

ARTICLE 500

HAZARDOUS (CLASSIFIED) LOCATIONS

Introduction to Article 500—Hazardous (Classified) Locations

A hazardous (classified) location is an area where the possibility of fire or explosion can be created by the presence of flammable or combustible gases or vapors, combustible dusts, or easily ignitable fibers/flyings. Electric arcs, sparks, and/or heated surfaces can serve as a source of ignition in such environments.

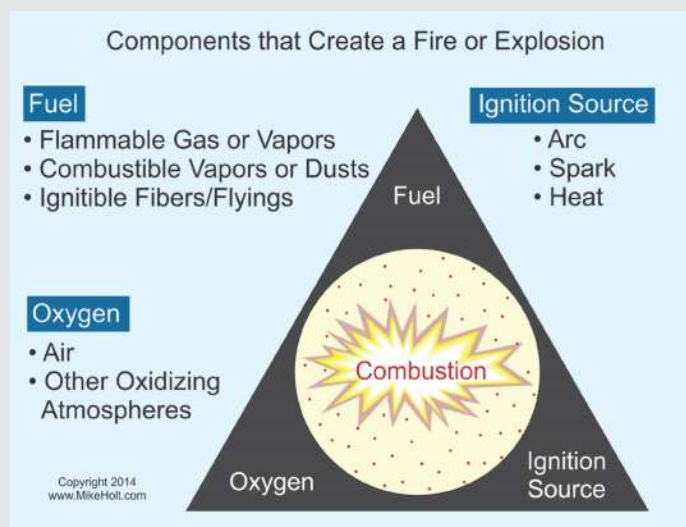
Article 500 provides a foundation for applying Article 501 (Class I Locations), Article 502 (Class II Locations), Article 503 (Class III Locations), and Article 504 (Intrinsically Safe Systems)—all of which immediately follow Article 500. This article also provides a foundation for applying Articles 510 through 516.

Before you apply any of the articles just mentioned, you must understand and apply Article 500 which is fairly long and detailed. You'll notice when studying this article that there are many Informational Notes that you should review. Although Informational Notes aren't *NEC* requirements [90.5(C)], they contain information that help *Code* users better understand the related *NEC* rules.

A Fire Triangle (fuel, oxygen, and energy source) helps illustrate the concept of how combustion occurs. [Figure 500-1](#)

- **Fuel.** Flammable gases or vapors, combustible dusts, and easily ignitable fibers/flyings.
- **Oxygen.** Air and oxidizing atmospheres.
- **Ignition Source.** Electric arcs or sparks, heat-producing equipment such as luminaires and motors, failure of transformers, coils, or solenoids, as well as sparks caused by metal tools dropping on metal surfaces.

Many of the graphics contained in Chapter 5 use two shades of red to identify a Division location (darker red for Division 1 and lighter red to identify Division 2). In some cases, these color schemes are used as a background color to help you tell if the graphic applies to Division 1, Division 2, or both (split color background).



[Figure 500-1](#)

500.1 Scope—Articles 500 Through 504

To prevent injury, death, or extensive damage to structures from fires or explosions, the *NEC* contains stringent requirements for equipment and its installation in hazardous (classified) locations where fire or explosion hazards may exist due to flammable gases, flammable liquid-produced vapors, combustible liquid-produced vapors, combustible dusts, or fibers/flyings. The specific requirements for electrical installations in hazardous (classified) locations are contained in:

- Article 501. Class I—Flammable or Combustible Liquid-Produced Vapors or Flammable Gases
- Article 502. Class II—Combustible Dust
- Article 503. Class III—Easily Ignitable Fibers/Flyings
- Article 504. Intrinsically Safe Systems

Author's Comment:

- See the definition of “Structure” in Article 100.
- Locating electrical wiring and equipment outside a classified location provides the safest electrical installation and is often more cost-effective [500.5(A) Note].
- Many of the graphics contained in Chapter 5 use two shades of red to identify a Division location (darker red for Division 1 and lighter red to identify Division 2). In some cases, these color schemes are used as a background color to help you tell if the graphic applies to Division 1, Division 2, or both (split color background).
- The *NEC* doesn't classify specific hazardous (classified) locations, except as identified in Articles 511 through 517. Determining the classification of a specific hazardous area is the responsibility of those who understand the dangers of the products being used, such as the fire marshal, plant facility engineer, or insurance underwriter. It isn't the responsibility of the electrical designer, electrical contractor, or electrical inspector. Prior to performing any wiring in or near a hazardous (classified) location, contact the plant facility and design engineer to ensure that proper installation and materials are used. Be sure to review 500.4(B) for additional standards that might need to be consulted.

Other articles in Chapter 5 containing specific hazardous installation requirements include:

- Article 505. Class I, Zone 0, 1, and 2 Locations

- Article 511. Commercial Garages, Repair, and Storage
- Article 513. Aircraft Hangars
- Article 514. Motor Fuel Dispensing Facilities
- Article 515. Bulk Storage Plants
- Article 516. Spray Application, Dipping, and Coating Processes
- Article 517. Health Care Facilities

500.2 Definitions

The definitions contained in 500.2 apply to Articles 500 through 504 and Articles 510 through 516.

Combustible Dust. Dust particles that are 500 microns or smaller and present a fire or explosion hazard when dispersed and ignited in air.

Author's Comment:

- The size of the material may be a significant factor in distinguishing dust (Class II) from fibers and flyings (Class III).

Dust-ignitionproof. Equipment enclosed in a manner that excludes dust and doesn't permit arcs, sparks, or heat inside the enclosure to ignite accumulations or suspensions of a specified dust on or in the vicinity of the enclosure.

Dusttight. Enclosures constructed so that dust won't enter under specific test conditions. Examples of dusttight enclosures include FS boxes and bell boxes. [Figure 500–2](#)

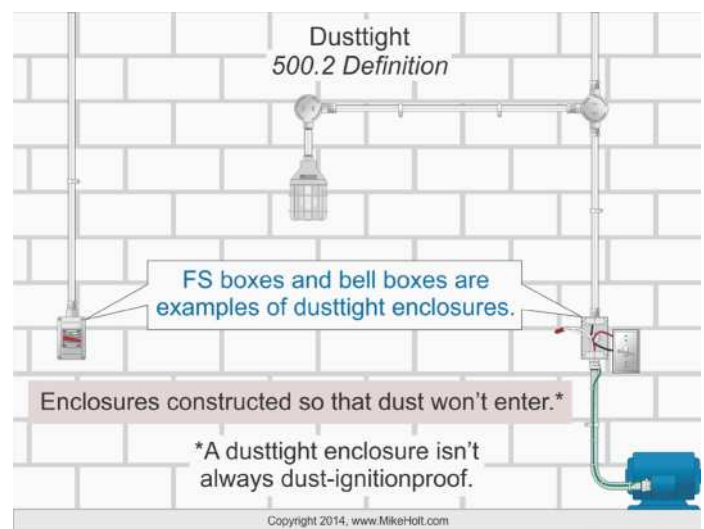


Figure 500–2

500.4 General

Hermetically Sealed. Equipment sealed against the entrance of an external atmosphere. [Figure 500–3](#)



Figure 500–3

Oil Immersion. Electrical equipment immersed in a protective liquid.

Purged and Pressurized.

(1) Purging (Class I). Supplying an enclosure with a protective gas at a sufficient positive pressure to reduce the concentration of any flammable gas or vapor.

(2) Pressurization (Class I or II). Supplying an enclosure with a protective gas with or without continuous flow at sufficient pressure to prevent the entrance of a flammable gas or vapor, a combustible dust, or an ignitable fiber.

500.3 Other Articles

Except as modified in Articles 500 through 504, all installation requirements contained in Chapters 1 through 4 of the *NEC* apply to electrical equipment and wiring installed in hazardous (classified) locations.

(A) Classification Documentation. All hazardous (classified) locations must be properly documented. The documentation must be available to those who are authorized to design, install, inspect, maintain, or operate the electrical equipment.

Author's Comment:

- Proper documentation of hazardous areas assists the designer, installer, and authority having jurisdiction in ensuring compliance with the stringent requirements contained in Articles 501–517 of the *Code*.
- To ensure compliance with the above requirements, some authorities having jurisdiction require drawings that indicate hazardous (classified) location areas and their classification.

(B) Other Standards. Important information related to topics covered in Chapter 5 may be found in other publications.

Note 1: To ensure a proper and safe installation, the authority having jurisdiction should be familiar with the industry involved and standards of the National Fire Protection Association (NFPA), the American Petroleum Institute (API), and the International Society of Automation (ISA).

Note 2: For further information on the classification of locations, see:

- *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, NFPA 497
- *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*, NFPA 34
- *Area Classification in Hazardous (Classified) Dust Locations*, ISA 12.10
- *Flammable and Combustible Liquids Code*, NFPA 30
- *Recommended Practice for Classification of Locations of Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2*, ANSI/API RP 500
- *Standard for Spray Application Using Flammable or Combustible Materials*, NFPA 33
- *Liquefied Petroleum Gas Code*, NFPA 58
- *Standard for Fire Protection in Wastewater Treatment and Collection Facilities*, NFPA 820

Note 3: For further information on protection against static electricity and lightning hazards in hazardous (classified) locations, see:

- *Standard for the Installation of Lightning Protection Systems*, NFPA 780
- *Recommended Practice on Static Electricity*, NFPA 77
- *Protection Against Ignitions Arising Out of Static Lightning and Stray Currents*, API RP 2003–1998

500.5 Classifications of Locations



Scan the QR code for a video clip of Mike explaining this topic; this is a sample from the DVDs that accompany this textbook.

(A) Classifications of Locations. Locations are classified according to the properties of the flammable gases, flammable liquid-produced vapors, combustible liquid-produced vapors, combustible dusts, or easily ignitable fibers/flyings that may be present, and the likelihood that a flammable or combustible concentration will be present.

Note: To reduce expensive equipment and expensive wiring methods, locate as much electrical equipment as possible in an unclassified location.

Each room, section, or area is considered individually in determining its classification. [Figure 500–4](#)

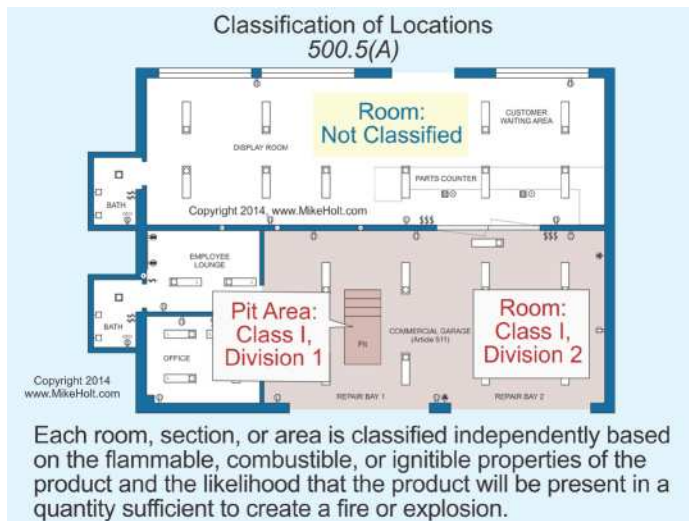


Figure 500–4

Author's Comment:

- The same building or structure might contain any combination of Class I, Division 1 and 2 locations; Class II, Division 1 and 2 locations; and/or Class III, Division 1 and 2 locations.
- See the definitions of “Building” and “Structure” in Article 100.

(B) Identification of a Class I Location. A Class I location is an area where flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors may be present in quantities sufficient to produce explosive or ignitable mixtures.

(1) Class I, Division 1 Location. A Class I, Division 1 location is a location in which: [Figure 500–5](#)

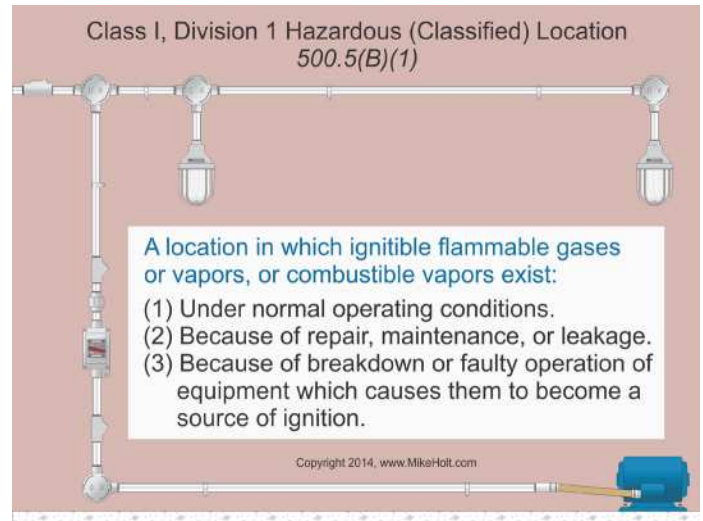


Figure 500–5

- (1) Ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors may exist in the course of normal operations, or
- (2) Ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquids above their flash points may exist frequently due to repair or maintenance operations or because of leakage, or
- (3) Breakdown or faulty equipment releases ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors and the electrical equipment becomes a source of ignition.

Note 1: Class I, Division 1 locations include:

- (1) Areas where volatile flammable liquids or liquefied flammable gases are transferred from one container to another, such as at gasoline storage and dispensing areas.
- (2) Interiors of spray booths and areas in the vicinity of spraying and painting operations where volatile flammable solvents are used to coat products with paint or plastics.
- (3) Locations containing open tanks or vats of volatile flammable liquids, or dip tanks for parts cleaning or other operations.

Author's Comment:

- See 500.5(B)(1)(3) Notes 1 and 2 in the *NEC* for more information.

(2) Class I, Division 2 Location. An area where volatile flammable gases, or combustible or flammable liquid-produced vapors, would become hazardous only in case of an accident or of some unusual operating condition, or under any of the following conditions: [Figure 500-6](#)

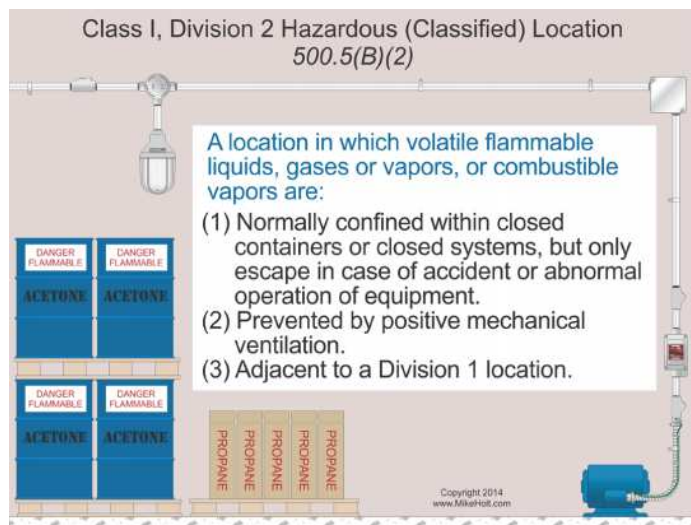


Figure 500-6

- (1) If flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors are handled, processed, or used, but are normally confined within closed containers and the gases would only escape in the case of accidental rupture or breakdown, or in case of abnormal operation of equipment.

- (2) If ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors are normally prevented by positive mechanical ventilation, but might become hazardous through failure or abnormal operation of the ventilating equipment.
- (3) Areas adjacent to a Class I, Division 1 location and to where flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors might occasionally be communicated unless prevented by adequate positive-pressure ventilation with effective safeguards against ventilation failure.

Note 1: The quantity of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry with respect to explosions or fires are all factors that should be taken into consideration.

(C) Identification of a Class II Location. Class II locations are those where the presence of combustible dust may be suspended in the air or accumulates on electrical equipment in quantities sufficient to ignite or explode. [Figure 500-7](#)

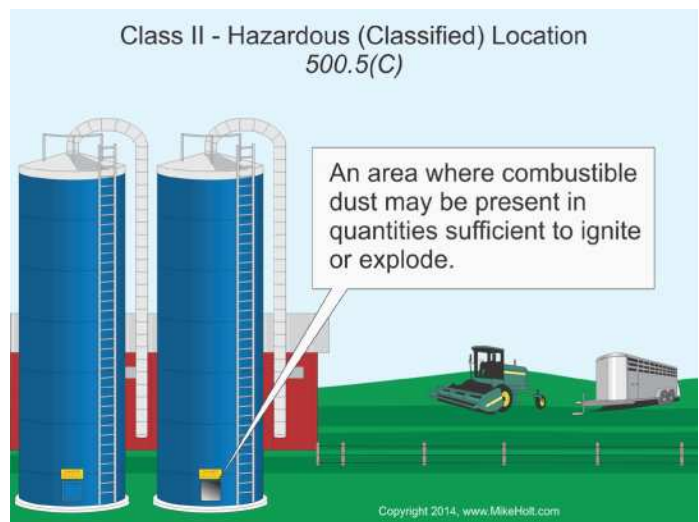


Figure 500-7

(1) Class II, Division 1 Location. A Class II, Division 1 location is an area where combustible dust may exist under any of the following conditions:

- (1) Nonconductive combustible dust is continuously or periodically suspended in the air in sufficient quantities to produce mixtures that will ignite or explode, or
- (2) If faulty equipment releases ignitable mixtures of dust and the equipment becomes a source of ignition.

(2) Class II, Division 2 Location. An area where combustible dust would become hazardous under any of the following conditions:

- (1) If combustible dust, due to abnormal operations, may be present in the air in quantities sufficient to produce explosive or ignitable mixtures, or
- (2) If combustible dust accumulation is normally insufficient to interfere with the normal operation of electrical equipment, but where malfunctioning of equipment may result in combustible dust being suspended in the air, or
- (3) If combustible dust accumulations on, in, or near electrical equipment could be sufficient to interfere with the safe dissipation of heat from electrical equipment, or could be ignitable by abnormal operation or failure of electrical equipment.

Note 1: The quantity of combustible dust that may be present and the adequacy of dust removal systems should be considered when determining the area classification.

(D) Identification of a Class III Location. A Class III location is an area where easily ignitable fibers or materials producing combustible flyings are handled, manufactured, or used and aren't likely to be suspended in the air in quantities sufficient to produce ignitable mixtures.

(1) Class III, Division 1 Location. A Class III, Division 1 location is an area where easily ignitable fibers/flyings are manufactured, handled, or used.

Note 1: Such locations usually include some parts of rayon, cotton, and other textile mills or clothing manufacturing plants, as well as facilities that create sawdust and flyings by pulverizing or cutting wood.

(2) Class III, Division 2 Location. A Class III, Division 2 location is an area where easily ignitable fibers/flyings are stored or handled other than in the manufacturing process.

500.6 Material Groups

For purposes of testing, approval, and area classification, various air mixtures must be grouped in accordance with 500.6(A) and (B). **Figure 500-8**

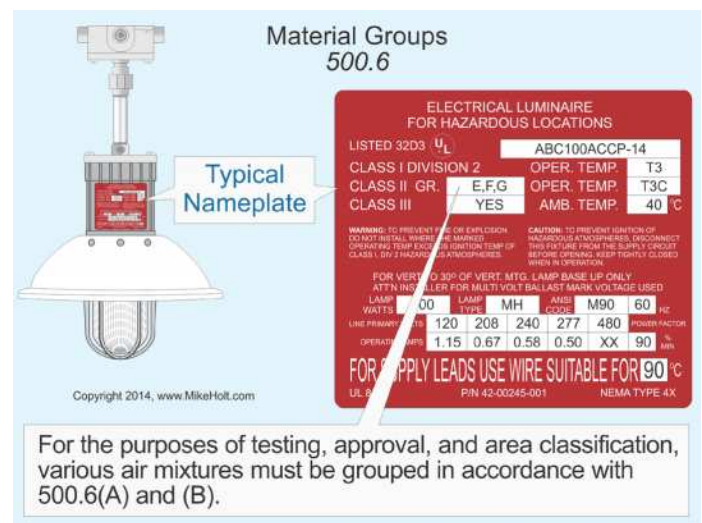


Figure 500-8

Author's Comment:

- Refer to 500.6(A) and (B) in the *NEC* to be certain that equipment is listed for the proper group.
- The Cooper Crouse-Hinds *Code Digest* contains a substantial list of different products and their group designations. It can be downloaded from www.coopercrouse-hinds.eu/en/service/brochures.html.

500.7 Protection Techniques

Acceptable protection techniques for electrical and electronic equipment in hazardous (classified) locations include:

(A) Explosionproof Equipment. Explosionproof equipment is permitted in any Class 1 location. **Figure 500-9**



Figure 500-9

Author's Comment:

- Explosionproof equipment is designed to be capable of withstanding and containing the force of an internal explosion, and the hot gases within the enclosure cool as they escape [Article 100—Definitions]. [Figure 500-10](#)

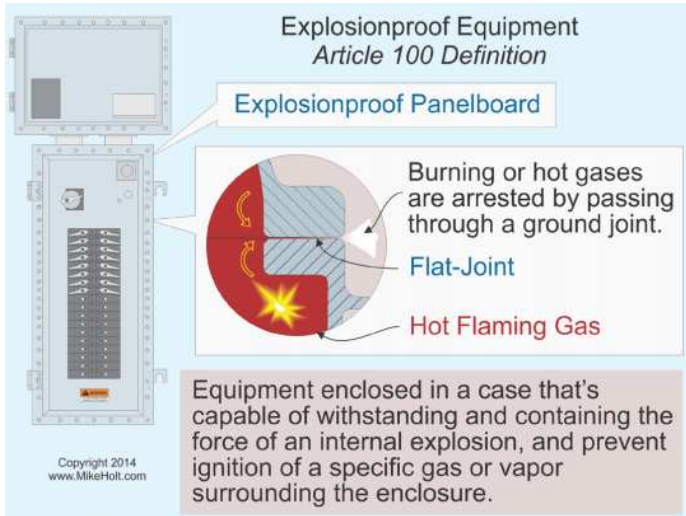


Figure 500-10

(B) Dust-Ignitionproof Enclosures. Dust-ignitionproof enclosures are permitted in any Class II location. [Figure 500-11](#)

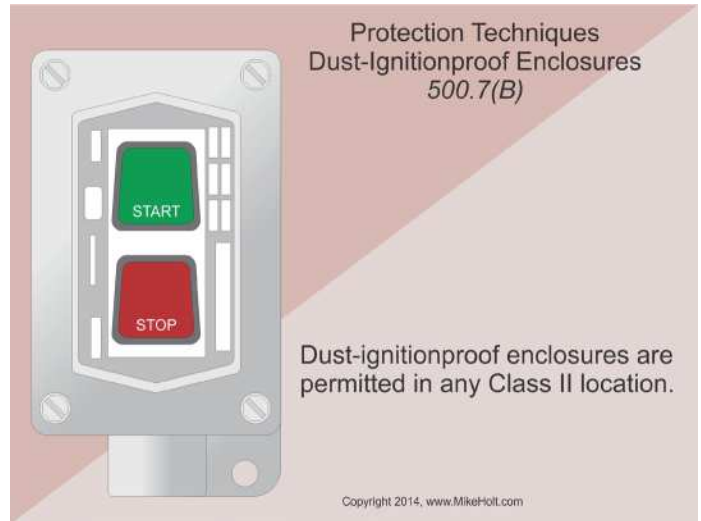


Figure 500-11

Author's Comment:

- Dust-ignitionproof enclosures are designed to exclude dusts and won't permit arcs, sparks, or heat within the enclosure to cause ignition of exterior dust [500.2].

(C) Dusttight Enclosures. Dusttight enclosures are permitted in Class II, Division 2 or any Class III location. [Figure 500-12](#)



Figure 500-12

(D) Purged and Pressurized Systems. These systems are permitted for equipment in any hazardous (classified) locations for which they're identified. [Figure 500–13](#)



Figure 500–13

(E) Intrinsically Safe Systems. These systems are allowed in any hazardous (classified) location. None of the requirements contained in Articles 501 through 503, or 510 through 516 apply to intrinsically safe system installations, except as required by Article 504.

Author's Comment:

- Intrinsically safe systems are incapable of releasing sufficient electrical or thermal energy to cause ignition of flammable gases or vapors [504.2].

(I) Oil-Immersed Contacts. Oil-immersed make-and-break contacts can be installed in a Class I, Division 2 location.

(J) Hermetically Sealed Contacts. Hermetically sealed contacts can be installed in Class I, Division 2; Class II, Division 2; or Class III, Division 1 and 2 Locations.

(L) Other Protection Techniques. Other protection techniques used in equipment identified for use in hazardous (classified) locations are permitted.

Author's Comment:

- The *NEC* is silent on the meaning of this section. The key is the use of the term “Identified,” which is defined in Article 100 as, “Recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular *Code* requirement.”

500.8 Equipment

(A) Suitability of Equipment. Suitability of identified equipment must be determined by one of the following:

- (1) Equipment listing or labeling. [Figure 500–14](#)

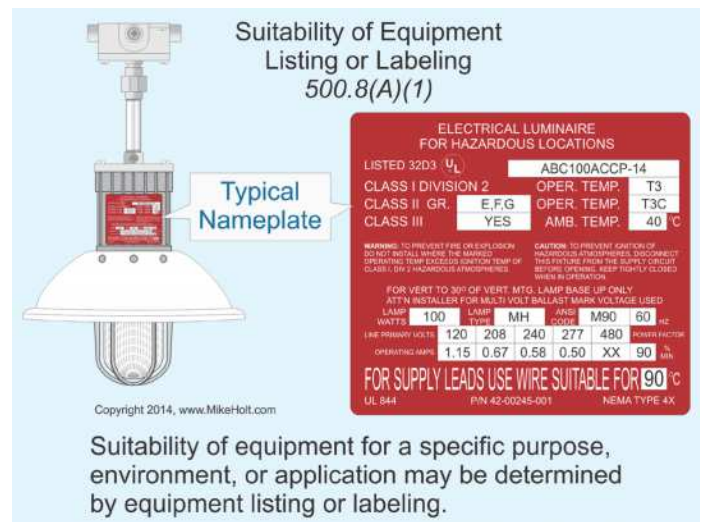


Figure 500–14

- (2) Evidence of evaluation by a qualified testing laboratory or inspection agency concerned with product evaluation.
- (3) Evidence approved by the authority having jurisdiction, such as a manufacturer's self-evaluation or an owner's engineering judgment.

Note: Additional documentation may include certificates demonstrating compliance with applicable equipment standards, indicating special conditions of use, and other pertinent information.

(B) Approval for Class and Properties.

(1) Identified for Use. Equipment installed in any hazardous (classified) location must be identified for the class and explosive, combustible, or ignitable properties of the specific gas, vapor, dust, or fiber/flyings that will be present. Equipment in Class I locations must not have any exposed surfaces that reach temperatures higher than the autoignition temperature of the gas or vapor present.

(2) Divisions. Equipment identified for Class I, Division 1 locations can be installed in a Class I, Division 2 location of the same class, group, and temperature class.

Author's Comment:

- 500.5(B) through (D) explains the differences between Class I, Class II, and Class III locations, as well as the differences between Division 1 and Division 2.

(3) General-Purpose Enclosures. General-purpose enclosures not containing make-and-break contacts can be installed in a Class I, Division 2 location. [Figure 500-15](#)

(D) Temperature.

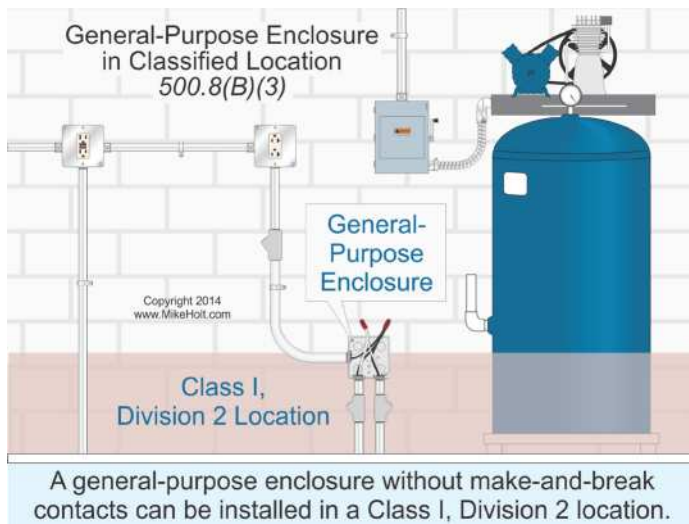


Figure 500-15

(1) Class I Temperature. Class I equipment must not permit the exposed equipment surface to operate at a temperature in excess of the autoignition temperature of the specific gas or vapor, as listed in Table 500.8(C). [Figure 500-16](#)

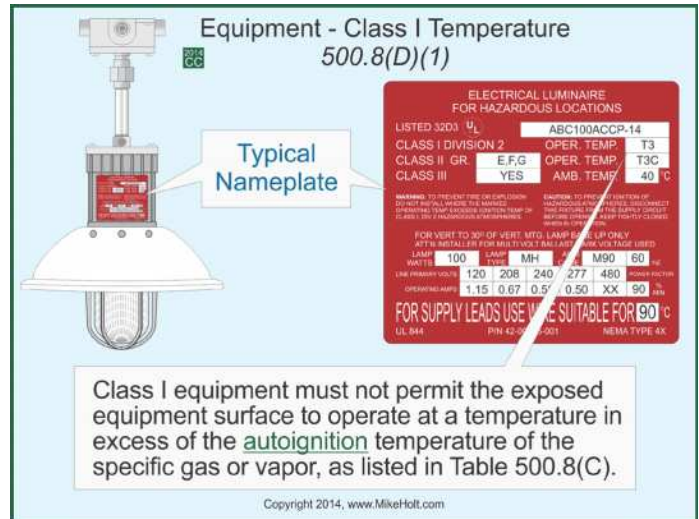


Figure 500-16

Maximum °C	Temperature °F	Identification Number
450	842	T1
300	572	T2
280	536	T2A
260	500	T2B
230	446	T2C
215	419	T2D
200	392	T3
180	356	T3A
165	329	T3B
160	320	T3C
135	275	T4
120	248	T4A
100	212	T5
85	185	T6

Author's Comment:

- This is accomplished by ensuring that the temperature marking on the equipment (especially luminaires and motors) doesn't exceed the autoignition temperature of the specific gas or vapor to be encountered.

(2) Class II Temperature. Class II equipment must not allow the exposed equipment surface to operate at a temperature in excess of the [autoignition](#) temperature of the specific dust, as listed in 500.8(C).

Author's Comment:

- This is accomplished by ensuring that the temperature marking on the equipment (especially luminaires) doesn't exceed the autoignition temperature of the specific dust to be encountered.

(E) Threaded Conduit. All threaded conduits must be made wrenchtight to prevent arcing when ground-fault current flows through the raceway system and to ensure the explosionproof or dust-ignitionproof integrity of the raceway system.

(1) Equipment with NPT Threaded Entries. Threaded entries into explosionproof equipment must be made up with at least five threads fully engaged.

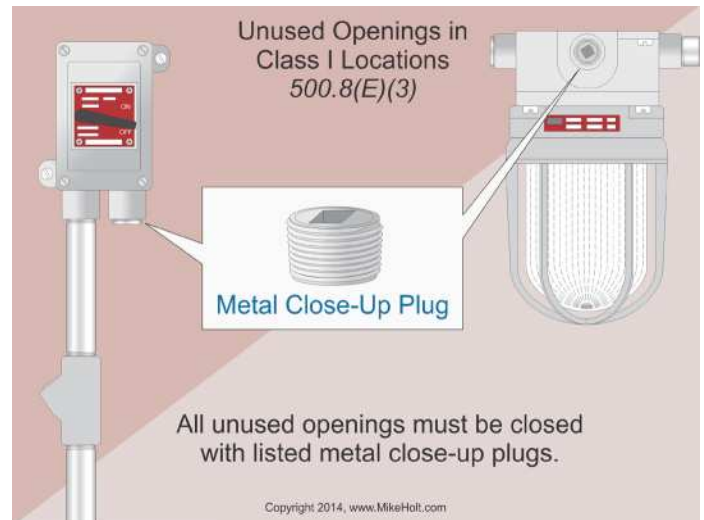
Ex: For listed explosionproof equipment, factory-threaded entries must be made up with at least 4½ threads fully engaged.

Author's Comment:

- This requirement ensures that if an explosion occurs within a raceway or enclosure, the expanding gas will sufficiently cool as it dissipates through the threads. This prevents hot flaming gases from igniting the surrounding atmosphere of a hazardous (classified) location.
- Keep in mind that it's assumed that the flammable atmosphere outside the raceway will seep into the raceway system over time. The goal of the *Code* is to contain any explosion that occurs inside the raceway so the event won't ignite the flammable mixture outside of the raceway.

(2) Equipment with Metric-Threaded Entries. Equipment with metric-threaded entries must be installed using listed fittings.

(3) Unused Openings. All unused openings must be closed with listed metal close-up plugs [110.12(A)]. [Figure 500–17](#)



[Figure 500–17](#)

(F) Optical Fiber Cable. Where optical fiber cable is capable of carrying current (composite optical fiber cable), the optical fiber cable must be installed in accordance with Articles 500, 501, 502, or 503.

Author's Comment:

- Composite optical fiber cable contains current-carrying conductors [770.2] and they're capable of causing a dangerous spark that can ignite flammable atmospheres, so they must be installed just like other conductors in a hazardous (classified) location. On the other hand, nonconductive optical fiber cable [770.2] has no current-carrying conductors or metallic strength members so it need not be installed in accordance with Articles 500, 501, 502, or 503. This is because optical fiber cable without current-carrying conductors or strength members can't ignite flammable atmospheres. [Figure 500–18](#)

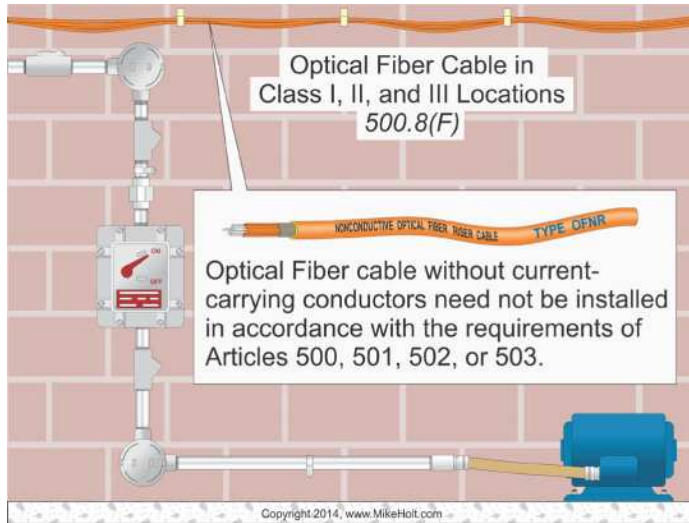


Figure 500–18

500.9 Specific Occupancies

In addition, the following articles also apply:

- Article 511—Commercial Garages, Repair, and Storage
- Article 513—Aircraft Hangars
- Article 514—Motor Fuel Dispensing Facilities
- Article 515—Bulk Storage Plants
- Article 516—Spray Application, Dipping, and Coating Processes
- Article 517—Health Care Facilities

Author's Comment:

- Article 500 contains a general background on hazardous (classified) locations as well as describing the differences between Class I, II, and III locations and the difference between Division 1 and Division 2 in each of the three classifications.
- Articles 501, 502, and 503 contain the actual Class I, Class II, and Class III installation requirements, including wiring methods, seals, and specific equipment requirements.