and the enclosure shall be permitted.

6-3.7.4 The pressure or flow device shall be capable of indicating (or actuating an alarm) when the purging pressure or flow is inadequate to maintain a static pressure within the enclosure as specified in 6-3.2. The device of Figure 6-3c shall also be capable of indicating (or actuating an alarm) if pressure exceeds a pre-determined safe range (indicates plugging of restriction B).

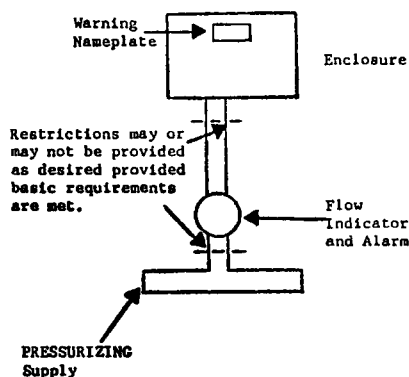


Figure 6-3a

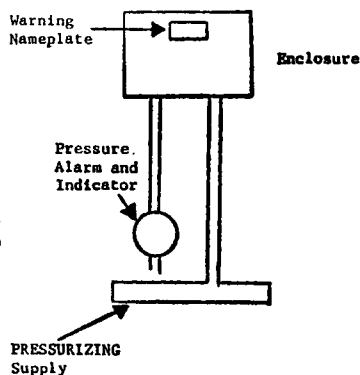


Figure 6-3b

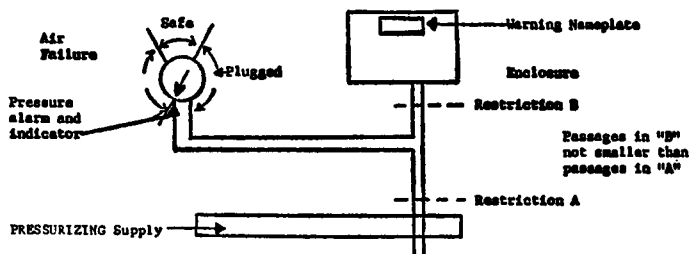


Figure 6-3c

Acceptable Installations for Pressurizing

Chapter 7 Pressurized Control Rooms

7-1 General.

7-1.1* These requirements apply to buildings or portions of buildings commonly referred to as control rooms when located close to areas which may contain combustible dusts.

7-1.2 If the control room is located in an area made hazardous by combustible dusts, 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.

7-2 Considerations Relating to Positive Pressure Ventilation.

7-2.1 Factors to be considered in designing a control room suitable for safe operation in hazardous atmospheres are:

The number of people to be housed (air conditioning load).

The type of equipment to be housed.

The location of the control room in relation to the process units and potential sources of dust, such as elevator legs, belt conveyers, and vent stacks.

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

NOTE: Air filtering may be necessary.

Appendix A (Continued)

A7-1.1 Control rooms commonly house one or more of the following facilities:

Process control instruments and panels.

Data processing equipment.

Communications equipment.

Electrical lighting and electrical power equipment and controls.

Emergency power-producing equipment to serve lighting and control devices.

Lunch, restroom and locker facilities for operating personnel.

Offices for process supervisors and technical personnel.

Maintenance facilities for calibration and repair of process instruments and control devices.

Heating and ventilating equipment.

In processes which can create hazardous atmospheres, the control rooms may serve as a separated location for devices capable of releasing sufficient electrical or thermal energy to cause ignition.