NFPA No.

496

PURGED AND PRESSURIZED ENCLOSURES FOR ELECTRICAL EQUIPMENT 1972

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NATIONAL FIRE PROTECTION ASSOCIATION
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Official NFPA Definitions

Adopted Jan. 23, 1964: Revised Dec. 9, 1969. Where variances to these definitions are found, efforts to eliminate such conflicts are in process.

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

NFPA No. 496 — 1972

1972 Edition 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 1972 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 to the 1971 Edition were adopted at the 1972 NFPA Annual Meeting.

Amendments Adopted in 1972: Paragraph 6353 and Section 829 amended by the addition of second sentences.

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SCOPE: This committee serves as a policy-making and correlating group to administer and process reports of the various sectional committees dealing with chemicals and explosives.

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SCOPE: (1) To develop data on the properties of chemicals enabling proper selection of electrical equipment for use in atmospheres containing flammable gases, vapors or dusts; (2) to make recommendations for the prevention of fires and explosions through the use of intrinsically safe, continuously purged, pressurized, explosion-proof, or dust ignition-proof electrical equipment when installed in such chemical atmospheres.

†Nonvoting.

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

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

Chapter 1. General Provisions

11. Object and Scope

111. 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. By this means, equipment which is not otherwise acceptable for hazardous locations may be utilized in accordance with the National Electrical Code.

12. Equipment and Locations Covered

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

122. 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.

13. Degree of Hazard

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

132. 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.

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

14. 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 concentra-

tions 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

21. Scope

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

22. General Requirements

221. 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.

222. Any window in a purged enclosure shall be tempered glass at least ¼ inch thick, shatterproof glass or other shatterproof material.

223. 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 must be purged.

2231. Once the enclosure has been purged of hazardous concentrations, it is not obligatory to maintain any given flow rate. It is only necessary that positive pressure be maintained within the enclosure.

224. Since the intent is to purge an enclosure to reduce the concentration of hazardous vapors or gases to an acceptably safe level, compartments within the main enclosure or adjacent enclosures connected to the main enclosure must be considered separately.

2241. They may be adequately vented to the main enclosure.

a. An internal enclosure or an adjacent enclosure that is being considered as part of and purged with the main enclosure must have nonrestricted top and bottom vents, common to the purged main enclosure, having a minimum size for each vent of 1 square inch per 400 cubic inches of the volume of the internal or adjacent enclosure.

NOTE: 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.

2242. They may be separately purged.

2243. Equipment contained therein may be protected by other approved means.

225. If the enclosure is opened or if a failure occurs within the purging system pressure may not be adequate to exclude the entrance of flammable vapors or gases. Suitable precautions such as indicators, interlocks, etc., must be provided to safeguard the installation.

226. 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.

2261. Air of normal instrument quality is acceptable as are other suitable supplies such as inert gas.

NOTE: Ordinary plant compressed air is usually not suitable.

2262. The compressor suction line should preferably not pass through any area having hazardous atmospheres. The compressor intake must be located in a nonhazardous area.

2263. If the compressor suction line passes through a hazardous area, it must be of noncombustible material suitably protected against mechanical damage and corrosion.

2264. The compressor suction line must be designed to prevent leaks which might permit hazardous vapors to be drawn into the compressor.

227. 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 must be independent or automatic shutdown must be provided.

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

231. Before power is turned on, at least four enclosure volumes of purge gas must have passed through the enclosure while maintaining an internal enclosure pressure of at least 0.1 inch of water.

NOTE: 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.

2311. 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.

232. The enclosure must be maintained under a positive pressure of not less than 0.1 inch of water when the power is on.

NOTE: 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.

233. 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 D286.

NOTE: 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.

234. Safety interlocks to remove power upon failure of purging supply are not required.

235. Acceptable installations are shown in Figures No. 1, 2, and 3.

236. An alarm or indication of purge system failure must be provided. The device may be mechanical, pneumatic or electric, and the signal may be audible or visual.

NOTE: The visual or audible alarm shall be so located that it can be readily noticed and action can be taken.

2361. If electrical, it must meet the requirements for its location.

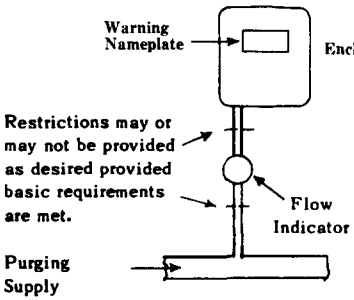

FIGURE 1

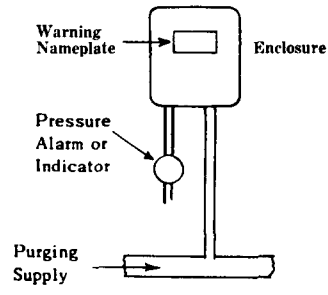

FIGURE 2

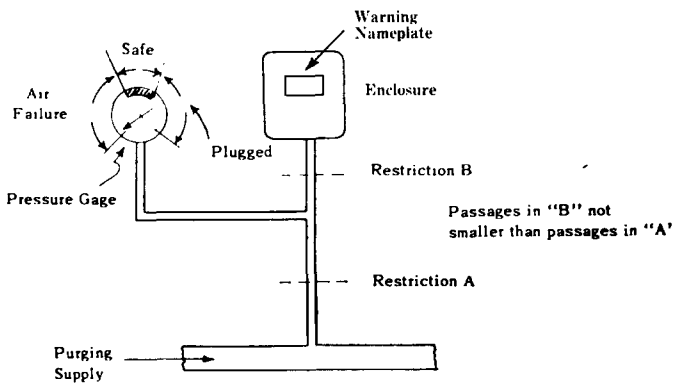

FIGURE 3

Acceptable installations for Types Y and Z purging

2362. 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.

2363. If a pneumatic indicator is used, no valve between the device and the enclosure shall be permitted.

2364. The pressure or flow device must 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.

237. A red warning nameplate must 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 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.

NOTE: The manufacturer is to recommend purge conditions and flow rate necessary to pass at least four enclosure volumes in the stated time X.

238. 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 D286, except that:

2381. If 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 must 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 may 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 may 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.

24. 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.

241. All requirements in 231 to and including 237 must be met.

242. Equipment shall conform to the requirements for Division 2 locations.

NOTE: The requirement for equipment to be used in Division 2 locations is that it should not normally contain a source of ignition. Such sources of ignition may be make-and-break contacts or high surface temperatures in contact with the atmosphere which may become hazardous.

243. Specific requirements are:

2431. 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.

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

2432. 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 D286.

2433. If any temperature exists over 80 percent of the ignition temperature (°C) of the gases or vapors involved, the surface having this temperature shall be enclosed within a chamber hermetically sealed against the entrance of gases or vapors.

NOTE: 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 which may become hazardous. It is essential, that in such enclosures the surface of the glass envelope, which 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.

NOTE: If the conditions specified under 242 and 243 are met, the equipment can be located in a Division 2 location in a general purpose enclosure without purging.

25. 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.

251. A timing device must 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. The timing device must meet the requirements of its location.

NOTE: The manufacturer is to recommend purge conditions and flow rate necessary to pass four enclosure volumes in a stated time.

252. The enclosure must be maintained under a positive pressure of not less than 0.1 inch of water when the power is on.

253. A device must be incorporated to remove potential automatically from all circuits within the enclosure not suitable for Division 1 upon failure of the purging supply. (Refer to 257.)

254. A door switch must 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. The door switch, even though located within the enclosure, must be suitable for Division 1 locations.

NOTE: 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.

255. 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 D286.

2551. If any temperature exists over 80 percent of the ignition temperature (°C) of the gases or vapors involved, the surface having this temperature shall be enclosed within a chamber hermetically sealed against the entrance of gases or vapors.

NOTE: 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.

2552. 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.

256. Acceptable installations are shown in Figures No. 4, 5, and 6.

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

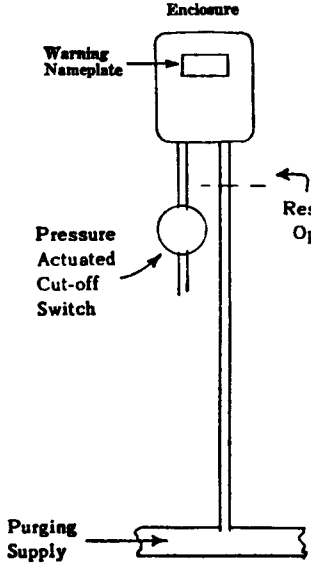

FIGURE 4

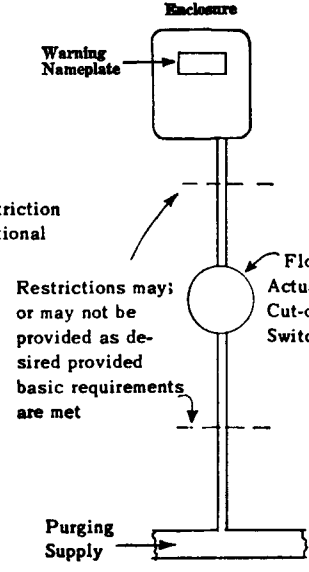

FIGURE 5

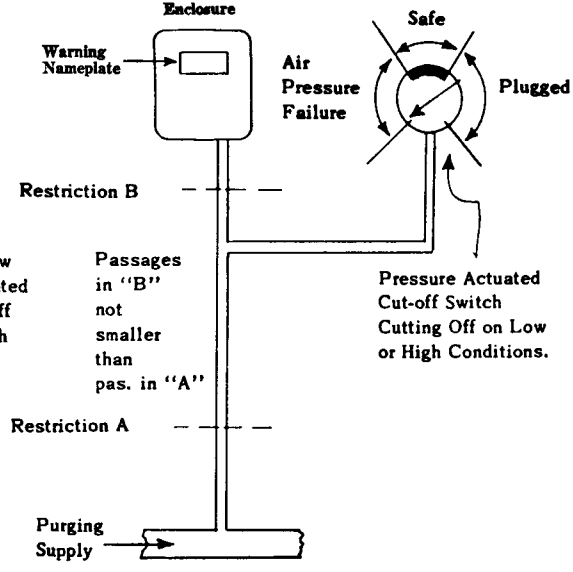

FIGURE 6

Acceptable installations for Type X purging

2571. It must conform to the requirements of its location.

2572. 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.

2573. If a pneumatic device is used, no valve between the device and the enclosure *shall* be permitted.

2574. The pressure or flow device of Figure 4 and Figure 5 must 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.

2575. The pressure device of Figure 6 must be capable of cutting off power if pressure exceeds or falls below a predetermined safe range.

258. A red warning nameplate must be mounted on the instrument. 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 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.

NOTE: The manufacturer is to recommend purge conditions and flow rate necessary to pass at least four enclosure volumes in the stated time X.

Chapter 3. Purged Control Rooms

31. Scope

311. 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.

32. Control Room

321. 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.

322. 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.

323. If the control room is located in a hazardous area, it must be designed to prevent the entry of flammable liquids and flammable atmospheres. 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.

33. Considerations Relating to Positive Pressure Ventilation

331. Factors to be considered in designing a control room suitable for safe operation in hazardous atmospheres are:

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.

3311. 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. Air filtering may be desirable.

NOTE: The source of air must be determined from the nature of the process and the physical layout. 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. Ducting must be constructed of noncombustible material. The fan suction line must 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.

3312. 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.

3313. The air system should be designed to provide positive-pressure ventilation for all areas of the room.

3314. Monitoring devices such as gas analyzers or similar devices may be needed to detect flammable vapors and gases and give suitable warning.

34. Requirements for Positive Pressure Air Systems

341. 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.

3411. The positive pressure air system may include heating, ventilating and air conditioning equipment plus any auxiliary equipment found necessary to comply with the above.

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

343. If Type X purging is required, all power to the control room must be automatically shut down upon air system failure. Cutting off power to the control room may shut down the process, and this fact must be considered. For Types Y and Z purging, shutdown of power to the control room is not required.

344. The positive pressure air system failure should be sensed by the discharge pressure of air from the fan and be signaled by a visible or audible alarm.

NOTE 1: The visual or audible alarm shall be so located that it can be readily noticed and action can be taken.

NOTE 2: 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.

345. Provisions must be made to energize the control room safely after an air system interruption. Such provisions are:

3451. Check with a flammable vapor indicator to determine when it is safe to energize the control room.

3452. 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.

3453. 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.

3454. The electrical power for the air system fan must be taken off the power line ahead of any disconnects that must be energized to return power to the control room.

Chapter 4. Purged Power Equipment Enclosures

41. Scope

411. 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.

412. For purposes of purging, electrical power equipment can be divided into two groups:

4121. PURGED EQUIPMENT. Equipment, such as switchgear and motor controllers, which does not require air flow for heat dissipation, but which requires pressurization to prevent entrance of flammable gases or vapors.

4122. VENTILATED EQUIPMENT. Equipment, such as motors, which requires air flow for heat dissipation.

42. Requirements for Purged Equipment

421. The enclosure shall be of substantial noncombustible construction and reasonably tight. Gaskets are permissible.

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

423. Piping for air or inert gas supply (if used) should be protected against mechanical damage.

424. Whether the type of purging is X, Y or Z, before power is turned on at least ten enclosure volumes of purge gas must 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, except that:

4241. 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.

425. 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 Method of Test for Autogenous Ignition Temperatures of Petroleum Products, ASTM D286.

426. 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 is not mandatory in the cases of Y and Z purging failures.

NOTE: The visual or audible alarm shall be so located that it can be readily noticed and action can be taken.

427. A red warning nameplate must 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 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.

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

428. 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 D286, except that:

4281. If 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 must 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 may 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 may 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.

4282. 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 tempera-

ture of the equipment beyond design limits and to de-energize the equipment automatically.

43. Requirements for Ventilated Equipment

431. The enclosure shall be noncombustible construction with necessary openings limited to minimum practical size and kept as airtight as possible.

432. The enclosure shall be purged by at least ten (10) air changes before the electrical equipment is energized. The auxiliary air equipment must be suitable for the location.

433. 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.

434. The source of air for ventilation shall be free of hazardous concentrations of flammable vapors and gases, contaminants and any other foreign matter. Air filtering may be desirable.

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

436. The flow of air should be as uniform as possible within the enclosure so as to avoid, or at least minimize, air pockets.

437. The flow of air must be adequate to keep the equipment adequately cooled depending on the operating design requirements. The air required for cooling will be more than that required for purging.

438. 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 D286.

439. The electrical circuits of the equipment within the enclosure shall be interlocked with the ventilating equipment so that:

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

(b) The equipment will automatically shut down when the ventilating equipment stops unless shutting down the equipment can produce unsafe conditions; then an audible as well as a visible signal should be sounded so corrective steps can be taken.

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

Chapter 5. General Provisions

51. Object and Scope

511. 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. By this means, equipment which is not otherwise acceptable for hazardous locations may be utilized in accordance with the National Electrical Code.

52. Equipment and Locations Covered

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

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

53. 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 ignitible 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 ignitible 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.

54. Degree of Hazard

541. 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.

542. 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

61. Scope

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

62. General Requirements

621. The enclosure shall be reasonably tight and of such noncombustible material and construction that is not likely to be broken under conditions to which it is likely to be subjected.

6211. Precautions should be taken to protect the enclosure from excessive pressure of the pressurizing supply. Pressure control valves can fail and the use of relief devices may be necessary. Excess pressure relieving devices shall be designed to prevent escape of sparks or burning material to a hazardous area when they relieve.

622. Any window in a pressurized enclosure shall be tempered glass at least ¼-inch thick, shatterproof glass or other shatterproof material.

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

624. The intent is to pressurize an enclosure to prevent the entrance of dust. Subdivisions within the main enclosure or adjacent enclosures connected to the main enclosure may be collectively pressurized if there is adequate communication to maintain the specified pressure at all points.

625. If the enclosure is opened or if a failure occurs within the pressurizing system, pressure may not be adequate to exclude the entrance of combustible dusts. Suitable precautions such as indicators, pressure switches, interlocks, etc., shall be provided to safeguard the installation.

626. 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.

6261. Air of normal instrument quality is acceptable as are 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.

6262. The compressor suction line should preferably not pass through any area having hazardous atmospheres. The compressor intake shall be located in a nonhazardous area.

6263. If the compressor suction line passes through a hazardous area, it shall be of noncombustible material suitably protected against mechanical damage and corrosion.

6264. The compressor suction line shall be designed to prevent leaks which might permit hazardous vapors or dusts to be drawn into the compressor.

63. 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.

631. Before the power is turned on, the interior of the enclosure shall be free of dust.

6311. If combustible dusts have collected within the enclosure, it shall be opened and the dust removed before pressurizing.

632. 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

NOTE: 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.

633. 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.

NOTE: 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 requires the use of a tool to be opened.

634. A red 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.

NOTE: 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.

635. 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.* 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. Dust which is carbonized or is excessively dry is highly susceptible to spontaneous ignition. 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: In the event that an external enclosure temperature in excess of the limits set forth in paragraph 635 exists, pressurizing cannot prevent an explosion. An excessive surface temperature must therefore be prevented.

6351. If any internal component has a maximum surface temperature greater than that indicated in 635, the surface having

*Laboratory Equipment and Test Procedures for Evaluating Explosibility of Dusts, (RI 5624). Available from Bureau of Mines, Pittsburgh, Pennsylvania.

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 635.

NOTE: Because the source of ignition caused by high temperature is not immediately removed by cutting off power to the equipment, any component having a surface temperature approaching the ignition temperature of the combustible dust involved should be protected in accordance with 6351 or 6352.

6352. As an alternate to 6351, if any temperature exists over that indicated in 635 of the combustible dust involved then:

(a) 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 must 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:

(b) The hot component may 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 may 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.

6353. 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. 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 visual alarms suitable for the area shall be energized.

636. Acceptable installations are shown in Figures 7, 8, and 9.

637. An alarm or indication of pressurized system failure must be provided. The device may be mechanical, pneumatic or electric, and the signal may be audible or visual.

6371. If electrical, it must meet the requirements for its location.

6372. 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.

6373. If a pneumatic indicator is used, no valve between the device and the enclosure shall be permitted.

6374. The pressure or flow device must 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 632. The device of Figure 9 shall also be capable of indicating (or actuating an alarm) if pressure exceeds a predetermined safe range (indicates plugging of restriction B).

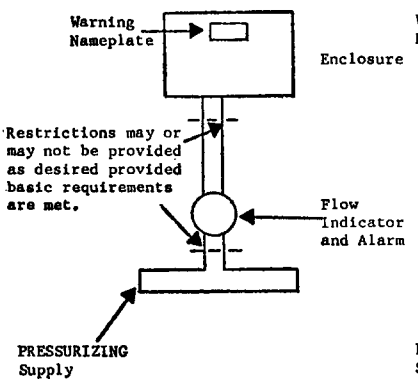

Fig. 7

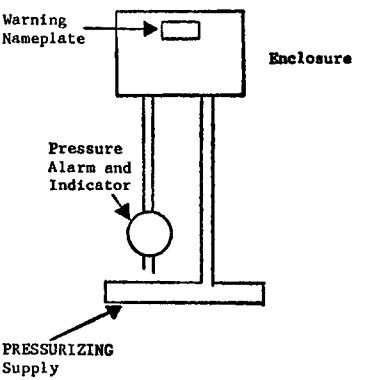

Fig. 8

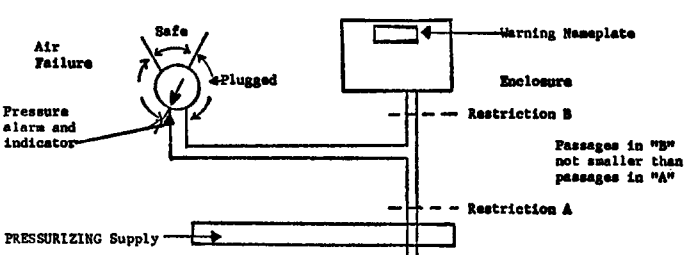

Fig. 9

Acceptable Installations for Pressurizing

Chapter 7. Pressurized Control Rooms

71. Scope

711. 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.

72. Control Room

721. 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.

722. 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.

723. 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, 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.

73. Considerations Relating to Positive Pressure Ventilation

731. 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.

732. 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. Air filtering may be necessary.