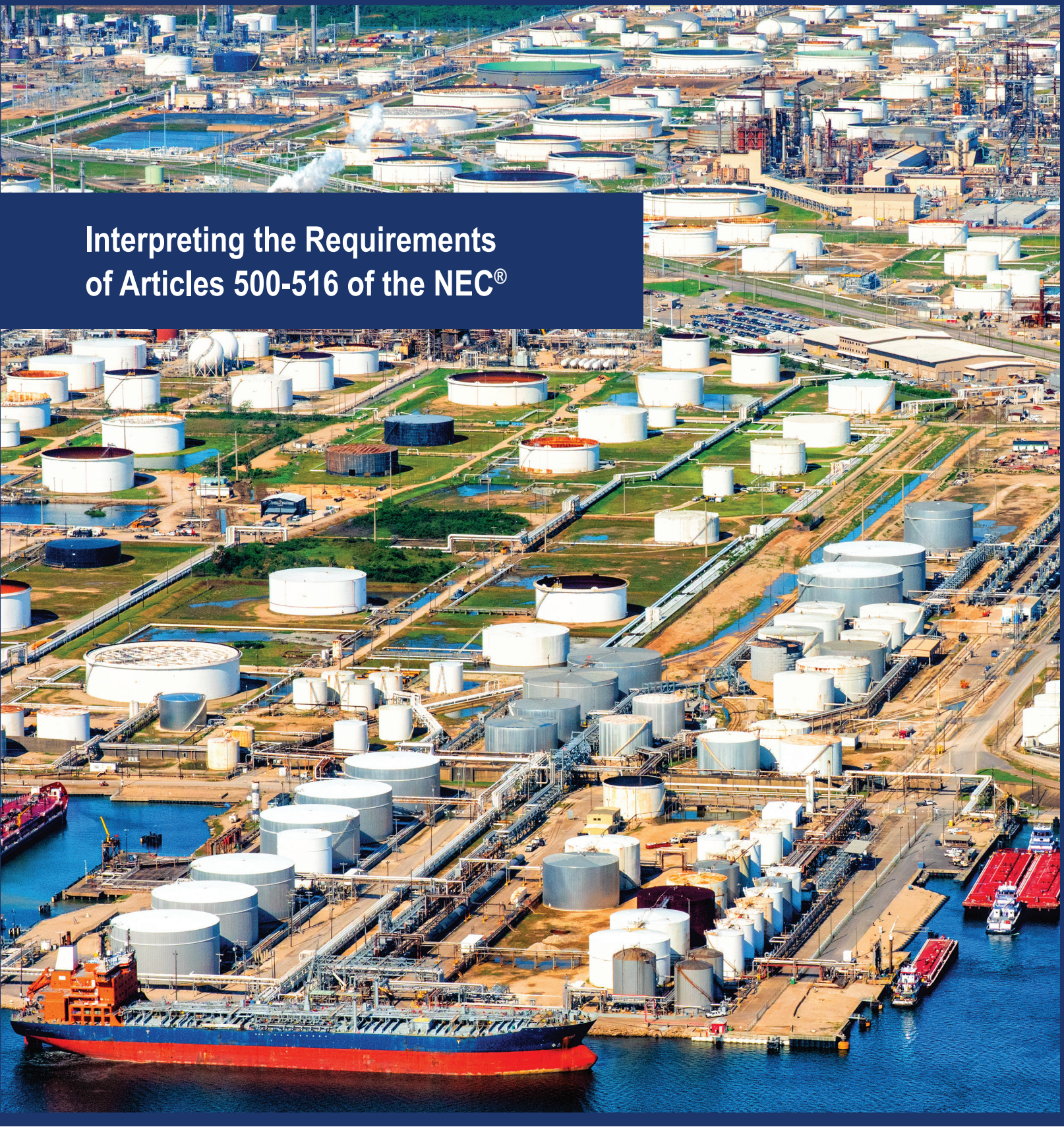

Interpreting the Requirements of Articles 500-516 of the NEC®

2023 National Electrical Code® Review

A Guide for the Use of Appleton™ Products in Hazardous Locations

EMERSON

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Purpose Of The Review

- To assist in interpreting the requirements of Articles 500 through 516 of the 2023 NEC®.
- To provide information that will assist in minimizing the fire and explosive hazards encountered in classified locations, including references to sources where more detailed information can be obtained.
- To provide the reader with an overview of the various types of electrical equipment, and equipment design, used in hazardous locations.
- To provide a guide for the correct selection and installation of electrical products in hazardous (classified) locations, in conformance with the National Electrical Code®.

Code Excerpts/Notations

- The 2023 National Electrical Code® Articles 90 and 100, and 500 through 516 are indicated with black text.
- Underlined text indicates a change from the previous NEC® edition.
- Emerson staff commentaries, where practical, have been located directly following the published NEC® articles.
- Commentaries on NEC® presented in blue text.

Appendix A contains tables of flash points and auto ignition temperatures for common hazardous gases and vapors as well as information on ignition temperatures for hazardous dusts.

Appendix B contains an informative list of associated installation standards for electrical equipment with which Appleton™ products are designed, tested, and manufactured to comply. This appendix also includes the NEMA Enclosure Type definitions and a practical conversion chart that can be used to convert a NEMA Enclosure Type to an IEC® IP Classification.

Appendix C contains an informative list of electrical and fire safety organizations.

Appendix D contains an informative quick selection guide of Appleton™ products for each type of hazardous location.

Appendix E contains clarifying diagrams of typical Appleton™ hazardous location product installations.

Technical Help Available

The information presented in this booklet provides extensive help in determining NEC® requirements for the use of electrical products in hazardous locations. However, even though every attempt has been made to provide complete data, questions inevitably arise. In these circumstances, contact your local Emerson sales representative for technical assistance. In addition, our staff of technical experts is at your service and can be contacted via: appleton.technicalservices@emerson.com.

The NEC® and other NFPA® Standards are international standards. All measurements in the 2023 NEC® are shown in SI metric units, followed by the inch-pound value in parentheses. For example, 3.2 mm (1/8 in).

A soft metric conversion is when the dimensions of a product already designed and manufactured to the English or Imperial inch or pound system have their dimensions converted to metric dimensions. The product does not change.

A hard metric measurement is where a product has been designed to SI metric dimensions. No conversion from English or Imperial inch-pound measurement units is involved.

A hard conversion is where an existing product is redesigned into a new size. For example, if a dimension is required to be 10 feet, it is shown in the NEC® as 3.0 m (10 ft.). Where rounding off would create a safety hazard, the metric conversions are mathematically identical. Note that the 10 feet remains the same, and the metric value of 3.03 m appears and has not been rounded off to 3.0 m.

Disclaimer

The information presented in this booklet has been assembled from various sources. Although every attempt has been made to ensure accuracy, neither Emerson Electric Co. nor Appleton Grp LLC assumes responsibility for any inaccuracies or omissions in the data presented. As a safety precaution, information to be utilized from this booklet should be verified from the 2023 National Electrical Code® and other sources.

Permissions

TRADE SIZES

The electrical industry has been incorrectly referring to raceways in inches for many years. Raceway sizes have always been an approximation. For example, there has never been a 1/2" raceway. The NEC® in Section 90.9(C)(1) states that “where the actual measured size of a product is not the same as the nominal size, trade size designators shall be used rather than dimensions.” To alleviate potential confusion, this text uses only the term trade size when referring to conduit and tubing sizes.

The Majority of Appleton™ Products Designed for Hazardous Locations are Suitable for All Classes

Many Appleton™ electrical products approved for Class I, Division 1 and 2, are also suitable for Class II, Division 1 and 2, and for Class III, Division 1 and 2. A glance through the Appleton™ product catalogs will confirm this information. All Appleton™ products intended for use in Class I, Class II, and Class III locations are designed to conform to the relevant requirements in NEC® Sections:

- 500.7(A) Explosionproof. Class I, Division 1
- 500.7(G) Nonincendive, Class I, Division 2
- 500.7(B) Dust Ignitionproof, Class II, Division 1
- 500.7(C) Dusttight, Class II, Division 2, Class II, Divisions 1 and 2

Equivalency Ratings

The NEC® and the listing product standards address equivalency ratings between the Class-Division classification system and the Class-Zone classification system. This is accomplished by considering the safety hazards for the corresponding classification system against what the listing product standards require for a level of evaluation. In many cases a standard that is utilized for one classification system may be deemed to adequately address the safety hazards of the other classification system. Equivalency ratings are required to be marked on the equipment to be permitted for installation into the specific classified system. These ratings are addressed in the relevant hazardous location sections.

It is critical to understand that products that have been evaluated and listed to the Zone classification system. IEC® based ANSI product standards have also been evaluated for their safety concerning electrical fire and shock hazards. These products will have an AEx marking. Products that have been evaluated to the direct IEC® standards for Explosive Atmospheres have only been evaluated to their safety in an Explosive Atmosphere. These products are marked as Ex and are not permitted in accordance with the NEC®.

Appleton™ Products By Emerson Meet Or Exceed Authoritative Standards

Appleton™ explosionproof, flameproof, dust-ignitionproof, dusttight, nonincendive, increased safety, restricted breathing, and nonsparking products meet or exceed the prescribed requirements of Underwriters Laboratories, Inc., and Chapter 5 of the 2020 National Electrical Code®. They provide an extra margin of safety and greater durability than the minimum specifications require.

Many other national, state, and local codes and regulations are invoked where custom-made equipment is manufactured. This Code Review is offered only as a guide to the correct and safe protection for classified products installed in hazardous location applications. State and local authorities and codes should always be consulted to properly meet all installation requirements.

Conditions Defining Hazardous Locations

In order to create an explosion, three things need to be present: fuel, oxygen, and an ignition source. In addition to these three factors being present, an explosion will only occur if the mixture of the fuel with oxygen is between its upper and lower flammable limits.

The lower flammable limit (LFL) is the minimum level of fuel that must be present, as a percentage of the total fuel/oxygen mixture, to start and sustain combustion. At fuel levels below the minimum flammable limit, there is not enough fuel mixed with oxygen to support combustion.

The upper flammable limit (UFL) is the maximum level of fuel that can be present, as a percentage of the total fuel/oxygen mixture, to start and sustain combustion. At fuel levels above the upper flammable limit, there is not enough oxygen mixed with fuel to support combustion.

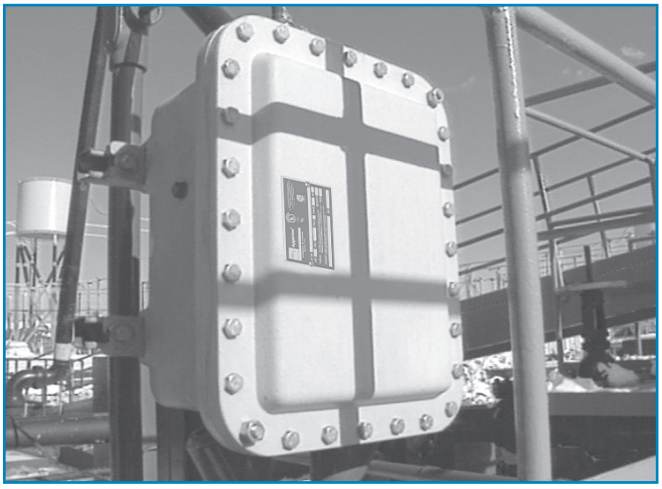
A hazardous (classified) location exists when a manufacturing, storage or handling process provides a fuel, consisting of a flammable gas, flammable liquid-produced vapors, combustible liquid-produced vapors, combustible dust, combustible flying or fiber, or some combination of these three elements; and these flammable components can be mixed with enough oxygen from the ambient air to form an explosive atmosphere between the LFL and UFL. Standards written by organizations like the National Fire Protection Association (NFPA®) and the American Petroleum Institute (API®) define the requirements for classification of hazardous locations.

Ignition of an explosive atmosphere can be caused either by a spark or a hot surface. Hazardous location electrical equipment needs to be specially designed and built to prevent any sparks or hot surfaces from becoming ignition sources. Protection techniques and test requirements are specified in electrical equipment standards, published by certification agencies, like Underwriters Laboratories (UL®), Canadian Standards Association (CSA®) and Factory Mutual (FM); and standards writing organizations such as The International Society of Automation (ISA®) and the International Electrotechnical Commission (IEC®).

Even if electrical equipment is designed and built to employ protection techniques for hazardous locations, it could cause an ignition hazard either by being improperly matched to the hazard present, or having the equipment protection technique invalidated or compromised by improper or inappropriate installation and maintenance methods.

The objective of Articles 500 through 516 of the NEC® is to ensure that hazardous location occupancies are properly identified and evaluated, and to make sure that the electrical equipment and wiring installed and used in hazardous locations does not become an ignition source for an explosive atmosphere. This is accomplished by:

- Defining and classifying the forms and types of flammable and combustible materials that may be present;
- Requiring that hazardous (classified) locations be assessed, formally classified and documented for the degree and type of hazard that they represent;
- Recognizing different hazardous location and flammable or combustible atmosphere classification systems, and specifying how they might coexist in the same installation;
- Defining and recognizing explosion protection techniques for electrical equipment that are matched to the particular hazardous atmosphere(s) that may be present;
- Specifying electrical equipment marking and other certification documentation that must be provided by manufacturers of hazardous location electrical equipment to installers, users and inspectors;
- Providing specialized installation requirements for specific hazardous location protection techniques or occupancies;
- Providing references to standards and publications from NFPA® and other recognized organizations where users and inspectors can obtain more information; and
- Where necessary, requiring that specification and installation of electrical equipment in hazardous locations be done under the direction of specially qualified individuals.



The following is a partial list of Registered Trademarks of Appleton Grp LLC that may be found in this 2023 Code Review Booklet.

A-51
Appleton
Areamaster
Baymaster
Code·Master
Contender
ETP
FM 8
FM 9
Form 35
Form 35
Glomaster
Grip-Tite
Ground-Tite
Intraground
Kwiko
Levolier
Linmaster
McGill
Mercmaster
NEER
Nelson
O-Z/Gedney
Plexpower
Powertite
Pozi - Grip
Quad-Lead
Reelite
Retromaster
Rigmaster
Speed-Lock
ST
STNM
Stylmaster
Twinpak
U-Line
Unicode
Unilets
V-51
Viamaster
Wallmaster

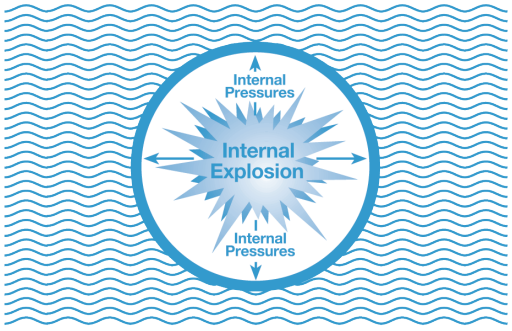
Metric Designator and Trade Size

Trade Size	
Metric	Inches
12	3/8
16	1/2
21	3/4
27	1
35	1-1/4
41	1-1/2
53	2
63	2-1/2
78	3
91	3-1/2
103	4
129	5
155	6

Design of Explosionproof Equipment

There is a rather common misconception that explosionproof equipment is gas-tight. It would be inadvisable to make an entire wiring system gas-tight. Whenever an enclosure was opened for servicing apparatus, for example, the explosive mixture could enter and be trapped in the enclosure. The trapped atmosphere could then explode the instant the apparatus was again operated. The explosion could develop pressures sufficient to burst a gastight enclosure and allow flames to escape into the surrounding atmosphere.

The requirement is not that enclosures be gas-tight, but that they be designed and manufactured strong enough to contain an explosion and prevent the escape of flame or heat that could ignite surrounding atmospheres. Burned gases do escape from explosionproof equipment, but their escape path has been engineered so the temperature of the escaping gas is well below its ignition point when it escapes into the surrounding atmosphere. Appleton™ explosionproof products are designed to withstand a hydrostatic test of four times the maximum internal explosion pressure that could be developed from a gas explosion.



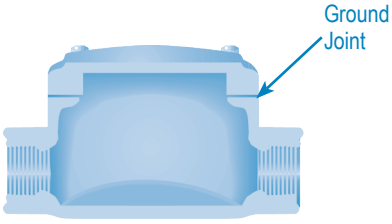
Appleton™ products have several different types of explosionproof construction. They are as follows:

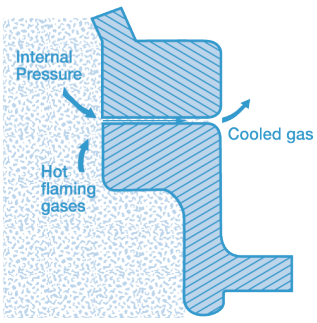
- Ground joint construction
- Threaded joint construction
- Threaded joint construction (other than NPT threads)
- Labyrinth-path construction
- Precision acme/square thread construction
- Close tolerance shaft construction

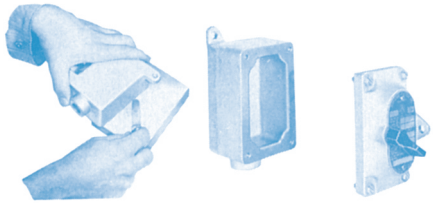
Ground Joint Construction

Ground joint construction has two carefully machined metal surfaces which are bolted tightly together keeping the hot flaming gases caused by an explosion inside. Internal pressures force the hot gases out between the ground surfaces but are cooled in the process and therefore cannot ignite the surrounding atmosphere.

The end user does not need to be concerned with these requirements as these requirements are controlled by the manufacturer and inspected by the Certification Agency. The end user should take care to ensure the flamepath is not damaged during installation.







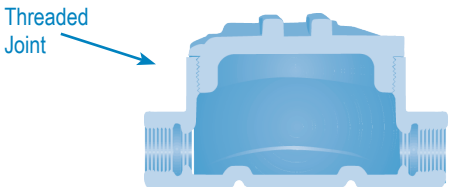
The mating surfaces of both cover and body are precision machined to meet or exceed explosionproof requirements of NEC® and UL®.

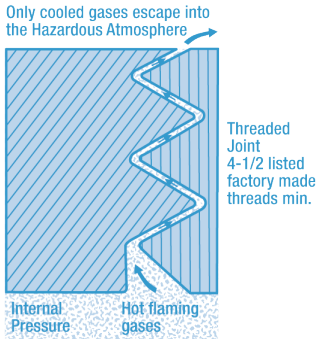
Threaded Joint Construction

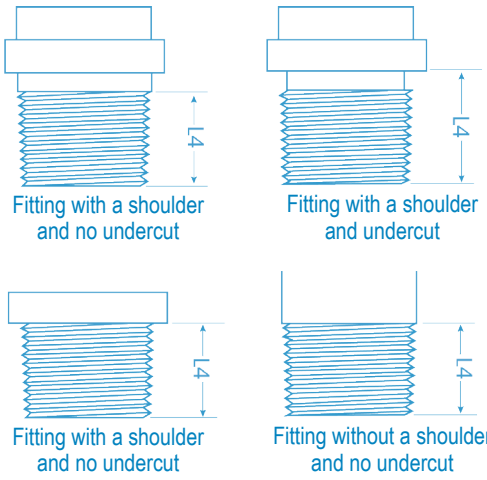
Threaded conduit entry joint construction is where either conduit or connectors are installed into an enclosure or box. A minimum installed thread engagement of 5 full threads is required where the threads are NPT (National Pipe Tapered) construction with the exception that if the threads are factory made the minimum thread engagement requirement is 4-1/2 threads. In case of explosion, the threaded surfaces will allow the internal gas pressures to be dissipated and cooled (see illustration), but will not allow hot flaming gases to escape to the surrounding atmosphere. The ANSI standard for Class I, Division 1 Explosionproof fittings and connectors requires the minimum male NPT thread length to be not less than the L4 plane length of conduit.

The L4 thread plane length is intended to ensure that the male NPT threads of these fittings and connectors do not "bottom" on the shoulder of the female entries prior to achieving wrenchtight make-up with female NPT threaded equipment entries of enclosures or corresponding fittings. "Bottoming" of the connectors on the female entry shoulders can prevent proper root-to-crest engagement of the NPT threads causing an improper flamepath. When measuring the L4 Length it is important to understand that this length does not necessarily mean that the length is comprised entirely of threads. It is intended to permit the "travel" of the threads into the conduit entry thus providing for a good root-to-crest thread makeup.

The minimum number of threads required on the conduit is the L4 length where the minimum number of threads provided on the male connector hubs should be no less than 4-1/2 threads where factory made with a minimum length of thread "plane" being the L4 length. See the illustration for typical examples of L4 dimension measurement for fittings. Note: Residually exposed threads that exist after the wrench-make-up should not be perceived to be an engagement, grounding, or bonding concern. The end user needs to ensure that the installed conduit and/or connectors meet the minimum thread engagement requirements in accordance with the National Electrical Code.

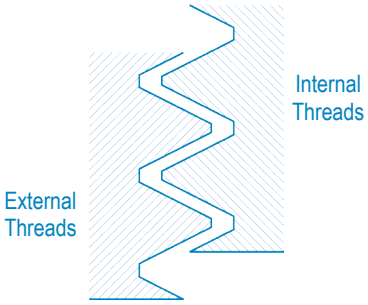






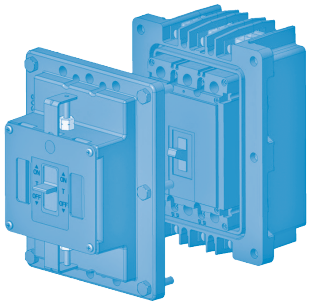
Threaded Joint Construction (Other Than NPT Threads)

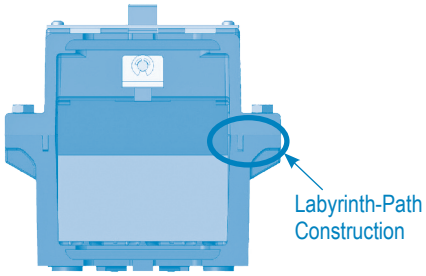
Threaded construction for non-NPT threads are typically used on covers for boxes, as well as control operators such as push buttons, selector switches and pilot lights. These threads are straight NPSM (National Pipe Straight – Mechanical). The manufacturer is required to meet specific thread pitch requirements (class of fit) and minimum thread engagement requirements. These are based on the Class and Groups that the product is rated for. The end user does not need to be concerned with these requirements as these requirements are controlled by the manufacturer and inspected by the Listing Agency. The end user should take care to ensure the flamepath is not damaged during installation and maintenance.



Labyrinth-Path Construction

Labyrinth-path joint construction provides a torturous path for gases or vapors to slowly escape from the enclosure, cooling them in the process. Projections on the cover fit into corresponding recesses of the body. Hot gases or vapors begin their escape from the enclosure up the inner projection, reversing directions a total of five times before exiting at the outer projection of the enclosure. By the time the gases or vapors escape from the enclosure, they have cooled sufficiently to prevent ignition of the surrounding atmosphere. The end user does not need to be concerned with these requirements as these requirements are controlled by the manufacturer and inspected by the Listing Agency. The end user should take care to ensure the flamepath is not damaged during installation and maintenance.

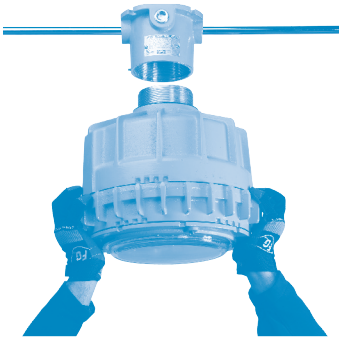




Precision Acme/Square Thread Construction

Appleton™ Code•Master™ LED Luminaires feature Acme double lead threads on the ballast body, mounting hoods, and globe assembly. Only half as many turns are required for Acme double lead threads as for single lead threads, this speeds fixture installation and maintenance. The threads do not stick or gall, eliminating problems often encountered with single lead threads during fixture unit removal.

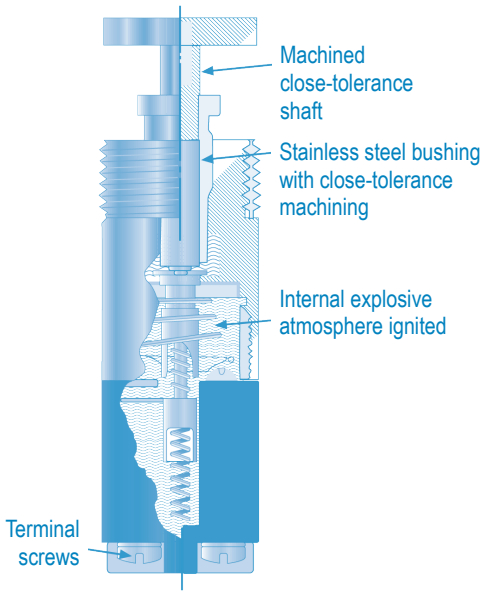
Precision Acme double lead threads provide a controlled flamepath, ensuring safe operation in ignitable atmospheres. The controlled spacing of threads provides quick removal. The end user does not need to be concerned with these requirements as they are controlled by the manufacturer and inspected by the Listing Agency. The end user should take care to ensure the flamepath is not damaged during installation and maintenance.



Close Tolerance Shaft Construction

Close tolerance shaft construction is where two closely machined surfaces make contact over a prescribed distance allowing sufficient dissipation and cooling of internal pressures, but will not allow flames into the surrounding ignitable atmosphere. These close tolerance shafts are considered a flamepath. The end user does not need to be concerned with these requirements as these requirements are controlled by the manufacturer and inspected by the Listing Agency.

This type of construction is used for shafts where threaded joint construction cannot be utilized such as in push button stations and other similar equipment. The end user does not need to be concerned with these requirements as these requirements are controlled by the manufacturer and inspected by the Listing Agency.



Typical Factory Sealed Construction

Factory sealed apparatus eliminates the need for conduit seals at conduit entries, while isolating the enclosure from the rest of the conduit and enclosure system.

Appleton™ explosionproof EFD Push Button stations feature an ultra-compact factory sealed, momentary contact push button assembly. Two push buttons can be mounted side by side on a single gang EFD cover with pilot light above. This provides a compact, start-stop-pilot, control device. The end user does not need to be concerned with these requirements as these requirements are controlled by the manufacturer and inspected by the Listing Agency.

Combination Push Button and Pilot Light.

CHANGES TO ARTICLE 90 – INTRODUCTION

The following Article 90 sections have been revised during the 2023 NEC® Code cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 90.1 through 90.8:
- Article 90 has been restructured to provide more clarity.
- There were no significant Technical revisions.
- Underlined section numbers indicate a relocation of the text.

ARTICLE 90 Introduction

90.1 Scope.

This article covers use and application, arrangement, and enforcement of this *Code*. It also covers the expression of mandatory, permissive, and nonmandatory text, provides guidance on the examination of equipment and on wiring planning, and specifies the use and expression of measurements.

90.2 Use and Application

90.2(A) Practical Safeguarding. The purpose of this *Code* is the practical safeguarding of persons and property from hazards arising from the use of electricity. This *Code* is not intended as a design specification or an instruction manual for untrained persons.

90.2(B) Adequacy. This *Code* contains provisions that are considered necessary for safety. Compliance therewith and proper maintenance result in an installation that is essentially free from hazard but not necessarily efficient, convenient, or adequate for good service or future expansion of electrical use.

Informational Note: Hazards often occur because of overloading of wiring systems by methods or usage not in conformity with this *Code*. This occurs because initial wiring did not provide for increases in the use of electricity. An initial adequate installation and reasonable provisions for system changes provide for future increases in the use of electricity.

90.2(C) Installations Covered. This *Code* covers the installation and removal of electrical conductors, equipment, and raceways; signaling and communications conductors, equipment, and raceways; and optical fiber cables for the following:

(1) Public and private premises, including buildings, structures, mobile homes, recreational vehicles, and floating buildings

(2) Yards, lots, parking lots, carnivals, and industrial substations

(3) Installations of conductors and equipment that connect to the supply of electricity

(4) Installations used by the electric utility, such as office buildings, warehouses, garages, machine shops, and recreational buildings, that are not an integral part of a generating plant, substation, or control center

(5) Installations supplying shore power to ships and watercraft in marinas and boatyards, including monitoring of leakage current

(6) Installations used to export electric power from vehicles to premises wiring or for bidirectional current flow

90.2(D) Installations Not Covered. This *Code* does not cover the following:

(1) Installations in ships, watercraft other than floating buildings, railway rolling stock, aircraft, or automotive vehicles other than mobile homes and recreational vehicles

Informational Note: Although the scope of this *Code* indicates that the *Code* does not cover installations in ships, portions of this *Code* are incorporated by reference into Title 46, *Code* of Federal Regulations, Parts 110–113.

(2) Installations underground in mines and self-propelled mobile surface mining machinery and its attendant electrical trailing cable

(3) Installations of railways for generation, transformation, transmission, energy storage, or distribution of power used exclusively for operation of rolling stock or installations used exclusively for signaling and communications purposes

(4) Installations of communications equipment under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations

(5) Installations under the exclusive control of an electric utility where such installations

a. Consist of service drops or service laterals, and associated metering, or

b. Are on property owned or leased by the electric utility for the purpose of communications, metering, generation, control, transformation, transmission, energy storage, or distribution of electric energy, or

c. Are located in legally established easements or rights-of-way, or

d. Are located by other written agreements either designated by or recognized by public service commissions, utility commissions, or other regulatory agencies having jurisdiction for such installations. These written agreements shall be limited to installations for the purpose of communications, metering, generation, control, transformation, transmission, energy storage, or distribution of electric energy where legally established easements or rights of-way cannot be obtained. These installations shall be limited to federal lands, Native American reservations through the U.S. Department of the Interior Bureau of Indian Affairs, military bases, lands controlled by port authorities and state agencies and departments, and lands owned by railroads.

Informational Note to (4) and (5): Examples of utilities may include those entities that are typically designated or recognized by governmental law or regulation by public service/utility commissions and that install, operate, and maintain electric supply (such as generation, transmission, or distribution systems) or communications systems (such as telephone, CATV, Internet, satellite, or data services). Utilities may be subject to compliance with *Code*s and standards covering their regulated activities as adopted under governmental law or regulation. Additional information can be found through consultation with the appropriate governmental bodies, such as state regulatory commissions, the Federal Energy Regulatory Commission, and the Federal Communications Commission.

90.2(E) Relation to Other International Standards. The requirements in this Code address the fundamental principles of protection for safety contained in Section 131 of International Electrotechnical Commission Standard 60364-1, Low-voltage Electrical Installations – Part 1: Fundamental Principles, Assessment of General Characteristics, Definitions.

Informational Note: See IEC 60364-1, Low-voltage Electrical Installations – Part 1: Fundamental Principles, Assessment of General Characteristics, Definitions, Section 131, for fundamental principles of protection for safety that encompass protection against electric shock, protection against thermal effects, protection against overcurrent, protection against fault currents, and protection against overvoltage. All of these potential hazards are addressed by the requirements in this Code.

90.2(F) Special Permission. The authority having jurisdiction for enforcing this *Code* may grant exception for the installation of conductors and equipment that are not under the exclusive control of the electric utilities and are used to connect the electric utility supply system to the service conductors of the premises served, provided such installations are outside a building or structure, or terminate inside at a readily accessible location nearest the point of entrance of the service conductors.

90.3 Code Arrangement. This *Code* is divided into the introduction and nine chapters, as shown in Figure 90.3. Chapters 1, 2, 3, and 4 apply generally. Chapters 5, 6, and 7 apply to special occupancies, special equipment, or other special conditions and may supplement or modify the requirements in Chapters 1 through 7.

Chapter 8 covers communications systems and is not subject to the requirements of Chapters 1 through 7 except where the requirements are specifically referenced in Chapter 8.

Chapter 9 consists of tables that are applicable as referenced.

Informative annexes are not part of the requirements of this *Code* but are included for informational purposes only.

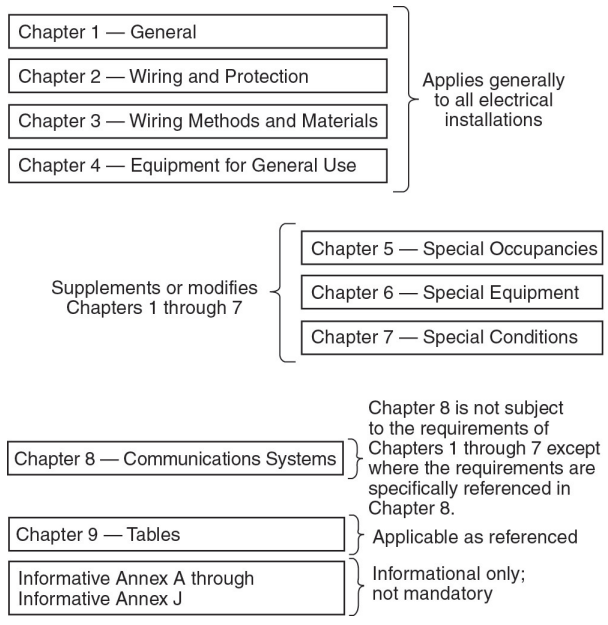


Figure 90.3 Code Arrangement.

90.4 Enforcement.

90.4(A) Application. This Code is intended to be suitable for mandatory application by governmental bodies that exercise legal jurisdiction over electrical installations, including signaling and communications systems, and for use by insurance inspectors.

90.4(B) Interpretations. The authority having jurisdiction for enforcement of the Code has the responsibility for making interpretations of the rules, for deciding on the approval of equipment and materials, and for granting the special permission contemplated in a number of the rules.

90.4(C) Specific Requirements and Alternative Methods. By special permission, the authority having jurisdiction may waive specific requirements in this Code or permit alternative methods where it is assured that equivalent objectives can be achieved by establishing and maintaining effective safety.

90.4(D) New Products, Constructions, or Materials. This Code may require new products, constructions, or materials that may not yet be available at the time the Code is adopted. In such event, the authority having jurisdiction may permit the use of the products, constructions, or materials that comply with the most recent previous edition of this Code adopted by the jurisdiction.

Informational Note: See Informative Annex H, Administration and Enforcement, for a model of guidelines that can be used to create an electrical inspection and enforcement program and to adopt NFPA 70, National Electrical Code.

To obtain information on the status of the regional adoption of this *Code* visit the NEMA Field Representative's website at https://www.nema.org/standards/technical/fieldreps.

For non-formal assistance in interpreting the rules in this *Code* as they apply to Appleton Group products, the Appleton Group Technical Support Team is willing to assist you. In addition, you may contact the regional NEMA Field Representative who's contact information is available at their website referenced above.

90.5 Mandatory Rules, Permissive Rules, and Explanatory Material.

90.5(A) Mandatory Rules. Mandatory rules of this *Code* are those that identify actions that are specifically required or prohibited and are characterized by the use of the terms shall or shall not.

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

90.5(C) Explanatory Material. Explanatory material, such as references to other standards, references to related sections of this *Code*, or information related to a *Code* rule, is included in this *Code* in the form of informational notes or an informative annex. Unless the standard reference includes a date, the reference is to be considered as the latest edition of the standard. Such notes are informational only and are not enforceable as requirements of this *Code*.

Brackets containing section references to another NFPA document are for informational purposes only and are provided as a guide to indicate the source of the extracted text. These bracketed references immediately follow the extracted text.

Informational Note: The format and language used in this *Code* follows guidelines established by NFPA and published in the NEC Style Manual. Copies of this manual can be obtained from NFPA.

90.5(D) Informative Annexes. Nonmandatory information relative to the use of the *NEC* is provided in informative annexes. Informative annexes are not part of the enforceable requirements of the *NEC*, but are included for information purposes only.

90.6 Formal Interpretations. To promote uniformity of interpretation and application of this *Code*, formal interpretation procedures have been established and are found in the Regulations Governing the Development of NFPA Standards.

For general assistance in interpreting the rules in this *Code* as they apply to Appleton products, the Appleton Group Technical Support Team (appleton.technicalservices@emerson.com) is available to assist you. In addition, you may contact the regional NEMA Field Representative at https://www.nema.org/standards/technical/fieldreps.

90.7 Examination of Equipment for Safety. For specific items of equipment and materials referred to in this *Code*, examinations for safety made under standard conditions provide a basis for approval where the record is made generally available through promulgation by organizations properly equipped and qualified for experimental testing, inspections of the run of goods at factories, and service-value determination through field inspections. This avoids the necessity for repetition of examinations by different examiners, frequently with inadequate facilities for such work, and the confusion that would result from conflicting reports on the suitability of devices and materials examined for a given purpose.

It is the intent of this *Code* that factory-installed internal wiring or the construction of equipment need not be inspected at the time of installation of the equipment, except to detect alterations or damage, if the equipment has been listed by a qualified electrical testing laboratory that is recognized as having the facilities described in the preceding paragraph and that requires suitability for installation in accordance with this *Code*. Suitability shall be determined by application of requirements that are compatible with this *Code*.

Informational Note No. 1: See 110.3 for guidance on safety examinations.

Informational Note No. 2: See Article 100for definitions of Listed and Reconditioned.

Informational Note No. 3: See Informative Annex A for a list of product safety standards that are compatible with this Code.

90.8 Wiring Planning.

90.8(A) Future Expansion and Convenience. Plans and specifications that provide ample space in raceways, spare raceways, and additional spaces allow for future increases in electric power and communications circuits. Distribution centers located in readily accessible locations provide convenience and safety of operation.

90.8(B) Number of Circuits in Enclosures. It is elsewhere provided in this *Code* that the number of circuits confined in a single enclosure be varyingly restricted. Limiting the number of circuits in a single enclosure minimizes the effects from a short circuit or ground fault.

90.9 Units of Measurement.

90.9(A) Measurement System of Preference. For the purpose of this *Code*, metric units of measurement are in accordance with the modernized metric system known as the International System of Units (SI).

90.9(B) Dual System of Units. SI units shall appear first, and inchpound units shall immediately follow in parentheses. Conversion from inch-pound units to SI units shall be based on hard conversion except as provided in 90.9(C).

Exception: The tables located in Informative Annex C shall be permitted to list the trade sizes before SI units.

90.9(C) Permitted Uses of Soft Conversion. The cases given in 90.9(C)(1) through (C)(4) shall not be required to use hard conversion and shall be permitted to use soft conversion.

(1) Trade Sizes. Where the actual measured size of a product is not the same as the nominal size, trade size designators shall be used rather than dimensions. Trade practices shall be followed in all cases.

(2) Extracted Material. Where material is extracted from another standard, the context of the original material shall not be compromised or violated. Any editing of the extracted text shall be confined to making the style consistent with that of the NEC.

(3) Industry Practice. Where industry practice is to express units in inch-pound units, the inclusion of SI units shall not be required.

(D) Compliance. Conversion from inch-pound units to SI units shall be permitted to be an approximate conversion. Compliance with the numbers shown in either the SI system or the inch-pound system shall constitute compliance with this Code.

Informational Note No. 1: Hard conversion is considered a change in dimensions or properties of an item into new sizes that might or might not be interchangeable with the sizes used in the original measurement. Soft conversion is considered a direct mathematical conversion and involves a change in the description of an existing measurement but not in the actual dimension.

Informational Note No. 2: SI conversions are based on IEEE/ASTM SI 10-1997, Standard for the Use of the International System of Units (SI):The Modern Metric System.

CHANGES TO ARTICLE 100 - DEFINITIONS

Definition Parts I, II, and III have been removed in the 2023 NEC® and now all definitions are consolidated and listed in alphabetical order. Each definition is followed by a parenthetical notation as to which NEC® Code Panel is responsible for the definition. Where a parenthetical notation to an NEC® Article is denoted, this indicates that definition only pertains to that Article.

Underlined text indicates a definition that has been added or revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

ARTICLE 100 Definitions

Scope. This article contains only those definitions essential to the application of this Code. It is not intended to include commonly defined general terms or commonly defined technical terms from related codes and standards. An article number in parentheses following the definition indicates that the definition only applies to that article.

Informational Note: A definition that is followed by a reference in brackets has been extracted from one of the following standards. Only editorial changes were made to the extracted text to make it consistent with this Code.

NFPA 30A-2021, Code for Motor Fuel Dispensing Facilities and Repair Garages

NFPA 33-2021, Standard for Spray Application Using Flammable or Combustible Materials

NFPA 75-2020, Standard for the Fire Protection of Information Technology Equipment

NFPA 79-2021, Electrical Standard for Industrial Machinery

NFPA 99-2021, Health Care Facilities Code

NFPA 101®-2022, Life Safety Code®

NFPA 110-2019, Standard for Emergency and Standby Power Systems

NFPA 303-2021, Fire Protection Standard for Marinas and Boatyards

NFPA 307-2021, Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves

NFPA 499-2021, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

NFPA 501-2022, Standard on Manufactured Housing

NFPA 790-2021, Standard for Competency of Third-Party Field Evaluation Bodies

NFPA 1192-2021, Standard on Recreational Vehicles

Accessible (as applied to equipment). Capable of being reached for operation, renewal, and inspection. (CMP-1)

Accessible (as applied to wiring methods). Capable of being removed or exposed without damaging the building structure or finish or not permanently closed in or blocked by the structure, other electrical equipment, other building systems, or finish of the building. (CMP-1)

Accessible, Readily (Readily Accessible). Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to take actions such as to use tools (other than keys), to climb over or under, to remove obstacles, or to resort to portable ladders, and so forth. (CMP-1)

Informational Note: Use of keys is a common practice under controlled or supervised conditions and a common alternative to the ready access requirements under such supervised conditions as provided elsewhere in the *NEC*.

Adapter. A device used to adapt a circuit from one configuration of an attachment plug or receptacle to another configuration with the same current rating. (520) (CMP-15)

Adjustable Speed Drive. Power conversion equipment that provides a means of adjusting the speed of an electric motor. (CMP-11)

Informational Note: A variable frequency drive is one type of electronic adjustable speed drive that controls the rotational speed of an ac electric motor by controlling the frequency and voltage of the electrical power supplied to the motor.

Adjustable Speed Drive System. A combination of an adjustable speed drive, its associated motor(s), and auxiliary equipment. (CMP-11)

Aircraft Painting Hangar. An aircraft hangar constructed for the express purpose of spraying, coating, and/or dipping applications and provided with dedicated ventilation supply and exhaust. (CMP-14)

Alternate Power Source. One or more generator sets, or battery systems where permitted, intended to provide power during the interruption of the normal electrical service; or the public utility electrical service intended to provide power during interruption of service normally provided by the generating facilities on the premises. [**99**:3.3.4] (517) (CMP-15)

Ambulatory Health Care Occupancy. An occupancy used to provide services or treatment simultaneously to four or more patients that provides, on an outpatient basis, one or more of the following:

Treatment for patients that renders the patients incapable of taking action for self-preservation under emergency conditions without the assistance of others.

Anesthesia that renders the patients incapable of taking action for self-preservation under emergency conditions without the assistance of others.

Treatment for patients who, due to the nature of their injury or illness, are incapable of taking action for self-preservation under emergency conditions without the assistance of others.

[**101**:3.3.198.1] (517) (CMP-15)

Ampacity. The maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating. (CMP-6)

Amplifier (Audio Amplifier) (Pre-Amplifier). Electronic equipment that increases the current or voltage, or both, of an audio signal intended for use by another piece of audio equipment. Amplifier is the term used to denote an audio amplifier. (640) (CMP-12)

Appliance. Utilization equipment, generally other than industrial, that is fastened in place, stationary, or portable; is normally built in a standardized size or type; and is installed or connected as a unit to perform one or more functions such as clothes washing, air-conditioning, food mixing, deep frying, and so forth. (CMP-17)

Applicator. The device used to transfer energy between the output circuit and the object or mass to be heated. (665) (CMP-12)

Approved. Acceptable to the authority having jurisdiction. (CMP-1)

Arc-Fault Circuit Interrupter (AFCI). A device intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and by functioning to de-energize the circuit when an arc fault is detected. (CMP-2)

Array. A mechanically and electrically integrated grouping of modules with support structure, including any attached system components such as inverter(s) or dc-to-dc converter(s) and attached associated wiring. (690) (CMP-4)

Askarel. A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. (CMP-9)

Informational Note: Askarels of various compositional types are used. Under arcing conditions, the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases, depending on the askarel type.

Associated Apparatus. Apparatus in which the circuits are not necessarily intrinsically safe themselves but that affects the energy in the intrinsically safe circuits and is relied on to maintain intrinsic safety. Such apparatus is one of the following:

(1) Electrical apparatus that has an alternative type of protection for use in the appropriate hazardous (classified) location

(2) Electrical apparatus not so protected that shall not be used within a hazardous (classified) location

(CMP-14)

Informational Note No. 1: Associated apparatus has identified intrinsically safe connections for intrinsically safe apparatus and also might have connections for nonintrinsically safe apparatus.

Informational Note No. 2: An example of associated apparatus is an intrinsic safety barrier, which is a network designed to limit the energy (voltage and current) available to the protected circuit in the hazardous (classified) location under specified fault conditions.

Informational Note No. 3: See ANSI/UL 913, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations; ANSI/UL 60079-11, Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i"; and ANSI/ISA RP 12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation — Part 1: Intrinsic Safety, for additional information.

Associated Nonincendive Field Wiring Apparatus. Apparatus in which the circuits are not necessarily nonincendive themselves but that affects the energy in nonincendive field wiring circuits and is relied on to maintain nonincendive energy levels. Such apparatus is one of the following:

(1) Electrical apparatus that has an alternative type of protection for use in the appropriate hazardous (classified) location

(2) Electrical apparatus not so protected that shall not be used within a hazardous (classified) location

(CMP-14)

Informational Note No. 1: Associated nonincendive field wiring apparatus has designated associated nonincendive field wiring apparatus connections for nonincendive field wiring apparatus and also might have connections for other electrical apparatus.

Informational Note No. 2: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Attachment Fitting, Weight-Supporting (WSAF) (Weight-Supporting Attachment Fitting). A device that, by insertion into a weight-supporting ceiling receptacle, establishes a connection between the conductors of the attached utilization equipment and the branch-circuit conductors connected to the weight-supporting ceiling receptacle. (CMP-18)

Informational Note No. 1: A weight-supporting attachment fitting is different from an attachment plug because no cord is associated with the fitting. A weight-supporting attachment fitting in combination with a weight-supporting ceiling receptacle secures the associated utilization equipment in place and supports its weight.

Informational Note No. 2: See ANSI/NEMA WD 6, American National Standard for Wiring Devices — Dimensional Specifications, for the standard configuration of weight-supporting attachment fittings and related weight-supporting ceiling receptacles.

Attachment Plug (Plug Cap) (Plug). A device that, by insertion in a receptacle, establishes a connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle. (CMP-18)

Audio Autotransformer. A transformer with a single winding and multiple taps intended for use with an amplifier loudspeaker signal output. (640) (CMP-12)

Audio Signal Processing Equipment (Audio Equipment). Electrically operated equipment that produces, processes, or both, electronic signals that, when appropriately amplified and reproduced by a loudspeaker, produce an acoustic signal within the range of normal human hearing (typically 20–20 kHz). Within Article 640, the terms equipment and audio equipment are assumed to be equivalent to audio signal processing equipment. (640) (CMP-12)

Informational Note: This equipment includes, but is not limited to, loudspeakers; headphones; pre-amplifiers; microphones and their power supplies; mixers; MIDI (musical instrument digital interface) equipment or other digital control systems; equalizers, compressors, and other audio signal processing equipment; and audio media recording and playback equipment, including turntables, tape decks and disk players (audio and multimedia), synthesizers, tone generators, and electronic organs. Electronic organs and synthesizers may have integral or separate amplification and loudspeakers. With the exception of amplifier outputs, virtually all such equipment is used to process signals (using analog or digital techniques) that have nonhazardous levels of voltage or current.

Audio System. The totality of all equipment and interconnecting wiring used to fabricate a fully functional audio signal processing, amplification, and reproduction system. (640) (CMP-12)

Audio Transformer. A transformer with two or more electrically isolated windings and multiple taps intended for use with an amplifier loudspeaker signal output. (640) (CMP-12)

Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a *Code* or standard, or for approving equipment, materials, an installation, or a procedure. (CMP-1)

Informational Note: The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

Automatic. Performing a function without the necessity of human intervention. (CMP-1)

Bathroom. An area including a sink with one or more of the following: a toilet, a urinal, a tub, a shower, a bidet, or similar plumbing fixtures. (CMP-2)

Battery. A single cell or a group of cells connected together electrically in series, in parallel, or a combination of both. (CMP-13)

Battery, Flow. (Flow Battery) An energy storage component that stores its active materials in the form of one or two electrolytes external to the reactor interface. When in use, the electrolytes are transferred between reactor and storage tanks. (706) (CMP-13)

Informational Note: Three commercially available flow battery technologies are zinc air, zinc bromine, and vanadium redox, sometimes referred to as pumped electrolyte ESS.

Battery, Sealed. (Sealed Battery) A battery that has no provision for the routine addition of water or electrolyte or for external measurement of electrolyte specific gravity and might contain pressure relief venting. (CMP-13)

Battery, Stationary Standby. (Stationary Standby Battery) A battery that spends the majority of the time on continuous float charge or in a high state of charge, in readiness for a discharge event. (CMP-13)

Informational Note: Uninterruptible Power Supply (UPS) batteries are an example that falls under this definition.

Battery-Powered Lighting Units. Individual unit equipment for backup illumination consisting of a rechargeable battery; a battery-charging means; provisions for one or more lamps mounted on the equipment, or with terminals for remote lamps, or both; and a relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment. (517) (CMP-15)

Berth. The water space to be occupied by a boat or other vessel alongside or between bulkheads, piers, piles, fixed and floating docks, or any similar access structure. [**303**:3.3.2] (555) (CMP-7)

Informational Note: See the definition of Slip for additional information.

Bipolar Circuit. A dc circuit that is comprised of two monopole circuits, each having an opposite polarity connected to a common reference point. (CMP-4)

Block. A square or portion of a city, town, or village enclosed by streets and including the alleys so enclosed, but not any street. (800) (CMP-16)

Boatyard. A facility used for constructing, repairing, servicing, hauling from the water, storing (on land and in water), and launching of boats. [**303**:3.3.3] (555) (CMP-7)

Bodies of Water, Artificially Made. (Artificially Made Bodies of Water) Bodies of water that have been constructed or modified to fit some decorative or commercial purpose such as, but not limited to, aeration ponds, fish farm ponds, storm retention basins, treatment ponds, and irrigation (channel) facilities. Water depths may vary seasonally or be controlled. (682) (CMP-17)

Bodies of Water, Natural. (Natural Bodies of Water) Bodies of water such as lakes, streams, ponds, rivers, and other naturally occurring bodies of water, which may vary in depth throughout the year. (682) (CMP-17)

Bonded (Bonding). Connected to establish electrical continuity and conductivity. (CMP-5)

Bonding Conductor (Bonding Jumper). A conductor that ensures the required electrical conductivity between metal parts that are required to be electrically connected. (CMP-5)

Bonding Jumper, Equipment. (Equipment Bonding Jumper) The connection between two or more portions of the equipment grounding conductor. (CMP-5)

Bonding Jumper, Main. (Main Bonding Jumper) The connection between the grounded circuit conductor and the equipment grounding conductor, or the supply-side bonding jumper, or both, at the service. (CMP-5)

Bonding Jumper, Supply-Side. (Supply-Side Bonding Jumper) A conductor installed on the supply side of a service or within a service equipment enclosure(s), or for a separately derived system, that ensures the required electrical conductivity between metal parts required to be electrically connected. (CMP-5)

Bonding Jumper, System. (System Bonding Jumper) The connection between the grounded circuit conductor and the supply-side bonding jumper, or the equipment grounding conductor, or both, at a separately derived system. (CMP-5)

Border Light. A permanently installed overhead strip light. (520) (CMP-15)

Bottom Shield. A protective layer that is installed between the floor and flat conductor cable (Type FCC) to protect the cable from physical damage and may or may not be incorporated as an integral part of the cable. (324) (CMP-6)

Branch Circuit (Branch-Circuit). The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s). (CMP-2)

Branch Circuit, Appliance. (Appliance Branch Circuit) A branch circuit that supplies energy to one or more outlets to which appliances are to be connected and that has no permanently connected luminaires that are not a part of an appliance. (CMP-2)

Branch Circuit, General-Purpose. (General-Purpose Branch Circuit) A branch circuit that supplies two or more receptacles or outlets for lighting and appliances. (CMP-2)

Branch Circuit, Individual. (Individual Branch Circuit) A branch circuit that supplies only one utilization equipment. (CMP-2)

Branch Circuit, Motor. (Motor Branch Circuit) The circuit conductors, including equipment, between the motor branch-circuit short-circuit and ground-fault protective device and an individual motor. (CMP-11)

Branch Circuit, Multiwire. (Multiwire Branch Circuit) A branch circuit that consists of two or more ungrounded conductors that have a voltage between them, and a neutral conductor that has equal voltage between it and each ungrounded conductor of the circuit and that is connected to the neutral conductor of the system. (CMP-2)

Branch-Circuit Selection Current (BCSC). The value in amperes to be used instead of the rated-load current in determining the ratings of motor branch-circuit conductors, disconnecting means, controllers, and branch-circuit short-circuit and ground-fault protective devices wherever the running overload protective device permits a sustained current greater than the specified percentage of the rated-load current. The value of branch-circuit selection current will always be equal to or greater than the marked rated-load current. (440) (CMP-11)

Breakout Assembly. An adapter used to connect a multipole connector containing two or more branch circuits to multiple individual branch-circuit connectors. (520) (CMP-15)

Broadband. Wide bandwidth data transmission that transports multiple signals, protocols, and traffic types over various media types. (CMP-16)

Building. A structure that stands alone or that is separated from adjoining structures by fire walls. (CMP-1)

Building, Floating. (Floating Building) A building that floats on water, is moored in a permanent location, and has a premises wiring system served through connection by permanent wiring to an electrical supply system not located on the premises. (CMP-7)

Building, Manufactured. (Manufactured Building) Any building that is of closed construction and is made or assembled in manufacturing facilities on or off the building site for installation, or for assembly and installation on the building site, other than manufactured homes, mobile homes, park trailers, or recreational vehicles. (545) (CMP-7)

Building Component. Any subsystem, subassembly, or other system designed for use in or integral with or as part of a structure, which can include structural, electrical, mechanical, plumbing, and fire protection systems, and other systems affecting health and safety. (545) (CMP-7)

Building System. Plans, specifications, and documentation for a system of manufactured building or for a type or a system of building components, which can include structural, electrical, mechanical, plumbing, and fire protection systems, and other systems affecting health and safety, and including such variations thereof as are specifically permitted by regulation, and which variations are submitted as part of the building system or amendment thereto. (545) (CMP-7)

Bulkhead. A vertical structural wall, usually of stone, timber, metal, concrete, or synthetic material, constructed along, and generally parallel to, the shoreline to retain earth as an extension of the upland, and often to provide suitable water depth at the waterside face. [**303**:3.3.5] (555) (CMP-7)

Bull Switch. An externally operated wall-mounted safety switch that can contain overcurrent protection and is designed for the connection of portable cables and cords. (530) (CMP-15)

Bundled. Cables or conductors that are tied, wrapped, taped, or otherwise periodically bound together. (520) (CMP-15)

Busbar. A noninsulated conductor electrically connected to the source of supply and physically supported on an insulator providing a power rail for connection to utilization equipment, such as sensors, actuators, A/V devices, low-voltage luminaire assemblies, and similar electrical equipment. (393) (CMP-18)

Busbar Support. An insulator that runs the length of a section of suspended ceiling bus rail that serves to support and isolate the busbars from the suspended grid rail. (393) (CMP-18)

Busway. A raceway consisting of a metal enclosure containing factory-mounted, bare or insulated conductors, which are usually copper or aluminum bars, rods, or tubes. (CMP-8)

Cabinet. An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung. (CMP-9)

Cable, Abandoned. (Abandoned Cable) Installed cable that is not terminated at equipment other than a termination fitting or a connector and is not identified for future use with a tag. (CMP-16)

Informational Note: See 640.6(B), 645.5(G), 722.25, 760.25, 770.25, and 800.25 for requirements covering the removal of abandoned cables.

Cable, Armored (Type AC). (Armored Cable) A fabricated assembly of insulated conductors in a flexible interlocked metallic armor. (CMP-6)

Cable, Circuit Integrity (CI). (Circuit Integrity Cable) Cable(s) marked with the suffix "-CI" used for remote-control, signaling, power-limited, fire alarm, optical fiber, or communications systems that supply critical circuits to ensure survivability for continued circuit operation for a specified time under fire conditions. (CMP-3)

Informational Note: See **728.4** for power circuits installed for survivability.

Cable, Coaxial. (Coaxial Cable) A cylindrical assembly composed of a conductor centered inside a metallic tube or shield, separated by a dielectric material, and usually covered by an insulating jacket. (CMP-16)

Cable, Festoon. (Festoon Cable) Single- and multiple-conductor cable intended for use and installation where flexibility is required. (610) (CMP-12)

Cable, Flat Conductor (Type FCC). (Flat Conductor Cable) Three or more separate flat copper conductors placed horizontally edge-to-edge and enclosed within an insulating assembly. (324) (CMP-6)

Cable, Instrumentation Tray (Type ITC). (Instrumentation Tray Cable) A factory assembly of two or more insulated conductors, with or without an equipment grounding conductor(s), enclosed in a nonmetallic sheath. (CMP-3)

Cable, Integrated Gas Spacer (Type IGS). (Integrated Gas Spacer Cable A factory assembly of one or more conductors, each individually insulated and enclosed in a loose fit, nonmetallic flexible conduit as an integrated gas spacer cable rated 0 volts through 600 volts. (CMP-6)

Cable, Limited Use. (Limited-Use Cable) Cables that are intended to be used with protection such as a raceway or for specific restricted applications. (722) (CMP-3)

Cable, Medium Voltage(Type MV). (Medium Voltage Cable) A single or multiconductor solid dielectric insulated cable rated 2001 volts up to and including 35,000 volts, nominal. (CMP-6)

Cable, Metal Clad (Type MC). (Metal Clad Cable) A factory assembly of one or more insulated circuit conductors with or without optical fiber members enclosed in an armor of interlocking metal tape, or a smooth or corrugated metallic sheath. (CMP-6)

Cable, Metallic Conductor. (Metallic Conductor Cable) A factory assembly of two or more conductors having an overall covering. (CMP-16)

Cable, Mineral-Insulated, Metal-Sheathed (Type MI). (Mineral-Insulated, Metal-Sheathed Cable) A factory assembly of one or more conductors insulated with a highly compressed refractory mineral insulation and enclosed in a liquidtight and gastight continuous copper or alloy steel sheath. (CMP-6)

Cable, Nonmetallic-Sheathed. A factory assembly of two or more insulated conductors enclosed within an overall nonmetallic jacket. (CMP-6)

Cable, Nonmetallic-Sheathed (Type NM). Insulated conductors enclosed within an overall nonmetallic jacket. (CMP-6)

Cable, Nonmetallic-Sheathed (Type NMC). Insulated conductors enclosed within an overall, corrosion resistant, nonmetallic jacket. (CMP-6)

Cable, Optical Fiber. (Optical Fiber Cable) A factory assembly or field assembly of one or more optical fibers having an overall covering. (CMP-16)

Informational Note: A field-assembled optical fiber cable is an assembly of one or more optical fibers within a jacket. The jacket, without optical fibers, is installed in a manner similar to conduit or raceway. Once the jacket is installed, the optical fibers are inserted into the jacket, completing the cable assembly.

Cable, Optical Fiber, Conductive. (Conductive Optical Fiber Cable) A factory assembly of one or more optical fibers having an overall covering and containing non-current-carrying conductive member(s) such as metallic strength member(s), metallic vapor barrier(s), metallic armor, or metallic sheath. (CMP-16)

Cable, Optical Fiber, Hybrid. (Hybrid Optical Fiber Cable) A cable containing optical fibers and current-carrying electrical conductors. (CMP-16)

Cable, Optical Fiber, Nonconductive. (Nonconductive Optical Fiber Cable) A factory assembly of one or more optical fibers having an overall covering and containing no electrically conductive materials. (CMP-16)

Cable, Optical Fiber, Protected. (Protected Optical Fiber Cable) Optical fiber cable protected from releasing optical radiation into the atmosphere during normal operating conditions and foreseeable malfunctions by additional armoring, conduit, cable tray, or raceway. (CMP-14)

Informational Note: See ANSI/UL 60079-28, Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, for additional information.

Cable, Portable Power Feeder. (Portable Power Feeder Cable) One or more flexible shielded insulated power conductors enclosed in a flexible covering rated from 2001 to 25,000 volts. (CMP-6)

Cable, Power and Control Tray (Type TC). (Power and Control Tray Cable) A factory assembly of two or more insulated conductors, with or without associated bare or covered equipment grounding conductors, under a nonmetallic jacket. (CMP-6)

Cable, Power-Limited Tray (Type PLTC). (Power-Limited Tray Cable) A factory assembly of two or more insulated conductors rated at 300 volts, with or without associated bare or insulated equipment grounding conductors, under a nonmetallic jacket. (CMP-3)

Cable, Service. (Service Cable) Service conductors made up in the form of a cable. (CMP-10)

Cable, Service Entrance. (Service Entrance Cable) A single conductor or multiconductor cable provided with an overall covering, primarily used for services. (CMP-6)

Cable, Service Entrance (Type SE). Service-entrance cable having a flame-retardant, moisture-resistant covering. (CMP-6)

Cable, Service Entrance (Type USE). Service-entrance cable, identified for underground use, having a moisture-resistant covering, but not required to have a flame-retardant covering. (CMP-6)

Cable, Type P. A factory assembly of one or more insulated flexible tinned copper conductors, with associated equipment grounding conductor(s), with or without a braided metallic armor and with an overall nonmetallic jacket. (CMP-6)

Cable, Under Carpet. (Under Carpet Cable) Cables that are intended to be used under carpeting, floor covering, modular tiles, and planks. (722) (CMP-3)

Cable, Underground Feeder and Branch-Circuit (Type UF). (Underground Feeder and Branch-Circuit Cable) A factory assembly of one or more insulated conductors with an integral or an overall covering of nonmetallic material suitable for direct burial in the earth. (CMP-6)

Cable Assembly, Flat (Type FC). (Flat Cable Assembly) An assembly of parallel conductors formed integrally with an insulating material web specifically designed for field installation in surface metal raceway. (CMP-6)

Cable Bundle. A group of cables that are tied together or in contact with one another in a closely packed configuration for at least 1.0 m (40 in). (CMP-3)

Informational Note: Random or loose installation of individual cables can result in less heating. Combing of the cables can result in less heat dissipation and more signal cross talk between cables.

Cable Connector. A connector designed to join flat conductor cables (Type FCC) without using a junction box. (324) (CMP-6)

Cable Connector [as applied to hazardous (classified) locations]. An electrical device that is part of a cable assembly and that, by insertion of two mating configurations, establishes a connection between the conductors of the cable assembly and the conductors of a fixed piece of equipment. (CMP-14)

Informational Note No. 1: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for information on the use of cable connectors.

Informational Note No. 2: Cable connectors in other than hazardous (classified) locations are referred to as male and female fittings.

Informational Note No. 3: See ANSI/UL 2238, Cable Assemblies and Fittings for Industrial Control and Signal Distribution, and ANSI/UL 2237, Multi-Point Interconnection Power Cable Assemblies for Industrial Machinery, for examples of standards on male and female fittings in other than hazardous (classified) locations.

Cable Joint. A connection consisting of an insulation system and a connector where two (or more) medium voltage (Type MV) cables are joined together. (CMP-6)

Cable Management System. An apparatus designed to control and organize lengths of cable or cord. (CMP-12)

Cable Routing Assembly. A single channel or connected multiple channels, as well as associated fittings, forming a structural system that is used to support and route communications wires and cables, optical fiber cables, data cables associated with information technology and communications equipment, Class 2, Class 3, and Type PLTC cables, and power-limited fire alarm cables in plenum, riser, and general-purpose applications. (CMP-16)

Cable Sheath. A single or multiple layers of a protective covering that holds and protects the conductors or optical fibers, or both, contained inside. (CMP-16)

Cable System, Fire-Resistive. (Fire-Resistive Cable System) A cable and components used to ensure survivability of critical circuits for a specified time under fire conditions. (CMP-3)

Cable System, Flat Conductor. (Flat Conductor Cable System) A complete wiring system for branch circuits that is designed for installation under carpet squares. (324) (CMP-6)

Informational Note: The FCC system includes Type FCC cable and associated shielding, connectors, terminators, adapters, boxes, and receptacles.

Cable Termination. A connection consisting of an insulation system and a connector and installed on a medium voltage (Type MV) cable to connect from a cable to a device, such as equipment. (CMP-6)

Cable Tray System. A unit or assembly of units or sections and associated fittings forming a structural system used to securely fasten or support cables and raceways. (CMP-8)

Cablebus. An assembly of units or sections with insulated conductors having associated fittings forming a structural system used to securely fasten or support conductors and conductor terminations in a completely enclosed, ventilated, protective metal housing. This assembly is designed to carry fault current and to withstand the magnetic forces of such current. (CMP-8)

Informational Note: Cablebus is ordinarily assembled at the point of installation from the components furnished or specified by the manufacturer in accordance with instructions for the specific job.

Cell (as applied to batteries). The basic electrochemical unit, characterized by an anode and a cathode, used to receive, store, and deliver electrical energy. (CMP-13)

Cell, Sealed. (Sealed Cell) A cell that has no provision for the routine addition of water or electrolyte or for external measurement of electrolyte specific gravity and might contain pressure relief venting. (CMP-13)

Cell Line. An assembly of electrically interconnected electrolytic cells supplied by a source of direct-current power. (CMP-12)

Cell Line Attachments and Auxiliary Equipment. A term that includes, but is not limited to, auxiliary tanks; process piping; ductwork; structural supports; exposed cell line conductors; conduits and other raceways; pumps, positioning equipment, and cell cutout or bypass electrical devices. Auxiliary equipment includes tools, welding machines, crucibles, and other portable equipment used for operation and maintenance within the electrolytic cell line working zone. In the cell line working zone, auxiliary equipment includes the exposed conductive surfaces of ungrounded cranes and crane-mounted cell-servicing equipment. (668) (CMP-12)

Charge Controller. Equipment that controls dc voltage or dc current, or both, and that is used to charge a battery or other energy storage device. (CMP-13)

Charger Power Converter. The device used to convert energy from the power grid to a high-frequency output for wireless power transfer. (625) (CMP-12)

Child Care Facility. A building or structure, or portion thereof, for educational, supervisory, or personal care services for more than four children 7 years old or less. (406) (CMP-18)

Circuit Breaker. A device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating. (CMP-10)

Informational Note: The automatic opening means can be integral, direct acting with the circuit breaker, or remote from the circuit breaker.

Circuit Breaker, Adjustable. (Adjustable Circuit Breaker) A qualifying term indicating that the circuit breaker can be set to trip at various values of current, time, or both, within a predetermined range. (CMP-10)

Circuit Breaker, Instantaneous Trip. (Instantaneous Trip Circuit Breaker) A qualifying term indicating that no delay is purposely introduced in the tripping action of the circuit breaker. (CMP-10)

Circuit Breaker, Inverse Time. (Inverse Time Circuit Breaker) A qualifying term indicating that there is a delay purposely introduced in the tripping action of the circuit breaker, and the delay decreases as the magnitude of the current increases. (CMP-10)

Circuit Breaker, Nonadjustable. (Nonadjustable Circuit Breaker) A qualifying term indicating that the circuit breaker does not have any adjustment to alter the value of the current at which it will trip or the time required for its operation. (CMP-10)

Class 1 Circuit. The portion of the wiring system between the load side of the Class 1 power source and the connected equipment. (CMP-3)

Class 2 Circuit. The portion of the wiring system between the load side of a Class 2 power source and the connected equipment. Due to its power limitations, a Class 2 circuit considers safety from a fire initiation standpoint and provides acceptable protection from electric shock. (CMP-3)

Class 3 Circuit. The portion of the wiring system between the load side of a Class 3 power source and the connected equipment. Due to its power limitations, a Class 3 circuit considers safety from a fire initiation standpoint. Since higher levels of voltage and current than for Class 2 are permitted, additional safeguards are specified to provide protection from an electric shock hazard that could be encountered. (CMP-3)

Class 4 Circuit. The portion of the wiring system between the load side of a Class 4 transmitter and the Class 4 receiver or Class 4 utilization equipment, as appropriate. Due to the active monitoring and control of the voltage and current provided, a Class 4 circuit considers safety from a fire initiation standpoint and provides acceptable protection from electric shock. (726) (CMP-3)

Class 4 Device. Any active device connected to the Class 4 circuit; examples include a Class 4 transmitter, a Class 4 receiver, or Class 4 utilization equipment. (CMP-3)

Class 4 Power System. An actively monitored and controlled system consisting of one or more Class 4 transmitters and one or more Class 4 receivers connected by a cabling system. (CMP-3

Informational Note: A Class 4 circuit is also commonly referred to as a fault-managed power circuit.

Class 4 Receiver. A device that accepts Class 4 power and converts it for use by utilization equipment. (CMP-3)

Class 4 Transmitter. A device that sources Class 4 power. (726) (CMP-3)

Informational Note: A Class 4 transmitter is different from traditional power sources in that it monitors the line for faults (both line-to-line and line-to-ground) and ceases power transmission if a fault is sensed.

Class 4 Utilization Equipment. Devices that are directly powered by a Class 4 transmitter without the need for a separate Class 4 receiver (the receiver is integrated into the equipment). (CMP-3)

Closed Construction. \Any building, building component, assembly, or system manufactured in such a manner that all concealed parts of processes of manufacture cannot be inspected after installation at the building site without disassembly, damage, or destruction. (545) (CMP-7)

Clothes Closet. A nonhabitable room or space intended primarily for storage of garments and apparel. (CMP-1)

Clothes Closet Storage Space. The area within a clothes closet in which combustible materials can be kept. (410) (CMP-18)

Collector Rings. An assembly of slip rings for transferring electric energy from a stationary to a rotating member. (675) (CMP-7)

Combiner (DC). (dc Combiner) (Direct-Current Combiner) An enclosure that includes devices used to connect two or more PV system dc circuits in parallel. (690) (CMP-4)

Combustible Dust. Solid particles that are 500 µm or smaller (i.e., material passing a U.S. No. 35 Standard Sieve as defined in ASTM E11-17, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves) that can form an explosible mixture when suspended in air at standard atmospheric pressure and temperature. [**499**:3.3.3] (CMP-14)

Informational Note: See ASTM E1226, Standard Test Method for Explosibility of Dust Clouds; ISO 6184-1, Explosion protection systems — Part 1: Determination of explosion indices of combustible dusts in air; or ANSI/UL 80079-20-2, Explosive Atmospheres — Part 20-2: Material Characteristics — Combustible Dusts Test Methods, for procedures for determining the explosibility of dusts. Historically, explosibility has been described as presenting a flash fire or explosion hazard. It could be understood that potential hazards due to the formation of an explosible mixture when suspended in air at standard atmospheric pressure and temperature would include ignition.

Combustible Gas Detection System. A protection technique utilizing stationary gas detectors in industrial establishments. (CMP-14)

Commissioning. The process, procedures, and testing used to set up and verify the initial performance, operational controls, safety systems, and sequence of operation of electrical devices and equipment, prior to it being placed into active service. (CMP-13)

Communications Circuit. A metallic, fiber, or wireless circuit that provides voice/data (and associated power) for communications-related services between communications equipment. (CMP-16)

Communications Circuit, Network-Powered Broadband. (Network-Powered Broadband Communications Circuit) The circuit extending from the communications utility's or service provider's serving terminal or tap up to and including the network interface unit (NIU). (830) (CMP-16)

Informational Note: A typical one-family dwelling network-powered communications circuit consists of a communications drop or communications service cable and an NIU and includes the communications utility's serving terminal or tap where it is not under the exclusive control of the communications utility.

Communications Circuit, Premises. (Premises Communications Circuit) The circuit that extends voice, audio, video, data, interactive services, telegraph (except radio), and outside wiring for fire alarm and burglar alarm from the service provider's network terminal to the customer's communications equipment. (840) (CMP-16)

Communications Equipment. The electronic equipment that performs the telecommunications operations for the transmission of audio, video, and data, and includes power equipment (e.g., dc converters, inverters, and batteries), technical support equipment (e.g., computers), and conductors dedicated solely to the operation of the equipment. (CMP-16)

Informational Note: As the telecommunications network transitions to a more data-centric network, computers, routers, servers, and their powering equipment, are becoming essential to the transmission of audio, video, and data and are finding increasing application in communications equipment installations.

Communications Service Provider. An organization, business, or individual that offers communications service to others. (CMP-16)

Community Antenna Television Circuit (CATV). The circuit that extends community antenna television systems for audio, video, data, and interactive services from the service provider's network terminal to the appropriate customer equipment. (CMP-16)

Concealable Nonmetallic Extension. A listed assembly of two, three, or four insulated circuit conductors within a nonmetallic jacket, an extruded thermoplastic covering, or a sealed nonmetallic covering. The classification includes surface extensions intended for mounting directly on the surface of walls or ceilings and concealed with paint, texture, joint compound, plaster, wallpaper, tile, wall paneling, or other similar materials. (CMP-6)

Concealed. Rendered inaccessible by the structure or finish of the building. (CMP-1)

Informational Note: Wires in concealed raceways are considered concealed, even though they may become accessible by withdrawing them.

Concealed Knob-and-Tube Wiring. A wiring method using knobs, tubes, and flexible nonmetallic tubing for the protection and support of single insulated conductors. (CMP-6)

Conductor, Bare. (Bare Conductor) A conductor having no covering or electrical insulation whatsoever. (CMP-6)

Conductor, Copper-Clad Aluminum. (Copper-Clad Aluminum Conductor) Conductor drawn from a copper-clad aluminum rod, with the copper metallurgically bonded to an aluminum core. (CMP-6)

Conductor, Covered. (Covered Conductor) A conductor encased within material of composition or thickness that is not recognized by this Code as electrical insulation. (CMP-6)

Conductor, Insulated. (Insulated Conductor) Overhead service conductor encased in a polymeric material adequate for the applied nominal voltage and any conductor types described in 310.4. (396) (CMP-6)

Informational Note: See ICEA S-76-474-2011, Standard for Neutral Supported Power Cable Assemblies with Weather-Resistant Extruded Insulation Rated 600 Volts, for information about overhead service conductors.

Conductors, Outdoor Overhead. (Outdoor Overhead Conductors) Single conductors, insulated, covered, or bare, installed outdoors on support structures in free air. (399) (CMP-6)

Conduit, Flexible Metal (FMC). (Flexible Metal Conduit) A raceway of circular cross section made of helically wound, formed, interlocked metal strip. (CMP-8)

Conduit, High Density Polyethylene (HDPE). (High Density Polyethylene Conduit) A nonmetallic raceway of circular cross section, with associated couplings, connectors, and fittings for the installation of electrical conductors. (CMP-8)

Conduit, Intermediate Metal (IMC). (Intermediate Metal Conduit) A steel threadable raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed with its integral or associated coupling and appropriate fittings. (CMP-8)

Conduit, Liquidtight Flexible Metal (LFMC). (Liquidtight Flexible Metal Conduit) A raceway of circular cross section having an outer liquidtight, nonmetallic, sunlight-resistant jacket over an inner flexible metal core with associated couplings, connectors, and fittings for the installation of electric conductors. (CMP-8)

Conduit, Liquidtight Flexible Nonmetallic (LFNC). (Liquidtight Flexible Nonmetallic Conduit) A raceway of circular cross section of various types as follows:

A smooth seamless inner core and cover bonded together and having one or more reinforcement layers between the core and covers, designated as LFNC-A

A smooth inner surface with integral reinforcement within the raceway wall, designated as LFNC-B

A corrugated internal and external surface without integral reinforcement within the raceway wall, designated as LFNC-C. (CMP-8)

Informational Note: FNMC is an alternative designation for LFNC.

Conduit, Nonmetallic Underground with Conductors (NUCC). (Nonmetallic Underground Conduit with Conductors) A factory assembly of conductors or cables inside a nonmetallic, smooth wall raceway with a circular cross section. (CMP-8)

Conduit, Reinforced Thermosetting Resin (RTRC). (Reinforced Thermosetting Resin Conduit) A rigid nonmetallic raceway of circular cross section, with integral or associated couplings, connectors, and fittings for the installation of electrical conductors and cables. (CMP-8)

Conduit, Rigid Metal (RMC). (Rigid Metal Conduit) A threadable raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed with its integral or associated coupling and appropriate fittings. (CMP -8)

Conduit, Rigid Polyvinyl Chloride (PVC). (Rigid Polyvinyl Chloride Conduit) A rigid nonmetallic raceway of circular cross section, with integral or associated couplings, connectors, and fittings for the installation of electrical conductors and cables. (CMP-8)

Conduit Body. A separate portion of a conduit or tubing system that provides access through a removable cover(s) to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system.

Boxes such as FS and FD or larger cast or sheet metal boxes are not classified as conduit bodies. (CMP-9)

Connector. An electromechanical fitting. (393) (CMP-18)

Connector, Intercell. (Intercell Connector) An electrically conductive bar or cable used to connect adjacent cells. (CMP-13)

Connector, Intertier. (Intertier Connector) An electrical conductor used to connect two cells on different tiers of the same rack or different shelves of the same rack. (CMP-13)

Connector, Load. (Load Connector) An electromechanical connector used for power from the busbar to utilization equipment. (393) (CMP-18)

Connector, Pendant. (Pendant Connector) An electromechanical or mechanical connector used to suspend low-voltage luminaire or utilization equipment below the grid rail and to supply power to connect from the busbar to utilization equipment. (393) (CMP-18)

Connector, Power Feed. (Power Feed Connector) An electromechanical connector used to connect the power supply to a power distribution cable, to connect directly to the busbar, or to connect from a power distribution cable to the busbar. (393) (CMP-18)

Connector, Pressure (Solderless). (Pressure Connector) A device that establishes a connection between two or more conductors or between one or more conductors and a terminal by means of mechanical pressure and without the use of solder. (CMP-1)

Connector, Rail to Rail. (Rail to Rail Connector) An electromechanical connector used to interconnect busbars from one ceiling grid rail to another grid rail. (393) (CMP-18)

Connector Strip. A metal wireway containing pendant or flush receptacles. (520) (CMP-15)

Container (as applied to batteries). A single-cell or multicell vessel or jar that holds the plates, electrolyte, and other elements of a single unit in a battery. (CMP-13)

Continuous Load. A load where the maximum current is expected to continue for 3 hours or more. (CMP-2)

Control. The predetermined process of connecting, disconnecting, increasing, or reducing electric power. (750) (CMP-13)

Control Circuit. The circuit of a control apparatus or system that carries the electric signals directing the performance of the controller but does not carry the main power current. (CMP-11)

Control Circuits, Fault-Tolerant External. (Fault-Tolerant External Control Circuits) Those control circuits either entering or leaving the fire pump controller enclosure, which if broken, disconnected, or shorted will not prevent the controller from starting the fire pump from all other internal or external means and may cause the controller to start the pump under these conditions. (695) (CMP-13)

Control Device, Emergency Lighting. (Emergency Lighting Control Device) A separate or integral device intended to perform one or more emergency lighting control functions. (700) (CMP-13)

Informational Note: See UL 924, Emergency Lighting and Power Equipment, for information covering emergency lighting control devices.

Control Drawing. A drawing or other document provided by the manufacturer of the intrinsically safe or associated apparatus, or of the nonincendive field wiring apparatus or associated nonincendive field wiring apparatus, that details the allowed interconnections between the intrinsically safe and associated apparatus or between the nonincendive field wiring apparatus or associated nonincendive field wiring apparatus. (CMP-14)

Informational Note: See the following standards for additional information:

ANSI/ISA/UL 120202, Recommendations for the Preparation, Content, and Organization of Intrinsic Safety Control Drawings

ANSI/UL 913, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations

ANSI/UL 60079-11, Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i"

ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations

ANSI/ISA RP 12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation — Part 1: Intrinsic Safety

Control Room. An enclosed control space outside the hoistway, intended for full bodily entry, that contains the elevator motor controller. The room could also contain electrical and/or mechanical equipment used directly in connection with the elevator or dumbwaiter but not the electric driving machine or the hydraulic machine. (620) (CMP-12)

Control Space. A space inside or outside the hoistway intended to be accessed with or without full bodily entry that contains the elevator motor controller. This space could also contain electrical and/or mechanical equipment used directly in connection with the elevator, dumbwaiter, escalator, moving walk, or platform lift, but not the electrical driving machine or the hydraulic machine. (620) (CMP-12)

Control System. The overall system governing the starting, stopping, direction of motion, acceleration, speed, and retardation of the moving member. (620) (CMP-12)

Controller. A device or group of devices that serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected. (CMP-1)

Controller, Motion. (Motion Controller) The electrical device(s) for that part of the control system that governs the acceleration, speed, retardation, and stopping of the moving member. (620) (CMP-12)

Informational Note: The motor control function may be integral to the motion controller.

Controller, Motor. (Motor Controller) Any switch or device that is normally used to start and stop a motor by making and breaking the motor circuit current. (CMP-11)

Controller, Operation. (Operation Controller) The electrical device(s) for that part of the control system that initiates the starting, stopping, and direction of motion in response to a signal from an operating device. (620) (CMP-12)

Converter, DC-to-DC. (DC-to-DC Converter) A device that can provide an output dc voltage and current at a higher or lower value than the input dc voltage and current. (CMP-4)

Converter Circuit, DC-to-DC. (DC-to-DC Converter Circuit) The dc circuit conductors connected to the output of a dc-to-dc converter. (CMP-4)

Converting Device. That part of the heating equipment that converts input mechanical or electrical energy to the voltage, current, and frequency used for the heating applicator. A converting device consists of equipment using line frequency, all static multipliers, oscillator-type units using vacuum tubes, inverters using solid-state devices, or motor-generator equipment. (665) (CMP-12)

Cooking Unit, Counter-Mounted. (Counter-Mounted Cooking Unit) A cooking appliance designed for mounting in or on a counter and consisting of one or more heating elements, internal wiring, and built-in or mountable controls. (CMP-2)

Coordination, Selective. (Selective Coordination) Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the selection and installation of overcurrent protective devices and their ratings or settings for the full range of available overcurrents, from overload to the available fault current, and for the full range of overcurrent protective device opening times associated with those overcurrents. (CMP-10)

Cord, Flexible. (Flexible Cord) Two or more flexible insulated conductors enclosed in a flexible covering. (CMP-6)

Cord Connector. A contact device terminated to a flexible cord that accepts an attachment plug or other insertion device. (CMP-6)

Cord Connector [as applied to hazardous (classified) locations]. A fitting intended to terminate a cord to a box or similar device and reduce the strain at points of termination and might include an explosionproof, a dust-ignitionproof, or a flameproof seal. (CMP-14)

Cord Set. A length of flexible cord having an attachment plug at one end and a cord connector at the other end. (CMP-6)

Corrosive Environment. Areas or enclosures without adequate ventilation, where electrical equipment is located and pool sanitation chemicals are stored, handled, or dispensed . (680) (CMP-17).

Informational Note No. 1: See Advisory: Swimming Pool Chemical: Chlorine, OSWER 90-008.1, June 1990, available from the EPA National Service Center for Environmental Publications (NSCEP) as sanitation chemicals and pool water are considered to pose a risk of corrosion (gradual damage or destruction of materials) due to the presence of oxidizers (e.g., calcium hypochlorite, sodium hypochlorite, bromine, chlorinated isocyanurates) and chlorinating agents that release chlorine when dissolved in water.

Informational Note No. 2: See ANSI/APSP-11, Standard for Water Quality in Public Pools and Spas, ANSI/ASHRAE 62.1, Table 6-4 Minimum Exhaust Rates, and 2021 International Swimming Pool and Spa Code (ISPSC), Section 324, including associated definitions and requirements concerning adequate ventilation of indoor spaces such as equipment and chemical storage rooms, which can reduce the likelihood of the accumulation of corrosive vapors. Chemicals such as chlorine cause severe corrosive and deteriorating effects on electrical connections, equipment, and enclosures when stored and kept in the same vicinity.

Counter (Countertop). A fixed or stationary surface typically intended for food preparation and serving, personal lavation, or laundering or a similar surface that presents a routine risk of spillage of larger quantities of liquids upon outlets mounted directly on or in the surface. (CMP-2)

Informational Note No. 1: See UL 498, Receptacles and Attachment Plugs, and UL 943, Ground-Fault Circuit Interrupters, which establish the performance evaluation criteria and construction criteria.

Informational Note No. 2: See 406.5(E), 406.5(G)(1), and 406.5(H) for information on receptacles for counters and countertops distinguished from receptacles for work surfaces.

Crane. A mechanical device used for lifting or moving boats. [**303**:3.3.6] (555) (CMP-7)

Critical Branch. A system of feeders and branch circuits supplying power for task illumination, fixed equipment, select receptacles, and select power circuits serving areas and functions related to patient care that are automatically connected to alternate power sources by one or more transfer switches during interruption of the normal power source. [**99**:3.3.30] (517) (CMP-15)

Critical Operations Areas, Designated (DCOA). (Designated Critical Operations Areas) Areas within a facility or site designated as requiring critical operations power. (CMP-13)

Critical Operations Data System. An information technology equipment system that requires continuous operation for reasons of public safety, emergency management, national security, or business continuity. (645) (CMP-12)

Critical Operations Power Systems (COPS). Power systems for facilities or parts of facilities that require continuous operation for the reasons of public safety, emergency management, national security, or business continuity. (CMP-13)

Cutout Box. An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure. (CMP-9)

Data Center, Modular (MDC). (Modular Data Center) Prefabricated units, rated 1000 volts or less, consisting of an outer enclosure housing multiple racks or cabinets of information technology equipment (ITE) (e.g., servers) and various support equipment, such as electrical service and distribution equipment, HVAC systems, and the like. (646) (CMP-12)

Informational Note: A typical construction may use a standard ISO shipping container or other structure as the outer enclosure, racks or cabinets of ITE, service-entrance equipment and power distribution components, power storage such as a UPS, and an air or liquid cooling system. Modular data centers are intended for fixed installation, either indoors or outdoors, based on their construction and resistance to environmental conditions. MDCs can be configured as an all-in-one system housed in a single equipment enclosure or as a system with the support equipment housed in separate equipment enclosures.

DC Plugging Box. A dc device consisting of one or more 2-pole, 2-wire, nonpolarized, non-grounding-type receptacles intended to be used on dc circuits only. (530) (CMP-15)

Dead Front. Without live parts exposed to a person on the operating side of the equipment. (CMP-9)

Demand Factor. The ratio of the maximum demand of a system, or part of a system, to the total connected load of a system or the part of the system under consideration. (CMP-2)

Dental Office. A building or part thereof in which the following occur:

Examinations and minor treatments/procedures performed under the continuous supervision of a dental professional;

Use of limited to minimal sedation and treatment or procedures that do not render the patient incapable of self-preservation under emergency conditions; and

No overnight stays for patients or 24-hour operations.

[**99**:3.3.38] (CMP-15)

Device. A unit of an electrical system, other than a conductor, that carries or controls electric energy as its principal function. (CMP-1)

Dielectric Heating. Heating of a nominally insulating material due to its own dielectric losses when the material is placed in a varying electric field. (665) (CMP-12)

Disconnecting Means. A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply. (CMP-1)

Distribution Point (Center Yard Pole) (Meter Pole). An electrical supply point from which service drops, service conductors, feeders, or branch circuits to buildings or structures utilized under single management are supplied. (547) (CMP-7)

Informational Note: The service point is typically located at the distribution point.

Diversion Controller (Diversion Charge Controller) (Diversion Load Controller). Equipment that regulates the output of a source or charging process by diverting power to direct-current or alternating-current loads or to an interconnected utility service. (CMP-13)

Diversion Load. A load connected to a diversion charge controller or diversion load controller, also known as a dump load. (CMP-4)

Docking Facility. A covered or open, fixed or floating structure that provides access to the water and to which boats are secured. [**303**:3.3.7] (555) (CMP-7)

Dormitory Unit. A building or a space in a building in which group sleeping accommodations are provided for more than 16 persons who are not members of the same family in one room, or a series of closely associated rooms, under joint occupancy and single management, with or without meals, but without individual cooking facilities. (CMP 2)

Drop Box. A box containing pendant- or flush-mounted receptacles attached to a multiconductor cable via strain relief or a multipole connector. (520) (CMP-15)

Dust-Ignitionproof. Equipment enclosed in a manner that excludes dusts and does not permit arcs, sparks, or heat otherwise generated or liberated inside of the enclosure to cause ignition of exterior accumulations or atmospheric suspensions of a specified dust on or in the vicinity of the enclosure. (CMP-14)

Informational Note No. 1: See ANSI/UL 1203, Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations, for additional information on dust-ignitionproof enclosures.

Informational Note No. 2: See NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum), for additional information on dust-ignitionproof enclosures that are sometimes marked additionally marked Type 9.

Dusttight. Enclosures constructed so that dust will not enter under specified test conditions. (CMP-14)

Informational Note No. 1: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Informational Note No. 2: See NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum), and ANSI/UL 50E, Enclosures for Electrical Equipment, Environmental Considerations, for additional information on enclosure Types 3, 3X, 3S, 3SX, 4, 4X, 5, 6, 6P, 12, 12K, and 13 that are considered dusttight.

Duty, Continuous. (Continuous Duty) Operation at a substantially constant load for an indefinitely long time. (CMP-1)

Duty, Intermittent. (Intermittent Duty) Operation for alternate intervals of (1) load and no load; or (2) load and rest; or (3) load, no load, and rest. (CMP-1)

Duty, Periodic. (Periodic Duty) Intermittent operation in which the load conditions are regularly recurrent. (CMP-1)

Duty, Short-Time. (Short-Time Duty) Operation at a substantially constant load for a short and definite, specified time. (CMP-1)

Duty, Varying. (Varying Duty) Operation at loads, and for intervals of time, both of which may be subject to wide variation. (CMP-1)

Dwelling, One-Family. (One-Family Dwelling) A building that consists solely of one dwelling unit. (CMP-1)

Dwelling, Two-Family. (Two-Family Dwelling) A building that consists solely of two dwelling units. (CMP-1)

Dwelling, Multifamily. (Multifamily Dwelling) A building that contains three or more dwelling units. (CMP-1)

Dwelling Unit. A single unit, providing complete and independent living facilities for one or more persons, including permanent provisions for living, sleeping, cooking, and sanitation. (CMP-2)

Electric-Discharge Lighting. Systems of illumination utilizing fluorescent lamps, high-intensity discharge (HID) lamps, or neon tubing. (CMP-18)

Electric Power Production and Distribution Network. Power production, distribution, and utilization equipment and facilities, such as electric utility systems that are connected to premises wiring and are external to and not controlled by a system that operates in interactive mode. (CMP-13)

Electric Sign. A fixed, stationary, or portable self-contained, electrically operated and/or electrically illuminated utilization equipment with words or symbols designed to convey information or attract attention. (CMP-18)

Electric Supply Stations. Locations containing the generating stations and substations, including their associated generator, storage battery, transformer, and switchgear areas. (CMP-4)

Electric Vehicle (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and electric motorcycles, primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electric current. Plug-in hybrid electric vehicles (PHEV) are electric vehicles having a second source of motive power. (CMP-12)

Informational Note: Off-road, self-propelled electric mobile machines, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, and boats are not considered electric vehicles.

Electric Vehicle Connector. A device that, when electrically coupled (conductive or inductive) to an electric vehicle inlet, establishes an electrical connection to the electric vehicle for the purpose of power transfer and information exchange. (625) (CMP-12)

Informational Note: See 625.48 for further information on interactive system.

Electric Vehicle Power Export Equipment (EVPE). The equipment, including the outlet on the vehicle, that is used to provide electrical power at voltages greater than or equal to 30 Vac or 60 Vdc to loads external to the vehicle, using the vehicle as the source of supply. (625) (CMP-12)

Informational Note: Electric vehicle power export equipment and electric vehicle supply equipment or wireless power transfer equipment are sometimes contained in one piece of equipment, sometimes referred to as a bidirectional electric vehicle supply equipment (EVSE) or bidirectional wireless power transfer equipment (WPTE).

Electric Vehicle Supply Equipment (EVSE). Equipment for plug-in charging, including the ungrounded, grounded, and equipment grounding conductors, and the electric vehicle connectors, attachment plugs, personnel protection system, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the electric vehicle. (625) (CMP-12)

Informational Note: Electric vehicle power export equipment and electric vehicle supply equipment or wireless power transfer equipment (WPTE) are sometimes contained in one piece of equipment, sometimes referred to as a bidirectional EVSE or bidirectional WPTE.

Electrical Circuit Protective System. A system consisting of components and materials intended for installation as protection for specific electrical wiring systems with respect to the disruption of electrical circuit integrity upon exterior fire exposure. (CMP-16)

Electrical Datum Plane. A specified vertical distance above the normal high-water level at which electrical equipment can be installed and electrical connections can be made. (CMP-7)

Electrical Ducts. Electrical conduits, or other raceways round in cross section, that are suitable for use underground or embedded in concrete. (CMP-6)

Electrical Life Support Equipment. Electrically powered equipment whose continuous operation is necessary to maintain a patient's life. [**99**:3.3.45] (517) (CMP-15)

Electrical Resistance Trace Heating "60079-30-1". Type of protection for the purpose of producing heat on the principle of electrical resistance and typically composed of one or more metallic conductors and/or an electrically conductive material, suitably electrically insulated and protected. (CMP-14)

Informational Note: See ANSI/UL 60079-30-1, Explosive Atmospheres — Part 30-1: Electrical Resistance Trace Heating — General and Testing Requirements, for additional information.

Electrically Connected. A connection capable of carrying current as distinguished from connection through electromagnetic induction. (668) (CMP-12)

Electrified Truck Parking Space. A truck parking space that has been provided with an electrical system that allows truck operators to connect their vehicles while stopped and to use off-board power sources in order to operate on-board systems such as air conditioning, heating, and appliances, without any engine idling. (626) (CMP-12)

Informational Note: An electrified truck parking space also includes dedicated parking areas for heavy-duty trucks at travel plazas, warehouses, shipper and consignee yards, depot facilities, and border crossings. It does not include areas such as the shoulders of highway ramps and access roads, camping and recreational vehicle sites, residential and commercial parking areas used for automotive parking or other areas where ac power is provided solely for the purpose of connecting automotive and other light electrical loads, such as engine block heaters, and at private residences.

Electrified Truck Parking Space Wiring Systems. All of the electrical wiring, equipment, and appurtenances related to electrical installations within an electrified truck parking space, including the electrified parking space supply equipment. (626) (CMP-12)

Electrolyte. The medium that provides the ion transport mechanism between the positive and negative electrodes of a cell. (CMP-13)

Electrolytic Cell. A tank or vat in which electrochemical reactions are caused by applying electric energy for the purpose of refining or producing usable materials. (668) (CMP-12)

Electrolytic Cell Line Working Zone. The space envelope wherein operation or maintenance is normally performed on or in the vicinity of exposed energized surfaces of electrolytic cell lines or their attachments. (668) (CMP-12)

Electronic Power Converter. A device that uses power electronics to convert one form of electrical power into another form of electrical power. (CMP-4)

Informational Note: Examples of electronic power converters include, but are not limited to, inverters, dc-to-dc converters, and electronic charge controllers. These devices have limited current capabilities based on the device ratings at continuous rated power.

Electronically Protected. A motor provided with electronic control that is an integral part of the motor and protects the motor against dangerous overheating due to failure of the electronic control, overload, and failure to start. (430) (CMP-11)

Emergency Luminaire, Battery-Equipped. (Battery-Equipped Emergency Luminaire) A luminaire with a rechargeable battery, a battery charging means, and an automatic load control relay. (CMP-13)

Emergency Luminaire, Directly Controlled. (Directly Controlled Emergency Luminaire) A luminaire supplied by the facility emergency power system and with a control input for dimming or switching that provides an emergency illumination level upon loss of normal power. (700) (CMP-13)

Informational Note: See ANSI/UL 924, Emergency Lighting and Power Equipment, for information covering directly controlled emergency luminaires.

Emergency Power Supply (EPS). The source(s) of electric power of the required capacity and quality for an emergency power supply system (EPSS). (CMP-13)

Emergency Power Supply System (EPSS). A complete functioning EPS system coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of electric power. [**110**:3.3.4] (CMP-13)

Emergency Systems. Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. These systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life. (CMP-13)

Encapsulation "m". Type of protection where electrical parts that could ignite an explosive atmosphere by either sparking or heating are enclosed in a compound in such a way that this explosive atmosphere cannot be ignited. (CMP-14)

Informational Note: See ANSI/UL 60079-18, Explosive atmospheres — Part 18: Equipment protection by encapsulation "m", for additional information.

Enclosed. Surrounded by a case, housing, fence, or wall(s) that prevents persons from accidentally contacting energized parts. (CMP-1)

Enclosed-Break. Having electrical make-or-break contacts such that, if an internal explosion of the flammable gas or vapor that can enter it occurs, the device will withstand the internal explosion without suffering damage and without communicating the internal explosion to the external flammable gas or vapor.(CMP-14)

Informational Note: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Enclosure. The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. (CMP-1)

Informational Note: See Table 110.28 for examples of enclosure types.

Energized. Electrically connected to, or is, a source of voltage. (CMP-1)

Energized, Likely to Become. (Likely to Become Energized) Conductive material that could become energized because of the failure of electrical insulation or electrical spacing. (CMP-5)

Energy Management System (EMS). A system consisting of any of the following: a monitor(s), communications equipment, a controller(s), a timer(s), or other device(s) that monitors and/or controls an electrical load or a power production or storage source. (CMP-13)

Energy Storage System (ESS). One or more devices installed as a system capable of storing energy and providing electrical energy into the premises wiring system or an electric power production and distribution network. (CMP-13)

Informational Note No. 1: An ESS(s) can include but is not limited to batteries, capacitors, and kinetic energy devices (e.g., flywheels and compressed air). An ESS(s) can include inverters or converters to change voltage levels or to make a change between an ac or a dc system.

Informational Note No. 2: These systems differ from a stationary standby battery installation where a battery spends the majority of the time on continuous float charge or in a high state of charge, in readiness for a discharge event.

Entertainment Device. A mechanical or electromechanical device that provides an entertainment experience. (522) (CMP-15)

Informational Note: These devices can include animated props, show action equipment, animated figures, and special effects, coordinated with audio and lighting to provide an entertainment experience.

Equipment. A general term, including fittings, devices, appliances, luminaires, apparatus, machinery, and the like used as a part of, or in connection with, an electrical installation. (CMP-1)

Equipment, Mobile. (Mobile Equipment) Equipment with electrical components that is suitable to be moved only with mechanical aids or is provided with wheels for movement by a person(s) or powered devices. (513) (CMP-14)

Equipment, Portable. (Portable Equipment) Equipment fed with portable cords or cables intended to be moved from one place to another. (640) (CMP-12)

Equipment, Portable. (Portable Equipment) Equipment with electrical components suitable to be moved by a single person without mechanical aids. (511) (CMP-14)

Equipment, Portable. (Portable Equipment) Equipment fed with portable cords or cables intended to be moved from one place to another. (520) (CMP-15)

Equipment, Portable. (Portable Equipment) Equipment intended to be moved from one place to another. (530) (CMP-15)

Equipment, Signal. (Signal Equipment) Includes audible and visual equipment such as chimes, gongs, lights, and displays that convey information to the user. (620) (CMP-12)

Equipment Branch. A system of feeders and branch circuits arranged for delayed, automatic, or manual connection to the alternate power source and that serves primarily 3-phase power equipment. [**99**:3.3.50] (517) (CMP-15)

Equipment Protection Level (EPL). Level of protection assigned to equipment based on its likelihood of becoming a source of ignition, and distinguishing the differences between explosive gas atmospheres and explosive dust atmospheres. (CMP-14)

Informational Note: See ANSI/UL 60079-0, Explosive Atmospheres — Part 0: Equipment — General Requirements, for additional information.

Equipment Rack. A framework for the support, enclosure, or both, of equipment; can be portable or stationary. (640) (CMP-12)

Informational Note: See EIA/ECA 310-E-2005, Cabinets, Racks, Panels and Associated Equipment, for examples of equipment racks.

Equipotential Plane. Conductive parts bonded together to reduce voltage gradients in a designated area. (682) (CMP-17)

Equipotential Plane. Conductive elements that are connected together to minimize voltage differences. (CMP-7)

Essential Electrical System. A system comprised of alternate power sources and all connected distribution systems and ancillary equipment, designed to ensure continuity of electrical power to designated areas and functions of a health care facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system. [**99**:3.3.52] (517) (CMP-15)

Explosionproof Equipment. Equipment enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that might occur within it, that is capable of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited. (CMP-14)

Informational Note No. 1: See ANSI/UL 1203, Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations, for additional information.

Informational Note No. 2: See NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum), for additional information on explosionproof enclosures that are sometimes additionally marked Type 7.

Exposed (as applied to live parts). Capable of being inadvertently touched or approached nearer than a safe distance by a person. (CMP-1)

Informational Note: This term applies to parts that are not suitably guarded, isolated, or insulated.

Exposed (as applied to wiring methods). On or attached to the surface or behind panels designed to allow access. (CMP-1)

Exposed (Optical Fiber Cable Exposed to Accidental Contact). A conductive optical fiber cable in such a position that, in case of failure of supports or insulation, contact between the cable's non–current-carrying conductive members and an electrical circuit might result. (CMP-16)

Exposed (to Accidental Contact). A circuit in such a position that, in case of failure of supports or insulation, contact with another circuit may result. (CMP-16)

Exposed Conductive Surfaces. Those surfaces that are capable of carrying electric current and that are unprotected, uninsulated, unenclosed, or unguarded, permitting personal contact. [**99**:3.3.54] (517) (CMP-15)

Informational Note: Paint, anodizing, and similar coatings are not considered suitable insulation, unless they are listed for such use.

Externally Operable. Capable of being operated without exposing the operator to contact with live parts. (CMP-1)

Facility, On-Site Power Production. (On-Site Power Production Facility) The normal supply of electric power for the site that is expected to be constantly producing power. (695) (CMP-13)

Fastened-in-Place. Mounting means of equipment in which the fastening means are specifically designed to permit removal without the use of a tool. (625) (CMP-12)

Fault-Managed Power (FMP). A powering system that monitors for faults and controls current delivered to ensure fault energy is limited. (726) (CMP-3)

Informational Note No. 1: The monitoring and control systems differentiate fault-managed power from electric light and power circuits; therefore, alternative requirements to those of Chapters 1 through 4 are given regarding minimum wire sizes, ampacity adjustment and correction factors, overcurrent protection, insulation requirements, and wiring methods and materials.

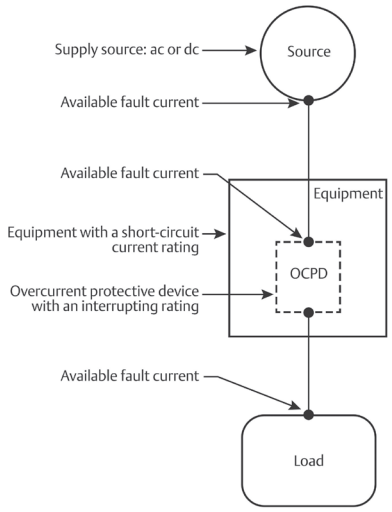
Informational Note No. 2: A fault-managed power circuit is also commonly referred to as a Class 4 circuit.

Fault Current. The current delivered at a point on the system during a short-circuit condition. (CMP-10)

Fault Current, Available. (Available Fault Current) The largest amount of current capable of being delivered at a point on the system during a short-circuit condition. (CMP-10)

Informational Note: A short-circuit can occur during abnormal conditions such as a fault between circuit conductors or a ground fault. See Informational Note Figure 100.1.

Informational Note Figure 100.1 Available Fault Current



Fault Protection Device. An electronic device that is intended for the protection of personnel and functions under fault conditions, such as network-powered broadband communications cable short or open circuit, to limit the current or voltage, or both, for a low-power network-powered broadband communications circuit and provide acceptable protection from electric shock. (830) (CMP-16)

Feeder. All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device. (CMP-10)

Feeder Assembly. The overhead or under-chassis feeder conductors, including the equipment grounding conductor, together with the necessary fittings and equipment; or the power-supply cord assembly for a mobile home, recreational vehicle, or park trailer, identified for the delivery of energy from the source of electrical supply to the panelboard within the mobile home, recreational vehicle, or park trailer. (CMP-7)

Festoon Lighting. A string of outdoor lights that is suspended between two points. (CMP-18)

Fibers/Flyings, Combustible. (Combustible Fibers/Flyings) Fibers/flyings, where any dimension is greater than 500 µm in nominal size, which can form an explosible mixture when suspended in air at standard atmospheric pressure and temperature. [**499**:3.3.4.1] (CMP-14)

Informational Note No. 1: This definition and Informational Notes No. 2 and No. 3 have been extracted from NFPA 499-2021, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas. The NFPA 499 reference is in brackets. Only editorial changes were made to the extracted text to make it consistent with this Code.

Informational Note No. 2: Section 500.5(D) defines a Class III location. Combustible fibers/flyings can be similar in physical form to ignitible fibers/flyings and protected using the same electrical equipment installation methods. Examples of fibers/flyings include flat platelet-shaped particulate, such as metal flake, and fibrous particulate, such as particle board core material. If the smallest dimension of a combustible material is greater than 500 µm, it is unlikely that the material would be combustible fibers/flyings, as determined by test. Finely divided solids with lengths that are large compared to their diameter or thickness usually do not pass through a 500 µm sieve, yet when tested could potentially be determined to be explosible. [**499**:A.3.3.4.1]

Informational Note No. 3: See ASTM E1226, Standard Test Method for Explosibility of Dust Clouds, ISO 6184-1, Explosion protection systems — Part 1: Determination of explosion indices of combustible dusts in air, or ISO/IEC/UL 80079-20-2, Explosive atmospheres — Part 20-2: Material characteristics — Combustible dusts test methods, for procedures for determining the explosibility of dusts. A material that is found to not present an explosible mixture could still be an ignitible fiber/flying, as defined in this article. Historically, the explosibility condition has been described as presenting a flash fire or explosion hazard. It could be understood that the potential hazard due to the formation of an explosible mixture when suspended in air at standard atmospheric pressure and temperature would include ignition. [**499**:A.3.3.4.1]

Fibers/Flyings, Ignitible. (Ignitible Fibers/Flyings) Fibers/flyings where any dimension is greater than 500 µm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture, but could produce an ignitible layer fire hazard. [**499**:3.3.4.2] (CMP-14)

Informational Note No. 1: This definition and Informational Note No. 2 have been extracted from NFPA 499-2021, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas. The NFPA 499 reference is in brackets. Only editorial changes were made to the extracted text to make it consistent with this Code.

Informational Note No. 2: Section 500.5 of this Code prescribes a Class III location as one where ignitible fibers/flyings are present, but not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. This description addresses fibers/flyings that do not present a flash-fire hazard or explosion hazard by test. This could be because those fibers/flyings are too large or too agglomerated to be suspended in air in sufficient concentration, or at all, under typical test conditions. Alternatively, this could be because they burn so slowly that, when suspended in air, they do not propagate combustion at any concentration. In this document the zone classification system includes ignitible fibers/flyings as a fire hazard in a layer, which is not addressed in the IEC zone system (see IEC 60079-10-2, Explosive atmospheres — Part 10-2: Classification of areas — Explosive dust atmospheres). Where these are present, the user could also consider installation in accordance with Article 503 of this Code. [**499**:A.3.3.4.2]

Field Evaluation Body (FEB). An organization or part of an organization that performs field evaluations of electrical or other equipment. [**790**:3.3.4] (CMP-1)

Informational Note: See NFPA 790-2021, Standard for Competency of Third-Party Field Evaluation Bodies, provides guidelines for establishing the qualification and competency of a body performing field evaluations of electrical products and assembles with electrical components.

This definition addresses equipment that has been certified in the field, typically after installation. These approvals are only specific to those units that have been field evaluated.

Field Labeled (as applied to evaluated products). Equipment or materials to which has been attached a label, symbol, or other identifying mark of an FEB indicating the equipment or materials were evaluated and found to comply with requirements as described in an accompanying field evaluation report. [**790**:3.3.6] (CMP-1)

Fire Alarm Circuit. The portion of the wiring system between the load side of the overcurrent device or the power-limited supply and the connected equipment of all circuits powered and controlled by the fire alarm system. Fire alarm circuits are classified as either non–power-limited or power-limited. (CMP-3)

Fire Alarm Circuit, Non-Power-Limited (NPLFA). (Non-Power-Limited Fire Alarm Circuit) A fire alarm circuit powered by a source that is not power limited. (CMP-3)

Informational Note: See 760.41 and 760.43 for requirements for non-power-limited fire alarm circuits.

Fire Alarm Circuit, Power-Limited (PLFA). (Power-Limited Fire Alarm Circuit) A fire alarm circuit powered by a power-limited source . (CMP-3)

Informational Note: See 760.121 for requirements on power-limited fire alarm circuits.

Fitting. An accessory such as a locknut, bushing, or other part of a wiring system that is intended primarily to perform a mechanical rather than an electrical function. (CMP-1)

Fixed (as applied to equipment). Equipment that is fastened or otherwise secured at a specific location. (680) (CMP-17)

Fixed-in-Place. Mounting means of equipment using fasteners that require a tool for removal. (625) (CMP-12)

Flameproof "d". Type of protection where the enclosure will withstand an internal explosion of a flammable mixture that has penetrated into the interior, without suffering damage and without causing ignition, through any joints or structural openings in the enclosure of an external explosive gas atmosphere consisting of one or more of the gases or vapors for which it is designed. (CMP-14)

Informational Note: See ANSI/UL 60079-1, Explosive Atmospheres — Part 1: Equipment Protection by Flameproof Enclosures "d", for additional information.

Flammable Anesthetics. Gases or vapors, such as fluroxene, cyclopropane, divinyl ether, ethyl chloride, ethyl ether, and ethylene, that could form flammable or explosive mixtures with air, oxygen, or reducing gases such as nitrous oxide. (517) (CMP-15)

Flexible Bus Systems. An assembly of flexible insulated bus, with a system of associated fittings used to secure, support, and terminate the bus. (CMP-8)

Informational Note: Flexible bus systems are engineered systems for a specific site location and are ordinarily assembled at the point of installation from the components furnished or specified by the manufacturer.

Flexible Insulated Bus. A flexible rectangular conductor with an overall insulation. (CMP-8)

Flywheel ESS (FESS). A mechanical ESS composed of a spinning mass referred to as a rotor and an energy conversion mechanism such as a motor-generator that converts the mechanical energy to electrical energy. (706) (CMP-13)

Informational Note: There are primarily two types of rotor constructions, solid metal mass design and composite fiber design.

Footlight. A border light installed on or in the stage. (520) (CMP-15)

Forming Shell. A structure designed to support a wet-niche luminaire assembly and intended for mounting in a pool or fountain structure. (680) (CMP-17)

Fountain. An ornamental structure or recreational water feature from which one or more jets or streams of water are discharged into the air, including splash pads, ornamental pools, display pools, and reflection pools. The definition does not include drinking water fountains or water coolers. (680) (CMP-17)

Frame. Chassis rail and any welded addition thereto of metal thickness of 1.35 mm (0.053 in) or greater. (551) (CMP-7)

Free Air (as applied to conductors). Open or ventilated environment that allows for heat dissipation and air flow around an installed conductor. (CMP-6)

Fuel Cell. An electrochemical system that consumes fuel to produce an electric current. In such cells, the main chemical reaction used for producing electric power is not combustion. However, there may be sources of combustion used within the overall cell system, such as reformers/fuel processors. (CMP-4)

Fuel Cell System. The complete aggregate of equipment used to convert chemical fuel into usable electricity and typically consisting of a reformer, stack, power inverter, and auxiliary equipment. (CMP-4)

Fuse. An overcurrent protective device with a circuit-opening fusible part that is heated and severed by the passage of overcurrent through it. (CMP-10)

Informational Note: A fuse comprises all the parts that form a unit capable of performing the prescribed functions. It may or may not be the complete device necessary to connect it into an electrical circuit.

Fuse, Electronically Actuated. (Electronically Actuated Fuse) An overcurrent protective device that generally consists of a control module that provides current-sensing, electronically derived time–current characteristics, energy to initiate tripping, and an interrupting module that interrupts current when an overcurrent occurs. Such fuses may or may not operate in a current-limiting fashion, depending on the type of control selected. (CMP-10)

Fuse, Expulsion. (Expulsion Fuse) A vented fuse unit in which the expulsion effect of gases produced by the arc and lining of the fuseholder, either alone or aided by a spring, extinguishes the arc. (CMP-10)

Fuse, Nonvented Power. (Nonvented Power Fuse) A fuse without intentional provision for the escape of arc gases, liquids, or solid particles to the atmosphere during circuit interruption. (CMP-10)

Fuse, Power. (Power Fuse) A vented, nonvented, or controlled vented fuse unit in which the arc is extinguished by being drawn through solid material, granular material, or liquid, either alone or aided by a spring. (CMP-10)

Fuse, Vented Power. (Vented Power Fuse) A fuse with provision for the escape of arc gases, liquids, or solid particles to the surrounding atmosphere during circuit interruption. (CMP-10)

Garage. A building or portion of a building in which one or more self-propelled vehicles can be kept for use, sale, storage, rental, repair, exhibition, or demonstration purposes. (CMP-1)

Informational Note: See 511.1 for commercial garages, repair and storage.

Garage, Major Repair. (Major Repair Garage) A building or portions of a building where major repairs, such as engine overhauls, painting, body and fender work, welding or grinding, and repairs that require draining or emptying of the motor vehicle fuel tank are performed on motor vehicles, including associated floor space used for offices, parking, or showrooms. [**30A**:3.3.12.1] (CMP-14)

Garage, Minor Repair. (Minor Repair Garage) A building or portions of a building used for lubrication, inspection, and minor automotive maintenance work, such as engine tune-ups, replacement of parts, fluid changes (e.g., oil, antifreeze, transmission fluid, brake fluid, air-conditioning refrigerants), brake system repairs, tire rotation, and similar routine maintenance work, including the associated floor space used for offices, parking, or showrooms. [**30A**:3.3.12.2] (CMP-14)

General-Purpose Cables, Cable Routing Assemblies, and Raceways. Cables, cable routing assemblies, and raceways are suitable for general-purpose applications and are resistant to the spread of fire. (722) (CMP-3)

Generating Capacity, Inverter. (Inverter Generating Capacity) The sum of parallel-connected inverter maximum continuous output power at 40°C in watts, kilowatts, volt-amperes, or kilovolt-amperes. (CMP-4)

Generating Station. A plant wherein electric energy is produced by conversion from some other form of energy (e.g., chemical, nuclear, solar, wind, mechanical, or hydraulic) by means of suitable apparatus. (CMP-4)

Generator (Generator Set). A machine that converts mechanical energy into electrical energy by means of a prime mover and alternator and/or inverter. (CMP-13)

Generator, On-Site Standby. (On-Site Standby Generator) A facility producing electric power on site as the alternate supply of electric power. It differs from an on-site power production facility in that it is not constantly producing power. (695) (CMP-13)

Grid Bus Rail. A combination of the busbar, the busbar support, and the structural suspended ceiling grid system. (393) (CMP-18)

Ground. The earth. (CMP-5)

Ground Fault. An unintentional, electrically conductive connection between an ungrounded conductor of an electrical circuit and the normally non-current-carrying conductors, metal enclosures, metal raceways, metal equipment, or earth. (CMP-5)

Ground-Fault Circuit Interrupter (GFCI). A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a ground-fault current exceeds the values established for a Class A device. (CMP-2)

Informational Note: See UL 943, Standard for Ground-Fault Circuit Interrupters, for further information. Class A ground-fault circuit interrupters trip when the ground-fault current is 6 mA or higher and do not trip when the ground-fault current is less than 4 mA.

Ground-Fault Circuit Interrupter, Special Purpose (SPGFCI). (Special Purpose Ground-Fault Circuit Interrupter) A device intended for the detection of ground-fault currents, used in circuits with voltage to ground greater than 150 volts, that functions to de-energize a circuit or portion of a circuit within an established period of time when a ground-fault current exceeds the values established for Class C, D, or E devices. (CMP-2)

Informational Note: See UL 943C, Outline of Investigation for Special Purpose Ground-Fault Circuit Interrupters, for information on Classes C, D, or E special purpose ground-fault circuit interrupters.

Ground-Fault Current Path. An electrically conductive path from the point of a ground fault on a wiring system through normally non–current-carrying conductors, grounded conductors, equipment, or the earth to the electrical supply source. (CMP-5)

Informational Note: Examples of ground-fault current paths are any combination of equipment grounding conductors, metallic raceways, metallic cable sheaths, electrical equipment, and any other electrically conductive material such as metal, water, and gas piping; steel framing members; stucco mesh; metal ducting; reinforcing steel; shields of communications cables; grounded conductors; and the earth itself.

Ground-Fault Current Path, Effective. (Effective Ground-Fault Current Path) An intentionally constructed, low-impedance electrically conductive path designed and intended to carry current during ground-fault events from the point of a ground fault on a wiring system to the electrical supply source and that facilitates the operation of the overcurrent protective device or ground-fault detectors. (CMP-5)

Ground-Fault Detector-Interrupter, dc (GFDI). A device that provides protection for PV system dc circuits by detecting a ground fault and could interrupt the fault path in the dc circuit. (690) (CMP-4)

Informational Note: See UL 1741, Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources, and UL 62109, Standard for Power Converters for use in Photovoltaic Power Systems, for further information on GFDI equipment.

Ground-Fault Protection of Equipment (GFPE). A system intended to provide protection of equipment from damaging line-to-ground fault currents by operating to cause a disconnecting means to open all ungrounded conductors of the faulted circuit. This protection is provided at current levels less than those required to protect conductors from damage through the operation of a supply circuit overcurrent device. (CMP-5)

Grounded (Grounding). Connected (connecting) to ground or to a conductive body that extends the ground connection. (CMP-5)

Grounded, Functionally. (Functionally Grounded) A system that has an electrical ground reference for operational purposes that is not solidly grounded. (CMP-4)

Informational Note: A functionally grounded system is often connected to ground through an electronic means internal to an inverter or charge controller that provides ground-fault protection. Examples of operational purposes for functionally grounded systems include ground-fault detection and performance-related issues for some power sources.

Grounded, Solidly. (Solidly Grounded) Connected to ground without inserting any resistor or impedance device. (CMP-5)

Grounded Conductor. A system or circuit conductor that is intentionally grounded. (CMP-5)

Informational Note: Although an equipment grounding conductor is grounded, it is not considered a grounded conductor.

Grounded System, Impedance. (Impedance Grounded System) An electrical system that is grounded by intentionally connecting the system neutral point to ground through an impedance device. (CMP-5)

Grounding Conductor, Equipment (EGC). (Equipment Grounding Conductor) A conductive path(s) that is part of an effective ground-fault current path and connects normally non-current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both. (CMP-5)

Informational Note No. 1: It is recognized that the equipment grounding conductor also performs bonding.

Informational Note No. 2: See 250.118 for a list of acceptable equipment grounding conductors.

Grounding Conductor, Impedance. (Impedance Grounding Conductor) A conductor that connects the system neutral point to the impedance device in an impedance grounded system. (CMP-5)

Grounding Electrode. A conducting object through which a direct connection to earth is established. (CMP-5)

Grounding Electrode Conductor (GEC). A conductor used to connect the system grounded conductor or the equipment to a grounding electrode or to a point on the grounding electrode system. (CMP-5)

Grouped. Cables or conductors positioned adjacent to one another but not in continuous contact with each other. (520) (CMP-15)

Guarded. Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger. (CMP-1)

Guest Room. An accommodation combining living, sleeping, sanitary, and storage facilities within a compartment. (CMP-2)

Guest Suite. An accommodation with two or more contiguous rooms comprising a compartment, with or without doors between such rooms, that provides living, sleeping, sanitary, and storage facilities. (CMP-2)

Gutter, Metal Auxiliary. (Metal Auxiliary Gutter) A sheet metal enclosure used to supplement wiring spaces at meter centers, distribution centers, switchgear, switchboards, and similar points of wiring systems. The enclosure has hinged or removable covers for housing and protecting electrical wires, cable, and busbars. The enclosure is designed for conductors to be laid or set in place after the enclosures have been installed as a complete system. (CMP-8)

Gutter, Nonmetallic Auxiliary. (Nonmetallic Auxiliary Gutter) A flame-retardant, nonmetallic enclosure used to supplement wiring spaces at meter centers, distribution centers, switchgear, switchboards, and similar points of wiring systems. The enclosure has hinged or removable covers for housing and protecting electrical wires, cable, and busbars. The enclosure is designed for conductors to be laid or set in place after the enclosures have been installed as a complete system. (CMP-8)

Habitable Room. A room in a building for living, sleeping, eating, or cooking, but excluding bathrooms, toilet rooms, closets, hallways, storage or utility spaces, and similar areas. (CMP-2)

Handhole Enclosure. An enclosure for use in underground systems, provided with an open or closed bottom, and sized to allow personnel to reach into, but not enter, for the purpose of installing, operating, or maintaining equipment or wiring or both. (CMP-9)

Hazard Current. For a given set of connections in an isolated power system, the total current that would flow through a low impedance if it were connected between either isolated conductor and ground. [**99**:3.3.72] (517) (CMP-15)

Hazard Current, Fault. (Fault Hazard Current) The hazard current of a given isolated power system with all devices connected except the line isolation monitor. [**99**:3.3.72.1] (517) (CMP-15)

Monitor Hazard Current. The hazard current of the line isolation monitor alone. [**99**:3.3.72.2] (517) (CMP-15)

Total Hazard Current. The hazard current of a given isolated system with all devices, including the line isolation monitor, connected. [**99**:3.3.72.3] (517) (CMP-15)

Header. Transverse metal raceways for electrical conductors, providing access to predetermined cells of a precast cellular concrete floor, thereby permitting the installation of electrical conductors from a distribution center to the floor cells. (CMP-8)

Health Care Facilities. Buildings, portions of buildings, or mobile enclosures in which human medical, dental, psychiatric, nursing, obstetrical, or surgical care is provided. [**99**:3.3.73] (CMP-15)

Informational Note: Examples of health care facilities include, but are not limited to, hospitals, nursing homes, limited care facilities, clinics, medical and dental offices, and ambulatory care centers, whether permanent or movable.

Health Care Facility's Governing Body. The person or persons who have the overall legal responsibility for the operation of a health care facility. [**99**:3.3.74] (517) (CMP-15)

Heating Equipment. Any equipment that is used for heating purposes and whose heat is generated by induction or dielectric methods. (665) (CMP-12)

Heating Panel. A complete assembly provided with a junction box or a length of flexible conduit for connection to a branch circuit. (CMP-17)

Heating Panel Set. A rigid or nonrigid assembly provided with nonheating leads or a terminal junction assembly identified as being suitable for connection to a wiring system. (CMP-17)

Heating System. A complete system consisting of components such as heating elements, fastening devices, nonheating circuit wiring, leads, temperature controllers, safety signs, junction boxes, raceways, and fittings. (426) (CMP-17)

Heating System, Impedance. (Impedance Heating System) A system in which heat is generated in an object, such as a pipe, rod, or combination of such objects serving as a heating element, by causing current to flow through such objects by direct connection to an ac voltage source from an isolating transformer. In some installations the object is embedded in the surface to be heated or constitutes the exposed component to be heated. (CMP-17)

Heating System, Induction. (Induction Heating System) A system in which heat is generated in a pipeline or vessel wall by inducing current in the pipeline or vessel wall from an external isolated ac field source. (CMP-17)

Heating System, Skin Effect. (Skin-Effect Heating System) A system in which heat is generated on the inner surface of a ferromagnetic envelope embedded in or fastened to the surface to be heated.

Informational Note: Typically, an electrically insulated conductor is routed through and connected to the envelope at the other end. The envelope and the electrically insulated conductor are connected to an ac voltage source from an isolating transformer. (CMP-17)

Hermetic Refrigerant Motor-Compressor. A combination consisting of a compressor and motor, both of which are enclosed in the same housing, with no external shaft or shaft seals, with the motor operating in the refrigerant. (CMP-11)

Hoistway. Any shaftway, hatchway, well hole, or other vertical opening or space in which an elevator or dumbwaiter is designed to operate. (CMP-12)

Hospital. A building or portion thereof used on a 24-hour basis for the medical, psychiatric, obstetrical, or surgical care of four or more inpatients. [**101**:3.3.152] (CMP-15)

Host Sign. A sign or outline lighting system already installed in the field that is designated for field conversion of the illumination system with a retrofit kit. (600) (CMP-18)

Hydromassage Bathtub. A permanently installed bathtub equipped with a recirculating piping system, pump, and associated equipment. It is designed so it can accept, circulate, and discharge water upon each use. (680) (CMP-17)

Identified (as applied to equipment). Recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular *Code* requirement. (CMP-1)

Informational Note: Some examples of ways to determine suitability of equipment for a specific purpose, environment, or application include investigations by a qualified testing laboratory (listing and labeling), an inspection agency, or other organizations concerned with product evaluation.

In Sight From (Within Sight From) (Within Sight). Equipment that is visible and not more than 15 m (50 ft) distant from other equipment is in sight from that other equipment. (CMP-1)

Informational Note: See 110.29 for additional information.

Increased Safety "e". Type of protection applied to electrical equipment that does not produce arcs or sparks in normal service and under specified abnormal conditions, in which additional measures are applied to give increased security against the possibility of excessive temperatures and of the occurrence of arcs and sparks. (CMP-14)

Informational Note: See ANSI/UL 60079-7, Explosive Atmospheres — Part 7: Equipment Protection by Increased Safety "e", for additional information.

Induction Heating (Induction Melting) (Induction Welding). The heating, melting, or welding of a nominally conductive material due to its own I2R losses when the material is placed in a varying electromagnetic field. (665) (CMP-12)

Industrial Control Panel. An assembly of two or more components consisting of one of the following: (1) power circuit components only, such as motor controllers, overload relays, fused disconnect switches, and circuit breakers; (2) control circuit components only, such as push buttons, pilot lights, selector switches, timers, switches, and control relays; (3) a combination of power and control circuit components. These components, with associated wiring and terminals, are mounted on, or contained within, an enclosure or mounted on a subpanel. (CMP-11)

Informational Note: The industrial control panel does not include the controlled equipment.

Industrial Installation, Supervised. (Supervised Industrial Installation) The industrial portions of a facility where all of the following conditions are met:

Conditions of maintenance and engineering supervision ensure that only qualified persons monitor and service the system.

The premises wiring system has 2500 kVA or greater of load used in industrial process(es), manufacturing activities, or both, as calculated in accordance with Article 220.

The premises has at least one service or feeder that is more than 150 volts to ground and more than 300 volts phase-to-phase.

This definition excludes installations in buildings used by the industrial facility for offices, warehouses, garages, machine shops, and recreational facilities that are not an integral part of the industrial plant, substation, or control center. (240) (CMP-10)

Information Technology Equipment (ITE). Equipment and systems rated 1000 volts or less, normally found in offices or other business establishments and similar environments classified as ordinary locations, that are used for creation and manipulation of data, voice, video, and similar signals that are not communications equipment and do not process communications circuits. (CMP-12)

Informational Note: See UL 60950-1, Information Technology Equipment — Safety — Part 1: General Requirements, or UL 62368-1, Audio/Video Information and Communication Technology Equipment Part 1: Safety Requirements, for information on listing requirements for both information technology equipment and communications equipment.

Information Technology Equipment Room. A room within the information technology equipment area that contains the information technology equipment. [**75**:3.3.15] (CMP-12)

Innerduct. A nonmetallic raceway placed within a larger raceway. (CMP-16)

Insulated Bus Pipe (IBP). A cylindrical solid or hollow conductor with a solid insulation system, having conductive grading layers and a grounding layer imbedded in the insulation, and provided with an overall covering of insulating or metallic material. IBP is also referred to as tubular covered conductor (TCC). (CMP-8)

Insulated Bus Pipe System. An assembly that includes bus pipe, connectors, fittings, mounting structures, and other fittings and accessories. (CMP-8)

Insulating End. An insulator designed to electrically insulate the end of a flat conductor cable (Type FCC). (324) (CMP-6)

Interactive Mode. The operating mode for power production equipment or microgrids that operate in parallel with and are capable of delivering energy to an electric power production and distribution network or other primary source. (CMP-4)

Informational Note: Interactive mode is an operational mode of both interactive systems and of equipment such as interactive inverters.

Interrupting Rating. The highest current at rated voltage that a device is identified to interrupt under standard test conditions. (CMP-10)

Informational Note: Equipment intended to interrupt current at other than fault levels may have its interrupting rating implied in other ratings, such as horsepower or locked rotor current.

Intersystem Bonding Termination (IBT). A device that provides a means for connecting intersystem bonding conductors for communications systems to the grounding electrode system. (CMP-16)

Intrinsic Safety "i". Type of protection where any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under prescribed test conditions. (CMP-14)

Informational Note: See ANSI/UL 913, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations; and ANSI/UL 60079-11, Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i", for additional information.

Intrinsically Safe Apparatus. Apparatus in which all the circuits are intrinsically safe. (CMP-14)

Informational Note No. 1: See ANSI/UL 913, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations, and ANSI/UL 60079-11, Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i", for additional information.

Informational Note No. 2: See ANSI/ISA RP 12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation — Part 1: Intrinsic Safety, for installation information.

Intrinsically Safe Circuit. A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under prescribed test conditions. (CMP-14)

Informational Note: See ANSI/UL 913, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations, and ANSI/UL 60079-11, Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i", for test conditions.

Intrinsically Safe Circuits, Different. (Different Intrinsically Safe Circuits) Intrinsically safe circuits in which the possible interconnections have not been evaluated and identified as intrinsically safe. (CMP-14)

Informational Note: See ANSI/UL 913, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations, and ANSI/UL 60079-11, Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i", for additional information.

Intrinsically Safe System. An assembly of interconnected intrinsically safe apparatus, associated apparatus, and interconnecting cables, in which those parts of the system that might be used in hazardous (classified) locations are intrinsically safe circuits. (CMP-14)

Informational Note No. 1: An intrinsically safe system might include more than one intrinsically safe circuit.

Informational Note No. 2: See ANSI/UL 913, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations; ANSI/UL 60079-11, Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i"; and ANSI/UL 60079-25, Explosive Atmospheres — Part 25: Intrinsically Safe Electrical Systems, for additional information.

Informational Note No. 3: See ANSI/ISA RP 12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation — Part 1: Intrinsic Safety, for installation information.

Invasive Procedure. Any procedure that penetrates the protective surfaces of a patient's body (i.e., skin, mucous membrane, cornea) and that is performed with an aseptic field (procedural site). [Not included in this category are placement of peripheral intravenous needles or catheters used to administer fluids and/or medications, gastrointestinal endoscopies (i.e., sigmoidoscopies), insertion of urethral catheters, and other similar procedures.] [**99**:3.3.91] (517) (CMP-15)

Inverter. Equipment that changes dc to ac. (CMP-4)

Inverter, Interactive. (Interactive Inverter) Inverter equipment having the capability to operate only in interactive mode. (CMP-13)

Inverter, Multimode. (Multimode Inverter) Inverter equipment capable of operating in both interactive and island modes. (CMP-4)

Inverter, Stand-alone. (Stand-alone Inverter) Inverter equipment having the capabilities to operate only in island mode. (CMP-4)

Inverter Input Circuit. Conductors connected to the dc input of an inverter. (CMP-13)

Inverter Output Circuit. Conductors connected to the ac output of an inverter. (CMP-13)

Inverter Utilization Output Circuit. Conductors between the multimode or stand-alone inverter and utilization equipment. (706) (CMP-13)

Irrigation Machine. An electrically driven or controlled machine, with one or more motors, not hand-portable, and used primarily to transport and distribute water for agricultural purposes. (675) (CMP-7)

Irrigation Machine, Center Pivot. (Center Pivot Irrigation Machine) A multimotored irrigation machine that revolves around a central pivot and employs alignment switches or similar devices to control individual motors. (675) (CMP-7)

Island Mode. The operating mode for power production equipment or microgrids that allows energy to be supplied to loads that are disconnected from an electric power production and distribution network or other primary power source. (CMP-4)

Isolated (as applied to location). Not readily accessible to persons unless special means for access are used. (CMP-1)

Isolated Power System. A system comprising an isolation transformer or its equivalent, a line isolation monitor, and its ungrounded circuit conductors. [**99**:3.3.93] (517) (CMP-15)

Isolation Transformer. A transformer of the multiple-winding type, with the primary and secondary windings physically separated, that inductively couples its ungrounded secondary winding to the grounded feeder system that energizes its primary winding. [**99**:3.3.94] (517) (CMP-15)

Kitchen. An area with a sink and permanent provisions for food preparation and cooking. (CMP-2)

Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner. (CMP-1)

Informational Note: If a listed product is of such a size, shape, material, or surface texture that it is not possible to apply legibly the complete label to the product, the complete label may appear on the smallest unit container in which the product is packaged.

Laundry Area. An area containing or designed to contain a laundry tray, clothes washer, or clothes dryer. (CMP-2)

Leakage-Current Detector-Interrupter (LCDI). A device provided in a power supply cord or cord set that senses leakage current flowing between or from the cord conductors and interrupts the circuit at a predetermined level of leakage current. (440) (CMP-11)

LED Sign Illumination System. A complete lighting system for use in signs and outline lighting consisting of light-emitting diode (LED) light sources, power supplies, wire, and connectors to complete the installation. (600) (CMP-18)

Legally Required Standby Systems. Those systems required and so classed as legally required standby by municipal, state, federal, or other codes or by any governmental agency having jurisdiction. These systems are intended to automatically supply power to selected loads (other than those classed as emergency systems) in the event of failure of the normal source. (CMP-13)

Life Safety Branch. A system of feeders and branch circuits supplying power for lighting, receptacles, and equipment essential for life safety that is automatically connected to alternate power sources by one or more transfer switches during interruption of the normal power source. [**99**:3.3.97] (517) (CMP-15)

Lighting Assembly, Cord-and-Plug-Connected. (Cord-and-Plug-Connected Lighting Assembly) A lighting assembly consisting of a luminaire intended for installation in the wall of a spa, hot tub, or storable pool, and a cord-and-plug-connected transformer or power supply. (680) (CMP-17)

Lighting Assembly, Through-Wall. (Through-Wall Lighting Assembly) A lighting assembly intended for installation above grade, on or through the wall of a pool, consisting of two interconnected groups of components separated by the pool wall. (680) (CMP-17)

Lighting Outlet. An outlet intended for the direct connection of a lampholder or luminaire. (CMP-18)

Lighting Track (Track Lighting). A manufactured assembly designed to support and energize luminaires that are capable of being readily repositioned on the track. Its length can be altered by the addition or subtraction of sections of track. (CMP-18)

Limited Care Facility. A building or portion of a building used on a 24-hour basis for the housing of four or more persons who are incapable of self-preservation because of age; physical limitation due to accident or illness; or limitations such as intellectual disability/developmental disability, mental illness, or chemical dependency. [**101**:3.3.93.2] (CMP-15)

Limited Finishing Workstation. A power-ventilated apparatus that is capable of confining the vapors, mists, residues, dusts, or deposits that are generated by a limited spray application process. Such apparatus is not a spray booth or spray room, as herein defined. [**33**:3.3.23.1] (CMP-14)

Informational Note: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials, Section 14.3, for information on limited finishing workstations.

Line Isolation Monitor. A test instrument designed to continually check the balanced and unbalanced impedance from each line of an isolated circuit to ground and equipped with a built-in test circuit to exercise the alarm without adding to the leakage current hazard. [**99**:3.3.99] (517) (CMP-15)

Liquid Immersion "o". Type of protection where electrical equipment is immersed in a protective liquid so that an explosive atmosphere that might be above the liquid or outside the enclosure cannot be ignited. (CMP-14)

Informational Note: See ANSI/UL 60079-6, Explosive Atmospheres — Part 6: Equipment Protection by Liquid Immersion "o", for additional information.

Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose. (CMP-1)

Informational Note: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. Use of the system employed by the listing organization allows the authority having jurisdiction to identify a listed product.

Typically, a listed product is complete in nature in that it can be installed in an electrical system by following the installation *Code*. A listed product typically does not require specific conditions of acceptance to be provided. See the editorial added definitions of Classified and Recognized Component.

Live Parts. Energized conductive components. (CMP-1)

Load Management. The process within an energy management system that limits the total electrical load on an electrical supply system to a set value by adjusting or controlling the individual loads. (625) (CMP-12)

Informational Note: Load management is sometimes called demand-side management (DSM).

Location, Anesthetizing. (Anesthetizing Location) Any space within a facility that has been designated for the administration of any flammable or nonflammable inhalation anesthetic agent during examination or treatment, including the use of such agents for relative analgesia. (517) (CMP-15)

Location, Anesthetizing, Flammable. (Flammable Anesthetizing Location) Any area of the facility that has been designated to be used for the administration of any flammable inhalation anesthetic agents in the normal course of examination or treatment. (517) (CMP-15)

Location, Damp. (Damp Location) Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture. (CMP-1)

Informational Note: Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses.

Location, Dry. (Dry Location) A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction. (CMP-1)

Location, Remote. (Remote Location) A location, other than a motion picture or television studio, where a production is filmed or recorded. (530) (CMP-15)

Location, Wet. (Wet Location) A location that is one or more of the following:

(1) Unprotected and exposed to weather
(2) Subject to saturation with water and other liquids
(3) Underground
(4) In concrete slabs or masonry in direct contact with the earth

(CMP-1)

Informational Note: A vehicle washing area is an example of a wet location saturated with water or other liquids.

Location, Wet Procedure. (Wet Procedure Location) The area in a patient care space where a procedure is performed that is normally subject to wet conditions while patients are present, including standing fluids on the floor or drenching of the work area, either of which condition is intimate to the patient or staff. [**99**:3.3.187] (517) (CMP-15)

Informational Note: Routine housekeeping procedures and incidental spillage of liquids do not define a wet procedure location. [**99**:A.3.3.187]

Locations, Hazardous (Classified). [Hazardous (Classified) Locations] Locations where fire or explosion hazards might exist due to flammable gases, flammable liquid–produced vapors, combustible liquid–produced vapors, combustible dusts, combustible fiber/flyings, or ignitible fibers/flyings. (CMP-14)

Locations, Unclassified. (Unclassified Locations) Locations determined to be neither Class I, Division 1; Class I, Division 2; Zone 0; Zone 1; Zone 2; Class II, Division 1; Class II, Division 2; Class III, Division 1; Class III, Division 2; Zone 20; Zone 21; Zone 22; nor any combination thereof. (CMP-14)

Long-Time Rating. A rating based on an operating interval of 5 minutes or longer. (660) (CMP-12)

Long-Time Rating (Standby Power). A rating based on an operating interval of 5 minutes or longer. (517) (CMP-15)

Loudspeaker (Speaker). Equipment that converts an ac electric signal into an acoustic signal. (640) (CMP-12)

Low-Voltage Contact Limit. A voltage not exceeding the following values:

(1) 15 volts (RMS) for sinusoidal ac
(2) 21.2 volts peak for nonsinusoidal ac
(3) 30 volts for continuous dc
(4) 12.4 volts peak for dc that is interrupted at a rate of 10 to 200 Hz

(680) (CMP-17)

Low-Voltage Suspended Ceiling Power Distribution System. A system that serves as a support for a finished ceiling surface and consists of a busbar and busbar support system to distribute power to utilization equipment supplied by a Class 2 power supply. (393) (CMP-18)

Luminaire. A complete lighting unit consisting of a light source such as a lamp or lamps, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light. A lampholder itself is not a luminaire. (CMP-18)

Luminaire, Dry-Niche. (Dry-Niche Luminaire) A luminaire intended for installation in the floor or wall of a pool, spa, or fountain in a niche that is sealed against the entry of water. (680) (CMP-17)

Luminaire, No-Niche. (No-Niche Luminaire) A luminaire intended for installation above or below the water without a niche. (680) (CMP-17)

Luminaire, Wet-Niche. (Wet-Niche Luminaire) A luminaire intended for installation in a forming shell mounted in a pool or fountain structure where the luminaire will be completely surrounded by water. (680) (CMP-17)

Machine Room. An enclosed machinery space outside the hoistway, intended for full bodily entry, that contains the electrical driving machine or the hydraulic machine. The room could also contain electrical and/or mechanical equipment used directly in connection with the elevator or dumbwaiter. (620) (CMP-12)

Machine Room and Control Room, Remote. (Remote Machine Room and Control Room) A machine room or control room that is not attached to the outside perimeter or surface of the walls, ceiling, or floor of the hoistway. (620) (CMP-12)

Machinery, Industrial (Industrial Machine). (Industrial Machinery) A power-driven machine (or a group of machines working together in a coordinated manner), not portable by hand while working, that is used to process material by cutting; forming; pressure; electrical, thermal, or optical techniques; lamination; or a combination of these processes. It can include associated equipment used to transfer material or tooling, including fixtures, to assemble/disassemble, to inspect or test, or to package. The associated electrical equipment, including the logic controller(s) and associated software or logic together with the machine actuators and sensors, are considered as part of the industrial machine. (CMP-12)

Machinery Space. A space inside or outside the hoistway, intended to be accessed with or without full bodily entry, that contains the elevator, dumbwaiter, platform lift, or stairway chairlift equipment and could also contain equipment used directly in connection with the elevator, dumbwaiter, platform lift, or stairway chairlift. (620) (CMP-12)

Machinery Space and Control Space, Remote. (Remote Machinery Space and Control Space) A machinery space or control space that is not within the hoistway, machine room, or control room and that is not attached to the outside perimeter or surface of the walls, ceiling, or floor of the hoistway. (620) (CMP-12)

Manufactured Home. A structure, transportable in one or more sections, which in the traveling mode is 2.4 m (8 ft) or more in width or 12.2 m (40 ft) or more in length, or when erected on site is 29.77 m2 (320 ft2) or more is built on a permanent chassis and is designed to be used as a dwelling with or without a permanent foundation, whether or not connected to the utilities, and includes plumbing, heating, air conditioning, and electrical systems contained therein. The term includes any structure that meets all the requirements of this paragraph except the size requirements and with respect to which the manufacturer voluntarily files a certification required by the regulatory agency. Calculations used to determine the number of square meters (square feet) in a structure are based on the structure's exterior dimensions and include all expandable rooms, cabinets, and other projections containing interior space, but do not include bay windows. [**501**:1.2.12] (CMP-7)

Informational Note No. 1: Unless otherwise indicated, the term mobile home includes manufactured home and excludes park trailers.

Informational Note No. 2: See the applicable building code for definition of the term permanent foundation.

Informational Note No. 3: See 24 CFR Part 3280, Manufactured Home Construction and Safety Standards, of the Federal Department of Housing and Urban Development, for additional information on the definition.

Manufactured Wiring System. A system containing component parts that are assembled in the process of manufacture and cannot be inspected at the building site without damage or destruction to the assembly and used for the connection of luminaires, utilization equipment, continuous plug-in type busways, and other devices. (604) (CMP-7)

Marina. A facility, generally on the waterfront, that stores and services boats in berths, on moorings, and in dry storage or dry stack storage. [**303**:3.3.13] (555) (CMP-7)

Maximum Output Power. The maximum power delivered by an amplifier into its rated load as determined under specified test conditions. (640) (CMP-12)

Informational Note: The maximum output power can exceed the manufacturer's rated output power for the same amplifier.

Maximum Output Power. The maximum 1 minute average power output a wind turbine produces in normal steady-state operation (instantaneous power output can be higher). (694) (CMP-4)

Maximum Voltage. The greatest difference in potential produced between any two conductors of a wind turbine circuit. (694) (CMP-4)

Maximum Water Level. The highest level that water can reach before it spills out. (680) (CMP-17)

Medical Office. A building or part thereof in which the following occur:

Examinations and minor treatments/procedures performed under the continuous supervision of a medical professional;

The use of limited to minimal sedation and treatment or procedures that do not render the patient incapable of self-preservation under emergency conditions; and

No overnight stays for patients or 24-hour operations.

[**99**:3.3.110] (CMP-15)

Membrane Enclosure. A temporary enclosure used for the spraying of workpieces that cannot be moved into a spray booth where open spraying is not practical due to proximity to other operations, finish quality, or concerns such as the collection of overspray. (CMP-14)

Informational Note: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials, Chapter 18, for information on the construction and use of membrane enclosures.

Messenger-Supported Wiring. An exposed wiring support system using a messenger wire to support insulated conductors by any one of the following:

(1) A messenger with rings and saddles for conductor support
(2) A messenger with a field-installed lashing material for conductor support
(3) Factory-assembled aerial cable
(4) Multiplex cables utilizing a bare conductor, factory assembled and twisted with one or more insulated conductors, such as duplex, triplex, or quadruplex type of construction

(CMP-6)

Messenger Wire (Messenger). A wire that is run along with or integral with a cable or conductor to provide mechanical support for the cable or conductor. (CMP-6)

Metal Shield Connections. Means of connection for flat conductor cables (Type FCC) designed to electrically and mechanically connect a metal shield to another metal shield, to a receptacle housing or self-contained device, or to a transition assembly. (324) (CMP-6)

Microgrid. An electric power system capable of operating in island mode and capable of being interconnected to an electric power production and distribution network or other primary source while operating in interactive mode, which includes the ability to disconnect from and reconnect to a primary source and operate in island mode. (CMP-4)

Informational Note No. 1: See IEEE 1547, IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interface; IEEE 2030.7, IEEE Standard for the Specification of Microgrid Controllers; IEEE 2030.8, IEEE Standard for the Testing of Microgrid Controllers; and UL1008B, Outline for Source Interconnection, for additional information about microgrids.

Informational Note No. 2: Examples of power sources in microgrids include such items as photovoltaic systems, generators, fuel cell systems, wind electric systems, energy storage systems, electric vehicles that are used as a source of supply, and electrical power conversion from other energy sources.

Microgrid, Health Care (Health Care Microgrid System). (Health Care Microgrid) A group of interconnected loads and distributed energy resources within clearly defined boundaries that acts as a single controllable entity with respect to the utility. [**99**:3.3.75] (517) (CMP-15)

Microgrid Control System (MCS). A structured control system that manages microgrid operations, functionalities for utility interoperability, islanded operations, and transitions. (CMP-4)

Informational Note: MCS differ from multiple standby generators or uninterruptible power supplies that are evaluated and rated to operate as a single source of backup power upon loss of the primary power source. MCS functions include coordination, transitions, and interoperability between multiple power sources.

Microgrid Interconnect Device (MID). A device that enables a microgrid system to separate from and reconnect to an interconnected primary power source. (CMP-4)

Mixer. Equipment used to combine and level match a multiplicity of electronic signals, such as from microphones, electronic instruments, and recorded audio. (640) (CMP-12)

Mobile. X-ray equipment mounted on a permanent base with wheels and/or casters for moving while completely assembled. (660) (CMP-12)

Mobile Home. A factory-assembled structure or structures transportable in one or more sections that are built on a permanent chassis and designed to be used as a dwelling without a permanent foundation where connected to the required utilities and that include the plumbing, heating, air-conditioning, and electrical systems contained therein. (CMP-7)

Informational Note: Unless otherwise indicated, the term mobile home includes manufactured home and excludes park trailers.

Mobile Home Lot. A designated portion of a mobile home park designed for the accommodation of one mobile home and its accessory buildings or structures for the exclusive use of its occupants. (550) (CMP-7)

Mobile Home Park. A contiguous parcel of land that is used for the accommodation of mobile homes that are intended to be occupied. (550) (CMP-7)

Module, AC. (AC Module) A complete, environmentally protected unit consisting of solar cells, inverter, and other components, designed to produce ac power. (690) (CMP-4)

Module System, AC. (AC Module System) An assembly of ac modules, wiring methods, materials, and subassemblies that are evaluated, identified, and defined as a system. (690) (CMP-4)

Momentary Rating. A rating based on an operating interval that does not exceed 5 seconds. (660) (CMP-12)

Momentary Rating (Maximum Power). A rating based on an operating interval that does not exceed 5 seconds. (517) (CMP-15)

Monitor. An electrical or electronic means to observe, record, or detect the operation or condition of the electric power system or apparatus. (750) (CMP-13)

Monopole Circuit. An electrical subset of a PV system that has two conductors in the output circuit, one positive (+) and one negative (−). (690) (CMP-4)

Monorail. Overhead track and hoist system for moving material around the boatyard or moving and launching boats. [**303**:3.3.16] (555) (CMP-7)

Mooring(s). Any place where a boat is wet stored or berthed. [**303**:3.3.17] (555) (CMP-7)

Motion Picture Studio (Television Studio). A building, group of buildings, other structures, and outdoor areas designed, constructed, permanently altered, designated, or approved for the purpose of motion picture or television production. (530) (CMP-15)

Motor Control Center. An assembly of one or more enclosed sections having a common power bus and principally containing motor control units. (CMP-11)

Motor Fuel Dispensing Facility. That portion of a property where motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles or marine craft or into approved containers, including all equipment used in connection therewith. [**30A**:3.3.11] (CMP-14)

Informational Note: See 511.1 with respect to electrical wiring and equipment for other areas used as lubritoriums, service rooms, repair rooms, offices, salesrooms, compressor rooms, and similar locations.

Multi-Circuit Cable Outlet Enclosure. An enclosure containing one or more multi-circuit plugs, receptacles, or both. (520) (CMP-15)

Multioutlet Assembly. A surface, flush, or freestanding assemblage with a raceway and fittings or other enclosure provided with one or more receptacles, for the purpose of supplying power to utilization equipment. (CMP-18)

Nacelle. An enclosure housing the alternator and other parts of a wind turbine. (694) (CMP-4)

Neon Tubing. Electric-discharge luminous tubing, including cold cathode luminous tubing, that is manufactured into shapes to illuminate signs, form letters, parts of letters, skeleton tubing, outline lighting, other decorative elements, or art forms and filled with various inert gases. (600) (CMP-18)

Network Interface Unit (NIU). A device that converts a broadband signal into component voice, audio, video, data, and interactive services signals and provides isolation between the network power and the premises signal circuits. These devices often contain primary and secondary protectors. (CMP-16)

Network Terminal. A device that converts network-provided signals (optical, electrical, or wireless) into component signals, including voice, audio, video, data, wireless, optical, and interactive services, and is considered a network device on the premises that is connected to a communications service provider and is powered at the premises. (CMP-16)

Neutral Conductor. The conductor connected to the neutral point of a system that is intended to carry current under normal conditions. (CMP-5)

Neutral Point. The common point on a wye-connection in a polyphase system or midpoint on a single-phase, 3-wire system, or midpoint of a single-phase portion of a 3-phase delta system, or a midpoint of a 3-wire, direct-current system. (CMP-5)

Informational Note: At the neutral point of the system, the vectorial sum of the nominal voltages from all other phases within the system that utilize the neutral, with respect to the neutral point, is zero potential.

Nonautomatic. Requiring human intervention to perform a function. (CMP-1)

Nonincendive Circuit. A circuit, other than field wiring, in which any arc or thermal effect produced under intended operating conditions of the equipment, is not capable, under specified test conditions, of igniting the flammable gas–air, vapor–air, or dust–air mixture. (CMP-14)

Informational Note: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Nonincendive Component. A component having contacts for making or breaking an incendive circuit and the contacting mechanism is constructed so that the component is incapable of igniting the specified flammable gas–air or vapor–air mixture. The housing of such a component is not intended to exclude the flammable atmosphere or contain an explosion. (CMP-14)

Informational Note: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Nonincendive Equipment. Equipment having electrical/electronic circuitry that is incapable, under normal operating conditions, of causing ignition of a specified flammable gas–air, vapor–air, or dust–air mixture due to arcing or thermal means. (CMP-14)

Informational Note: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Nonincendive Field Wiring. Wiring that enters or leaves an equipment enclosure and, under normal operating conditions of the equipment, is not capable, due to arcing or thermal effects, of igniting the flammable gas–air, vapor–air, or dust–air mixture. Normal operation includes opening, shorting, or grounding the field wiring. (CMP-14)

Informational Note: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Nonincendive Field Wiring Apparatus. Apparatus intended to be connected to nonincendive field wiring. (CMP-14)

Informational Note: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Nonlinear Load. A load where the wave shape of the steady-state current does not follow the wave shape of the applied voltage. (CMP-1)

Informational Note: Electronic equipment, electronic/electric-discharge lighting, adjustable-speed drive systems, and similar equipment may be nonlinear loads.

Nonmetallic Extension. An assembly of two insulated conductors within a nonmetallic jacket or an extruded thermoplastic covering. The classification includes surface extensions intended for mounting directly on the surface of walls or ceilings. (CMP-6)

Nonsparking. Constructed to minimize the risk of arcs or sparks capable of creating an ignition hazard during conditions of normal operation. (CMP-14)

Informational Note: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Normal/Emergency Power Source. A power source on the output side of a transfer switch or uninterruptible power supply that is automatically available upon loss of normal power. (700) (CMP-13).

Normal High-Water Level (as applies to electrical datum plane distances). Natural or Artificially Made Shorelines: An elevation delineating the highest water level that has been maintained for a sufficient period of time to leave evidence upon the landscape, commonly the point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial.

Rivers and Streams: The elevation of the top of the bank of the channel. Streams, rivers, and tributaries that are prone to flooding and effects of water runoff shall consider the "bankfull stage" where an established gauge height at a given location along a river or stream, above which a rise in water surface will cause the river or stream to overflow the lowest natural stream bank somewhere in the corresponding reach.

Flood Control Bodies of Water: The flood pool maximum water surface elevation of a reservoir, equal to the elevation of the spillway.

Nonflood Control Bodies of Water: The flowage easement boundary in which the highest water surface elevation defined by the area existing between governmental-owned property line(s) and a contour line with perpetual rights to flood the area in connection with the operation of the reservoir.

(CMP-7)

Nurses' Station. A space intended to provide a center of nursing activity for a group of nurses serving bed patients, where patient calls are received, nurses dispatched, nurses' notes written, inpatient charts prepared, and medications prepared for distribution to patients. Where such activities are carried on in more than one location within a nursing unit, all such separate spaces are considered a to be parts of the nurses' station. (517) (CMP-15)

Nursing Home. A building or portion of a building used on a 24-hour basis for the housing and nursing care of four or more persons who, because of mental or physical incapacity, might be unable to provide for their own needs and safety without the assistance of another person. [**101**:3.3.150.2] (CMP-15)

Office Furnishing. Cubicle panels, partitions, study carrels, workstations, desks, shelving systems, and storage units that may be mechanically and electrically interconnected to form an office furnishing system. (CMP-18)

Oil Immersion. Electrical equipment immersed in a protective liquid so that an explosive atmosphere that might be above the liquid or outside the enclosure cannot be ignited. (CMP-14)

Informational Note: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Open Wiring on Insulators. An exposed wiring method using cleats, knobs, tubes, and flexible tubing for the protection and support of single insulated conductors run in or on buildings. (CMP-6)

Operating Device. The car switch, pushbuttons, key or toggle switch(s), or other devices used to activate the operation controller. (620) (CMP-12)

Operator. The individual responsible for starting, stopping, and controlling an amusement ride or supervising a concession. (525) (CMP-15)

Optical Radiation. Electromagnetic radiation at wavelengths in vacuum between the region of transition to X-rays and the region of transition to radio waves that is approximately between 1 nm and 1000 µm. (CMP-14)

Informational Note: See ANSI/UL 60079-28, Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, for information on types of protection that can be applied to minimize the risk of ignition in explosive atmospheres from optical radiation in the wavelength range from 380 nm to 10 µm.

Optical Radiation, Inherently Safe "op is". (Inherently Safe Optical Radiation "op is") Type of protection to minimize the risk of ignition in explosive atmospheres from optical radiation where visible or infrared radiation is incapable of producing sufficient energy under normal or specified fault conditions to ignite a specific explosive atmosphere. (CMP-14)

Informational Note: See ANSI/UL 60079-28, Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, for additional information.

Optical Radiation, Protected "op pr". (Protected Optical Radiation "op pr") Type of protection to minimize the risk of ignition in explosive atmospheres from optical radiation where visible or infrared radiation is confined inside optical fiber or other transmission medium under normal constructions or constructions with additional mechanical protection based on the assumption that there is no escape of radiation from the confinement. (CMP-14)

Informational Note: See ANSI/UL 60079-28, Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, for additional information.

Optical System With Interlock "op sh". Type of protection to minimize the risk of ignition in explosive atmospheres from optical radiation where visible or infrared radiation is confined inside optical fiber or other transmission medium with interlock cutoff provided to reliably reduce the unconfined beam strength to safe levels within a specified time in case the confinement fails and the radiation becomes unconfined. (CMP-14)

Informational Note: See ANSI/UL 60079-28, Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, for additional information.

Optional Standby Systems. Those systems intended to supply power to public or private facilities or property where life safety does not depend on the performance of the system. These systems are intended to supply on-site generated or stored power to selected loads either automatically or manually. (CMP-13)

Organ, Electronic. (Electronic Organ) A musical instrument that imitates the sound of a pipe organ by producing sound electronically. (CMP-12)

Informational Note: Most new electronic organs produce sound digitally and are called digital organs.

Organ, Pipe. (Pipe Organ) A musical instrument that produces sound by driving pressurized air (called wind) through pipes selected via a keyboard. (CMP-12)

Organ, Pipe Sounding Apparatus. (Pipe Organ Sounding Apparatus) (Pipe Organ Chamber). The sound-producing part of a pipe organ, including, but not limited to, pipes, chimes, bells, the pressurized air- (wind-) producing equipment (blower), associated controls, and power equipment. (CMP-12)

Outlet. A point on the wiring system at which current is taken to supply utilization equipment. (CMP-1)

Outlet Box Hood. A housing shield intended to fit over a faceplate for flush-mounted wiring devices, or an integral component of an outlet box or of a faceplate for flush-mounted wiring devices. The hood does not serve to complete the electrical enclosure; it reduces the risk of water coming in contact with electrical components within the hood, such as attachment plugs, current taps, surge protective devices, direct plug-in transformer units, or wiring devices. (CMP-18)

Outline Lighting. An arrangement of incandescent lamps, electric-discharge lighting, or other electrically powered light sources to outline or call attention to certain features such as the shape of a building or the decoration of a window. (CMP-18)

Output Cable to the Electric Vehicle. An assembly consisting of a length of flexible EV cable and an electric vehicle connector (supplying power to the electric vehicle). (625) (CMP-12)

Output Cable to the Primary Pad. A multiconductor, shielded cable assembly consisting of conductors to carry the high-frequency energy and any status signals between the charger power converter and the primary pad. (625) (CMP-12)

Overcurrent. Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault. (CMP-10)

Informational Note: A current in excess of rating may be accommodated by certain equipment and conductors for a given set of conditions. Therefore, the rules for overcurrent protection are specific for particular situations.

Overcurrent Protective Device, Branch-Circuit. (Branch-Circuit Overcurrent Protective Device) A device capable of providing protection for service, feeder, and branch circuits and equipment over the full range of overcurrents between its rated current and its interrupting rating. (CMP-10)

Overcurrent Protective Device, Current-Limiting. (Current-Limiting Overcurrent Protective Device) A device that, when interrupting currents in its current-limiting range, reduces the current flowing in the faulted circuit to a magnitude substantially less than that obtainable in the same circuit if the device were replaced with a solid conductor having comparable impedance. (240) (CMP-10)

Overcurrent Protective Device, Supplementary. (Supplementary Overcurrent Protective Device) A device intended to provide limited overcurrent protection for specific applications and utilization equipment such as luminaires and appliances. This limited protection is in addition to the protection provided in the required branch circuit by the branch-circuit overcurrent protective device. (CMP-10)

Overhead Gantry. A structure consisting of horizontal framework, supported by vertical columns spanning above electrified truck parking spaces, that supports equipment, appliances, raceway, and other necessary components for the purpose of supplying electrical, HVAC, internet, communications, and other services to the spaces. (626) (CMP-12)

Overload. Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of its ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload. (CMP-10)

Packaged Therapeutic Tub or Hydrotherapeutic Tank Equipment Assembly. A factory-fabricated unit consisting of water-circulating, heating, and control equipment mounted on a common base, intended to operate a therapeutic tub or hydrotherapeutic tank. Equipment can include pumps, air blowers, heaters, lights, controls, sanitizer generators, and so forth. (680) (CMP-17)

Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet, enclosure, or cutout box placed in or against a wall, partition, or other support; and accessible only from the front. (CMP-9)

Panelboard, Enclosed. (Enclosed Panelboard) An assembly of buses and connections, overcurrent devices, and control apparatus with or without switches or other equipment, installed in a cabinet, cutout box, or enclosure suitable for a panelboard application. (CMP-9)

Park Electrical Wiring Systems. All of the electrical wiring, luminaires, equipment, and appurtenances related to electrical installations within a mobile home park, including the mobile home service equipment. (550) (CMP-7)

Park Trailer. A unit that is built on a single chassis mounted on wheels and has a gross trailer area not exceeding 37 m2 (400 ft2) in the set-up mode. (552) (CMP-7)

Part-Winding Motors. A part-winding start induction or synchronous motor is one that is arranged for starting by first energizing part of its primary (armature) winding and, subsequently, energizing the remainder of this winding in one or more steps. A standard part-winding start induction motor is arranged so that one-half of its primary winding can be energized initially, and, subsequently, the remaining half can be energized, both halves then carrying equal current. (CMP 11)

Informational Note: A hermetic refrigerant motor-compressor is not considered a standard part-winding start induction motor.

Passenger Transportation Facilities. Any area open to the public associated with passenger transportation such as an airport, bus terminal, highway rest stop and service area, marina, seaport, ferry slip, subway station, train station, or port of entry. (CMP-18)

Patient Bed Location. The location of a patient sleeping bed, or the bed or procedure table of a Category 1 space. [**99**:3.3.138] (CMP-15)

Patient Care–Related Electrical Equipment. Electrical equipment appliance that is intended to be used for diagnostic, therapeutic, or monitoring purposes in a patient care vicinity. [**99**:3.3.139] (517) (CMP-15)

Patient Care Space Category. Any space of a health care facility wherein patients are intended to be examined or treated. [**99**:3.3.140] (517) (CMP-15)

Informational Note No. 1: The health care facility's governing body designates patient care space in accordance with the type of patient care anticipated.

Informational Note No. 2: Business offices, corridors, lounges, day rooms, dining rooms, or similar areas typically are not classified as patient care spaces. [**99**:A.3.3.140]

Category 1 Space (Category 1). Space in which failure of equipment or a system is likely to cause major injury or death of patients, staff, or visitors. [**99**:3.3.140.1] (CMP-15)

Informational Note: These spaces, formerly known as critical care rooms, are typically where patients are intended to be subjected to invasive procedures and connected to line-operated, patient care–related appliances. Examples include, but are not limited to, special care patient rooms used for critical care, intensive care, and special care treatment rooms such as angiography laboratories, cardiac catheterization laboratories, delivery rooms, operating rooms, post-anesthesia care units, trauma rooms, and other similar rooms. [**99**:A.3.3.140.1]

Category 2 Space (Category 2). Space in which failure of equipment or a system is likely to cause minor injury to patients, staff, or visitors. [**99**:3.3.140.2] (CMP-15)

Informational Note: These spaces were formerly known as general care rooms. Examples include, but are not limited to, inpatient bedrooms, dialysis rooms, in vitro fertilization rooms, procedural rooms, and similar rooms. [**99**:A.3.3.140.2]

Category 3 Space (Category 3). Space in which the failure of equipment or a system is not likely to cause injury to patients, staff, or visitors but can cause discomfort. [**99**:3.3.140.3] (517) (CMP-15)

Informational Note: These spaces, formerly known as basic care rooms, are typically where basic medical or dental care, treatment, or examinations are performed. Examples include, but are not limited to, examination or treatment rooms in clinics, medical and dental offices, nursing homes, and limited care facilities. [**99**:A.3.3.140.3]

Category 4 Space (Category 4). Space in which failure of equipment or a system is not likely to have a physical impact on patient care. [**99**:3.3.140.4] (517) (CMP-15)

Informational Note: These spaces were formerly known as support rooms. Examples of support spaces include, but are not limited to, anesthesia work rooms, sterile supply, laboratories, morgues, waiting rooms, utility rooms, and lounges. [**99**:A.3.3.140.4]

Patient Care Vicinity. A space, within a location intended for the examination and treatment of patients, extending 1.8 m (6 ft) beyond the normal location of the bed, chair, table, treadmill, or other device that supports the patient during examination and treatment and extending vertically to 2.3 m (7 ft 6 in) above the floor. [**99**:3.3.141] (517) (CMP-15)

Patient Equipment Grounding Point. A jack or terminal that serves as the collection point for redundant grounding of electric appliances serving a patient care vicinity or for grounding other items in order to eliminate electromagnetic interference problems. [**99**:3.3.142] (517) (CMP-15)

Performance Area. The stage and audience seating area associated with a temporary stage structure, whether indoors or outdoors, constructed of scaffolding, truss, platforms, or similar devices, that is used for the presentation of theatrical or musical productions or for public presentations. (520) (CMP-15)

Permanent Amusement Attraction. A ride device, entertainment device, or a combination of both that is installed such that portability or relocation is impracticable. (522) (CMP-15)

Permanently Installed Decorative Fountains and Reflection Pools. Those that are constructed in the ground, on the ground, or in a building in such a manner that the fountain cannot be readily disassembled for storage, whether or not served by electrical circuits of any nature. These units are primarily constructed for their aesthetic value and are not intended for swimming or wading. (680) (CMP-17)

Personnel Protection System (as applied to EVSE). A system of personnel protection devices and constructional features that when used together provide protection against electric shock of personnel. (625) (CMP-12)

Phase, Manufactured. (Manufactured Phase) The phase that originates at the phase converter and is not solidly connected to either of the single-phase input conductors. (CMP-13)

Phase Converter. An electrical device that converts single-phase power to 3-phase electric power. (CMP-13)

Informational Note: Phase converters have characteristics that modify the starting torque and locked-rotor current of motors served, and consideration is required in selecting a phase converter for a specific load.

Phase Converter, Rotary. (Rotary-Phase Converter) A device that consists of a rotary transformer and capacitor panel(s) that permits the operation of 3-phase loads from a single-phase supply. (455) (CMP-13)

Phase Converter, Static. (Static-Phase Converter) A device without rotating parts, sized for a given 3-phase load to permit operation from a single-phase supply. (455) (CMP-13)

Photovoltaic Cell (PV). (Solar Cell). The basic photovoltaic device that generates dc electricity when exposed to light. (CMP-4)

Pier. A structure extending over the water and supported on a fixed foundation (fixed pier), or on flotation (floating pier), that provides access to the water. [**303**:3.3.18] (CMP-7)

Pier, Fixed. (Fixed Pier) Pier constructed on a permanent, fixed foundation, such as on piles, that permanently establishes the elevation of the structure deck with respect to land. [**303**:3.3.18.2] (CMP-7)

Pier, Floating. (Floating Pier) Pier designed with inherent flotation capability that allows the structure to float on the water surface and rise and fall with water level changes. [**303**:3.3.18.3] (CMP-7)

Pipeline. A length of pipe including pumps, valves, flanges, control devices, strainers, and/or similar equipment for conveying fluids. (CMP-17)

Plenum. A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system. (CMP-3)

Plenum Cable, Cable Routing Assemblies, and Raceways. Cables, cable routing assemblies, and raceways that have adequate fire-resistant and low smoke-producing characteristics and are suitable for use in ducts, plenums, and other spaces used for environmental air. (722) (CMP-3)

Point of Entrance. The point within a building at which the wire or cable emerges from an external wall, from the roof, or from a concrete floor slab. (CMP-16)

Pool. Manufactured or field-constructed equipment designed to contain water on a permanent or semipermanent basis and used by persons for swimming, wading, immersion, or therapeutic purposes, but not including bodies of water incorporated as part of an industrial process or lakes, lagoons, surf parks, or other natural and man-made bodies of water that may incorporate swimming and swimming areas. (680) (CMP-17)

Informational Note: Natural and man-made bodies of water, which includes lakes, lagoons, surf parks, or other similar bodies of water, are addressed in Article 682.

Pool, Immersion. (Immersion Pool) A pool for ceremonial or ritual immersion of users, which is designed and intended to have its contents drained or discharged. (680) (CMP-17)

Pool, Permanently Installed Swimming, Wading, Immersion, and Therapeutic. (Permanently Installed Swimming, Wading, Immersion, and Therapeutic Pools) Those that are constructed or installed in the ground or partially in the ground, and all pools installed inside of a building, whether or not served by electrical circuits of any nature. (680) (CMP-17)

Pool, Storable; used for Swimming, Wading, or Immersion (Storable Immersion Pool). (Storable Pool) Pools installed entirely on or above the ground that are intended to be stored when not in use and are designed for ease of relocation, regardless of water depth. (680) (CMP-17)

Pool Cover, Electrically Operated. (Electrically Operated Pool Cover) Motor-driven equipment designed to cover and uncover the water surface of a pool by means of a flexible sheet or rigid frame. (680) (CMP-17)

Pool Lift, Electrically Powered. (Electrically Powered Pool Lift) An electrically powered lift that provides accessibility for people with disabilities to and from a pool or spa. (680) (CMP-17)

Portable. A device intended for indoor or outdoor use that is designed to be hand-carried from location to location, or easily transported without the use of other devices or equipment. (625) (CMP-12)

Portable. X-ray equipment designed to be hand-carried. (660) (CMP-12)

Portable (as applied to equipment). Equipment that is actually moved or can easily be moved from one place to another in normal use. (680) (CMP-17)

Portable Power Distribution Unit. A power distribution box containing receptacles and overcurrent devices. (520) (CMP-15)

Informational Note: See ANSI/UL 1640, Portable Power-Distribution Equipment, for information on portable power distribution units.

Portable Structures. Units designed to be moved including, but not limited to, amusement rides, attractions, concessions, tents, trailers, trucks, and similar units. (525) (CMP-15)

Portable Substation. A portable assembly, usually mounted on a trailer, containing primary and secondary switchgear and a transformer. (530) (CMP-15)

Powder Filling "q". Type of protection where electrical parts capable of igniting an explosive atmosphere are fixed in position and completely surrounded by filling material (glass or quartz powder) to prevent the ignition of an external explosive atmosphere. (CMP-14)

Informational Note: See ANSI/UL 60079-5, Explosive Atmospheres — Part 5: Equipment protection by powder filling "q", for additional information.

Power Outlet. An enclosed assembly that may include receptacles, circuit breakers, fuseholders, fused switches, buses, and watt-hour meter mounting means; intended to supply and control power to mobile homes, recreational vehicles, park trailers, or boats or to serve as a means for distributing power required to operate mobile or temporarily installed equipment.(CMP-7)

Power Outlet, Marina. (Marina Power Outlet) An enclosed assembly that can include equipment such as receptacles, circuit breakers, fused switches, fuses, watt-hour meters, panelboards, and monitoring means identified for marina use. (555) (CMP-7)

Power Production Equipment. Electrical generating equipment supplied by any source other than a utility service, up to the source system disconnecting means. (CMP-4)

Informational Note: Examples of power production equipment include such items as generators, solar photovoltaic systems, and fuel cell systems.

Power Source Output Conductors. The conductors between power production equipment and the service or other premises wiring. (CMP-4)

Power Supply. A Class 2 power supply connected between the branch-circuit power distribution system and the busbar low-voltage suspended ceiling power distribution system. (393) (CMP-18)

Power-Supply Cord. An assembly consisting of an attachment plug and a length of flexible cord connected to utilization equipment. (CMP-6)

Premises. The land and buildings located on the user's side of the point of demarcation between the communications service provider and the user. (800) (CMP-16)

Premises-Powered. Using power provided locally from the premises. (CMP-16)

Premises Wiring (System). Interior and exterior wiring, including power, lighting, control, and signal circuit wiring together with all their associated hardware, fittings, and wiring devices, both permanently and temporarily installed. This includes one of the following:

Wiring from the service point or power source to the outlets

Wiring from and including the power source to the outlets where there is no service point

Such wiring does not include wiring internal to appliances, luminaires, motors, controllers, motor control centers, and similar equipment. (CMP-1)

Informational Note: Power sources include, but are not limited to, interconnected or stand-alone batteries, solar photovoltaic systems, other distributed generation systems, or generators.

Pressurized. The process of supplying an enclosure with a protective gas with or without continuous flow at sufficient pressure to prevent the entrance of combustible dust or ignitible fibers/flyings. (CMP-14)

Pressurized Enclosure "p". Type of protection for electrical equipment that uses the technique of guarding against the ingress of the external atmosphere, which might be explosive, into an enclosure by maintaining a protective gas therein at a pressure above that of the external atmosphere. (CMP-14)

Informational Note: See ANSI/UL-60079-2, Explosive Atmospheres — Part 2: Equipment protection by pressurized enclosures "p", for additional information.

Pressurized Room "p". A room volume protected by pressurization and of sufficient size to permit the entry of a person who might occupy the room. (CMP-14)

Informational Note: See ANSI/UL 60079-13, Explosive Atmospheres — Part 13: Equipment protection by pressurized room "p" and artificially ventilated room "v", for information on the requirements for rooms intended for human entry where pressurization is used as a means of reducing the risk of explosion.

Primary Pad. A device external to the EV that transfers power via the contactless coupling as part of a wireless power transfer system. (625) (CMP-12)

Primary Source. An electric utility or another source of power that acts as the main forming and stabilizing source in an electric power system. (CMP-4)

Prime Mover. The machine that supplies the mechanical horsepower to a generator. (CMP-13)

Process Seal. A seal between electrical systems and flammable or combustible process fluids where a failure could allow the migration of process fluids into the premises' wiring system. (CMP-14)

Informational Note: See ANSI/UL 122701, Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids, for additional information.

Production Areas. Areas where portable electrical equipment is used to implement the capture of images. (530) (CMP-15)

Projector, Nonprofessional. (Nonprofessional Projector) Those types of projectors that do not comply with the definition of Professional-Type Projector. (540) (CMP-15)

Projector, Professional-Type. (Professional-Type Projector) A type of projector using 35- or 70-mm film that has a minimum width of 35 mm (13⁄8 in) and has on each edge 212 perforations per meter (5.4 perforations per inch), or a type using carbon arc, xenon, or other light source equipment that develops hazardous gases, dust, or radiation. (540) (CMP-15)

Proscenium. The wall and arch that separates the stage from the auditorium (i.e., house). (520) (CMP-15)

Protection by Enclosure "t". Type of protection for explosive dust atmospheres where electrical equipment is provided with an enclosure providing dust ingress protection and a means to limit surface temperatures. (CMP-14)

Informational Note: See ANSI/UL 60079-31, Explosive Atmospheres — Part 31: Equipment Dust Ignition Protection by Enclosure "t", for additional information.

Psychiatric Hospital. A building used exclusively for the psychiatric care, on a 24-hour basis, of four or more inpatients. (517) (CMP-15)

Purged and Pressurized. The process of (1) purging, supplying an enclosure with a protective gas at a sufficient flow and positive pressure to reduce the concentration of any flammable gas or vapor initially present to an acceptable level; and (2) pressurization, supplying an enclosure with a protective gas with or without continuous flow at sufficient pressure to prevent the entrance of a flammable gas or vapor, a combustible dust, or an ignitible fiber. (CMP-14)

Informational Note: See NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment, for additional information.

Purpose-Built. A custom luminaire, a piece of lighting equipment, or an effect that is constructed for a specific purpose and is not serially manufactured or available for general sale. (530) (CMP-15)

PV DC Circuit (PV System DC Circuit). Any dc conductor in PV source circuits, PV string circuits, and PV dc-to-dc converter circuits. (690) (CMP-4)

PV DC Circuit, Source. (PV Source Circuit) The PV dc circuit conductors between modules in a PV string circuit, and from PV string circuits or dc combiners, to dc combiners, electronic power converters, or a dc PV system disconnecting means. (690) (CMP-4)

PV DC Circuit, String. (PV String Circuit) The PV source circuit conductors of one or more series-connected PV modules. (690) (CMP-4)

PV Module (Module). A complete, environmentally protected unit consisting of solar cells and other components designed to produce dc power. (CMP-4)

PV (Photovoltaic) System (PV System) (Photovoltaic System). The total components, circuits, and equipment up to and including the PV system disconnecting means that, in combination, convert solar energy into electric energy. (CMP-4)

Qualified Person. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. (CMP-1)

Informational Note: See NFPA 70E-2021, Standard for Electrical Safety in the Workplace, for electrical safety training requirements.

Raceway. An enclosed channel designed expressly for holding wires, cables, or busbars, with additional functions as permitted in this Code. (CMP-8)

Raceway Cell. A single enclosed tubular space in a cellular metal or concrete floor member, the axis of the cell being parallel to the axis of the floor member. (CMP-8)

Raceway, Cellular Metal Floor. (Cellular Metal Floor Raceway) The hollow spaces of cellular metal floors, together with suitable fittings, that may be approved as enclosed channel for electrical conductors. (CMP-8)

Raceway, Communications. (Communications Raceway) An enclosed channel of nonmetallic materials designed expressly for holding communications wires and cables; optical fiber cables; data cables associated with information technology and communications equipment; Class 2, Class 3, and Type PLTC cables; and power-limited fire alarm cables in plenum, riser, and general-purpose applications. (CMP-16)

Raceway, Strut-Type Channel. (Strut-Type Channel Raceway) A metal raceway that is intended to be mounted to the surface of or suspended from a structure, with associated accessories for the installation of electrical conductors and cables. (CMP-8)

Raceway, Surface Metal. (Surface Metal Raceway) A metal raceway that is intended to be mounted to the surface of a structure, with associated couplings, connectors, boxes, and fittings for the installation of electrical conductors. (CMP-8)

Raceway, Surface Nonmetallic. (Surface Nonmetallic Raceway) A nonmetallic raceway that is intended to be mounted to the surface of a structure, with associated couplings, connectors, boxes, and fittings for the installation of electrical conductors. (CMP-8)

Raceway, Underfloor. (Underfloor Raceway) A raceway and associated components designed and intended for installation beneath or flush with the surface of a floor for the installation of cables and electrical conductors. (CMP-8)

Rail. The structural support for the suspended ceiling system typically forming the ceiling grid supporting the ceiling tile and listed utilization equipment, such as sensors, actuators, A/V devices, and low-voltage luminaires and similar electrical equipment. (393) (CMP-18)

Rainproof. Constructed, protected, or treated so as to prevent rain from interfering with the successful operation of the apparatus under specified test conditions. (CMP-1)

Raintight. Constructed or protected so that exposure to a beating rain will not result in the entrance of water under specified test conditions. (CMP-1)

Rated-Load Current (RLC). The current of a hermetic refrigerant motor-compressor resulting when it is operated at the rated load, rated voltage, and rated frequency of the equipment it serves. (440) (CMP-11)

Rated Output Power. The amplifier manufacturer's stated or marked output power capability into its rated load. (640) (CMP-12)

Rated Power. The output power of a wind turbine at its rated wind speed. (694) (CMP-4)

Informational Note: See IEC 61400-12-1, Power Performance Measurements of Electricity Producing Wind Turbines, for the method for measuring wind turbine power output.

Receptacle. A contact device installed at the outlet for the connection of an attachment plug, or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device. A single receptacle is a single contact device with no other contact device on the same yoke or strap. A multiple receptacle is two or more contact devices on the same yoke or strap. (CMP-18)

Informational Note: A duplex receptacle is an example of a multiple receptacle that has two receptacles on the same yoke or strap.

Receptacle, Weight-Supporting Ceiling (WSCR). (Weight-Supporting Ceiling Receptacle) A contact device installed at an outlet box for the connection and support of luminaries or ceiling-suspended (paddle) fans using a weight-supporting attachment fitting (WSAF). (CMP-18)

Informational Note: See ANSI/NEMA WD 6, American National Standard for Wiring Devices — Dimensional Specifications, for the standard configuration of weight-supporting ceiling receptacles and related weight-supporting attachment fittings.

Receptacle Outlet. An outlet where one or more receptacles are installed. (CMP-18)

Recognized Component. Many listing agencies provide for a Component Recognition as opposed to a listing. These component recognition evaluations cover the evaluation of components or materials intended for use in a complete product or system. They are intended for incorporation into another end product that is eligible to be listed. A typical example of these types of components are switches employed in the design of an end product. (This is an interpretation by the technical reviewers.)

Reconditioned. Electromechanical systems, equipment, apparatus, or components that are restored to operating conditions. This process differs from normal servicing of equipment that remains within a facility, or replacement of listed equipment on a one-to-one basis. (CMP-10)

Informational Note: The term reconditioned is frequently referred to as rebuilt, refurbished, or remanufactured.

Recreational Vehicle (RV) (Camping Trailer) (Motor Home) (Travel Trailer) (Truck Camper). A vehicle or slide-in camper that is primarily designed as temporary living quarters for recreational, camping, or seasonal use; has its own motive power or is mounted on or towed by another vehicle; is regulated by the National Highway Traffic Safety Administration as a vehicle or vehicle equipment; does not require a special highway use permit for operation on the highways; and can be easily transported and set up on a daily basis by an individual. [**1192**:3.3.52] (551) (CMP-7)

Informational Note: See NFPA 1192, Standard on Recreational Vehicles, Informative Annex A, for product types and definitions for motor homes and towable recreational vehicles.

Recreational Vehicle Park. Any parcel or tract of land under the control of any person, organization, or governmental entity wherein two or more recreational vehicle, recreational park trailer, and/or other camping sites are offered for use by the public or members of an organization for overnight stays. (551) (CMP-7)

Recreational Vehicle Site. A specific area within a recreational vehicle park or campground that is set aside for use by a camping unit. (551) (CMP-7)

Recreational Vehicle Site Supply Equipment. A power outlet assembly located near the point of entrance of supply conductors to a recreational vehicle site and intended to constitute the disconnecting means for connected recreational vehicles. (551) (CMP-7)

Recreational Vehicle Stand. That area of a recreational vehicle site intended for the placement of a recreational vehicle. (551) (CMP-7)

Reference Grounding Point. The ground bus of the panelboard or isolated power system panel supplying the patient care room. [**99**:3.3.158] (517) (CMP-15)

Relative Analgesia. A state of sedation and partial block of pain perception produced in a patient by the inhalation of concentrations of nitrous oxide insufficient to produce loss of consciousness (conscious sedation). (517) (CMP-15)

Relay, Automatic Load Control. (Automatic Load Control Relay) An emergency lighting control device used to set normally dimmed or normally-off switched emergency lighting equipment to full power illumination levels in the event of a loss of the normal supply by bypassing the dimming/switching controls, and to return the emergency lighting equipment to normal status when the device senses the normal supply has been restored. (700) (CMP-13)

Informational Note: See ANSI/UL 924, Emergency Lighting and Power Equipment, for the requirements covering automatic load control relays.

Remote-Control Circuit. Any electrical circuit that controls any other circuit through a relay or an equivalent device. (CMP-3)

Remote Disconnect Control. An electric device and circuit that controls a disconnecting means through a relay or equivalent device. (645) (CMP-12)

Resistance Heating Element. A specific separate element to generate heat that is stand-alone, externally attached to, embedded in, integrated with, or internal to the object to be heated. (CMP-17)

Informational Note: Tubular heaters, strip heaters, heating cable, heating tape, heating blankets, immersion heaters, and heating panels are examples of resistance heaters.

Restricted Industrial Establishment [as applied to hazardous (classified) locations]. Establishment with restricted public access, where the conditions of maintenance and supervision ensure that only qualified persons service the installation. (CMP-14)

Retrofit Kit. A complete subassembly of parts and devices for field conversion of utilization equipment. (CMP-18)

Retrofit Kit, General Use. (General Use Retrofit Kit) A kit consisting of primary parts, which does not include all the parts for a complete subassembly but includes a list of required parts and installation instructions to complete the subassembly in the field. (600) (CMP-18)

Retrofit Kit, Sign Specific. (Sign Specific Retrofit Kit) A kit consisting of the necessary parts and hardware to allow for field installation in a host sign, based on the included installation instructions. (600) (CMP-18)

Reverse Polarity Protection (Backfeed Protection). A system that prevents two interconnected power supplies, connected positive to negative, from passing current from one power source into a second power source. (393) (CMP-18)

Ride Device. A device or combination of devices that carry, convey, or direct a person(s) over or through a fixed or restricted course within a defined area for the primary purpose of amusement or entertainment. (522) (CMP-15)

Riser Cable, Cable Routing Assemblies, and Raceways. Cables, cable routing assemblies, and raceways that have fire-resistant characteristics capable of preventing the carrying of fire from floor to floor and are suitable for use in a vertical run in a shaft or from floor to floor. (722) (CMP-3)

Safe Zone. Low probability of damage other than a slight swelling of the capacitor case, as identified by the case rupture curve of the capacitor. (460) (CMP-11)

Safety Circuit. The part of a control system containing one or more devices that perform a safety-related function. [**79**:3.3.95] (CMP-12)

Informational Note: See NFPA 79-2021, Electrical Standard for Industrial Machinery. Safety-related control system and safety interlock circuit are common terms that can be used to refer to the safety circuit in other standards. The safety circuit can include hard-wired, communication, and software-related components.

Sealable Equipment. Equipment enclosed in a case or cabinet that is provided with a means of sealing or locking so that live parts cannot be made accessible without opening the enclosure. (CMP-1)

Informational Note: The equipment may or may not be operable without opening the enclosure.

Sealed [as applied to hazardous (classified) locations]. Constructed such that equipment is sealed effectively against entry of an external atmosphere and is not opened during normal operation or for any maintenance activities. (CMP-14)

Informational Note: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Sealed, Hermetically. (Hermetically Sealed) Sealed against the entrance of an external atmosphere, such that the seal is made by fusion of metal to metal, ceramic to metal, or glass to metal. (CMP-14)

Informational Note: See ANSI/UL 121201, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations, for additional information.

Section Sign. A sign or outline lighting system, shipped as subassemblies, that requires field-installed wiring between the subassemblies to complete the overall sign. The subassemblies are either physically joined to form a single sign unit or are installed as separate remote parts of an overall sign. (600) (CMP-18)

Selected Receptacles. A minimal number of receptacles selected by the health care facility's governing body as necessary to provide essential patient care and facility services during loss of normal power. [**99**:3.3.164] (517) (CMP-15)

Self-Contained Therapeutic Tubs or Hydrotherapeutic Tanks. A factory-fabricated unit consisting of a therapeutic tub or hydrotherapeutic tank with all water-circulating, heating, and control equipment integral to the unit. Equipment may include pumps, air blowers, heaters, light controls, sanitizer generators, and so forth. (680) (CMP-17)

Separable Power Supply Cable Assembly. A flexible cord or cable, including ungrounded, grounded, and equipment grounding conductors, provided with a cord connector, an attachment plug, and all other fittings, grommets, or devices installed for the purpose of delivering energy from the source of electrical supply to the truck or transport refrigerated unit (TRU) flanged surface inlet. (626) (CMP-12)

Separately Derived System. An electrical power supply output, other than a service, having no direct connection(s) to circuit conductors of any other electrical source other than those established by grounding and bonding connections. (CMP-5)

Service. The conductors and equipment connecting the serving utility to the wiring system of the premises served. (CMP-10)

Service Conductors. The conductors from the service point to the service disconnecting means. (CMP-10)

Service Conductors, Overhead. (Overhead Service Conductors) The overhead conductors between the service point and the first point of connection to the service-entrance conductors at the building or other structure. (CMP-10)

Service Conductors, Underground. (Underground Service Conductors) The underground conductors between the service point and the first point of connection to the service-entrance conductors in a terminal box, meter, or other enclosure, inside or outside the building wall. (CMP-10)

Informational Note: Where there is no terminal box, meter, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building.

Service Drop. The overhead conductors between the serving utility and the service point. (CMP-10)

Service-Entrance Conductor Assembly. Multiple single-insulated conductors twisted together without an overall covering, other than an optional binder intended only to keep the conductors together. (CMP-6)

Service-Entrance Conductors. The service conductors between the terminals of the service equipment to the service drop, overhead service conductors, service lateral, or underground service conductors. (CMP-10)

Informational Note: Where service equipment is located outside the building walls, there could be no service-entrance conductors or they might be entirely outside the building.

Service Equipment. The necessary equipment, consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the serving utility and intended to constitute the main control and disconnect of the serving utility. (CMP-10)

Service Equipment, Mobile Home. (Mobile Home Service Equipment) The equipment containing the disconnecting means, overcurrent protective devices, and receptacles or other means for connecting a mobile home feeder assembly. (550) (CMP-7)

Service Lateral. The underground conductors between the utility electric supply system and the service point. (CMP-10)

Service Point. The point of connection between the facilities of the serving utility and the premises wiring. (CMP-10)

Informational Note: The service point can be described as the point of demarcation between where the serving utility ends and the premises wiring begins. The serving utility generally specifies the location of the service point based on the conditions of service.

Servicing. The process of following a manufacturer's set of instructions or applicable industry standards to analyze, adjust, or perform prescribed actions upon equipment with the intention to preserve or restore the operational performance of the equipment. (CMP-1)

Informational Note: Servicing often encompasses maintenance and repair activities.

Shore Power. The electrical equipment required to power a floating vessel including, but not limited to, the receptacle and cords. (555) (CMP-7)

Shoreline. The farthest extent of standing water under the applicable conditions that determine the electrical datum plane for the specified body of water. (682) (CMP-17)

Short Circuit. An abnormal connection (including an arc) of relatively low impedance, whether made accidentally or intentionally, between two or more points of different potential. (CMP-10)

Short-Circuit Current Rating. The prospective symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding defined acceptance criteria. (CMP-10)

Show Window. Any window, including windows above doors, used or designed to be used for the display of goods or advertising material, whether it is fully or partly enclosed or entirely open at the rear and whether or not it has a platform raised higher than the street floor level. (CMP-2)

Sign, Photovoltaic (PV) Powered (PV Powered Sign). [Photovoltaic (PV) Powered Sign] A complete sign powered by solar energy consisting of all components and subassemblies for installation either as an off-grid stand-alone, on-grid interactive, or non-grid interactive system. (600) (CMP-18)

Sign Body. A portion of a sign that may provide protection from the weather but is not an electrical enclosure. (600) (CMP-18)

Signaling Circuit. Any electrical circuit that energizes signaling equipment. (CMP-3)

Simple Apparatus. An electrical component or combination of components of simple construction with well-defined electrical parameters that does not generate more than 1.5 volts, 100 mA, and 25 mW, or a passive component that does not dissipate more than 1.3 watts and is compatible with the intrinsic safety of the circuit in which it is used. (CMP-14)

Informational Note No. 1: The following are examples of simple apparatus:

Passive components; for example, switches, instrument connectors, plugs and sockets, junction boxes, resistance temperature devices, and simple semiconductor devices such as LEDs

Sources of stored energy consisting of single components in simple circuits with well-defined parameters; for example, capacitors or inductors, whose values are considered when determining the overall safety of the system

Sources of generated energy; for example, thermocouples and photocells, that do not generate more than 1.5 volts, 100 mA, and 25 mW

Informational Note No. 2: See ANSI/UL 913, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations, and ANSI/UL 60079-11, Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i", for additional information.

Single-Pole Separable Connector. A device that is installed at the ends of portable, flexible, single-conductor cable that is used to establish connection or disconnection between two cables or one cable and a single-pole, panel-mounted separable connector. (CMP-18)

Site-Isolating Device. A pole-mounted disconnecting means installed at the distribution point for the purposes of isolation, system maintenance, emergency disconnection, or connection of optional standby systems. (547) (CMP-7)

Skeleton Tubing. Neon tubing that is itself the sign or outline lighting and is not attached to an enclosure or sign body. (600) (CMP-18)

Slip. A berthing space between or adjacent to piers, wharves, or docks; the water areas associated with boat occupation. [**303**:3.3.21] (555) (CMP-7)

Informational Note: See the definition of Berth for additional information.

Solid-State Phase-Control Dimmer. A solid-state dimmer where the wave shape of the steady-state current does not follow the wave shape of the applied voltage such that the wave shape is nonlinear. (CMP-15)

Solid-State Sine Wave Dimmer. A solid-state dimmer where the wave shape of the steady-state current follows the wave shape of the applied voltage such that the wave shape is linear. (CMP-15)

Spa or Hot Tub. A hydromassage pool, or tub for recreational or therapeutic use, not located in health care facilities, designed for immersion of users, and usually having a filter, heater, and motor-driven blower. It may be installed indoors or outdoors, on the ground or supporting structure, or in the ground or supporting structure. Generally, they are not designed or intended to have its contents drained or discharged after each use. (680) (CMP-17)

Spa or Hot Tub, Packaged Equipment Assembly. (Packaged Spa or Hot Tub Equipment Assembly) A factory-fabricated unit consisting of water-circulating, heating, and control equipment mounted on a common base, intended to operate a spa or hot tub. Equipment can include pumps, air blowers, heaters, lights, controls, sanitizer generators, and so forth. (680) (CMP-17)

Spa or Hot Tub, Self-Contained. (Self-Contained Spa or Hot Tub) Factory-fabricated unit consisting of a spa or hot tub vessel with all water-circulating, heating, and control equipment integral to the unit. Equipment can include pumps, air blowers, heaters, lights, controls, sanitizer generators, and so forth. (680) (CMP-17)

Space. A portion of the health care facility designated by the health care facility's governing body that serves a specific purpose. [**99**:3.3.171] (517) (CMP-15)

Special Permission. The written consent of the authority having jurisdiction. (CMP-1)

Special Protection "s". Type of protection that permits design, assessment, and testing of equipment that cannot be fully assessed within a recognized type of protection or combination of recognized types of protection because of functional or operational limitations, but that can be demonstrated to provide the necessary equipment protection level (EPL). (CMP-14)

Informational Note: See ANSI/UL 60079-33, Explosive Atmospheres — Part 33: Equipment Protection by Special Protection "s", for additional information.

Special-Purpose Multi-Circuit Cable System. A portable branch-circuit distribution system consisting of one or more trunk cables and optional breakout assemblies or multi-circuit outlet enclosures. (520) (CMP-15)

Spider (Cable Splicing Block). A device that contains busbars that are insulated from each other for the purpose of splicing or distributing power to portable cables and cords that are terminated with single-pole busbar connectors. (530) (CMP-15)

Spin Down. A shutdown condition of the FESS, where energy is being dissipated and the flywheel rotor is slowing down to a stop. (706) (CMP-13)

Informational Note: A complete stop of a flywheel rotor cannot occur instantaneously because of the high kinetic energy of the rotor, but rather occurs over time as a result of friction forces acting on the rotor.

Splash Pad. A fountain intended for recreational use by pedestrians and designed to contain no more than 25 mm (1 in) of water depth. This definition does not include showers intended for hygienic rinsing prior to use of a pool, spa, or other water feature. (680) (CMP-17)

Spray Area. Any fully enclosed, partly enclosed, or unenclosed area in which flammable or combustible vapors, mists, residues, dusts, or deposits are present due to the operation of spray processes, including:

(1) any area in the direct path of a spray application process;
(2) the interior of a spray booth, spray room, or limited finishing workstation, as herein defined;
(3) the interior of any exhaust plenum, eliminator section, or scrubber section;
(4) the interior of any exhaust duct or exhaust stack leading from a spray application process;
(5) the interior of any air recirculation path up to and including recirculation particulate filters;
(6) any solvent concentrator (pollution abatement) unit or solvent recovery (distillation) unit; and
(7) the inside of a membrane enclosure.

The following are not part of the spray area:

(1) fresh air make-up units;
(2) air supply ducts and air supply plenums;
(3) recirculation air supply ducts downstream of recirculation particulate filters; and
(4) exhaust ducts from solvent concentrator (pollution abatement) units. [**33:3**.3.2.3] (CMP-14)

Informational Note No. 1: Unenclosed spray areas are locations outside of buildings or are localized operations within a larger room or space. Such areas are normally provided with some local vapor extraction/ventilation system. In automated operations, the area limits are the maximum area in the direct path of spray operations. In manual operations, the area limits are the maximum area of spray when aimed at 90 degrees to the application surface.

Informational Note No. 2: See definitions for limited finishing workstation and membrane enclosure for additional information.

Spray Area, Outdoor. (Outdoor Spray Area) A spray area that is outside the confines of a building or that has a canopy or roof that does not limit the dissipation of the heat of a fire or dispersion of flammable vapors and does not restrict fire-fighting access and control. For the purpose of this standard, an outdoor spray area can be treated as an unenclosed spray area as defined in this Code. [**33**:3.3.2.3.1] (CMP-14)

Spray Area, Unenclosed. (Unenclosed Spray Area) Any spray area that is not confined by a limited finishing workstation, spray booth, or spray room, as herein defined. [**33**:3.3.2.3.2] (CMP-14)

Spray Booth. A power-ventilated enclosure for a spray application operation or process that confines and limits the escape of the material being sprayed, including vapors, mists, dusts, and residues that are produced by the spraying operation and conducts or directs these materials to an exhaust system. [**33**:3.3.19] (CMP-14)

Informational Note: A spray booth is an enclosure or insert within a larger room used for spraying, coating, and/or dipping applications. A spray booth can be fully enclosed or have open front or face and can include a separate conveyor entrance and exit. The spray booth is provided with a dedicated ventilation exhaust with supply air from the larger room or from a dedicated air supply.

Spray Room. A power-ventilated fully enclosed room with a specified fire resistance rating used exclusively for open spraying of flammable or combustible materials. [**33**:3.3.20] (CMP-14)

Stage Effect (Special Effect). An electrical or electromechanical piece of equipment used to simulate a distinctive visual or audible effect, such as a wind machine, lightning simulator, or sunset projector. (CMP-15)

Stage Equipment. Equipment at any location on the premises integral to the stage production including, but not limited to, equipment for lighting, audio, special effects, rigging, motion control, projection, or video. (520) (CMP-15)

Stage Lighting Hoist. A motorized lifting device that contains a mounting position for one or more luminaires, with wiring devices for connection of luminaires to branch circuits, and integral flexible cables to allow the luminaires to travel over the lifting range of the hoist while energized. (520) (CMP-15)

Stage Property. An article or object used as a visual element in a motion picture or television production, except painted backgrounds (scenery) and costumes. (530) (CMP-15)

Stage Set. A specific area set up with temporary scenery and properties designed and arranged for a particular scene in a motion picture or television production. (CMP-15)

Stage Switchboard, Fixed. (Fixed Stage Switchboard) A permanently installed switchboard, panelboard, or rack containing dimmers or relays with associated overcurrent protective devices, or overcurrent protective devices alone, used primarily to feed stage equipment. (CMP-15)

Stage Switchboard, Portable. (Portable Stage Switchboard) A portable rack or pack containing dimmers or relays with associated overcurrent protective devices, or overcurrent protective devices alone, used to feed stage equipment. (520) (CMP-15)

Stand Lamp. A portable stand that contains a general-purpose luminaire or lampholder with guard for the purpose of providing general illumination on a stage, in an auditorium, or in a studio. (520) (CMP-15)

Stand-Alone System. A system that is not connected to an electric power production and distribution network. (CMP-4)

Stationary (as applied to equipment). Equipment that is not moved from one place to another in normal use. (680) (CMP-17)

Storage, Dry Stack. (Dry Stack Storage) A facility, either covered or uncovered, constructed of horizontal and vertical structural members designed to allow placement of small boats in defined slots arranged both horizontally and vertically. [**303**:3.3.24.2] (555) (CMP-7)

Stored-Energy Power Supply System (SEPSS). A complete functioning EPSS powered by a stored-energy electrical source. (CMP-13)

Stranding, Compact. (Compact Stranding) A conductor stranding method in which each layer of strands is pressed together to minimize the gaps between the strands so the overall diameter of the finished conductor is less than a concentric stranded conductor and less than a compressed stranded conductor. (CMP-6)

Stranding, Compressed. (Compressed Stranding) A conductor stranding method in which the outer layer of strands is pressed together so the overall diameter of the finished conductor is less than a concentric stranded conductor but greater than a compact stranded conductor. (CMP-6)

Stranding, Concentric. (Concentric Stranding) A conductor consisting of a straight central strand surrounded by one or more layers of strands, helically laid in a geometric pattern. (CMP-6)

Strip Light. A luminaire with multiple lamps arranged in a row. (520) (CMP-15)

Structure. That which is built or constructed, other than equipment. (CMP-1)

Structure, Relocatable. (Relocatable Structure) A factory-assembled structure or structures transportable in one or more sections that are built on a permanent chassis and designed to be used as other than a dwelling unit without a permanent foundation. (545) (CMP-7)

Informational Note: Examples of relocatable structures are those units that are equipped for sleeping purposes only, contractor's and other on-site offices, construction job dormitories, studio dressing rooms, banks, clinics, stores, shower facilities and restrooms, training centers, or for the display or demonstration of merchandise or machines.

Subassembly. Component parts or a segment of a sign, retrofit kit, or outline lighting system that, when assembled, forms a complete unit or product. (600) (CMP-18)

Substation. An assemblage of equipment (e.g., switches, interrupting devices, circuit breakers, buses, and transformers) through which electric energy is passed for the purpose of distribution, switching, or modifying its characteristics. (CMP-9)

Supervisory Control and Data Acquisition (SCADA). An electronic system that provides monitoring and controls for the operation of the critical operations power system. (CMP-13)

Informational Note: This can include the fire alarm system, security system, control of the HVAC, the start/stop/monitoring of the power supplies and electrical distribution system, annunciation and communications equipment to emergency personnel, facility occupants, and remote operators.

Support Areas. Areas, other than fixed production offices, intended to support production and where image capture will not take place. Such areas include, but are not limited to, mobile production offices, storage, and workspaces; vehicles and trailers for cast, makeup, hair, lighting, grip, wardrobe, props, catering, and craft services; and portable restrooms. (530) (CMP-15)

Surge Arrester. A protective device for limiting surge voltages by discharging or bypassing surge current; it also prevents continued flow of follow current while remaining capable of repeating these functions. (CMP-10)

Surge-Protective Device (SPD). A protective device for limiting transient voltages by diverting or limiting surge current; it also prevents continued flow of follow current while remaining capable of repeating these functions and is designated as follows:

Type 1: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device

Type 2: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel

Type 3: Point of utilization SPDs

Type 4: Component SPDs, including discrete components, as well as assemblies. (CMP-10)

Informational Note: See UL 1449, Standard for Surge Protective Devices, for further information on SPDs.

Suspended Ceiling Grid. A system that serves as a support for a finished ceiling surface and other utilization equipment. (393) (CMP-18)

Switch, General-Use. (General-Use Switch) A switch intended for use in general distribution and branch circuits. It is rated in amperes, and it is capable of interrupting its rated current at its rated voltage. (CMP-9)

Switch, General-Use Snap. (General-Use Snap Switch) A form of general-use switch constructed so that it can be installed in device boxes or on box covers, or otherwise used in conjunction with wiring systems recognized by this Code. (CMP-9)

Switch, Isolating. (Isolating Switch) A switch intended for isolating an electrical circuit from the source of power. It has no interrupting rating, and it is intended to be operated only after the circuit has been opened by some other means. (CMP-9)

Switch, Motor-Circuit. (Motor-Circuit Switch) A switch rated in horsepower that is capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage. (CMP-11)

Switchboard. A large single panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments.(CMP-9)

Informational Note: These assemblies can be accessible from the rear or side as well as from the front and are not intended to be installed in cabinets.

Switchgear. An assembly completely enclosed on all sides and top with sheet metal (except for ventilating openings and inspection windows) and containing primary power circuit switching, interrupting devices, or both, with buses and connections. The assembly may include control and auxiliary devices. Access to the interior of the enclosure is provided by doors, removable covers, or both. (CMP-9)

Informational Note: All switchgear subject to NEC requirements is metal enclosed. Switchgear rated below 1000 V or less may be identified as "low-voltage power circuit breaker switchgear." Switchgear rated over 1000 V may be identified as "metal enclosed switchgear" or "metal-clad switchgear." Switchgear is available in non–arcresistant or arc-resistant constructions.

Switching Device (as applied to equipment rated over 1000 volts ac, 1500 volts dc, nominal). A device designed to close, open, or both, one or more electrical circuits. (CMP-9)

Cutout. An assembly of a fuse support with either a fuseholder, fuse carrier, or disconnecting blade. The fuseholder or fuse carrier may include a conducting element (fuse link) or may act as the disconnecting blade by the inclusion of a nonfusible member.

Disconnecting Switch (or Isolating Switch). A mechanical switching device used for isolating a circuit or equipment from a source of power.

Interrupter Switch. A switching device capable of making, carrying, and interrupting specified currents.

Oil-Filled Cutout. A cutout in which all or part of the fuse support and its fuse link or disconnecting blade is mounted in oil with complete immersion of the contacts and the fusible portion of the conducting element (fuse link) so that arc interruption by severing of the fuse link or by opening of the contacts will occur under oil.

Oil Switch. A switching device having contacts that operate under oil (or askarel or other suitable liquid).

Regulator Bypass Switch. A switching device or combination of switching devices designed to bypass equipment used to control voltage levels or related circuit characteristics.

System Isolation Equipment. A redundantly monitored, remotely operated contactor-isolating system, packaged to provide the disconnection/isolation function, capable of verifiable operation from multiple remote locations by means of lockout switches, each having the capability of being padlocked in the "off" (open) position. (430) (CMP-11)

Tap Conductor. A conductor, other than a service conductor, that has overcurrent protection ahead of its point of supply that exceeds the value permitted for similar conductors that are protected as described elsewhere in 240.4. (240) (CMP-10)

Task Illumination. Provisions for the minimum lighting required to carry out necessary tasks in the areas described in **517.34(A)**, including safe access to supplies and equipment and access to exits. [**99**:3.3.177] (517) (CMP-15)

Technical Power System. An electrical distribution system where the equipment grounding conductor is isolated from the premises grounded conductor and the premises equipment grounding conductor except at a single grounded termination point within a branch-circuit panelboard, at the originating (main breaker) branch-circuit panelboard or at the premises grounding electrode. (640) (CMP-12)

Temporary Equipment. Portable wiring and equipment intended for use with events of a transient or temporary nature where all equipment is presumed to be removed at the conclusion of the event. (640) (CMP-12)

Terminal (as applied to batteries). That part of a cell, container, or battery to which an external connection is made (commonly identified as post, pillar, pole, or terminal post). (CMP-13)

Thermal Protector (as applied to motors). A protective device for assembly as an integral part of a motor or motor-compressor that, when properly applied, protects the motor against dangerous overheating due to overload and failure to start. (CMP-11)

Informational Note: The thermal protector may consist of one or more sensing elements integral with the motor or motor-compressor and an external control device.

Thermal Resistivity. The heat transfer capability through a substance by conduction. (CMP-6)

Informational Note: Thermal resistivity is the reciprocal of thermal conductivity and is designated Rho, which is expressed in the units °C-cm/W.

Thermally Protected (as applied to motors). A motor or motor-compressor that is provided with a thermal protector. (CMP-11)

Top Shield. A grounded metal shield covering under-carpet components of the flat conductor cable (Type FCC) system for the purposes of providing protection against physical damage. (324) (CMP-6)

Tower. A pole or other structure that supports a wind turbine. (694) (CMP-4)

Transfer Switch. An automatic or nonautomatic device for transferring one or more load conductor connections from one power source to another. (CMP-13)

Transfer Switch, Branch-Circuit Emergency Lighting. (Branch-Circuit Emergency Lighting Transfer Switch) A device connected on the load side of a branch-circuit overcurrent protective device that transfers only emergency lighting loads from the normal power source to an emergency power source. (700) (CMP-13)

Informational Note: See ANSI/UL 1008, Transfer Switch Equipment, for information covering branch-circuit emergency lighting transfer switches.

Transfer Switch, Bypass Isolation. (Bypass Isolation Transfer Switch) A manual, nonautomatic, or automatic operated device used in conjunction with a transfer switch to provide a means of directly connecting load conductors to a power source and of disconnecting the transfer switch. (CMP-13)

Transfer Switch, Meter-Mounted. (Meter-Mounted Transfer Switch) A transfer switch connected between the utility meter and the meter base. (CMP-13)

Informational Note: Meter-mounted transfer switches can plug into the meter base. Transfer switches that incorporate the meter base in the transfer equipment assembly are not considered meter-mounted transfer switches.

Transformer. Equipment, either single-phase or polyphase, that uses electromagnetic induction to convert current and voltage in a primary circuit into current and voltage in a secondary circuit. (CMP-9)

Transition Assembly. An assembly to facilitate connection of the flat conductor cable (Type FCC) system to other wiring systems, incorporating (1) a means of electrical interconnection and (2) a suitable box or covering for providing electrical safety and protection against physical damage. (324) (CMP-6)

Transport Refrigerated Unit (TRU). A trailer or container, with integrated cooling or heating, or both, used for the purpose of maintaining the desired environment of temperature-sensitive goods or products. (626) (CMP-12)

Transportable. X-ray equipment that is to be installed in a vehicle or that may be readily disassembled for transport in a vehicle. (660) (CMP-12)

Truck. A motor vehicle designed for the transportation of goods, services, and equipment. (626) (CMP-12)

Truck Coupler. A truck flanged surface inlet and mating cord connector. (626) (CMP-12)

Truck Flanged Surface Inlet. The device(s) on the truck into which the connector(s) is inserted to provide electric energy and other services. This device is part of the truck coupler. For the purposes of this article, the truck flanged surface inlet is considered to be part of the truck and not part of the electrified truck parking space supply equipment. (626) (CMP-12)

Trunk Cable. A portable extension cable containing six or more branch circuits, a male multipole plug, and a female multipole receptacle. (520) (CMP-15)

Tubing, Electrical Metallic (EMT). (Electrical Metallic Tubing) An unthreaded thinwall raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed utilizing appropriate fittings. (CMP-8)

Tubing, Electrical Nonmetallic (ENT). (Electrical Nonmetallic Tubing) A nonmetallic, pliable, corrugated raceway of circular cross section with integral or associated couplings, connectors, and fittings for the installation of electrical conductors. It is composed of a material that is resistant to moisture and chemical atmospheres and is flame retardant.

A pliable raceway is a raceway that can be bent by hand with a reasonable force but without other assistance. (CMP-8)

Tubing, Flexible Metallic (FMT). (Flexible Metallic Tubing) A metal raceway that is circular in cross section, flexible, and liquidtight without a nonmetallic jacket. (CMP-8)

Two-Fer. An assembly containing one male plug and two female cord connectors used to connect two loads to one branch circuit. (520) (CMP-15)

Ungrounded. Not connected to ground or to a conductive body that extends the ground connection. (CMP-5)

Type of Protection "n". Type of protection where electrical equipment, in normal operation, is not capable of igniting a surrounding explosive gas atmosphere and a fault capable of causing ignition is not likely to occur. (CMP-14)

Informational Note: See ANSI/UL 60079-15, Explosive Atmospheres — Part 15: Equipment Protection by Type of Protection "n", for additional information.

Ungrounded. Not connected to ground or to a conductive body that extends the ground connection. (CMP-5)

Uninterruptible Power Supply (UPS). A device or system that provides quality and continuity of ac power through the use of a stored-energy device as the backup power source for a period of time when the normal power supply is incapable of performing acceptably. (CMP-13)

Unit Equipment. A battery-equipped emergency luminaire that illuminates only as part of the emergency illumination system and is not illuminated when the normal supply is available. (CMP-13)

Utilization Equipment. Equipment that utilizes electric energy for electronic, electromechanical, chemical, heating, lighting, or similar purposes. (CMP-1)

Valve Actuator Motor (VAM) Assemblies. A manufactured assembly, used to operate a valve, consisting of an actuator motor and other components such as motor controllers, torque switches, limit switches, and overload protection. (430) (CMP-11)

Informational Note: VAMs typically have short-time duty and high-torque characteristics.

Ventilated. Provided with a means to permit circulation of air sufficient to remove an excess of heat, fumes, or vapors. (CMP-14)

Vessel. A container such as a barrel, drum, or tank for holding fluids or other material. (CMP-17)

Volatile Flammable Liquid. A flammable liquid having a flash point below 38°C (100°F), or a flammable liquid whose temperature is above its flash point, or a Class II combustible liquid that has a vapor pressure not exceeding 276 kPa (40 psia) at 38°C (100°F) and whose temperature is above its flash point. (CMP-14)

Voltage (of a circuit). The greatest root-mean-square (rms) (effective) difference of potential between any two conductors of the circuit concerned. (CMP-1)

Informational Note: Some systems, such as 3-phase 4-wire, single-phase 3-wire, and 3-wire direct current, may have various circuits of various voltages.

Voltage, High. (High Voltage) A potential difference of more than 1000 volts, nominal. (CMP-9)

Informational Note: Circuits and equipment rated at potential differences of more than 1000 volts and up to 52 kV are also commonly referred to as medium voltage.

Voltage, Low. (Low Voltage). An electromotive force rated 24 volts, nominal, or less. (551) (CMP-7)

Voltage, Nominal. (Nominal Voltage) A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240 volts, 480Y/277 volts, 600 volts). (CMP-1)

Informational Note No. 1: The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

Informational Note No. 2: See ANSI C84.1-2011, Voltage Ratings for Electric Power Systems and Equipment (60 Hz).

Voltage, Nominal (as applied to battery or cell).(Nominal Voltage) The value assigned to a cell or battery of a given voltage class for the purpose of convenient designation. The operating voltage of the cell or battery may vary above or below this value. (CMP-13)

Informational Note: The most common nominal cell voltages are 2 volts per cell for the lead-acid batteries, 1.2 volts per cell for alkali batteries, and 3.2 to 3.8 volts per cell for Li-ion batteries. Nominal voltages might vary with different chemistries.

Voltage to Ground. For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded; for ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit. (CMP-1)

Watertight. Constructed so that moisture will not enter the enclosure under specified test conditions. (CMP-1)

Weatherproof. Constructed or protected so that exposure to the weather will not interfere with successful operation. (CMP-1)

Informational Note: Rainproof, raintight, or watertight equipment can fulfill the requirements for weatherproof where varying weather conditions other than wetness, such as snow, ice, dust, or temperature extremes, are not a factor.

Wharf. A structure at the shoreline that has a platform built along and parallel to a body of water with either an open deck or a superstructure. [**307**:3.3.28] (555) (CMP-7)

Wind Turbine. A mechanical device that converts wind energy to electrical energy. (CMP-4)

Wind Turbine Output Circuit. (Turbine Output Circuit) The circuit conductors between the internal components of a wind turbine (which might include an alternator, integrated rectifier, controller, and/or inverter) and other equipment. (694) (CMP-4)

Wire. A factory assembly of one or more insulated conductors without an overall covering. (805) (CMP-16)

Wireless Power Transfer (WPT). The transfer of electrical energy from a power source to an electrical load via magnetic fields by a contactless means between a primary device and a secondary device. (625) (CMP-12)

Wireless Power Transfer Equipment (WPTE). Equipment installed specifically for the purpose of transferring energy between the premises wiring and the electric vehicle without physical electrical contact. (625) (CMP-12)

Informational Note No. 1: The general form of WPTE consists of two physical packages: a control box and a primary pad.

Informational Note No. 2: Electric vehicle power export equipment and wireless power transfer equipment are sometimes contained in one set of equipment, sometimes referred to as a bidirectional WPTE.

Wireways, Metal. (Metal Wireways) Sheet metal troughs with hinged or removable covers for housing and protecting electrical wires and cable and in which conductors are laid in place after the raceway has been installed as a complete system. (CMP-8)

Wireways, Nonmetallic. (Nonmetallic Wireways) Flame-retardant, nonmetallic troughs with removable covers for housing and protecting electrical wires and cables in which conductors are laid in place after the raceway has been installed as a complete system. (CMP-8)

Work Surface. A fixed, stationary, or portable surface typically intended for dry use and for tasks other than food preparation, personal lavation, or laundering that presents an incidental risk of spillage of smaller quantities of beverages and other liquids upon outlets mounted directly on or recessed in the surface. (CMP-2)

Informational Note No. 1: See UL 111, Outline of Investigation for Multioutlet Assemblies, and UL 962A, Furniture Power Distribution Units, which establish the performance evaluation criteria and construction criteria.

Informational Note No. 2: See 406.5(F), 406.5(G)(1), and 406.5(H) for information on receptacles for work surfaces distinguished from receptacles for counters and countertops.

Zone. A physically identifiable area (such as barriers or separation by distance) within an information technology equipment room, with dedicated power and cooling systems for the information technology equipment or systems. (645) (CMP-12)

CHANGES TO ARTICLE 500 – HAZARDOUS (CLASSIFIED) LOCATIONS, CLASSES I, II, AND III, DIVISIONS 1 AND 2

The following Article 500 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 500.1: Scope.
- 500.4: Documentation.
- 500.5(D): Classification of Locations. Class III Locations.
- 500.7: Protection Techniques
- 500.7(Q): Protection Techniques. Protection by Impedance Heating "IEEE 844.3"
- 500.7(R): Protection Techniques. Enclosed-Break.
- 500.7(S): Protection Techniques. Nonsparking.
- 500.7(T): Protection Techniques. Sealed.
- 500.7(U): Protection Techniques. Special Protection Techniques.
- 500.8(G): Equipment. Equipment Involving Optical Radiation.

ARTICLE 500 Hazardous (Classified) Locations, Classes I, II, and III, Divisions 1 and 2

500.1 Scope.

500.1(A) Covered.

This article covers area classification and general requirements for electrical and electronic equipment and wiring rated at all voltages where fire or explosion hazards might exist due to flammable gases, flammable liquid–produced vapors, combustible liquid–produced vapors, combustible dusts, combustible fibers/flyings, or ignitible fibers/flyings in the following:

(1) Class I, Division 1 or Class I, Division 2 hazardous (classified) locations

(2) Class II, Division 1 or Class II, Division 2 hazardous (classified) locations

(3) Class III, Division 1 or Class III, Division 2 hazardous (classified) locations

Informational Note No. 1: See NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, and NFPA 499, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, for extracted information referenced in brackets. Only editorial changes were made to the extracted text to make it consistent with this *Code*.

Informational Note No. 2: See Article 100 for the definition of *restricted industrial establishment [as applied to hazardous (classified) locations].*

500.1(B) Not Covered.

This article does not cover electrical and electronic equipment and wiring rated at all voltages for the following:

(1) Zone 0, Zone 1, or Zone 2 hazardous (classified) locations

(2) Zone 20, Zone 21, or Zone 22 hazardous (classified) locations

(3) Locations subject to the unique risk and explosion hazards associated with explosives, pyrotechnics, and blasting agents

(4) Locations where pyrophoric materials are the only materials used or handled

(5) Features of equipment that involve nonelectrical potential sources of ignition (e.g., couplings, pumps, gearboxes, brakes, hydraulic and pneumatic motors, fans, engines, compressors)

Informational Note No. 1: Common nonelectrical potential sources of ignition include hot surfaces and mechanically generated sparks.

Informational Note No. 2: See ANSI/UL 80079-36, *Explosive Atmospheres — Part 36: Non-Electrical Equipment for Explosive Atmospheres — Basic Method and Requirements*, and ANSI/UL 80079-37, *Explosive Atmospheres — Part 37: Non-Electrical Equipment for Explosive Atmospheres — Non-Electrical Type of Protection Constructional Safety "c" Control of Ignition Source "b", Liquid Immersion "k"*, for additional information.

The Scope has been rewritten to provide more clarification as to what is and what is not covered as well as providing additional information.

500.4 Documentation. Areas designated as hazardous (classified) locations or determined to be unclassified shall be documented on an area classification drawing and other associated documentation. This documentation shall be available to the authority having jurisdiction (AHJ) and those authorized to design, install, inspect, maintain, or operate electrical equipment at the location.

Informational Note No. 1: See the following standards for additional information on the classification of locations:

(1) NFPA 30, Flammable and Combustible Liquids Code

(2) NFPA 32, Standard for Drycleaning Facilities

(3) NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials

(4) NFPA 34, Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids

(5) NFPA 35, Standard for the Manufacture of Organic Coatings

(6) NFPA 36, Standard for Solvent Extraction Plants

(7) NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals

(8) NFPA 55, Compressed Gases and Cryogenic Fluids Code

(9) NFPA 58, Liquefied Petroleum Gas Code

(10) NFPA 59, Utility LP-Gas Plant Code

(11) NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

(12) NFPA 499, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

(13) NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities

(14) ANSI/API RP 500, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2

(15) ISA-12.10, Area Classification in Hazardous (Classified) Dust Locations

Informational Note No. 2: See NFPA 77, Recommended Practice on Static Electricity; NFPA 780, Standard for the Installation of Lightning Protection Systems; and API RP 2003, Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents, for information on protection against static electricity and lightning hazards in hazardous (classified) locations.

Informational Note No. 3: See NFPA 30, Flammable and Combustible Liquids Code; and ANSI/API RP 500, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2, for information on ventilation.

Informational Note No. 4: See ANSI/API RP 14F, Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Division 1, and Division 2 Locations, for information on electrical systems for hazardous (classified) locations on offshore oil- and gas-producing platforms, drilling rigs, and workover rigs.

Informational Note No. 5: See ANSI/UL 121203, Portable/Personal Electronic Products Suitable for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2, Class III, Division 1, Class III, Division 2, Zone 21 and Zone 22 Hazardous (Classified) Locations, for information on portable or transportable equipment having self-contained power supplies, such as battery-operated equipment, which could potentially become an ignition source in hazardous (classified) locations.

Informational Note No. 6: See IEC/IEEE 60079-30-2, Explosive atmospheres — Part 30-2: Electrical resistance trace heating — Application guide for design, installation and maintenance, for information on electrical resistance trace heating for hazardous (classified) locations.

Informational Note No. 7: See IEEE 844.2/CSA C293.2, IEEE/CSA Standard for Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — Application Guide for Design, Installation, Testing, Commissioning, and Maintenance, for information on electric skin effect trace heating for hazardous (classified) locations.

Informational Note No. 8: See IEEE 844.4/CSA C293.4, IEEE/CSA Standard for Impedance Heating of Pipelines and Equipment — Application Guide for Design, Installation, Testing, Commissioning, and Maintenance, for information on electric impedance heating for hazardous (classified) locations.

500.4 has been revised to require the documentation to include an area classification drawing. This requirement had not been specifically addressed before, however was intended.

500.5 Classifications of Locations.

500.5(A) General.

(1) Locations shall be classified depending on the properties of the flammable gas, flammable liquid–produced vapor, combustible liquid–produced vapors, combustible dusts, or fibers/flyings that could be present, and the likelihood that a flammable or combustible concentration or quantity is present. Each room, section, or area shall be considered individually in determining its classification. Where pyrophoric materials are the only materials used or handled, these locations are outside the scope of this article.

Pyrophoric materials are outside of the scope of Article 500.

Informational Note: Through the exercise of ingenuity in the layout of electrical installations for hazardous (classified) locations, it is frequently possible to locate much of the equipment in a reduced level of classification or in an unclassified location and, thus, to reduce the amount of special equipment required.

(1) Refrigerant machinery rooms that contain ammonia refrigeration systems and are equipped with adequate mechanical ventilation that operates continuously or is initiated by a detection system at a concentration not exceeding 150 ppm shall be permitted to be classified as "unclassified" locations.

Informational Note: For further information regarding classification and ventilation of areas involving closed-circuit ammonia refrigeration systems, see ANSI/IIAR 2-2014, Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems.

Hazardous locations are classified by the type of the hazard present, represented by the Class, and by the degree to which the hazard is present, represented by the Division. The NEC® only addresses classification of locations that are hazardous due to the presence of flammable gases, flammable liquid-produced vapors, combustible liquid-produced vapors or combustible dusts or ignitable flyings/fibers. Pyrophoric materials are not covered. A Pyrophoric material is any material that ignites spontaneously or emits sparks when rubbed, scratched, or struck.

Although flammable liquid-produced and combustible liquid-produced vapors have always needed to be considered when classifying a Class I, Division 1 and Class I, Division 2 area, they are now noted as being a requirement when determining the classified area.

Areas containing ammonia refrigeration may be classified as "unclassified" locations based on the use of gas detection and adequate ventilation. This aligns with the ASHRAE standard. This requirement correlates with the applicable ANSI standards that govern ammonia refrigeration systems.

500.5(B) Class I Locations. Class I locations are those in which flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors are or may be present in the air in quantities sufficient to produce explosive or ignitible mixtures. Class I locations shall include those specified in 500.5(B)(1) and (B)(2).

500.5(B)(1) Class I, Division 1. A Class I, Division 1 location is a location:

(1) In which ignitible concentrations of flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors can exist under normal operating conditions, or

(2) In which ignitible concentrations of such flammable gases, flammable liquid–produced vapors, or combustible liquids above their flash points might exist frequently because of repair or maintenance operations or because of leakage, or

(3) In which breakdown or faulty operation of equipment or processes might release ignitible concentrations of flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors and might also cause simultaneous failure of electrical equipment in such a way as to directly cause the electrical equipment to become a source of ignition

Informational Note: This classification usually includes the following locations:

(1) Where volatile flammable liquids or liquefied flammable gases are transferred from one container to another

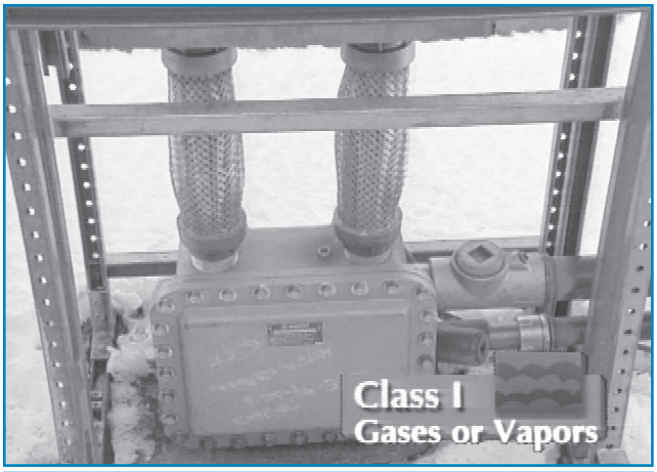
(2) Interiors of spray booths and areas in the vicinity of spraying and painting operations where volatile flammable solvents are used

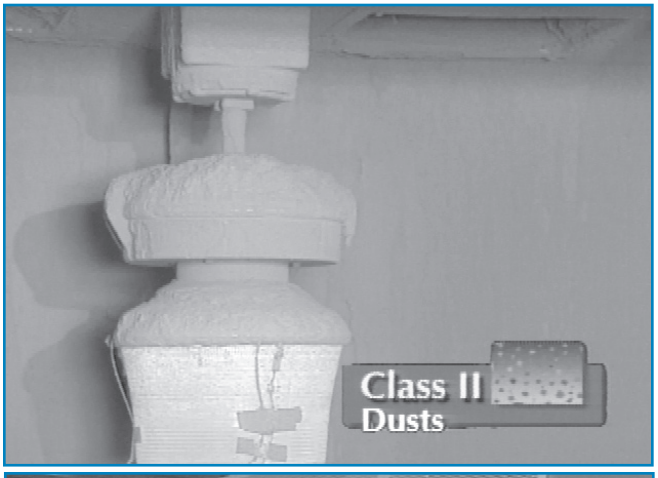
(3) Locations containing open tanks or vats of volatile flammable liquids

(4) Drying rooms or compartments for the evaporation of flammable solvents

(5) Locations containing fat- and oil-extraction equipment using volatile flammable solvents

(6) Portions of cleaning and dyeing plants where flammable liquids are used





(7) Gas generator rooms and other portions of gas manufacturing plants where flammable gas might escape

(8) Inadequately ventilated pump rooms for flammable gas or for volatile flammable liquids

(9) Interiors of refrigerators and freezers in which volatile flammable materials are stored in open, lightly stoppered, or easily ruptured containers

(10) Inside of inadequately vented enclosures containing instruments normally venting flammable gases or vapors to the interior of the enclosure

(11) Inside of vented tanks containing volatile flammable liquids

(12) Area between inner and outer roof sections of floating roof tanks containing volatile flammable fluids

(13) Inadequately ventilated areas within spraying or coating operations using volatile flammable fluids

(14) Interior of exhaust ducts used to vent ignitible concentrations of gases or vapors

(15) All other locations where ignitible concentrations of flammable vapors or gases are likely to occur during normal operations

Experience has demonstrated the prudence of avoiding the installation of instrumentation or other electrical equipment in these particular areas altogether or where it cannot be avoided because it is essential to the process and other locations are not feasible [see 500.5(A), Informational Note] using electrical equipment or instrumentation approved for the specific application or consisting of intrinsically safe systems as described in Article 504.

A Class I, Division 1 location is one where there is or may be an explosive atmosphere of gases or vapors mixed with air present during normal operation, for any reason.

500.5(B)(2) Class I, Division 2. A Class I, Division 2 location is a location:

(1) In which volatile flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems or in case of abnormal operation of equipment, or

(2) In which ignitible concentrations of flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors are normally prevented by positive mechanical ventilation and which might become hazardous through failure or abnormal operation of the ventilating equipment, or

(3) That is adjacent to a Class I, Division 1 location, and to which ignitible concentrations of flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors above their flash points might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.

Informational Note No. 1: This classification usually includes locations where volatile flammable liquids or flammable gases or vapors are used but that, in the judgment of the authority having jurisdiction, would become hazardous only in case of an accident or of some unusual operating condition. The quantity of flammable material that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry or business with respect to explosions or fires are all factors that merit consideration in determining the classification and extent of each location.

Informational Note No. 2: See NFPA 30, Flammable and Combustible Liquids Code, and NFPA 58, Liquefied Petroleum Gas Code. Piping without valves, checks, meters, and similar devices would not ordinarily introduce a hazardous condition even though used for flammable liquids or gases. Depending on factors such as the quantity and size of the containers and ventilation, locations used for the storage of flammable liquids or liquefied or compressed gases in sealed containers might be considered either hazardous (classified) or unclassified locations.

A Class I, Division 2 location is one where there is an explosive atmosphere of gases or vapors mixed with air when an abnormal condition exists, such as failure of a containment wall or ventilation system.

500.5(C) Class II Locations. Class II locations are those that are hazardous because of the presence of combustible dust. Class II locations shall include those specified in 500.5(C)(1) and (C)(2).

500.5(C)(1) Class II, Division 1. A Class II, Division 1 location is a location:

(1) In which combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitible mixtures, or

(2) Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitible mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electrical equipment, through operation of protection devices, or from other causes, or

(3) In which Group E combustible dusts may be present in quantities sufficient to be hazardous in normal or abnormal operating conditions.

Informational Note: Dusts containing magnesium or aluminum are particularly hazardous, and the use of extreme precaution is necessary to avoid ignition and explosion.

This section specifically references Group E metal dust. This is a more appropriate reference than "dusts of an electrically conductive nature," which is vague, since just about any dust can become electrically conductive when it has a high enough moisture content. Group E dusts are not permitted in a Class II, Division 2 location therefore the *Code* acknowledges that even under abnormal operating conditions, the location containing Group E dusts is to be classified as a Class II, Division 1 location.

500.5(C)(2) Class II, Division 2. A Class II, Division 2 location is a location:

(1) In which combustible dust due to abnormal operations may be present in the air in quantities sufficient to produce explosive or ignitible mixtures; or

(2) Where combustible dust accumulations are present but are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but could as a result of infrequent malfunctioning of handling or processing equipment become suspended in the air; or

(3) In which combustible dust accumulations on, in, or in the vicinity of the electrical equipment could be sufficient to interfere with the safe dissipation of heat from electrical equipment, or could be ignitible by abnormal operation or failure of electrical equipment.

Informational Note No. 1: The quantity of combustible dust that may be present and the adequacy of dust removal systems are factors that merit consideration in determining the classification and may result in an unclassified area.

Informational Note No. 2: Where products such as seed are handled in a manner that produces low quantities of dust, the amount of dust deposited may not warrant classification.

This section separates the dust accumulation issue from the dust suspension probability issue.

500.5 (D) Class III Locations.

500.5 (D)(1) Class III, Division 1. Class III, Division 1 locations shall include those locations specified in 500.5(D)(1)(a) and (D)(1)(b).

(a) Combustible Fibers/Flyings. Locations where nonmetal combustible fibers/flyings are in the air under normal operating conditions in quantities sufficient to produce explosible mixtures or where mechanical failure or abnormal operation of machinery or equipment might cause combustible fibers/flyings to be produced and might also provide a source of ignition through simultaneous failure of electrical equipment, through operation of protection devices, or from other causes shall be classified as Class III, Division 1. Locations where metal combustible fibers/flyings are present shall be classified as Class II, Division 1, Group E.

Informational Note No. 1: Such locations usually include some parts of rayon, cotton, and other textile mills; associated manufacturing and processing plants; cotton gins and cotton-seed mills; flax-processing plants; clothing manufacturing plants; woodworking plants; and establishments and industries involving similar hazardous processes or conditions.

Informational Note No. 2: Combustible fibers/flyings include flat platelet-shaped particulates, such as metal flakes, and fibrous board, such as particle board.

(b) Ignitible Fibers/Flyings. Locations where ignitible fibers/flyings are handled, manufactured, or used shall be classified as Class III, Division 1.

Informational Note No. 1: Such locations usually include some parts of rayon, cotton, and other textile mills; associated manufacturing and processing plants; cotton gins and cotton-seed mills; flax-processing plants; clothing manufacturing plants; woodworking plants; and establishments and industries involving similar hazardous processes or conditions.

Informational Note No. 2: Ignitible fibers/flyings can include rayon, cotton (including cotton linters and cotton waste), sisal or henequen, istle, jute, hemp, tow, cocoa fiber, oakum, baled waste kapok, Spanish moss, excelsior, and other materials of similar nature.

500.5(D)(2) Class III, Division 2. Class III, Division 2 locations shall include those locations specified in 500.5(D)(2)(a) and (D)(2)(b).

(a) Combustible Fibers/Flyings. Locations where nonmetal combustible fibers/flyings might be present in the air in quantities sufficient to produce explosible mixtures due to abnormal operations or where accumulations of nonmetal combustible fibers/flyings accumulations are present but are insufficient to interfere with the normal operation of electrical equipment or other apparatus but could, as a result of infrequent malfunctioning of handling or processing equipment, become suspended in the air shall be classified as Class III, Division 2.

(b) Ignitible Fibers/Flyings. Locations where ignitible fibers/flyings are stored or handled, other than in the process of manufacture, shall be classified as Class III, Division 2.

500.5(D) has been revised to include combustible fibers/flyers.

500.6 Materials

500.6(A) Class I Group Classifications. Class I groups shall be in accordance with **500.6(A)(1)** through **(A)(4)**.

Informational Note No. 1: The explosion characteristics of air mixtures of gases or vapors vary with the specific material involved. For Class I locations, Groups A, B, C, and D, the classification involves determinations of maximum explosion pressure and maximum safe clearance between parts of a clamped joint in an enclosure. It is necessary, therefore, that equipment be identified not only for class but also for the specific group of the gas or vapor that will be present.

Informational Note No. 2: Certain chemical atmospheres may have characteristics that require safeguards beyond those required for any of the Class I groups. Carbon disulfide is one of these chemicals because of its low autoignition temperature (90°C) and the small joint clearance permitted to arrest its flame.

GROUPS A, B, C AND D (Class I)

Potentially explosive gases and vapors are divided into four groups, A, B, C, and D. NFPA® 497, "Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas", contains information on which gases and vapors go into each of these groups, and also provides information on how to classify hazardous areas due to the presence of flammable gases and vapors.

The four gas groups were created so that electrical equipment intended to be used in hazardous (classified) locations could be rated for families of gases and vapors, and tested with a designated worst-case gas/air mixture to cover the entire group. If electrical equipment will be used only in the presence of one flammable gas, the testing can be done with that gas instead of the designated test gas.

There are four characteristics of flammable gases that are critical to the design of electrical equipment to be used in hazardous (classified) locations. These characteristics are: maximum experimental safe gap (MESG), minimum igniting current ratio (MIC ratio), maximum explosion pressure, and autoignition temperature.

The gases fall into Gas Groups A, B, C or D based on two of these characteristics: MESG and MIC ratio.

The MESG is determined by using a device called the Westerberg apparatus. This device has two chambers that are separated by two parallel metal plates. The plates can be adjusted to different gaps between them. A flammable gas/air mixture is introduced into both sides of the apparatus, and is then ignited on one side. The MESG is the maximum gap between the two plates that will not cause ignition of the gas in the volume without the ignition source.

MESG is important in the design of explosionproof enclosures, which rely on the enclosure to keep an ignition inside the enclosure from propagating to the outside atmosphere. Enclosures for gases with a small MESG number will require smaller gaps in their joints and tighter tolerances than those designed for gases with higher MESG numbers.

The MIC ratio is the minimum current required in a specified inductive ignition device that will ignite a gas/air mixture; divided by the minimum current required to ignite a methane/air mixture, using the same inductive ignition device. The resulting MIC ratio compares the minimum ignition energy of the gas/air mixture being tested, to the minimum ignition energy of methane. The most likely reason that methane is used as the reference is because the early work in hazardous location safety was done in coal mines where methane is the gas most often encountered.

The minimum ignition energy is important in the design of an intrinsically safe apparatus, which limits the energy that can be stored and released by any part of a circuit to less than the minimum ignition energy of the gas or vapor that will be present in use.

The maximum explosion pressure is the peak pressure produced inside an enclosure when the designated test gas/air mixture is ignited inside of it. This parameter is important in the design of explosionproof enclosures, since the housing has to survive a hydrostatic pressure test, without permanent deformation, to a pressure based on a multiple of the maximum explosion pressure.

The substance's autoignition temperature is the lowest temperature at which it will burst into flame in air, even without an external spark or other source. This parameter is important for all methods of protection. The autoignition temperature, however, has no correlation to MESG or the MIC ratio. For example, hydrogen has both a very low MESG and MIC ratio, but has a very high autoignition temperature over +500 °C (+932 °F).

The gas groups, from A to D, contain gases with MESG values and MIC ratios that go from smallest to largest. More information on the properties of flammable gases and vapors can be found in Appendix A.

500.6(A)(1) Group A. Acetylene. [**497**:3.3.5.1.1]

Gas Group A contains only acetylene. Acetylene has similar MESG and MIC ratio numbers to hydrogen, but is separated into its own Group because of two other reasons. Acetylene will form hot particles when combusted in concentrations with air over about 30%, and design considerations for Group A enclosures need to consider the ejection of these hot particles. Acetylene can also react with some metals and form unstable compounds. Acetylene is the designated test gas for Group A.

500.6(A)(2) Group B. Flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value less than or equal to 0.45 mm or a minimum igniting current ratio (MIC ratio) less than or equal to 0.40. [**497**:3.3.5.1.2]

Informational Note: A typical Class I, Group B material is hydrogen.

500.6(A)(3) Group C. Flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.45 mm and less than or equal to 0.75 mm, or a minimum igniting current (MIC) ratio greater than 0.40 and less than or equal to 0.80. [**497**:3.3.5.1.3]

Informational Note: A typical Class I, Group C material is ethylene.

Gas Group C contains flammable gas having either an MESG value greater than 0.45 mm and less than or equal to 0.75 mm, or an MIC ratio greater than 0.40 and less than or equal to 0.80. Ethylene is the designated test gas for Group C.

500.6(A)(4) Group D. Flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.75 mm or a minimum igniting current (MIC) ratio greater than 0.80. [**497**:3.3.5.1.4]

Informational Note No. 1: A typical Class I, Group D material is propane. [**497**:3.3.5.1.4]

Informational Note No. 2: See ANSI/ASHRAE 15, Safety Standard for Refrigeration Systems, for information on the classification of areas involving ammonia atmospheres.

Ammonia is a Group D gas that is often encountered and widely used as a component in refrigerants and fertilizers. For classification of areas involving ammonia, see ANSI/ASHRAE 15-1994, "Safety *Code* for Mechanical Refrigeration", and ANSI/CGA G2.1 1989, "Safety Requirements for the Storage and Handling of Anhydrous Ammonia".

500.6(B) Class II Combustible Dust Group Classifications. Combustible dust shall be grouped in accordance with **500.6(B)(1)** through **(B)(3)**.

Groups E, F and G (Class II)

Combustible dusts are defined as any finely divided solid material 420 microns or less in diameter (U.S. No. 40 Standard Sieve or smaller), and are divided into three Groups, E, F, and G. NFPA® 499, "Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas", contains information on which dusts go into each of these groups, and also provides information on how to classify hazardous areas due to the presence of combustible dusts. More information on the properties of combustible dusts can be found in Appendix A-2.

500.6(B)(1) Group E. Atmospheres containing combustible metal dusts, including aluminum, magnesium, and their commercial alloys, or other combustible dusts whose particle size, abrasiveness, and conductivity present similar hazards in the use of electrical equipment. [**499**:3.3.4.1]

Informational Note: Certain metal dusts may have characteristics that require safeguards beyond those required for atmospheres containing the dusts of aluminum, magnesium, and their commercial alloys. For example, zirconium, thorium, and uranium dusts have extremely low ignition temperatures [as low as 20°C (68°F)] and minimum ignition energies lower than any material classified in any of the Class I or Class II groups.

Section 500.6(B)(1) states that "Group E dusts are considered to be electrically conductive." These dusts are metal dusts, such as aluminum, magnesium, and their commercial alloys or other dusts of small particle size, abrasiveness and/or electrical conductivity as to present a similar hazard. Although electrical conductivity is not a major criteria for classifying dusts into Groups, it is a characteristic nature of Group E dusts. If the dust is electrically conductive, caution is advised, as these dusts may ignite from bridging the gap between energized terminals, from arcs or from failure of equipment. Where Group E dusts are present in hazardous quantities, only Class II, Division 1 electrical equipment can be used. There is no such classification as Class II, Division 2, Group E. There is no middle ground. Either the location contains enough electrically conductive dusts to make it a Division 1 location, or there is not enough dust present to make it a hazardous location. However, great care must be taken, as only a small amount of electrically conductive combustible dust can make a location Class II, Division 1, Group E. Unless thorough tests are made, it is safer to use Division 1 equipment.

Group E contains combustible metal dusts. Any area that has a sufficient quantity of Group E dusts present to cause a hazard must be classified as Class II, Division 1. Classification as a Division 2 area is not allowed. Metal dusts can be extremely hazardous. Some metals, like magnesium, can burn even when under water.

500.6(B)(2) Group F. Atmospheres containing combustible carbonaceous dusts that have more than 8 percent total entrapped volatiles (see ASTM D3175-2017, Standard Test Method for Volatile Matter in the Analysis Sample of Coal and Coke, for coal and coke dusts) or that have been sensitized by other materials so that they present an explosion hazard. [**499**:3.3.4.2] Coal, carbon black, charcoal, and coke dusts are examples of carbonaceous dusts. [**499**:A.3.3.4.2]

Informational Note: Testing of specific dust samples, following established ASTM testing procedures, is a method used to identify the combustibility of a specific dust and the need to classify those locations containing that material as Group F.

500.6(B)(3) Group G. Atmospheres containing combustible dusts not included in Group E or Group F, including flour, grain, wood, plastic, and chemicals. [**499**:3.3.4.3]

Informational Note No. 1: See NFPA 499, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, for information on group classification of Class II materials.

Informational Note No. 2: The explosion characteristics of air mixtures of dust vary with the materials involved. For Class II locations, Groups E, F, and G, the classification involves the tightness of the joints of assembly and shaft openings to prevent the entrance of dust in the dust-ignitionproof enclosure, the blanketing effect of layers of dust on the equipment that may cause overheating, and the ignition temperature of the dust. It is necessary, therefore, that equipment be identified not only for the class but also for the specific group of dust that will be present.

Informational Note No. 3: See ANSI/IEEE C2, National Electrical Safety Code, Section 127A, Coal Handling Areas. Certain dusts might require additional precautions due to chemical phenomena that can result in the generation of ignitible gases.

500.6(C) Class III Combustible Fibers/Flyings. Combustible fibers/flyings shall not be further grouped.

500.6(D) Class III Ignitible Fibers/Flyings. Ignitible fibers/flyings shall not be further grouped.

500.7 Protection Techniques. Electrical and electronic equipment in hazardous (classified) locations shall be protected by one or more of the techniques in 500.7(A) through (P). Suitability of the protection techniques for specific hazardous locations is shown in **Chapter 9, Table 13**.

Table 13 in Chapter 9 has been added to provide further clarity to the Protection Techniques. It identifies the permitted Classified Areas that the specific Protection Technique id suitable for use in It also identifies the corresponding Protection Technique marking.

500.7(A) Explosionproof Equipment. This protection technique shall be permitted for equipment in Class I, Division 1 or 2 locations.

Explosionproof enclosures are very widely used to protect electrical equipment in hazardous (classified) locations. The protection concept works by enclosing the electrical apparatus inside a robust housing, where every path from the inside of the enclosure to the outside, called a flamepath, is controlled. If a flammable atmosphere gets inside the enclosure and is ignited by the electrical apparatus, the flamepaths will prevent that ignition from being transmitted to the flammable atmosphere outside the enclosure. The outside surface temperature of the explosionproof enclosure also must be controlled so it does not become an ignition source for the outside atmosphere. More information on explosionproof enclosures and flamepath construction can be found in the beginning of this *Code* Review under Types of Explosionproof Construction – Appleton™ Products.

500.7(B) Dust Ignitionproof. This protection technique shall be permitted for equipment in Class II, Division 1 or 2 locations.

Dust Ignitionproof prevents dusts from entering into the enclosure and also controls and/or publishes the maximum external surface temperatures at a given ambient under normal service conditions.

500.7(C) Dusttight. This protection technique shall be permitted for equipment in Class II, Division 2 or Class III, Division 1 or 2 locations.

Dust protection concepts work by ensuring enclosures that are used in Class II environments keep dust from entering enclosures in quantities large enough to cause a problem with the electrical equipment inside. For dust-ignitionproof enclosures the outside surface temperature of the enclosure also must be controlled to avoid thermal ignition of a dust cloud, or burning of a dust layer on the enclosure.

500.7(D) Purged and Pressurized. This protection technique shall be permitted for equipment in any hazardous (classified) location for which it is identified.

Purging can be used to keep a hazardous atmosphere from reaching its lower flammable limit (LFL). Pressurizing with clean air or inert gas can be used to keep flammable gas or dust out of an enclosure, or even entire rooms or buildings. If inert gas is used in areas where personnel will be present, care must be taken to avoid any asphyxiation hazards.

500.7(E) Intrinsic Safety. This protection technique shall be permitted for equipment in Class I, Division 1 or Division 2; Class II, Division 1 or Division 2; or Class III, Division 1 or Division 2 locations.

Intrinsic safety does not depend on an enclosure to protect electrical apparatus. Intrinsic safety is a system consisting of a special power limiter (associated apparatus) located in the unclassified area, the wiring to the unit in the hazardous area, and the hazardous area apparatus. This system is designed so that it is not capable of storing and releasing enough energy in the hazardous location to ignite a flammable atmosphere. The system must be safe even with up to two faults applied to the circuit. Intrinsic safety, because of the limited amount of power that can be transmitted to the hazardous location, is limited to instrumentation and other applications that do not use much power. This is especially true for Gas Groups A and B, where the gases have very low ignition energies. In addition to Division 1 wiring methods, any ordinary location wiring method can be used for the wiring between the associated apparatus in the safe area and the hazardous location apparatus, provided the wiring is separated adequately from other circuits. This is possible because there is not enough energy in each intrinsically safe circuit to cause an ignition capable spark, even if the wires are shorted to each other or to ground.

500.7(F) Nonincendive Circuit. This protection technique shall be permitted for equipment in Class I, Division 2; Class II, Division 2; or Class III, Division 1 or 2 locations.

Nonincendive circuits are energy limited, like intrinsically safe circuits for Division 1; they cannot release enough energy to cause a flammable atmosphere to ignite. Unlike intrinsically safe circuits, they are evaluated with no faults applied, since the risk in Division 2 of having a flammable atmosphere present is lower. These circuits can also be installed using ordinary location wiring methods, provided adequate separation from other circuits is maintained.

500.7(G) Nonincendive Equipment. This protection technique shall be permitted for equipment in Class I, Division 2; Class II, Division 2; or Class III, Division 1 or 2 locations.

Nonincendive equipment does not depend on an enclosure as protection against causing ignition of a flammable atmosphere. It has no normally arcing or sparking components that are not protected by other methods, and has no hot surface capable of causing thermal ignition of a flammable atmosphere. Nonincendive equipment may have both incendive and nonincendive circuit connections, for instance, a 120 V connection for power, which is incendive; and a signal or sensor circuit that is nonincendive. Appropriate Division 2 wiring methods must always be used to wire incendive circuits.

500.7(H) Nonincendive Component. This protection technique shall be permitted for equipment in Class I, Division 2; Class II, Division 2; or Class III, Division 1 or 2 locations.

A nonincendive component is treated the same as nonincendive equipment. The wiring connections to a nonincendive component may be either incendive or nonincendive, and must be installed appropriately.

500.7(I) Oil Immersion. This protection technique shall be permitted for current-interrupting contacts in Class I, Division 2 locations as described in **501.115(B)(1)(2)**.

Oil immersion works by submerging arcing or sparking contacts in a noncombustible mineral oil, isolating the flammable atmosphere from the ignition source. This method of protection is not very widely used anymore since it requires frequent maintenance.

500.7(J) Hermetically Sealed. This protection technique shall be permitted for equipment in Class I, Division 2; Class II, Division 2; or Class III, Division 1 or 2 locations.

Hermetic sealing isolates ignition capable arcing or sparking contacts from flammable atmospheres by placing them in an enclosure that is sealed gastight, by using fusion joints of metal, glass, or ceramic materials.

500.7(K) Detection System for Flammable Gases. A detection system for flammable gases shall be permitted as a means of protection in restricted industrial establishments.

500.7(K) Revised to align with the restricted industrial establishment definition in Article 100 that has also been added.

500.7(K)(1) General. Any gas detection system utilized as a protection technique shall meet all of the requirements in **500.7(K)(1)(a)** through **(K)(1)(e)**.

(a) The gas detection equipment used shall be listed for Class I, Division 1 and listed for the detection of the specific gas or vapor to be encountered.

(b) The gas detection system shall not utilize portable or transportable equipment or temporary wiring methods.

(c) The gas detection system shall only use point-type sensors. The system shall be permitted to be augmented with open-path (line-of-sight)–type sensors, but open-path–type sensors shall not be the basis for this protection technique.

(d) The type of detection equipment and its listing, installation location(s), alarm and shutdown criteria, and calibration frequency shall be documented where combustible gas detectors are used as a protection technique.

(e) The applications for the use of combustible gas detection systems as a protection technique shall be limited to **500.7(K)(2), (K)(3),** or **(K)(4)**.

Informational Note No. 1: See ANSI/UL 121303, Guide for Use of Detectors for Flammable Gases, or ANSI/FM 121303, Guide for Use of Detectors for Flammable Gases, for additional information.

Informational Note No. 2: See ANSI/UL 60079-29-1, Explosive Atmospheres — Part 29-1: Gas Detectors — Performance Requirements of Detectors for Flammable Gases, or ANSI/FM 60079-29-1, Explosive Atmospheres — Part 29-1: Gas Detectors — Performance Requirements of Detectors for Flammable Gases, for additional information.

Informational Note No. 3: See ANSI/API RP 500, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2, for additional information.

Informational Note No. 4: See ANSI/UL 60079-29-2, Explosive Atmospheres — Part 29-2: Gas Detectors — Selection, Installation, Use and Maintenance of Detectors for Flammable Gases and Oxygen, or ANSI/FM-60079-29-2, Explosive atmospheres — Part 29-2: Gas Detectors — Selection, Installation, Use and Maintenance of Detectors for Flammable Gases and Oxygen, for additional information.

500.7(K)(2) Inadequate Ventilation. A location, enclosed space, or building that is classified as a Class I, Division 1 location due to inadequate ventilation and is provided with a detection system for flammable gases shall be permitted to use electrical equipment, installation methods, and wiring practices suitable for Class I, Division 2 installations. Sensing a gas concentration of not more than 40 percent of the lower flammable limit or a gas detector system malfunction shall activate an alarm (audible or visual, or both, as most appropriate for the area).

500.7(K)(3) Interior of a Building or Enclosed Space. Any building or enclosed space that does not contain a source of flammable gases or vapors that is located in, or has an opening into, a Class I, Division 2 hazardous (classified) location and is provided with a detection system for flammable gases shall be permitted to use electrical equipment, installation methods, and wiring practices suitable for unclassified installations under all of the following conditions:

(1) An alarm (audible or visual, or both) shall be sounded at not more than 20 percent of the lower flammable limit.

(2) Sensing a gas concentration of not more than 40 percent of the lower flammable limit or a gas detector system malfunction shall activate an alarm (audible or visual, or both, as most appropriate for the area) and initiate automatic disconnection of power from all electrical devices in the area that are not suitable for Class I, Division 2.

(3) The power disconnecting device(s) shall be suitable for Class I, Division 1 if located inside the building or enclosed space. If the disconnecting device(s) is located outside the building or enclosed space, it shall be suitable for the location in which it is installed.

Redundant or duplicate equipment (such as sensors) shall be permitted to be installed to avoid disconnecting electrical power when equipment malfunctions are indicated.

When automatic shutdown could introduce additional or increased hazard, this technique shall not be permitted.

500.7(K)(4) Interior of a Control Panel. Inside the interior of a control panel containing instrumentation or other equipment using or measuring flammable liquids, gases, or vapors, which is provided with a detection system for flammable gases shall be permitted to use electrical equipment, installation methods, and wiring practices suitable for Class I, Division 2 installations.

An alarm (audible or visual, or both) shall be sounded at not more than 40 percent of the lower flammable limit.

Protection of electrical apparatus using combustible gas detection works by using these detectors, rated for use in the hazardous area, to shut down equipment when the flammable gas level gets to a predetermined point, usually 25% of the LFL. This protection method was introduced to allow the use of Division 2 rated equipment in Division 1 under certain conditions, or to allow the use of ordinary location equipment in Division 2. There are some circumstances where specialized equipment that is not hazardous area rated has to be used in a hazardous area to maintain the overall safety of the process. Use of this protection scheme should be very rare. There is a great deal of engineering and technical expertise necessary to successfully implement protection of this type, and that is why it is limited to industrial establishments with limited public access.

Documentation for the application of the combustible gas detection protection method is required.

500.7(L) Inherently Safe Optical Radiation "op is." This protection technique shall be permitted for equipment in Class I or II, Division 1 or 2 locations for which the equipment is identified.

Informational Note: The identified class and division depends on the intended explosive atmosphere and the number of faults applied as part of the protection technique evaluation.

500.7(M) Protected Optical Radiation "op pr." This protection technique shall be permitted for equipment in Class I or II, Division 2 locations for which the equipment is identified.

Informational Note: The identified class and division depends on the intended explosive atmosphere as part of the protection technique evaluation.

500.7(N) Optical System With Interlock "op sh." This protection technique shall be permitted for equipment in Class I or II, Division 1 or 2 locations for which the equipment is identified.

Informational Note: The identified class and division depends on the intended explosive atmosphere and the number of faults applied as part of the protection technique evaluation.

Non-convergent LED light sources such as luminaires are not considered to be a source of optical radiation that would create dangerous isolated temperature rises on surfaces in a hazardous (classified) location. For other light sources that do not apply to the hazardous condition refer to ANSI/UL 60079-28 "Explosive Atmospheres – Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation".

500.7(O) Protection by Skin Effect Trace Heating "IEEE 844.1". This protection technique shall be permitted for skin effect trace heating equipment in Class I, Division 2; Class II, Division 2; or Class III, Division 2 for which it is listed.

Since Section 500.4 pertaining to Documentation requirements contains this protection technique in an Informational Note No. 7 of 500.4, it has also been added to this section for correlation.

500.7(P) Protection by Electrical Resistance Trace Heating "60079-30-1". This protection technique shall be permitted for electrical resistance trace heating equipment in Class I, Division 1; Class I, Division 2; Class II, Division 1; Class II, Division 2; Class III, Division 1; or Class III, Division 2 locations for which it is listed.

500.7(Q) Protection by Impedance Heating "IEEE 844.3". This protection technique shall be permitted for impedance heating equipment in Class I, Division 2; Class II, Division 2; or Class III, Division 2 locations for which it is listed.

500.7(Q) has been added as a permitted protection technique for Class I, Division 2 and Class III, Division 2.

500.7(R) Enclosed-Break. This protection technique shall be permitted for equipment in Class I, Division 2 locations.

500.7(R) has been added for "Enclosed-break" protection technique as it is a Class I, Division 2 type of protection in accordance with ANSI/UL 121201. It is not a new Class I, Division 2 type of protection, but had not been identified in the NEC as such.

500.7(S) Nonsparking. This protection technique shall be permitted for equipment in Class I, Division 2 locations.

500.7(S) has been added for "Nonsparking" protection technique as it is a Class I, Division 2 type of protection in accordance with ANSI/UL 121201. It is not a new Class I, Division 2 type of protection, but had not been identified in the NEC as such.

500.7(T) Sealed. This protection technique shall be permitted for equipment in Class I, Division 2; Class II, Division 2; Class III, Division 1; or Class III, Division 2 locations.

500.7(T) has been added for "Sealed" protection technique as it is a Class I, Division 2 type of protection in accordance with ANSI/UL 121201. It is not a new Class I, Division 2 type of protection, but had not been identified in the NEC as such.

500.7(U) Special Protection Techniques. Protection techniques not specified in 500.7(A) through (T) shall be permitted for use in equipment listed for use in hazardous (classified) locations.

Informational Note: See ANSI/UL 60079-33, Explosive Atmospheres — Part 33: Equipment Protection by Special Protection "s", for additional information.

500.7(U) revised to provide context as to the types of protection techniques that are permitted.

500.8 Equipment. Explosionproof or dust-ignitionproof equipment shall not be permitted for use at temperatures lower than -25°C (-13°F) unless they are identified for low-temperature service.

Informational Note: At low ambient temperatures, flammable concentrations of vapors might not exist in a location classified as Class I, Division 1 at normal ambient temperature.

500.8(A) Suitability. Suitability of identified equipment shall be determined by one of the following:

(1) Equipment listing or labeling

(2) Evidence of equipment evaluation from a qualified testing laboratory or inspection agency concerned with product evaluation

(3) Evidence acceptable to the authority having jurisdiction such as a manufacturer's self-evaluation or an owner's engineering judgment

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

Section 500.8 requires that electrical equipment installed in a hazardous location meet the requirements to be used in that location, and gives three different ways that the information about the suitability of the equipment can be obtained. Equipment listing and labeling is the most common method of determining suitability however Appleton Grp LLC has the ability in most cases, to provide evidence of suitability by the other permitted methods upon request.

500.8(B) Approval for Class and Properties.

500.8(B)(1) Equipment Identification. Equipment shall be identified not only for the class of location but also for the explosive, combustible, or ignitible properties of the specific gas, vapor, dust, or fibers/flyings that will be present. In addition, Class I equipment shall not have any exposed surface that operates at a temperature in excess of the autoignition temperature of the specific gas or vapor. Class II equipment shall not have an external temperature higher than that specified in **500.8(D)(2)**. Class III equipment shall not exceed the maximum surface temperatures specified in **503.5**.

Exception No. 1: Group D equipment shall be permitted to be used for atmospheres containing butadiene if all conduit runs into explosionproof equipment are provided with explosionproof seals installed within 450 mm (18 in.) of the enclosure.

Exception No. 2: Group C equipment shall be permitted to be used for atmospheres containing allyl glycidyl ether, n-butyl glycidyl ether, ethylene oxide, propylene oxide, and acrolein if all conduit runs into explosionproof equipment are provided with explosionproof seals installed within 450 mm (18 in.) of the enclosure.

Informational Note: See 500.8(C)(6)(a) regarding general-purpose equipment. Luminaires and other heat-producing apparatus, switches, circuit breakers, and plugs and receptacles are potential sources of ignition and are investigated for suitability in classified locations. Such types of equipment, as well as cable terminations for entry into explosionproof enclosures, are available as listed for Class I, Division 2 locations. Fixed wiring, however, might use wiring methods that are not evaluated with respect to classified locations. Therefore, wiring products such as cable, raceways, boxes, and fittings are not marked as being suitable for Class I, Division 2 locations.

Some mechanical and electrical wiring products are necessary and acceptable to use in Class I, Division 2 hazardous locations in accordance with Chapter 5 of the NEC®; however they will not be marked as rated for Class I, Division 2 as there are no specific requirements for these products as they are considered non-heat producing and non-sparking.

500.8(B)(2) Equipment Application. Equipment that has been identified for a Division 1 location shall be permitted in a Division 2 location of the same class, group, and temperature class and shall comply with the requirements of **500.8(B)(2)(a)** or **(B)(2)(b)** as applicable.

(a) Intrinsically safe apparatus having a control drawing requiring the installation of associated apparatus for a Division 1 installation shall be permitted to be installed in a Division 2 location if the same associated apparatus is used for the Division 2 installation.

(b) Equipment that is required to be explosionproof shall incorporate seals in accordance with **501.15(A)** or **(D)** when the wiring methods of **501.10(B)** are employed.

Autoignition temperature is not related to other gas properties and has to be considered independently. Intrinsically safe installations are a system, and must be installed as a system in order to meet their design requirements, even when installed in Class I, Division 2. Explosionproof enclosures usually contain arcing and sparking devices, and the seals are necessary to maintain the integrity of the installation of the explosionproof enclosure in Class I, Division 2 as well as in Class I, Division 1.

500.8(B)(3) General-Purpose Equipment. Where specifically permitted in Part III of Articles **501**, **502**, and **503**, general-purpose equipment or equipment in general purpose enclosures shall be permitted to be installed in Division 2 locations if the equipment does not constitute a source of ignition under normal operating conditions.

Determining whether or not a particular piece of general-purpose equipment is suitable to use in a Division 2 location requires evidence of suitability from a qualified source.

500.8(B)(4) Process Seals. Equipment that depends on a single compression seal, diaphragm, or tube to prevent flammable or combustible fluids from entering the equipment shall be identified for a Class I, Division 2 location even if installed in an unclassified location. Equipment installed in a Class I, Division 1 location shall be identified for the Class I, Division 1 location.

Informational Note: Equipment used for flow measurement is an example of equipment having a single compression seal, diaphragm, or tube.

This section recognizes that the inside of an electrical equipment enclosure that is connected to a flammable process through a single seal, is in fact a Class I, Division 2 area. Leakage or failure of the seal could produce a flammable atmosphere inside the equipment enclosure. Since the inside of the enclosure meets the definition of a Class I, Division 2 location, the electrical equipment must be identified as suitable for use in a Class I, Division 2 location, even if the location outside the enclosure is not classified. Measures that must be taken to ensure process gas or fluid does not enter the wiring raceway are addressed in 501.17.

500.8(B)(5) Motors. Unless otherwise specified, normal operating conditions for motors shall be assumed to be rated full-load steady conditions.

500.8(B)(6) Simultaneous Classifications. Where flammable gases, flammable liquid–produced vapors or combustible liquid–produced vapors and combustible dusts are or might be present at the same time, the simultaneous presence of the specific materials shall be considered when determining the safe operating temperature of the electrical equipment.

Dust layers can cause an insulating effect that can raise the operating temperature of heat producing electrical equipment in normal operation. This might create a situation where an equipment surface temperature exposed to the flammable atmosphere would be cool enough for a particular flammable gas when dust is not present, but would be over the temperature rating of the same flammable gas when dust is present.

500.8(C) Marking. Equipment shall be marked to show the environment for which it has been evaluated. Unless otherwise specified or allowed in **500.8(C)(6)**, the marking shall include the information specified in **500.8(C)(1)** through **(C)(5)**.

Table 500.8(C)(4) Classification of Maximum Surface Temperature

Maximum Temperature °C	Maximum Temperature °F	Temperature Class (T Code)
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

These marking requirements are required to be denoted on the equipment and not just on the carton labels or instructions.

500.8(C)(1) Class. The marking shall specify the class(es) for which the equipment is suitable.

500.8(C)(2) Division. The marking shall specify the division if the equipment is suitable for Division 2 only. Equipment suitable for Division 1 shall be permitted to omit the division marking.

Informational Note: Informational Note: See **500.8(B)(2)**. Equipment not marked to indicate a division, or marked "Division 1" or "Div. 1," is suitable for both Division 1 and Division 2 locations. Equipment marked "Division 2" or "Div. 2" is suitable for Division 2 locations only.

500.8(C)(3) Material Classification Group. The marking shall specify the applicable material classification group(s) or specific gas, vapor, dust, or fiber/flying in accordance with **500.6**.

Exception: Fixed luminaires marked for use only in Class I, Division 2 or Class II, Division 2 locations shall not be required to indicate the group.

Informational Note: A specific gas, vapor, dust, or fiber/flying is typically identified by the generic name, chemical formula, CAS number, or combination thereof.

In the absence of specifying the material classification groups, the equipment may be classified for use in the presence of a specific classified material.

500.8(C)(4) Equipment Temperature. The marking shall specify the temperature class or operating temperature at a 40°C ambient temperature, or at the higher ambient temperature if the equipment is rated and marked for an ambient temperature of greater than 40°C. For equipment installed in a Class II, Division 1 location, the temperature class or operating temperature shall be based on operation of the equipment when blanketed with the maximum amount of dust that can accumulate on the equipment. The temperature class, if provided, shall be indicated using the temperature class (T *Codes*) shown in **Table 500.8(C)(4)**. Equipment for Class I and Class II shall be marked with the maximum safe operating temperature, as determined by simultaneous exposure to the combinations of Class I and Class II conditions.

Exception: Equipment of the non–heat-producing type, such as junction boxes, conduit, and fittings, and equipment of the heat-producing type having a maximum temperature not more than 100°C shall not be required to have a marked operating temperature or temperature class.

Informational Note: More than one marked temperature class or operating temperature, for gases and vapors, dusts, and different ambient temperatures, may appear.

The product listing standards for Class II, Division 1 equipment require that the temperature class and/or operating temperature be determined when the equipment is covered with the maximum amount of dust. Listed equipment for Class II, Division 1 has been evaluated in accordance with this requirement. This is not a new requirement in the product listing standards.

500.8(C)(5) Ambient Temperature Range. Electrical equipment designed for use in the ambient temperature range between –25°C to +40°C shall require no ambient temperature marking. For equipment rated for a temperature range other than –25°C to +40°C, the marking shall specify the special range of ambient temperatures in degrees Celsius. The marking shall include either the symbol "Ta" or "Tamb."

Informational Note: As an example, such a marking might be "–30°C ≤ Ta ≤ +40°C."

500.8(C)(6) Special Allowances.

(a) *General-Purpose Equipment.* Fixed general-purpose equipment in Class I locations, other than fixed luminaires, that is acceptable for use in Class I, Division 2 locations shall not be required to be marked with the class, division, group, temperature class, or ambient temperature range.

An example of this are fittings that are listed to the unclassified (ordinary) location standards. They are not specifically listed for Class I, Division 2 locations, however, the *Code* permits the installation of these fittings in a Class I, Division 2 location as they do not present an ignition source.

(b) *Dusttight Equipment*. Fixed dusttight equipment, other than fixed luminaires, that is acceptable for use in Class II, Division 2 and Class III locations shall not be required to be marked with the class, division, group, temperature class, or ambient temperature range.

Equipment other than luminaires are not required to be marked with the classification marking, however they should be identified as being suitable for Dusttight applications. Equipment that is rated as Enclosure Types 3, 3S, 3SX, 3X, 4, 4X, 5, 6, 6P, 12, 12K, and 13 are considered as suitable as Dusttight. See NEC® Table 110.28.

(c) *Associated Apparatus.* Associated intrinsically safe apparatus and associated nonincendive field wiring apparatus that are not protected by an alternative type of protection shall not be marked with the class, division, group, or temperature class. Associated intrinsically safe apparatus and associated nonincendive field wiring apparatus shall be marked with the class, division, and group of the apparatus to which it is to be connected.

(d) *Simple Apparatus.* "Simple apparatus" as defined in Article 100 Part III, shall not be required to be marked with class, division, group, temperature class, or ambient temperature range.

500.8(D) Temperature.

500.8(D)(1) Class I Temperature. The temperature marking specified in **500.8(C)** shall not exceed the autoignition temperature of the specific gas or vapor to be encountered.

Informational Note: See NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, for information on autoignition temperatures of gases and vapors.

500.8(D)(2) Class II Temperature. The temperature marking specified in **500.8(C)** shall be less than the ignition temperature of the specific dust or metal fiber/flying to be encountered.

Informational Note: See NFPA 499, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, for minimum ignition temperatures of specific dusts.

500.8(D)(3) Class III Temperature. The temperature marking specified in **500.8(C)** shall be less than the ignition temperature of the specific fiber/flying to be encountered, except as specified in 500.8(D)(3)(a) or (D)(3)(b).

(a) For nonmetal combustible fibers/flyings that might dehydrate or carbonize, the temperature marking shall not exceed the lower of either the ignition temperature or 165°C (329°F).

(b) When ignitible fibers/flyings are present, the maximum surface temperatures under operating conditions shall not exceed 165°C (329°F) for equipment that is not subject to overloading, and 120°C (248°F) for equipment (such as motors or power transformers) that might be overloaded.

500.8(E) Threading. The supply connection entry thread form shall be NPT or metric. Conduit and fittings shall be made wrenchtight to prevent sparking when fault current flows through the conduit system, and to ensure the explosionproof integrity of the conduit system where applicable. Equipment provided with threaded entries for field wiring connections shall be installed in accordance with **500.8(E)(1)** or **(E)(2)** and with **(E)(3)**.

500.8(E)(1) Equipment Provided with Threaded Entries for NPT-Threaded Conduit or Fittings. For equipment provided with threaded entries for NPT-threaded conduit or fittings, listed conduit, listed conduit fittings, or listed cable fittings shall be used. All NPT-threaded conduit and fittings shall be threaded with a National (American) Standard Pipe Taper (NPT) thread.

This section clarifies that not only is the conduit required to be "listed" but also the conduit fittings and cable fittings.

NPT-threaded entries into explosionproof equipment shall be made up with at least five threads fully engaged.

When using NPT entries it is important that these threads be installed wrenchtight. There is no clear definition for the term wrenchtight, however a good rule of thumb is handtight with no less than ¼ additional turn with a wrench. This is important to ensure that the roots and crests of the threads are fully engaged and therefore create a sound flamepath as well as a secure mechanical and electrical grounding joint.

Exception: For listed explosionproof equipment, joints with factory-threaded NPT entries shall be made up with at least four and one-half threads fully engaged.

This exception is to recognize that factory produced threads provide for better control of thread specification tolerances and that the resulting threading engagement is adequate to perform the function of an explosionproof joint.

Informational Note No. 1: See ASME B1.20.1, Pipe Threads, General Purpose (Inch), for thread specifications for male NPT threads.

Informational Note No. 2: See ASME B1.20.1, Pipe Threads, General Purpose (Inch), and ANSI/UL 1203, Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations, for information on female NPT-threaded entries using modified National Standard Pipe Taper (NPT) threads.

500.8(E)(2) Equipment Provided with Threaded Entries for Metric-Threaded Fittings. For equipment with metric-threaded entries, listed conduit fittings or listed cable fittings shall be used. Such entries shall be identified as being metric, or listed adapters to permit connection to conduit or NPT-threaded fittings shall be provided with the equipment and shall be used for connection to conduit or NPT-threaded fittings.

Metric-threaded fittings installed into explosionproof equipment shall have a class of fit of at least 6g/6H and shall be made up with at least five threads fully engaged.

Only listed conduit fittings or listed cable fittings are permitted to be installed into metric threaded entries.

These threads must be identified to prevent improper assembly of fittings that do not employ metric threaded male hubs. The end user does not need to be concerned with the class of fit requirements as this is controlled by the equipment manufacturer and inspected by the certification agency at the point of manufacture.

Informational Note: See ISO 965-1, ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data, and ISO 965-3, ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads, for threading specifications for metric-threaded entries.

500.8(E)(3) Unused Openings. All unused openings shall be closed with blanking elements or close-up plugs that are listed for the location. The thread engagement shall comply with the requirements of **500.8(E)(1)** or **(E)(2)**.

The listing standard, ANSI/UL 1203 requires an explosionproof box or enclosure to be factory-provided with close-up plugs for all entries except for one entry. These plugs might not independently be marked with the listing and classification information, however if not marked, they have been evaluated as part of the full box and enclosure listing.

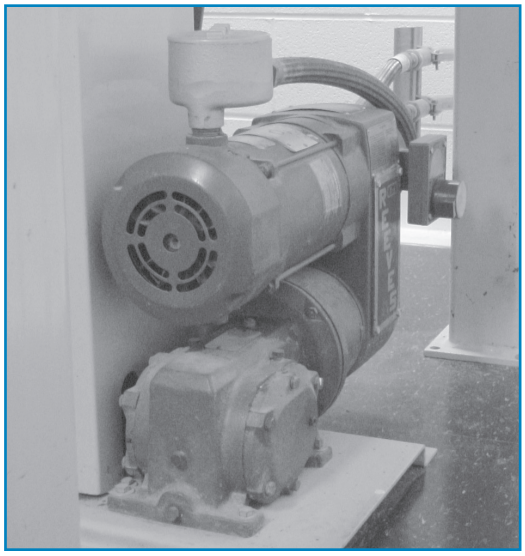
500.8(F) Optical Fiber Cables. An optical fiber cable, with or without current-carrying conductors (hybrid optical fiber cable), shall be installed to address the associated fire hazard and sealed to address the associated explosion hazard in accordance with Part II of Articles **501, 502,** or **503**, as applicable.

500.8(G) Equipment Involving Optical Radiation. The risk of ignition from optical radiation shall be evaluated for laser equipment, optical fiber equipment, and any other convergent light sources or beams where light is focused in one single point within a hazardous area with a wavelength range of 380 nm to 10 µm. This requirement shall include optical equipment that is located outside the explosive atmosphere, but whose emitted optical radiation enters such atmospheres.

Informational Note: See ANSI/UL 60079-28,Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, for information on types of protection that can be applied to minimize the risk of ignition in explosive atmospheres from optical radiation.

The Exception has been removed and are now addressed in the sub-section rule.

Non-convergent continuous LED light sources such as luminaires are not considered to be a source of optical radiation that would create dangerous isolated temperature rises on surfaces in a hazardous (classified) location. For other light sources that do not apply to the hazardous condition refer to ANSI/UL 60079-28 “Explosive Atmospheres – Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation”.



**TYPICAL CLASS I, DIVISION 1 WIRING.
EXGJH/EXLK FLEXIBLE COUPLING**

CHANGES TO ARTICLE 501 – CLASS I LOCATIONS

The following Article 501 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 501.10(A)(1): Class I, Division 1. General
- 501.10(A)(3): Class I, Division 1. Boxes and Fittings
- 501.30(B): Grounding and Bonding. Bonding
- 501.141: Flexible Cables. Class I, Division 2

ARTICLE 501 Class I Locations

Part I. General

501.1 Scope. This article covers the requirements for electrical and electronic equipment and wiring for all voltages in Class I, Division 1 and Division 2 locations where flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors are or might be present in the air in quantities sufficient to produce explosive or ignitible mixtures.

The general rules in NEC® chapters 1 through 4 apply to the electrical and electronic wiring and equipment in locations classified as Class I unless modified by Article 501.

The rules in Article 500 also apply to Article 501.

Equipment listed and marked in accordance with 505.9(C)(2) for use in Class I, Zone 0, 1, or 2 locations is permitted in Class I, Division 2 locations for the same gas and with a suitable temperature class. equipment listed and marked in accordance with 505.9(C)(2) for use in Class I, Zone 0 locations is permitted in Class I, Division 1 or Division 2 locations for the same gas with a suitable temperature class.

Note: See Article 505 for the requirements for installing electrical and electronic equipment and wiring for all voltages in Class I, Zone 0, Zone 1, or Zone 2 hazardous (classified) locations.

501.5 Zone Equipment. Equipment listed and marked in accordance with 505.9(C)(2) for use in Zone 0, 1, or 2 locations shall be permitted in Class I, Division 2 locations for the same gas and with a suitable temperature class. Equipment listed and marked in accordance with 505.9(C)(2) for use in Zone 0 locations shall be permitted in Class I, Division 1 or Division 2 locations for the same gas and with a suitable temperature class.

Part II. Wiring

501.10 Wiring Methods. Wiring methods shall comply with **501.10(A)** or **(B)**.

Class I, Division 1 wiring methods have traditionally included threaded rigid metal conduit (RMC) or threaded steel intermediate metal conduit (IMC), Type MI. cable, Type MC-HL cable, or Type ITC-HL cable, optical fiber cables, or rigid nonmetallic conduit (RNC). The 2020 NEC® introduces new permissible cable Types for use as general and flexible wiring methods for both Class I, Division 1 and 2.

AJBEW CAST JUNCTION BOX

PLEXPOWER™ PANELBOARD

501.10(A) Class I, Division 1.

501.10(A)(1) General. In Class I, Division 1 locations, the following wiring methods shall be permitted:

Informational Note No. 1: See Article 100 for the definition of restricted industrial establishment [as applied to hazardous (classified) locations].

A new information note is added referencing the definition of "restricted industrial establishments (as applied to hazardous (classified) locations)." With the removal of the "defining" text from several places in the section, it is important to send the user to the definition to confirm that the requirement has not changed.

Threaded conduit entries that are made in the field must have at least 5 threads fully engaged while those made by the manufacturer must have at least 4–1/2 threads fully engaged. This takes into consideration that factory produced threads are typically of precision quality due to the tooling and corresponding production control.

(1) Threaded rigid metal conduit (RMC) or threaded intermediate metal conduit (IMC), including RMC or IMC conduit systems with supplemental corrosion protection coatings.

(2) PVC conduit, RTRC conduit, or HDPE conduit, where encased in a concrete envelope a minimum of 50 mm (2 in.) thick and provided with not less than 600 mm (24 in.) of cover measured from the top of the conduit to grade. The concrete encasement shall be permitted to be omitted where it is in accordance with **514.8(C)** or **515.8(A)**. RMC or IMC conduit shall be used for the last 600 mm (24 in.) of the underground run to emergence or to the point of connection to the aboveground raceway. An equipment grounding conductor shall be included to provide for electrical continuity of the raceway system and for grounding of non–current-carrying metal parts.

PVC conduit, RTRC conduit, and HDPE conduit are permitted where encased in a concrete envelope a minimum of 50 mm (2 in) thick and provided with not less than 600 mm (24 in) of cover measured from the top of the conduit to grade. The concrete encasement can be omitted where the provisions of 514.8, Exception No. 2; and 515.8(A) are complied with. Threaded rigid metal conduit (RMC) or threaded steel intermediate metal conduit (IMC) is required the last 600 mm (24 in) of the underground run to emergence or to the point of connection to the above ground raceway. An equipment grounding conductor must be installed in accordance with 352.60, 355.60, and 353.60.

(3) Type MI cable terminated with fittings listed for the location. Type MI cable shall be installed and supported to avoid tensile stress at the termination fittings.

Type MI cable must be terminated with fittings listed for the location. Type MI cable shall be installed and supported in a manner to avoid tensile stress at the termination fittings. (See 332.12 for restrictions on the use of Type MI cable).

(4) In restricted industrial establishments, Type MC-HL cable listed for use in Class I, Zone 1 or Division 1 locations, with a gas/vaportight continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, and a separate equipment grounding conductor(s) in accordance with 250.122, and terminated with fittings listed for the application. If installed in a ladder, ventilated trough, or ventilated channel cable tray, the cable shall be installed in accordance with 392.22. Type MC-HL cable shall be installed in accordance with Part II of Article 330.

MC-HL cable is permitted in industrial establishments with restricted public access, where the conditions of maintenance and supervision ensure that only qualified persons service the installation. The Type MC-HL cable must be listed for use in Class I, Division 1 locations. It must have a gas/vaportight continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, separate grounding conductors in accordance with 250.122, and terminated with fittings listed for the application. (See 330.12 for restrictions on the use of Type MC cable). This section also requires that the installation methods for MC cable are to be followed when installing MC-HL cable.

(5) In restricted industrial establishments, Type ITC-HL cable listed for use in Class I, Division 1 or Zone 1 locations, with a gas/vaportight continuous corrugated metallic sheath and an overall jacket of suitable polymeric material, terminated with fittings listed for the application, and installed in accordance with **335.4**.

Type ITC-HL cable is permitted in industrial establishments with restricted public access, where the conditions of maintenance and supervision ensure that only qualified persons service the installation. The Type ITC-HL cable must be listed for use in Class I, Division 1 locations. It must have a gas/vaportight continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, and terminated with fittings listed for the application. (See 727.5 for restrictions on the use of Type ITC-HL cable). Installation methods for ITC cable are to be followed when installing ITC-HL cable. The construction of ITC-HL is similar to that of MC-HL cables. The difference is the conductors and quantities contained in the cable. Connectors that are listed for MC-HL cable are suitable for use with ITC-HL cable based on the same cable diameters.

(6) Optical fiber cable Type OFNP, Type OFCP, Type OFNR, Type OFCR, Type OFNG, Type OFCG, Type OFN, or Type OFC installed in raceways in accordance with **501.10(A)**. These optical fiber cables shall be sealed in accordance with **501.15**.

Section 770.3(A) permits the use of listed optical fiber cables in Hazardous (Classified) Locations providing they are sealed in accordance with the requirements in Chapter 5. Section 501.5 ensures the specific requirements for sealing these cables are known.

(7) In restricted industrial establishments for applications limited to 600 volts nominal or less, and where the cable is not subject to physical damage and is terminated with fittings listed for the location, Type TC-ER-HL cable. If installed in a ladder, ventilated trough, or ventilated channel cable tray, the cable shall be installed in accordance with **392.22**. Type TC-ER-HL cable shall be listed for use in Class I, Division 1 or Zone 1 locations and shall be installed in accordance with **336.10**.

Informational Note No. 2: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cables and cable fittings.

Type TC-ER-HL cable has been added as a permissible Class I, Division 1 general wiring method where the various conditions of an industrial establishment exists and where limited to 600 volts or less. Spacing requirements are included to avoid buildup of dust and increased heat in the cables. This cable had previously been permissible in a Class I, Division 1 location however, only where flexible connections where necessary.

The construction requirements for Type TC-ER-HL cable are located in Article 336.

PXSS2K-REX IS APPROVED FOR USE WITH TYPE TC-ER-HL CABLE

(8) In restricted industrial establishments listed Type P cable with metal braid armor, with an overall jacket, that is terminated with fittings listed for the location and installed in accordance with **337.10**. When installed in ladder, ventilated trough, or ventilated channel cable trays, cables shall be installed in a single layer, with a space not less than the larger cable diameter between the two adjacent cables, unless otherwise protected against dust buildup resulting in increased heat.

Informational Note No. 2: See ANSI/UL 1309,Marine Shipboard Cable, for information on construction, testing, and marking of Type P cable.

Informational Note No. 3: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cable fittings.

Type P cable is a permissible Class II, Division 1 general wiring method where the cable employs a metal armor braid and an overall polymeric jacket. Type P cable having metal braid armor has been permitted in Class II, Division 1 locations offshore for several decades. Spacing requirements are included to avoid the buildup of dust and increased heat in the cables.

PX2K-REX IS APPROVED FOR USE WITH TYPE P CABLE

501.10(A)(2) Flexible Connections. If flexibility is necessary to minimize the transmission of vibration from equipment during operation or to allow for movement after installation during maintenance, one of the following shall be permitted:

(1) Flexible fittings listed for the location.

Where flexible connections are necessary, flexible fittings listed for Class I, Division 1 locations are permitted (Appleton™ EXGJH/EXLK). Flexible cord is permitted when terminated with cord connectors that are listed for Class I, Division 1 or that are simply listed for use with the specific cord where they are sealed in accordance with the requirements in 501.140.

(2) Flexible cord in accordance with the provisions of **501.140**, terminated with cord connectors listed for the location.

Flexible fittings listed for the location have historically been the industry standard. These fittings are explosionproof and go through extensive testing to qualify for this application.

In lieu of these explosionproof "flexible" fittings, also allowed is flexible cord for extra hard usage and also Type TC-ER-HL cable, a more robust Type TC (Tray Cable) and now also Type P cable. These cables have additional installation requirements that must be adhered to. In addition, flexible cord for extra hard usage is allowed only where the required degree of movement provided by the portion of the circuit where the fixed wiring methods of 501.10(A) cannot provide the necessary degree of movement for fixed and mobile electrical utilization equipment.

(3) In restricted industrial establishments, for applications limited to 600 volts nominal or less where the cable is not subject to physical damage and is terminated with fittings listed for the location, Type TC-ER-HL cable. The cable shall be listed for use in Class I, Division 1 or Zone 1 locations and shall be installed in accordance with **336.10**.

"Restricted Industrial Establishments" is not a technical revision. It simply reduces the terminology previously used in the section rules.

The fittings have to be listed for Class I, Division 1 or Zone 1 locations.

Informational Note No. 1: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cables and cable fittings.

(4) In restricted industrial establishments, listed Type P cable with metal braid armor and an overall jacket where the cable is terminated with fittings listed for the location and installed in accordance with Part II of Article **337**.

Type P cable is a permissible Class I, Division 1 wiring method where flexible connections are necessary and where the cable employs a metal armor braid and an overall polymeric jacket. This type of cable has been permitted in offshore Class I, Division 1 locations for many years.

"Restricted Industrial Establishments" is not a technical revision. It simply reduces the terminology previously used in the section rules.

Informational Note No. 2: See UL 1309A,Outline of Investigation for Cable for Use in Mobile Installations, for information on construction, testing, and marking of Type P cable fittings.

Informational Note No. 3: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cable fittings.

501.10(A)(3) Boxes and Fittings. All boxes and fittings shall be identified for Class I, Division 1.

Informational Note No. 1: See ANSI/UL 2225, *Cables and Cable-Fittings for Use in Hazardous (Classified) Locations*, for information on construction, testing, and marking of cables, explosionproof cable fittings, and explosionproof cord connectors for entry into enclosures required to be explosionproof.

Informational Note No. 2: See ANSI/UL 1203, *Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations*, for information on construction, testing, and marking of explosionproof conduit fittings for entry into enclosures required to be explosionproof.

"Approved" has been revised to "Identified". See Article 100 Definitions for these terms.

All boxes, fittings, and joints must be approved for Class I, Division 1 applications. Unlike boxes and fittings that are permitted for installation in Class I, Division 2 locations, boxes and fittings specifically approved for Class I, Division 1 locations are marked with their Class and Division rating. In most cases they are also marked with their rated gas Groups. The product standard for conduit fittings is ANSI/UL 1203. The Informational Note also identifies the product standard for Cord and Cable Fittings. A product only marked with its rated Class and Division is rated for all gas Groups within that Class and Division. A product not marked with the Division is suitable for use in both Division 1 and Division 2.

501.10(B) Class I, Division 2.

501.10(B)(1) General. In Class I, Division 2 locations, all wiring methods in accordance with **501.10(A)** and the following wiring methods shall be permitted:

Informational Note No. 1: See Article 100 for the definition of restricted industrial establishment [as applied to hazardous (classified) locations].

This is not a technical revision. It simply reduces the terminology previously used in the section rules.

(1) Rigid metal conduit (RMC) or intermediate metal conduit (IMC) with listed threaded or threadless fittings, including RMC or IMC conduit systems with supplemental corrosion protection coatings.

Threadless fittings that are listed for use with RMC and IMC are suitable for use in Class I, Division 2 locations. These fittings are evaluated to the ordinary locations (unclassified) standards. They are not required be "listed for the location", just listed for use with RMC and IMC.

(2) Enclosed gasketed busways and enclosed gasketed wireways.

(3) Type PLTC cable or Type PLTC-ER cable used for Class 2 and Class 3 circuits, including installation in cable tray systems. The cable shall be terminated with listed fittings. Type PLTC-ER cable shall include an equipment grounding conductor in addition to a drain wire that might be present.

The fittings are not required to be "listed for the location" here. They are only required to be "listed" for Tray Cable. PLTC and PLTC-ER are types of Tray Cables.

(4) Type ITC cable or Type ITC-ER cable as permitted in **335.4** and terminated with listed fittings. Type ITC-ER cable shall include an equipment grounding conductor in addition to a drain wire.

The fittings are not required to be "listed for the location" here. They are only required to be "listed" for Tray Cable. ITC and ITC-ER are types of Tray Cables.

(5) Type MC, Type MV, Type TC, or Type TC-ER cable, including installation in cable tray systems. Type TC-ER cable shall include an equipment grounding conductor in addition to a drain wire that might be present. All cable types shall be terminated with listed fittings.

Type TC-ER cable is a permissible wiring method for Class I, Division 2 locations as other extended run cables had been permitted such as PLTC-ER and ITC-ER which are all constructed to the same strength requirements.

(6) Where metal conduit will not provide the corrosion resistance needed for the installation environment, any of the following shall be permitted:

a. Listed reinforced thermosetting resin conduit (RTRC), factory elbows, and associated fittings, all marked with the suffix -XW

b. PVC-coated RMC, factory elbows, and associated fittings

c. PVC-coated IMC, factory elbows, and associated fittings

d. In restricted industrial establishments, Schedule 80 PVC conduit, factory elbows, and associated fittings

Type RTRC-XW conduit and Schedule 80 PVC conduit are only permitted where the authority having jurisdiction (AHJ) considers other conduit types do not provide sufficient corrosion resistance.

(7) Optical fiber cable Type OFNP, Type OFCP, Type OFNR, Type OFCR, Type OFNG, Type OFCG, Type OFN, or Type OFC installed in cable trays or any other raceway in accordance with **501.10(B)**. Optical fiber cables shall be sealed in accordance with **501.15**.

(8) Cablebus.

(9) In restricted industrial establishments, listed Type P cable with or without metal braid armor, with an overall jacket, and terminated with fittings listed for the location when entering explosionproof, flameproof, or pressurized equipment. The cable shall be installed in accordance with Part II of Article **337**.

Informational Note No. 2: See ANSI/UL 1309A,Outline of Investigation for Cable for Use in Mobile Installations, for information on construction, testing, and marking of Type P cable.

Informational Note No. 3: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cable fittings.

Where seals are required for boundary conditions as defined in 501.15(A)(4), the Division 1 wiring method shall extend into the Division 2 area to the seal, which shall be located on the Division 2 side of the Division 1–Division 2 boundary.

501.10(B)(2) Flexible Connections. If flexibility is necessary to minimize the transmission of vibration from equipment during operation or to allow for movement after installation during maintenance, one or more of the following shall be permitted:

(1) Listed flexible metal fittings.

(2) Flexible metal conduit with listed fittings and bonded in accordance with **501.30(B)**

(3) Interlocked armor Type MC cable with listed fittings.

(4) Liquidtight flexible metal conduit with listed fittings and bonded in accordance with **501.30(B)**

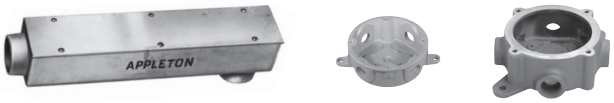
TYPICAL CLASS I, DIVISION 2 RIGID CONDUIT INSTALLATION.

SHOWN BELOW ARE JUST A FEW OF THE MANY PRODUCTS SUITABLE FOR USE IN CLASS I, DIVISION 2 AREAS. PRODUCTS FOR DIVISION 2 NEED NOT BE EXPLOSIONPROOF, EXCEPT AS NOTED IN NEC® 501.10(B)(4).

CONDUIT BODIES

FORM 35™ FM7™ MOGUL FM8™

BOXES



PTB JB GSU

CONNECTORS FOR CABLE, CORD OR LFMC

TMC2 CG ST™ WITH GROUND LUG

(5) Liquidtight flexible nonmetallic conduit with listed fittings.

(6) Flexible cord listed for extra-hard usage and terminated with listed fittings, with a conductor for use as an equipment grounding conductor

Refer to 501.140 for flexible cord installation requirements.

(7) For elevator use, an identified elevator cable of Type EO, Type ETP, or Type ETT, shown under the "use" column in **Table 400.4** for "hazardous (classified) locations" and terminated with listed fittings

(8) In restricted industrial establishments, listed Type P cable with or without metal braid armor, with an overall jacket, terminated with listed fittings and installed in accordance with Part II of Article **337**

Where flexibility is needed Flexible Metal Fittings, Flexible Metal Conduit with listed fittings, Liquidtight Flexible Metal Conduit with listed fittings, Liquidtight Flexible Nonmetallic Conduit with listed fittings, or flexible cord listed for extra-hard usage and terminated with listed fittings shall be used. Type MC cable with interlocked armor is now permitted. In addition, Type EO, ETP, or ETT are now permitted for elevator use. The fittings for these permitted cables are not required to be listed "for the location," as there are no product standards for Class I, Division 2 fittings. This means that the fitting is required to be listed for use with the specific type of conduit or for use with cord. An additional conductor for grounding shall be included in the flexible cord. Refer to 501.30(B) for additional requirements for bonding and grounding of flexible conduit.

501.10(B)(3) Nonincendive Field Wiring. Nonincendive field wiring shall be permitted using any of the wiring methods permitted for unclassified locations. Nonincendive field wiring systems shall be installed in accordance with the control drawing(s). Simple apparatus, not shown on the control drawing, shall be permitted in a nonincendive field wiring circuit, provided the simple apparatus does not interconnect the nonincendive field wiring circuit to any other circuit.

Informational Note: See Article 100 for the definition of simple apparatus.

Separate nonincendive field wiring circuits shall be installed in accordance with one of the following:

(1) In separate cables

(2) In multiconductor cables where the conductors of each circuit are within a grounded metal shield

(3) In multiconductor cables or in raceways, where the conductors of each circuit have insulation with a minimum thickness of 0.25 mm (0.01 in)

Nonincendive field wiring is permitted using any of the methods suitable for wiring in unclassified locations. However, it must be installed in accordance with the control drawing(s). Simple apparatus as defined in Article 100, not shown on the control drawing is permitted in a nonincendive field wiring circuit, provided the simple apparatus does not interconnect the nonincendive field wiring circuit to any other circuit.

Separate nonincendive field wiring circuits are permitted to be installed in separate cables, in multiconductor cables that employ conductors for each circuit in a separate metal shield, or in multiconductor cables that employ circuit conductors that each has a minimum insulation thickness of 0.25 mm (0.01 in).

501.10(B)(4) Boxes and Fittings. Boxes and fittings shall be explosionproof if required by **501.105(B)(2), 501.115(B)(1), or501.150(B)(1).**

Informational Note No. 1: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cable for entry into enclosures required to be explosionproof.

Informational Note No. 2: See ANSI/UL 1203, Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of explosionproof conduit fittings for entry into enclosures required to be explosionproof.

These referenced sections essentially describe equipment that employs arcing and sparking contacts.

Fittings that are not required to be explosionproof in a Class I, Division 2 location are required to be listed for the specific wiring methods in 501.10(B)(2). They are not required to be listed for the location (classified area). They are only required to be listed for the specific wiring method in accordance with the ordinary location (unclassified) fitting ANSI product standard.

Note: The ANSI fitting product standard is ANSI/UL 514B “Conduit, Tubing, and Cable Fittings”.

TMC2 Series connectors are suitable for use with MC cable when installed in accordance with 501.10(B) and 501.15(E). They are also suitable for use with Type TC Tray Cable when installed in accordance with 501.10(B).

501.15 Sealing and Drainage. Seals in conduit and cable systems shall comply with **501.15(A)** through **(F)**. Sealing compound shall be used in Type MI cable termination fittings to exclude moisture and other fluids from the cable insulation.

Informational Note No. 1: Seals are provided in conduit and cable systems to minimize the passage of gases and vapors and prevent the passage of flames from one portion of the electrical installation to another through the conduit. Such communication through Type MI cable is inherently prevented by construction of the cable. Unless specifically designed and tested for the purpose, conduit and cable seals are not intended to prevent the passage of liquids, gases, or vapors at a continuous pressure differential across the seal. Even at differences in pressure across the seal equivalent to a few inches of water, there may be a slow passage of gas or vapor through a seal and through conductors passing through the seal. Temperature extremes and highly corrosive liquids and vapors can affect the ability of seals to perform their intended function.

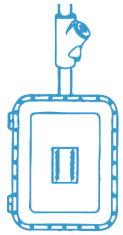
Informational Note No. 2: Gas or vapor leakage and propagation of flames may occur through the interstices between the strands of standard stranded conductors larger than 2 AWG. Special conductor constructions, such as compacted strands or sealing of the individual strands, are means of reducing leakage and preventing the propagation of flames.

PURPOSE OF SEALING FITTINGS.

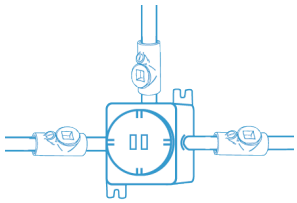
Conduit and cable seals are not intended to prevent the passage of liquids, gases or vapors through the conduit system.

Seals are only intended to minimize the passage of vapors or gases and prevent passage of flames through the conduit system. Because sealing compound is somewhat porous, gases and vapors do get through or can be transmitted through the air spaces between strands of stranded conductors. However, with only normal atmospheric pressure, the passage of gases or vapors through a seal is not sufficient to cause a hazardous condition.

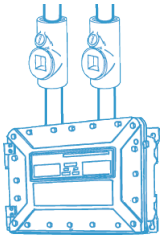
TYPICAL SEAL APPLICATIONS



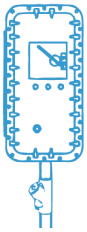
EYSF AND EYS FOR SEALING VERTICAL CONDUIT.



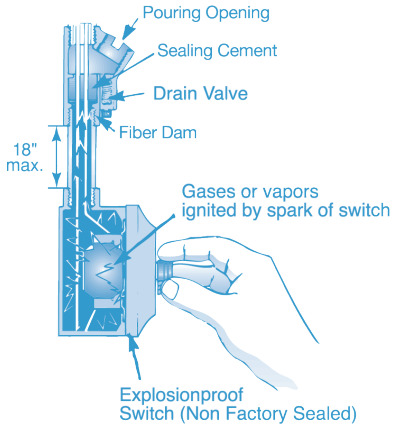
ESU AND EYF FOR SEALING HORIZONTAL OR VERTICAL CONDUIT.



EYF “CLOSE RADIUS” ALLOWS CLOSE POSITIONING OF CONDUIT.



EYD AND EYDM DRAIN SEALS ALLOW AUTOMATIC DRAINING.



SEALS REQUIRED IN EACH CONDUIT WITHIN 18” OF ARC-PRODUCING DEVICE.

Recognizing that standard sealing fittings do not completely prevent the passage of gases and vapors through the conduit system should create an increased awareness of the importance of sealing fittings, particularly in their use in reducing "pressure piling," an increasing pressure buildup along an entire conduit system as a result of explosions traveling through the system. The use of additional seals, in excess of *Code* requirements, will reduce this pressure and provide an extra margin of safety, especially important where the gas or vapor concentration is present continuously and at a dangerous level.

The propagation of flames and leakage of gases and vapors can occur through the interstices between the strands of standard stranded conductors in conductor sizes No. 2 AWG and larger. Sealing of individual strands or the use of compacted strands are proposed as means of dealing with this hazardous situation.

Appleton™ sealing fittings are suitable for Class I and II locations. EYS and EYD are for sealing vertical conduit. EY and ESU are for sealing vertical and horizontal conduit. EYDM and EYD also have drain valves.

Below is a non-all-inclusive list of common problems with preparing and pouring seals in the field.

1. Unpoured seals
2. Missing seals where required
3. Seals not within 18" of enclosure
4. Non-approved fitting between sealing fitting and enclosure, or between sealing fitting and boundary
5. XP enclosure flange obstructs filling opening
6. Improper dam prep – wires not separated from each other
7. Improper dam prep – wires not separated from the fitting interior
8. Improper dam prep – compound flows down conduit
9. Conductor insulation damage while packing the dam; using metal tools to pack dam.
10. Improper dam prep – dam cannot support the weight of the uncured compound, dam collapses before compound is set but plugs are in; the problem goes undetected.
11. Improper sealing fitting orientation – vertical/horizontal fitting installed upside down or vertical fitting installed horizontally.
12. Circuit energized before compound is set.
13. Compound is poured below minimum pouring temperature or temperature not maintained throughout set-up period
14. Compound not filled to bottom of threaded filling port
15. Non-approved compound and/or fiber
16. Compound too thick to pour and flow properly, due to improper mixture or waited too long after mixing.
17. Compound too thin to maintain max pressure , due to improper mixture
18. Sealing fittings obstructed or inaccessible – bank of several conduits, or other trades apparatus, etc.
19. Conductor fill over maximum allowed.
20. 40% fill in a 25% sealing fitting.
21. Drain seal tube not removed before installing plug.
22. Drain fitting not installed in drain seal
23. Improper selection based upon gas groups

501.15(A) Conduit Seals, Class I, Division 1. In Class I, Division 1 locations, conduit seals shall be located in accordance with **501.15(A)(1)** through **(A)(4)**.

501.15(A)(1) Entering Enclosures. Each conduit entry into an explosionproof enclosure shall have a conduit seal where either of the following conditions apply:

(1) The enclosure contains apparatus, such as switches, circuit breakers, fuses, relays, or resistors that may produce arcs, sparks, or temperatures that exceed 80 percent of the autoignition temperature, in degrees Celsius, of the gas or vapor involved in normal operation.

Exception: Seals shall not be required for conduit entering an enclosure under any one of the following conditions:

(1) The switch, circuit breaker, fuse, relay, or resistor is enclosed within a chamber hermetically sealed against the entrance of gases or vapors.

*(2) The switch, circuit breaker, fuse, relay, or resistor is immersed in oil in accordance with **501.115(B)(1)(2)**.*

(3) The switch, circuit breaker, fuse, relay, or resistor is enclosed within an enclosure, identified for the location, and marked "Leads Factory Sealed," or "Factory Sealed," "Seal not Required," or equivalent.

(4) The switch, circuit breaker, fuse, relay, or resistor is part of a nonincendive circuit.

Such apparatus may cause an ignition of gases or vapors that have migrated into the explosionproof enclosure. Under such an occurrence, the conduit seal will prevent the explosion and resulting flame front from propagating down the conduit system.

(1) The entry is metric designator 53 (trade size 2) or larger, and the enclosure contains terminals, splices, or taps.

This serves as an additional precaution for larger conduit systems. As these systems can be expected to contain greater gas migrations, the requirement for arcing and sparking apparatus in an explosionproof enclosure is expanded here to include containment of terminals, splices, or taps. This applies only when the conduit metric designator is 53 (2 trade size) or larger.

An enclosure, identified for the location, and marked "Leads Factory Sealed", or "Factory Sealed," or "Seal not Required," or equivalent shall not be considered to serve as a seal for another adjacent enclosure that is required to have a conduit seal.

External field-installed seals are NOT required if current-interrupting contacts are internally sealed in such a manner that arcs or sparks are not created within the enclosure leading to the conduit system (trade size 1-1/2 or smaller). The Appleton™ product catalogs refer to such equipment as "factory sealed."

Conduit seals shall be installed within 450 mm (18 in) from the enclosure or as required by the enclosure marking. Only threaded couplings, or explosionproof fittings such as unions, reducers, elbows, and capped elbows that are not larger than the trade size of the conduit, shall be permitted between the sealing fitting and the explosionproof enclosure.

Conduit bodies are not permitted in a Class I, Division 1 location. There are products that are rated as explosionproof that resemble a conduit body. These are referred to as hazardous location outlet boxes.

A conduit coupling is not identified as explosionproof, however these couplings are permitted by the *Code* to be connected to explosionproof equipment. Fittings such as unions, elbows, capped elbows and reducers are required to be explosionproof.

501.15(A)(2) Pressurized Enclosures. Conduit seals shall be installed within 450 mm (18 in) of the enclosure in each conduit entry into a pressurized enclosure where the conduit is not pressurized as part of the protection system.

Informational Note No. 1: Installing the seal as close as possible to the enclosure will reduce problems with purging the dead airspace in the pressurized conduit.

Informational Note No. 2: See NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment, for information regarding pressurized enclosures.

501.15(A)(3) Two or More Explosionproof Enclosures. Where two or more explosionproof enclosures that require conduit seals are connected by nipples or runs of conduit not more than 900 mm (36 in) long, a single conduit seal in each such nipple connection or run of conduit shall be considered sufficient if the seal is located not more than 450 mm (18 in) from either enclosure.

501.15(A)(4) Class I, Division 1 Boundary. A conduit seal shall be required in each conduit run leaving a Division 1 location. The sealing fitting shall be permitted to be installed on either side of the boundary within 3.05 m (10 ft) of the boundary, and it shall be designed and installed to minimize the amount of gas or vapor within the portion of the conduit installed in the Division 1 location that can be communicated beyond the seal. The conduit run between the conduit seal and the point at which the conduit leaves the Division 1 location shall contain no union, coupling, box, or other fitting except for a listed explosionproof reducer installed at the conduit seal.

Where the seal is located on the Division 2 side of the boundary, the Division 1 wiring method shall extend into the Division 2 area to the seal.

If the conduit seal is within 450 mm (18 in) of the enclosure on either side of the boundary and within 3.05 m (10 ft.) of the boundary it shall serve as both a boundary and equipment seal.

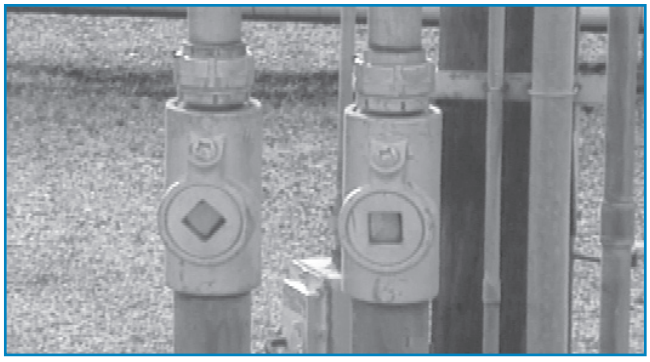
Exception No. 1: Metal conduit that contains no unions, couplings, boxes, or fittings, that passes completely through a Division 1 location with no fittings installed within 300 mm (12 in) of either side of the boundary, shall not require a conduit seal if the termination points of the unbroken conduit are located in unclassified locations.

*Exception No. 2: For underground conduit installed in accordance with **300.5** where the boundary is below grade, the sealing fitting shall be permitted to be installed after the conduit emerges from below grade, but there shall be no union, coupling, box, or fitting, other than listed explosionproof reducers at the sealing fitting, in the conduit between the sealing fitting and the point at which the conduit emerges from below grade.*

The listed explosionproof reducers are not required to be provided with the sealing fitting by the sealing fitting manufacturer. Where listed explosionproof reducers are used they must be rated for the Class and the Group in which they are installed.

501.15(B) Conduit Seals, Class I, Division 2. In Class I, Division 2 locations, conduit seals shall be located in accordance with **501.15(B)(1)** and **(B)(2)**.

501.15(B)(1) Entering Enclosures. For connections to enclosures that are required to be explosionproof, a conduit seal shall be provided in accordance with **501.15(A)(1)(1)** and **(A)(3)**. All portions of the conduit run or nipple between the seal and enclosure shall comply with **501.10(A)**.



501.15(B)(2) Class I, Division 2 Boundary. A conduit seal shall be required in each conduit run leaving a Class I, Division 2 location. The sealing fitting shall be permitted to be installed on either side of the boundary within 3.05 m (10 ft) of the boundary and it shall be designed and installed to minimize the amount of gas or vapor within the portion of the conduit installed in the Division 2 location that can be communicated beyond the seal. Wiring methods permitted in **501.10(B)(1)(1)** or **(B)(1)(6)** shall be used between the sealing fitting and the point at which the conduit leaves the Division 2 location, and a threaded connection shall be used at the sealing fitting. The conduit run between the conduit seal and the point at which the conduit leaves the Division 2 location shall contain no union, coupling, box, or other fitting except for a listed explosionproof reducer installed at the conduit seal. Such seals shall not be required to be explosionproof but shall be identified for the purpose of minimizing the passage of gases permitted under normal operating conditions and shall be accessible.

Informational Note No. 1: See ANSI/UL 514B, Conduit, Tubing, and Cable Fittings, for additional information.

This boundary seal is not required to be approved for Class I, Division 1 (explosionproof) locations. Where a seal other than one approved for Class I, Division 1 (explosionproof) locations is used, it must be identified for the purpose of minimizing the passage of gases under normal operating conditions. The Informational Note is provided to identify the product standard that contains requirements for seals that are unclassified.

Exception No. 1: Metal conduit that contains no unions, couplings, boxes, or fittings and that passes completely through a Division 2 location with no fittings installed within 300 mm (12 in) of either side of the boundary shall not require a seal if the termination points of the unbroken conduit are located in unclassified locations.

Exception No. 2: Conduit terminating in an unclassified location where the metal conduit transitions to cable tray, cablebus, ventilated busway, or Type MI cable, or to cable not installed in any cable tray or raceway system, shall not require a seal where passing from the Division 2 location into the unclassified location under the following conditions:

(1) The unclassified location is outdoors, or the unclassified location is indoors and the conduit system is entirely in one room.

(2) The conduits do not terminate at an enclosure containing an ignition source in normal operation.

Exception No. 3: Conduit systems passing from an enclosure or a room that is unclassified, as a result of pressurization, into a Division 2 location shall not require a seal at the boundary.

Informational Note No. 2: See NFPA 496,Standard for Purged and Pressurized Enclosures for Electrical Equipment, for further information.

Exception No. 4: Aboveground conduit shall not require a seal where passing from a Division 2 location into an unclassified location if all of the following conditions are met:

(1) No part of the conduit system segment passes through a Division 1 location where the conduit segment contains unions, couplings, boxes, or fittings that are located within 300 mm (12 in) of the Division 1 location.

(2) The conduit system segment is located entirely outdoors.

(3) The conduit system segment is not directly connected to canned pumps, process or service connections for flow, pressure, or analysis measurement, and so forth, that depend on a single compression seal, diaphragm, or tube to prevent flammable or combustible fluids from entering the conduit system.

(4) The conduit system segment contains only threaded metal conduit, unions, couplings, conduit bodies, and fittings in the unclassified location.

(5) The conduit system segment is sealed at its entry to each enclosure or fitting located in the Division 2 location that contains terminals, splices, or taps.

Where trade size of 2" or larger conduit is used with an enclosure required to be approved for Class I, Division 1, or at a boundary where any size conduit leaves a hazardous area to a non-hazardous area (or from Division 1 to Division 2), external seals must ALWAYS be used. However, external seals need not be placed within 18" of an enclosure containing an arcing device if the product is factory sealed for the specific Class and Group.

501.15(C) Class I, Divisions 1 and 2. Seals installed in Class I, Division 1 and Division 2 locations shall comply with **501.15(C)(1)** through **(C)(6)**.

*Exception: Seals that are not required to be explosionproof by **501.15(B)(2)** or **504.70** shall not be required to comply with **501.15(C)**.*

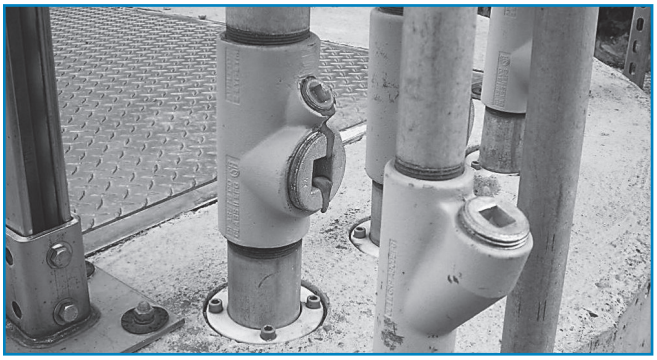
501.15(C)(1) Fittings. Enclosures that contain connections or equipment shall be provided with an integral sealing means, or sealing fittings listed for the location shall be used. Sealing fittings shall be listed for use with one or more specific compounds and shall be accessible.

Sealing fitting compounds are not listed on their own merits. They are listed and evaluated for use with the sealing fittings. Some sealing fittings are listed with more than one sealing compound. Where this is the case, refer to the sealing fitting installation instructions for proper preparation of the sealing compound.

501.15(C)(2) Compound. The compound shall provide a seal to minimize the passage of gas and/or vapors through the sealing fitting and shall not be affected by the surrounding atmosphere or liquids. The melting point of the compound shall not be less than 93°C (200°F).

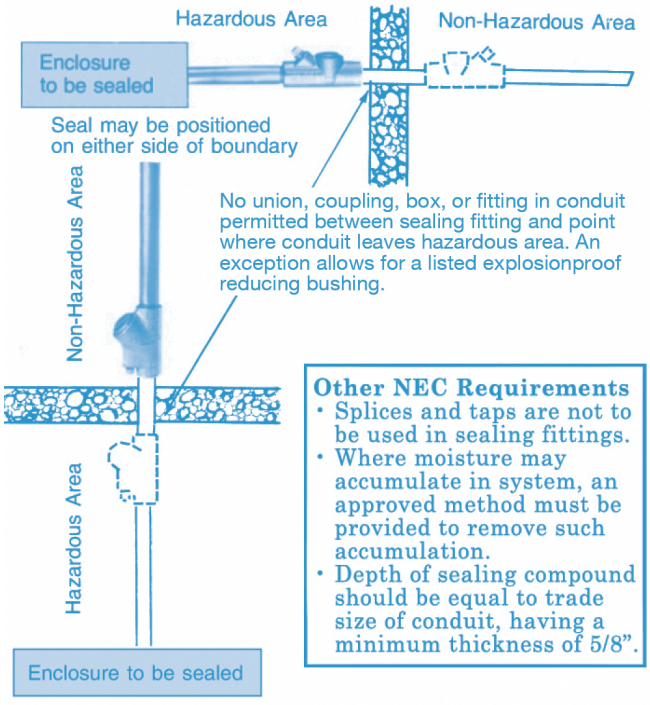
501.15(C)(3) Thickness of Compounds. The thickness of the sealing compound installed in completed seals, other than listed cable sealing fittings, shall not be less than the metric designator (trade size) of the sealing fitting expressed in the units of measurement employed; however, in no case shall the thickness of the compound be less than 16 mm (5/8 in).

501.15(C)(4) Splices and Taps. Splices and taps shall not be made in fittings intended only for sealing with compound; nor shall other fittings in which splices or taps are made be filled with compound.



SEAL FITTINGS (INSTALLED VERTICALLY)

CLASS I, DIVISION 1 AND 2. SEALING FITTINGS MUST BE INSTALLED AT BOUNDARY BETWEEN A HAZARDOUS AND NON-HAZARDOUS AREA. SEALING FITTINGS MUST ALSO BE INSTALLED AT BOUNDARY BETWEEN A CLASS I, DIVISION 1 AREA AND A CLASS I, DIVISION 2 AREA.



IMPORTANT NOTE: Where trade size of 2" or larger conduit is used with an enclosure required to be approved for Class I, Division 1, or at a boundary where any size conduit leaves a hazardous area to a non-hazardous area (or from Division 1 to Division 2), external seals must ALWAYS be used. However, external seals need not be placed within 18" of an enclosure containing an arcing device if the product is factory sealed for the specific Class and Group.

501.15(C)(5) Assemblies. An entire assembly shall be identified for the location where the equipment that may produce arcs, sparks, or high temperatures is located in a compartment that is separate from the compartment containing splices or taps, and an integral seal is provided where conductors pass from one compartment to the other. In Division 1 locations, seals shall be provided in conduit connecting to the compartment containing splices or taps where required by **501.15(A)(1)(2)**.

501.15(C)(6) Conductor or Optical Fiber Fill. The cross-sectional area of the conductors or optical fiber tubes (metallic or nonmetallic) permitted in a seal shall not exceed 25percent of the cross-sectional area of a rigid metal conduit of the same trade size unless the seal is specifically identified for a higher percentage of fill.

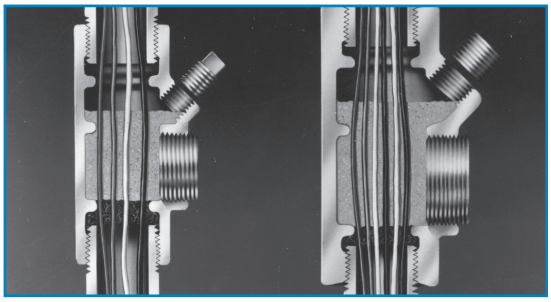
Conduit sealing fittings are available for expanded fill applications. These sealing fittings facilitate conduit fill applications up to 40% fill. Utilization of these seals can reduce the total number of conduit runs required by a given installation.

Appleton™ EF Series allows a maximum of 40% fill. These fittings are UL® Listed for Class I, Groups B, C, and D, Class II, Groups E, F, and G and Class III locations.

External seals are ALWAYS required in the following situations: (1) Class I, Division 1 areas where metric designator 53 (trade size 2) or larger conduit enters an enclosure (whether or factory sealed not or whether containing an arcing device or not); (2) in Class I, Division 1 or Class I, Division 2 areas where any size conduit enters an enclosure required to be approved for Class I, Division 1 (such as an enclosure with an arcing device); and (3) at a boundary where any size conduit leaves a hazardous area to an area of lesser hazard (see specific boundary situations below).

External seals are not required with an enclosure containing an arcing device if the product is factory sealed for the specific Class and Group [unless situations (1) and or (2) exist].

Note: In each conduit run passing from a Class I, Division 2 location into an unclassified location, the seal is not required to be rated as explosionproof.



CUT-A-WAY VIEW COMPARISON OF 25% FILL SEAL (LEFT) VS 40% EXPANDED FILL (RIGHT) TO MEET 501.15(C)(6).

501.15(D) Cable Seals, Class I, Division 1. In Division 1 locations, cable seals shall be located according to **501.15(D)(1)** through **(D)(3)**.

501.15 (D)(1) At Terminations. Cables shall be sealed at all terminations with sealing fittings. The seals at all terminations shall be in accordance with **501.15(C)** and shall be installed within 450 mm (18 in) of the enclosure or as required by the enclosure marking. Only threaded couplings or explosionproof fittings such as unions, reducers, elbows, and capped elbows not larger than the trade size of the conduit shall be permitted between the sealing fitting and the enclosure.

Type MC-HL cable with a gas/vaportight continuous corrugated metallic sheath and an overall jacket of suitable polymeric material, Type TC-ER-HL cable, and Type P cable shall be sealed with a listed fitting after the jacket and any other covering have been removed so that the sealing compound can surround each individual insulated conductor to minimize the passage of gases and vapors.

Shielded cables and twisted pair cables that have their conductors sealed in accordance with the instructions provided with their listed fitting to minimize the entrance of gases or vapors and prevent propagation of flame into the cable core shall not be required to have the shielding material removed or the twisted pairs separated.

Cable is required to be sealed at all terminations in a Class I, Division 1 location whether the enclosure contains arcing and sparking devices or not.

Shielded cables and twisted pair cables do not require the removal of the shielding material or separation of the twisted pairs within the seal fitting. The termination must be by an approved means to minimize the entrance of gases or vapors and prevent propagation of flame into the cable core. This exception recognizes that the removal of the cable shield for sealing individual conductors may cause electronic problems in some instrumentation circuits.

501.15(D)(2) Cables Capable of Transmitting Gases or Vapors. Cables with a gas/vaportight continuous sheath capable of transmitting gases or vapors through the cable core, installed in conduit, shall be sealed in the Class 1, Division 1 location after the jacket and any other coverings have been removed so that the sealing compound can surround each individual insulated conductor or optical fiber tube and the outer jacket.

Sealing requirements for these cable are the same as for those described for conduit, plus the additional requirement that sealing compound must surround each individual conductor and the outer jacket.

Exception: Multiconductor cables with a gas/vaportight continuous sheath capable of transmitting gases or vapors through the cable core shall be permitted to be considered a single conductor if ***the cable*** *is sealed in the conduit within 450 mm (18 in.) of the enclosure and the cable end is sealed within the enclosure by an approved means to minimize the entrance of gases or vapors and prevent the propagation of flame into the cable core, or by other approved methods. If both requirements are met, the shielding material shall not be required to be removed and* ***the twisted pairs of shielded cables and twisted pair cables shall not be required to be separated.***

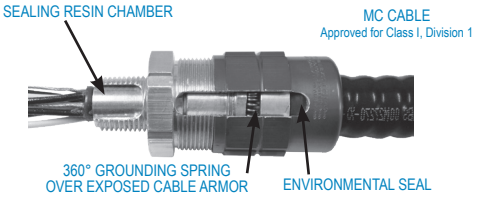
This exception provides that a multiconductor cable need not have the outer jacket removed and sealing compound applied around each individual conductor in certain situations. The entire cable is permitted to be considered as if it were a single conductor. The sealing compound, therefore, need only be applied to the outer jacket, provided that an approved method is used to prevent the entrance of gases or vapors or propagation of flame into the cable core (possible method is the use of epoxy mastics if future laboratory investigations determine that it provides the necessary protection required by 501.15(D)(2). The outer jacket of the cable in the conduit must be sealed within 18" of the enclosure.

501.15(D)(3) Cables Incapable of Transmitting Gases or Vapors. Each multiconductor cable installed in conduit shall be considered as a single conductor if the cable is incapable of transmitting gases or vapors through the cable core. These cables shall be sealed in accordance with **501.15(A)**.

Where cable is installed in conduit and is incapable of transmitting gases or vapors through the cable core, the sealing requirements are the same as those for conductors in conduit.

501.15(E) Cable Seals, Class I, Division 2. In Division 2 locations, cable seals shall be located in accordance with **501.15(E)(1)** through **(E)(4)**.

ES 25% FILL SEALING HUB WITH LOCKNUT AND SEALING GASKET OPTION



TMC2X SEALING CABLE FITTING APPROVED FOR CLASS I, DIVISION 1.

Exception: Cables with an unbroken gas/vaportight continuous sheath shall be permitted to pass through a Division 2 location without seals.

This exception recognizes that cables with an unbroken gas/vaportight sheath are to be treated like conduit when passing through a Division 2 location.

501.15(E)(1) Terminations. Cables entering enclosures that are required to be explosionproof shall be sealed at the point of entrance into the enclosure. The sealing fitting shall comply with **501.15(B)(1)** or be explosionproof. Multiconductor or optical multifiber cables with a gas/vaportight continuous sheath capable of transmitting gases or vapors through the cable core that are installed in a Division 2 location shall be sealed with a listed fitting after the jacket and any other coverings have been removed such that the sealing compound surrounds each individual insulated conductor or optical fiber tube in such a manner as to minimize the passage of gases and vapors. Multiconductor or optical multifiber cables installed in conduit shall be sealed in accordance with **501.15(D)**.

Cables entering enclosures that are not required to be explosionproof are not required to be sealed at their terminations in a Class I, Division 2 location.

The sealing requirements for multiconductor cables in conduit are treated the same for Class I, Division 1 and Class I, Division 2 locations where they enter enclosures that are required to be explosionproof.

Exception No. 1: Cables leaving an enclosure or room that is permitted to use general-purpose equipment as a result of Type Z pressurization and entering a Division 2 location shall not require a seal at the boundary.

This exception permits cables that pass from an enclosure or room that is unclassified as a result of Type Z pressurization into a Class I, Division 2 location to not require a seal at the boundary.

Exception No. 2: Removal of shielding material from shielded cables and separation of twisted pair cables shall not be required if the conductors are sealed in accordance with instructions provided with the listed fitting to minimize the entrance of gases or vapors and prevent propagation of flame into the cable core.

This exception is the same as the exception in 501.15(D)(1) for shielded cables and twisted pair cables. Its purpose is to not require the removal of the shielding material or separation of the twisted pairs provided the termination is by an approved means. The termination must be by an approved means to minimize the entrance of gases or vapors and prevent propagation of flame into the cable core. This exception recognizes that the removal of the cable shield for sealing individual conductors may cause electronic problems in some instrumentation circuits.

501.15(E)(2) Cables That Do Not Transmit Gases or Vapors. Cables that have a gas/vaportight continuous sheath and do not transmit gases or vapors through the cable core in excess of the quantity permitted for seal fittings shall not be required to be sealed except as required in **501.15(E)(1)**. The minimum length of such a cable run shall not be less than the length needed to limit gas or vapor flow through the cable core, excluding the interstices of the conductor strands, to the rate permitted for seal fittings [200 cm3/hr (0.007 ft3/hr) of air at a pressure of 1500 pascals (6 in of water)].

These types of cables are not required to be sealed in accordance with the same rules for Class I, Division 1 cable seals. They are however, required to be sealed at their terminations when entering enclosures that are required to be explosionproof in a Class I, Division 2 location.

As the described sealing characteristics of these cables are difficult to ascertain in the field, if there is any doubt as to the suitability of the cable to prevent the transmission of gases or vapors, the cable should be sealed according to 501(E)(3).

501.15(E)(3) Cables Capable of Transmitting Gases or Vapors. Cables with a gas/vaportight continuous sheath capable of transmitting gases or vapors through the cable core shall not be required to be sealed except as required in **501.15(E)(1)**, unless the cable is attached to process equipment or devices that may cause a pressure in excess of 1500 pascals (6 in of water) to be exerted at a cable end, in which case a seal, a barrier, or other means shall be provided to prevent migration of flammables into an unclassified location.

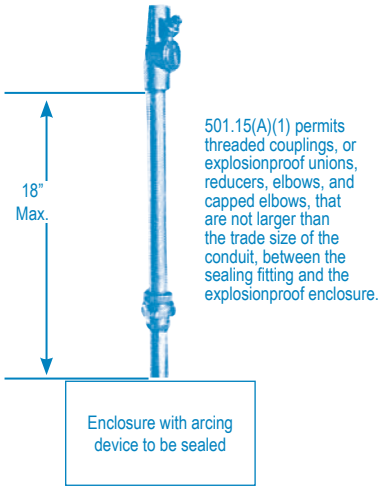
The requirements of this rule are essentially the same as 501.15(E)(2) with the additional requirement that if the cable is attached to certain process equipment that will result in additional pressure in the conduit system then a supplemental seal or barrier is required to prevent the migration of flammables into an unclassified area.

501.15(E)(4) Cables Without Gas/Vaportight Sheath. Cables that do not have a gas/vaportight continuous sheath shall be sealed at the boundary of the Division 2 and unclassified location in such a manner as to minimize the passage of gases or vapors into an unclassified location.

As gases and vapors are likely to penetrate through the interstices of the outer sheath it is required that these gases/vapors be prevented from migrating into an adjacent unclassified area. In the absence of being run in conduit where a conduit seal can be installed at the boundary, another option is to terminate and seal the cable into a Class I, Division 2 enclosure at the boundary of the Division 2 location. On the other side of this enclosure the cable could then be run through to the unclassified location with no additional seals required.

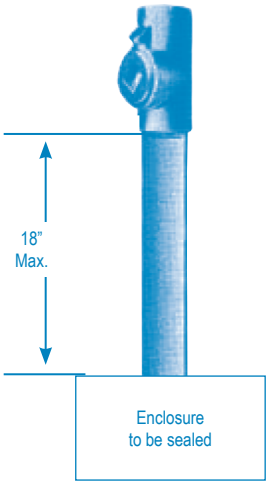
501.15(F) Drainage.

501.15(F)(1) Control Equipment. Where there is a probability that liquid or other condensed vapor may be trapped within enclosures for control equipment or at any point in the raceway system, approved means shall be provided to prevent accumulation or to permit periodic draining of such liquid or condensed vapor.



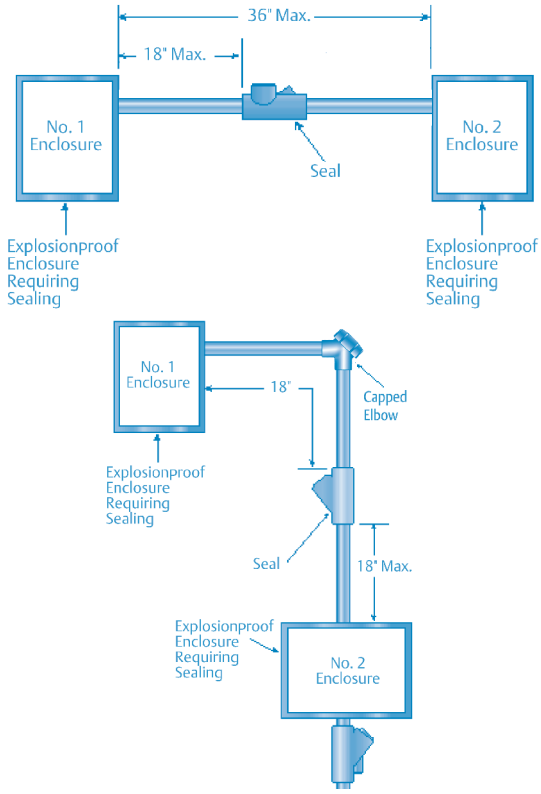
CLASS I, DIVISION 1 AND 2.

Seals must be placed in each conduit within 450 mm (18 in) of a device that may produce arcs, sparks, or high temperatures.



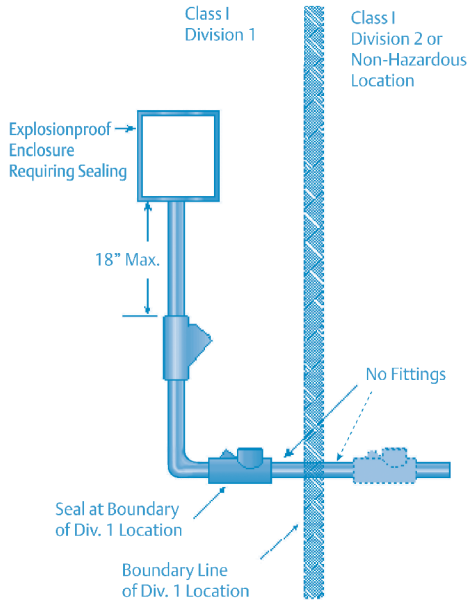
CLASS I, DIVISION 1.

Where metric designator 53 (trade size 2) or larger conduit enters an enclosure, seals are required within 450 mm (18 in) of the enclosure. (Seals are not required on any trade size conduit in Class I, Division 2 areas unless the enclosure is required to be approved for Class I, Division 1.)



CLASS I, DIVISION 1 AND 2.

According to the NEC® seals must be placed in each conduit within 450 mm (18 in) of an explosionproof enclosures. However, 501.15(A)(3) explains that when two or more explosionproof enclosures are connected by nipples or a run of conduit not more than 900 mm (36 in) long, a single conduit seal is sufficient provided it is not located more than 450 mm (18 in) from either enclosure.



CLASS I, DIVISION 1 AND 2.

NEC® requires seal at boundary of Class I, Division 1 location. The seal may be on either side of the boundary if there is no box, fitting, etc. between the boundary and the sealing fitting. It must be within 3.05 m (10 ft.) of either side of the boundary. Exception: reducing bushings may be installed in the sealing fitting.

SELECTION OF SEALS.

VERTICAL — FOR SEALING VERTICAL CONDUIT

EYSM
1/2" - 4"

EYS
1/2" - 1"

FOR SEALING VERTICAL/HORIZONTAL CONDUIT

ESUF
1/2"–1"

EY (CLOSE TURNING RADIUS)
1/2" - 1",
1-1/4" - 3",
3-1/2" - 6"

DRAIN SEALS — FOR VERTICAL CONDUIT

EYD (CLOSE TURNING RADIUS)
1/2" - 1",
1-1/4" - 3",
3-1/2" - 4"

FOR VERTICAL CONDUIT 40% CONDUIT FILL

EYS116
STANDARD

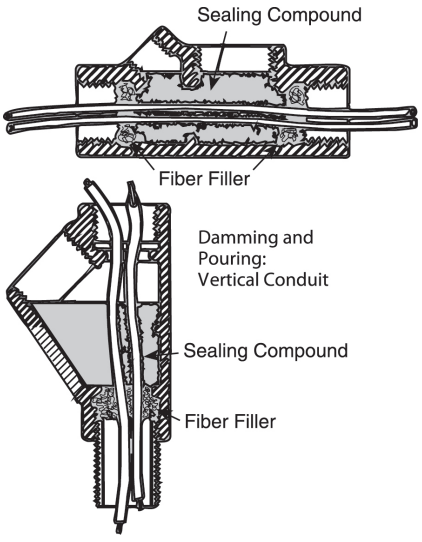
EYDEF
DRAIN

EYDEF
DRAIN

SEALING HUBS — FOR CONDUIT RISERS IN CAST OR SHEET METAL ENCLOSURES

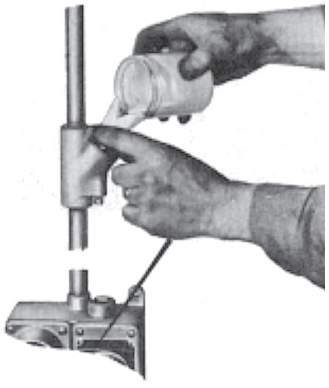
ES SERIES
1/2" - 6"

DAMMING AND POURING: HORIZONTAL CONDUIT



DAMMING AND POURING COMPOUNDS IN SEALING FITTINGS.

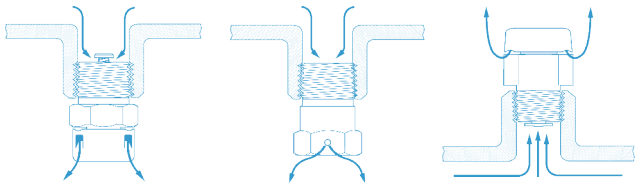
Construct dam in hub. Tuck filler around each conductor. Conductors should be separated and fiber packed tightly around them.



Mix KWIKO™ sealing cement thoroughly in a clean container. Pour directly into the sealing fitting. Depth of sealing compound should equal trade size of conduit, having a minimum of 16 mm (5/8 in) Thickness.

501.15(F)(2) Motors and Generators. Where liquid or condensed vapor may accumulate within motors or generators, joints and conduit systems shall be arranged to minimize the entrance of liquid. If means to prevent accumulation or to permit periodic draining are necessary, such means shall be provided at the time of manufacture and shall be considered an integral part of the machine.

Sections 501.15(F)(1) and 501.15(F)(2) require that if condensed vapor may be trapped in the enclosure, an approved means must be provided to prevent such accumulation or to permit periodic draining.



ECDB USED AS DRAIN

ECDB USED AS BREATHER

501.17 Process Sealing. Process-connected equipment, including, but not limited to, canned pumps, submersible pumps, and flow, pressure, temperature, or analysis measurement instruments, shall be sealed with process seals. A process seal shall be a device that prevents the migration of process fluids from the designed containment into the external electrical system. Process-connected electrical equipment that incorporates a single process seal, such as a single compression seal, diaphragm, or tube to prevent flammable or combustible fluids from entering a conduit or cable system capable of transmitting fluids, shall be provided with an additional means to mitigate a single process seal failure. The additional means might include, but are not limited to, the following:

(1) A suitable barrier meeting the process temperature and pressure conditions that the barrier will be subjected to upon failure of the single process seal. There shall be a vent or drain between the single process seal and the suitable barrier. Indication of the single process seal failure shall be provided by visible leakage, an audible whistle, or other means of monitoring.

(2) A listed Type MI cable assembly, rated at not less than 125 percent of the process pressure and not less than 125 percent of the maximum process temperature (in degrees Celsius), installed between the cable or conduit and the single process seal.

(3) A drain or vent located between the single process seal and a conduit or cable seal. The drain or vent shall be sufficiently sized to prevent overpressuring the conduit or cable seal above 6 in water column (1493 Pa). Indication of the single process seal failure shall be provided by visible leakage, an audible whistle, or other means of monitoring.

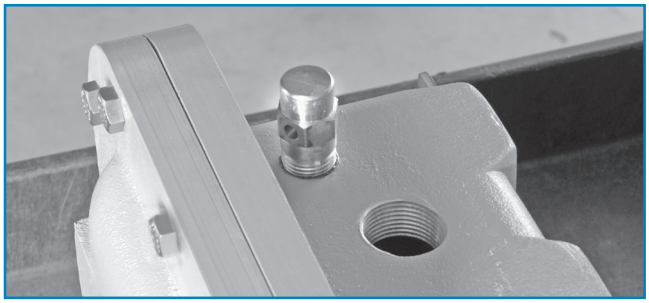
(4) An add-on secondary seal marked "secondary seal" and rated for the pressure and temperature conditions to which it will be subjected upon failure of the single process seal.

Process-connected electrical equipment that does not rely on a single process seal or is listed and marked "single seal", "dual seal", or "dual seal without annunciation" shall not be required to be provided with an additional means of sealing.

Process-connected electrical equipment marked "single seal — install conduit or cable seal" shall be sealed in accordance with **501.15**.

Informational Note: See ANSI/UL 122701,Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids, for construction and testing requirements for process sealing of listed and marked single seal, dual seal, or secondary seal equipment.

Section 501.17(4) recognizes secondary seal equipment as an acceptable means to mitigate a single process seal failure.



ECDB BREATHER INSTALLED IN TOP OF EXPLOSIONPROOF ENCLOSURE.

501.20 Conductor Insulation, Class I, Divisions 1 and 2. Where condensed vapors or liquids may collect on, or come in contact with, the insulation on conductors, such insulation shall be of a type identified for use under such conditions; or the insulation shall be protected by a sheath of lead or by other approved means.

501.25 Uninsulated Exposed Parts, Class I, Divisions 1 and 2. There shall be no uninsulated exposed parts, such as electrical conductors, buses, terminals, or components, that operate at more than 30 volts (15 volts in wet locations). These parts shall additionally be protected by a protection technique according to **500.7(E), (F),** or **(G)** that is suitable for the location.

501.30 Grounding and Bonding, Class I, Divisions 1 and 2. Regardless of the voltage of the electrical system, wiring systems and equipment shall comply with **501.30(A)** and **(B)**.

501.30(A) Grounding. Wiring systems and equipment shall be grounded in accordance with Part I and Part VI of Article **250**, as applicable.

501.30(B) Bonding. Bonding shall comply with Part I and Part V of Article **250**, as applicable, and **501.30(B)(1)** and **(B)(2)**.

501.30(B)(1) Specific Bonding Means. Bonding shall comply with **501.30(B)(1)(a)** and **(B)(1)(b)**.

(a) The locknut-bushing and double-locknut types of contacts shall not be depended on for bonding purposes, but bonding jumpers with identified fittings or other approved means of bonding shall be used. These bonding means shall apply to all metal raceways, fittings, boxes, cable trays, and enclosures, and other parts of raceway systems between Class I locations and the point of grounding for service equipment or point of grounding for a separately derived system. Metal struts, angles, or channels provided for support and mechanical or physical protection as permitted in **335.4(5), 336.10(7)(c),** or **722.135(C)** shall be bonded in accordance with **250.102**.

(b) Where the branch-circuit overcurrent protection is located on the load side of the disconnecting means, the specific bonding means shall be permitted to end at the nearest point where the grounded circuit conductor and the grounding electrode conductor are connected together on the line side of the building or structure disconnecting means as specified in **250.32(B)**.

Section revised to separate the requirements for Grounding from those for Bonding. The requirements for Grounding remain referenced to the general requirements of Article 250. The requirements for Bonding in a Hazardous (Classified) Location are more stringent than those in the general article 250 and therefore are presented here.

The locknut-bushing and double-locknut types of contacts must not be used for bonding purposes. Bonding jumpers with proper fittings or other approved means of bonding must be used. These methods apply to all intervening raceways, fittings, boxes, enclosures, etc. between Class I locations and point of grounding for service equipment or separately derived system. These methods only apply to the point of grounding of a building disconnecting means in accordance with 250.32(A), (B), and (C) where the branch circuit protective device is located on the load side of the disconnecting means.

501.30(B)(2) Flexible Metal Conduit and Liquidtight Flexible Metal Conduit. Flexible metal conduit and liquidtight flexible metal conduit shall comply with **501.30(B)(2)(a)** and **(B)(2)(b)**.

(a) Flexible metal conduit and liquidtight flexible metal conduit shall include an equipment bonding jumper of the wire type in accordance with **250.102**.

(b) In Class I, Division 2 locations, the bonding jumper shall not be required where all of the following conditions are met:

(1) Listed liquidtight flexible metal conduit 1.8 m (6 ft) or less in length, with fittings listed for grounding, is used.

(2) Overcurrent protection in the circuit is limited to 10 amperes or less.

(3) The load is part of a meter, instrument, or relay circuit.

Section 501.30(B)(2) requires that liquidtight flexible metal conduit, as well as flexible metal conduit, be installed with internal or external bonding jumpers in parallel with each conduit if these conduits are "to be relied upon to complete a sole equipment grounding path." The equipment bonding jumpers must comply with all other requirements of 250.102.

In Class I, Division 2 locations, the use of listed liquidtight flexible metal conduit 1.8 m (6 ft) or less in length if: (1) fittings listed for grounding are used; (2) the over-current protection in the circuit is limited to 10 amperes or less; and (3) circuit to a load is not a power utilization load.

501.35 Surge Protection.

501.35(A) Class I, Division 1. Surge arresters, surge-protective devices, and capacitors shall be installed in enclosures identified for Class I, Division 1 locations. Surge-protective capacitors shall be of a type designed for specific uty.

Surge arresters, transient voltage suppressors (TVSS), and capacitors shall be installed in enclosures identified for Class I, Division 1 locations. These enclosures may be identified as Explosionproof or Purged and Pressurized.

501.35(B) Class I, Division 2. Surge arresters and surge protective devices shall be nonarcing, such as metal-oxide varistor (MOV) sealed type, and surge-protective capacitors shall be of a type designed for specific duty. Enclosures shall be permitted to be of the general-purpose type. Surge protection of types other than described in this paragraph shall be installed in enclosures identified for Class I, Division 1 locations.

These enclosures are not required to be identified as Class I, Division 2 where they contain surge arresters and TVSS devices of the nonarcing type or where they contain surge-protective capacitors designated as special duty type. If they contain other surge protection types then the enclosure must be identified as Class I, Division 1.

Part III. Equipment

501.100 Transformers and Capacitors.

501.100(A) Class I, Division 1. In Class I, Division 1 locations, transformers and capacitors shall comply with **501.100(A)(1)** and **(A)(2)**.

501.100(A)(1) Containing Liquid That Will Burn. Transformers and capacitors containing a liquid that will burn shall be installed only in vaults that comply with **450.41** through **450.48** and with (1) through (4) as follows:

(1) There shall be no door or other communicating opening between the vault and the Division 1 location.

(2) Ample ventilation shall be provided for the continuous removal of flammable gases or vapors.

(3) Vent openings or ducts shall lead to a safe location outside of buildings.

(4) Vent ducts and openings shall be of sufficient area to relieve explosion pressures within the vault, and all portions of vent ducts within the buildings shall be of reinforced concrete construction.

501.100(B)(2) Not Containing Liquid That Will Burn. Transformers and capacitors that do not contain a liquid that will burn shall be installed in vaults complying with **501.100(A)(1)** or be identified for Class I locations.

501.100(B) Class I, Division 2. In Class I, Division 2 locations, transformers shall comply with **450.21** through **450.27**, and capacitors shall comply with **460.3** through **460.28**.

Caution should be taken when selecting transformers being used in Class I, Division 2 locations due to the temperature rise of the transformer. Transformer maximum normal operating temperature could exceed Class I gas autoignition temperature(s). The use of lower temperature rise transformers can be an acceptable method to address this concern.

Transformers are typically designed to have a specific maximum temperature rise at a specific maximum ambient. Also in the design is an allowable maximum hot spot temperature above the temperature rise.

Transformer maximum operating temperature = Temperature rise + Hot Spot (at a given Ambient).

501.105 Meters, Instruments, and Relays.

501.105(A) Class I, Division1. In Class I, Division 1 locations, meters, instruments, and relays, including kilowatt-hour meters, instrument transformers, resistors, rectifiers, and thermionic tubes, shall be provided with enclosures identified for Class I, Division 1 locations. Enclosures for Class I, Division 1 locations include explosionproof enclosures and purged and pressurized enclosures.

Informational Note: See NFPA 496-2017, Standard for Purged and Pressurized Enclosures for Electrical Equipment.

501.105(B) Class I, Division 2. In Class I, Division 2 locations, meters, instruments, and relays shall comply with **501.105(B)(2)** through **(B)(6)**.

501.105(B)(1) General-Purpose Assemblies. Where an assembly is made up of components for which general-purpose enclosures are acceptable as provided in **501.105(B)(1), (B)(2),** and **(B)(3)**, a single general-purpose enclosure shall be acceptable for the assembly. Where such an assembly includes any of the equipment described in **501.105(B)(1), 501.105(B)(2),** and **501.105(B)(3),** the maximum obtainable surface temperature of any component of the assembly that exceeds 100°C shall be clearly and permanently indicated on the outside of the enclosure. Alternatively, equipment shall be permitted to be marked to indicate the temperature class for which it is suitable, using the temperature class (T *Code*) of **Table 500.8(C)(4)**.

501.105(B)(2) Contacts. Switches, circuit breakers, and make-and-break contacts of pushbuttons, relays, alarm bells, and horns shall have enclosures identified for Class I, Division 1 locations in accordance with **501.105(A)**.

Exception: General-purpose enclosures shall be permitted if current interrupting contacts comply with one of the following:

(1) Are immersed in oil

(2) Are enclosed within a chamber that is hermetically sealed against the entrance of gases or vapors

(3) Are in nonincendive circuits

(4) Are listed for Division 2 locations

501.105(B)(3) Resistors and Similar Equipment. Resistors, resistance devices, thermionic tubes, rectifiers, and similar equipment that are used in or in connection with meters, instruments, and relays shall comply with **501.105(A)**.

*Exception: General-purpose-type enclosures shall be permitted if such equipment is without make-and-break or sliding contacts [other than as provided in **501.105(B)(2)**] and if the marked maximum operating temperature of any exposed surface will not exceed 80 percent of the autoignition temperature in degrees Celsius of the gas or vapor involved or has been tested and found incapable of igniting the gas or vapor. This exception shall not apply to thermionic tubes.*

501.105(B)(4) Without Make-or-Break Contacts. Transformer windings, impedance coils, solenoids, and other windings that do not incorporate sliding or make-or-break contacts shall be provided with enclosures. General-purpose-type enclosures shall be permitted.

501.105(B)(5) Fuses. Where general-purpose enclosures are permitted in **501.105(B)(2)** through **(B)(4)**, fuses for overcurrent protection of instrument circuits not subject to overloading in normal use shall be permitted to be mounted in general-purpose enclosures if each such fuse is preceded by a switch complying with **501.105(B)(2)**.

501.105(B)(6) Connections. To facilitate replacements, process control instruments shall be permitted to be connected through flexible cord and attachment plug and receptacle if all of the following conditions apply:

(1) The attachment plug and receptacle are listed for use in Class I, Division 2 locations and listed for use with flexible cords.

Exception No. 1 to (1): A Class I, Division 2 listing shall not be required if the circuit involves only nonincendive field wiring.

*Exception No. 2 to (1): In restricted industrial establishments, the Class I, Division 2 listing shall not be required if the requirements of **501.105(B)(6)(2), (B)(6)(3)**, and **(B)(6)(4)** are satisfied and the receptacle carries a label warning against plugging or unplugging when energized.*

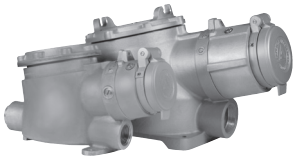
RECEPTACLES AND PLUGS—CLASS I, DIVISION 1 AND 2.

U-LINE™ 20 AMP

EBR 30, 60, 100, AND 150 AMP

CPS 20 AMP

CPP PLUG 20 AMP



FSQC 30, 60, 100 AMP

JBR 30, 60 AMP

(2) The flexible cord does not exceed 900 mm (3 ft), is of a type listed for extra-hard usage, or is listed for hard usage and protected by location.

(3) Only necessary receptacles are provided.

(4) Unless the attachment plug and receptacle are interlocked mechanically or electrically, or otherwise designed so that they cannot be separated when the contacts are energized and the contacts cannot be energized when the plug and socket outlet are separated, a switch complying with **501.105(B)(2)** is provided so that the attachment plug or receptacle is not necessary to interrupt current.

Exception to (4): The switch shall not be required if the circuit is nonincendive field wiring.

The requirement for marking the maximum surface temperature has been added for these enclosures that contain switches, circuit breakers, and make or break contacts or where transformers winding, impedance coils, or solenoids are contained. Where the contained equipment components do not exceed +100 °C (+212 °F) under normal operating conditions, the maximum surface temperature is not required to be marked on the general purpose enclosure.

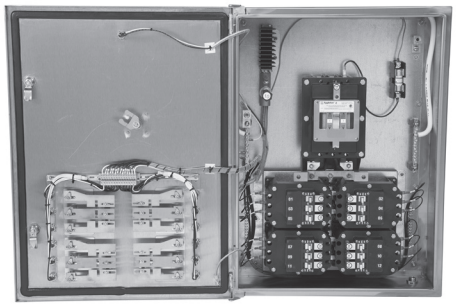
501.115 Switches, Circuit Breakers, Motor Controllers, and Fuses. These products contain arcing devices and must meet the requirements of **501.115(A)** and **(B)** as applicable. All Appleton™ switches, circuit breakers and motor starters comply with this Section. Products are offered that are suitable for use in Class I, Division 1 and Class I, Division 2 locations.

501.115(A) Class I, Division 1. In Class I, Division 1 locations, switches, circuit breakers, motor controllers, and fuses, including pushbuttons, relays, and similar devices, shall be provided with enclosures, and the enclosure in each case, together with the enclosed apparatus, shall be identified as a complete assembly for use in Class I locations.

501.115(B) Class I, Division 2. Switches, circuit breakers, motor controllers, and fuses in Class I, Division 2 locations shall comply with **501.115(B)(1)** through **(B)(4)**.

501.115(B)(1) Type Required. Circuit breakers, motor controllers, and switches intended to interrupt current in the normal performance of the function for which they are installed shall be provided with enclosures identified for Class I, Division 1 locations in accordance with **501.105(A)**, unless general-purpose enclosures are provided and any of the following apply:

(1) The interruption of current occurs within a chamber hermetically sealed against the entrance of gases and vapors.



PLEXPOWER™ PANELBOARD

This method prevents the source gas or vapor from gaining access into the device where the interruption of current is to occur.

(2) The current make-and-break contacts are oil-immersed and of the general-purpose type having a 50-mm (2-in.) minimum immersion for power contacts and a 25-mm (1-in.) minimum immersion for control contacts.

This method prevents the arcing of a current interrupting contact.

(3) The interruption of current occurs within an enclosure, identified for the location, and marked “Leads Factory Sealed”, or “Factory Sealed”, or “Seal not Required”, or equivalent.

This method prevents the propagation of an explosion into the general-purpose cavity of the enclosure.

(4) The device is a solid state, switching control without contacts, where the surface temperature does not exceed 80 percent of the autoignition temperature in degrees Celsius of the gas or vapor involved.

501.115(B)(2) Isolating Switches. Fused or unfused disconnect and isolating switches for transformers or capacitor banks that are not intended to interrupt current in the normal performance of the function for which they are installed shall be permitted to be installed in general-purpose enclosures.

501.115(B)(2) permits the use of disconnect and isolating switches in general-purpose enclosures in Class I, Division 2 locations if neither the switch or fuse operates as a normal current interrupting device. In such a case, the fuse is used for short-circuit protection only.

501.115(B)(3) Fuses. For the protection of motors, appliances, and lamps, other than as provided in 501.115(B)(4), standard plug or cartridge fuses shall be permitted, provided they are placed within enclosures identified for the location; or fuses shall be permitted if they are within general-purpose enclosures, and if they are of a type in which the operating element is immersed in oil or other approved liquid, or the operating element is enclosed within a chamber hermetically sealed against the entrance of gases and vapors, or the fuse is a nonindicating, filled, current-limiting type.

501.115(B)(4) Fuses Internal to Luminaires. Listed cartridge fuses shall be permitted as supplementary protection within luminaires.

Push button and selector switch control stations are used in conjunction with contactors or magnetic starters for remote control of motors.

Motor starter and circuit breaker enclosures, whether provided as combination units or as starters only or breakers only are Class I, Division 1, suitable for use in wet locations — AEB Bolted Series: NEMA 4X.

501.120 Control Transformers and Resistors. Transformers, impedance coils, and resistors used as, or in conjunction with, control equipment for motors, generators, and appliances shall comply with **501.120(A)** and **(B)**.

501.120(A) Class I, Division 1. In Class I, Division 1 locations, transformers, impedance coils, and resistors, together with any switching mechanism associated with them, shall be provided with enclosures identified for Class I, Division 1 locations in accordance with **501.105(A)**.

501.120(B) Class I, Division 2. In Class I, Division 2 locations, control transformers and resistors shall comply with **501.120(B)(1)** through **(B)(3)**.

MOTOR STARTERS FOR CLASS I, DIVISION 1 AND 2

ACSE MANUAL MOTOR STARTER

AEB SERIES BOLTED COVER MOTOR STARTER

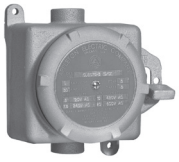
BREAKERS FOR CLASS I, DIVISION 1 AND 2

AE SERIES BOLTED COVER CLASS I, DIVISION 1 & 2 CIRCUIT BREAKER

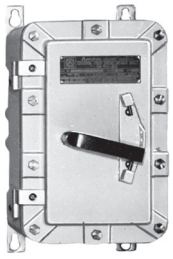
MOTOR STARTERS FOR CLASS I, DIVISION 2

PLEXPOWER™ SERIES FACTORY SEALED MOTOR STARTERS

DISCONNECT SWITCHES FOR CLASS I, DIVISION 1 AND 2.

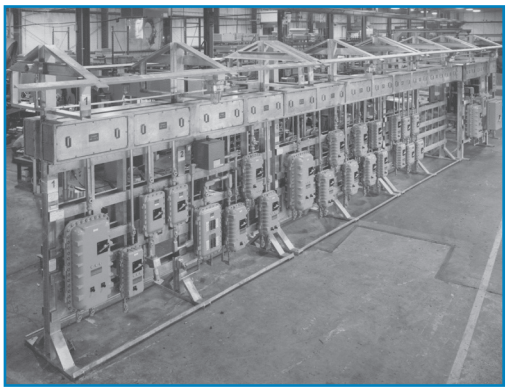


GUSC TUMBLER 30 AMP



EDS DISCONNECT 30-200 AMP

SWITCHRACK FOR CLASS I, DIVISION 2



SWITCHRACKS BUILT TO COMPLY WITH NEC STANDARDS

501.120(B)(1) Switching Mechanisms. Switching mechanisms used in conjunction with transformers, impedance coils, and resistors shall comply with **501.115(B)**.

501.120(B)(2) Coils and Windings. Enclosures for windings of transformers, solenoids, or impedance coils shall be permitted to be of the general-purpose type.

501.120(B)(3) Resistors. Resistors shall be provided with enclosures; and the assembly shall be identified for Class I locations, unless resistance is nonvariable and maximum operating temperature, in degrees Celsius, will not exceed 80 percent of the autoignition temperature of the gas or vapor involved or the resistor has been tested and found incapable of igniting the gas or vapor.

501.125 Motors and Generators.

501.125(A) Class I, Division 1. In Class I, Division 1 locations, motors, generators, and other rotating electrical machinery shall be one of the following:

(1) Identified for Class I, Division 1 locations

(2) Of the totally enclosed type supplied with positive-pressure ventilation from a source of clean air with discharge to a safe area, so arranged to prevent energizing of the machine until ventilation has been established and the enclosure has been purged with at least 10 volumes of air and so arranged to automatically deenergize the equipment when the air supply fails

(3) Of the totally enclosed inert gas–filled type supplied with a suitable reliable source of inert gas for pressurizing the enclosure, with devices provided to ensure a positive pressure in the enclosure and arranged to automatically de-energize the equipment when the gas supply fails

(4) For machines that are for use only in restricted industrial establishments the machine is permitted to be of a type designed to be submerged in a liquid that is flammable only when vaporized and mixed with air, or in a gas or vapor at a pressure greater than atmospheric and that is flammable only when mixed with air; and the machine is so arranged to prevent energizing it until it has been purged with the liquid or gas to exclude air, and also arranged to automatically de-energize the equipment when the supply of liquid or gas or vapor fails or the pressure is reduced to atmospheric

Motors and generators are only permitted under the above conditions of installation with the additional restriction that they can only be installed when in industrial establishments with restricted public access and where the conditions of maintenance and supervision ensure that only qualified persons service the installation.

Totally enclosed motors of the types specified in **501.125(A)(2)** or **(A)(3)** shall have no external surface with an operating temperature in degrees Celsius in excess of 80 percent of the autoignition temperature of the gas or vapor involved. Appropriate devices shall be provided to detect and automatically de-energize the motor or provide an adequate alarm if there is any increase in temperature of the motor beyond designed limits. Auxiliary equipment shall be of a type identified for the location in which it is installed.

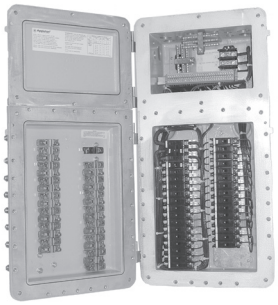
501.125(B) Class I, Division 2. In Class I, Division 2 locations, motors, generators, and other rotating electrical machinery shall comply with (1), (2), or (3). They shall also comply with (4) and (5), if applicable.

(1) Be identified for Class I, Division 2 locations, or

PANELBOARDS FOR CLASS I, DIVISION 1.

ALPN — NON-FACTORY SEALED PANELBOARD

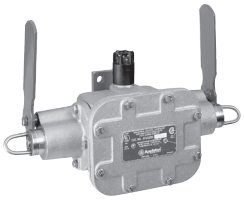
PANELBOARDS FOR CLASS I, DIVISION 2.



EWP — FACTORY SEALED

PLEXPOWER™ PANELBOARD

CONVEYOR SWITCHES FOR CLASS I, DIVISION 1 & 2.



AFUX — DOUBLE END

(2) Of the totally enclosed type supplied with positive-pressure ventilation from a source of clean air with discharge to a safe area, so arranged to prevent energizing of the machine until ventilation has been established and the enclosure has been purged with at least 10 volumes of air, and so arranged to automatically de-energize the equipment when the air supply fails

(3) Be open or nonexplosionproof enclosed motors, such as squirrel-cage induction motors without brushes, switching mechanisms, or similar arc-producing devices that are not identified for use in a Class I, Division 2 location.

(4) For machines that are for use only in restricted industrial establishments, the machine is permitted to be of a type designed to be submerged in a liquid that is flammable only when vaporized and mixed with air, or in a gas or vapor at a pressure greater than atmospheric and that is flammable only when mixed with air; and the machine is so arranged to prevent energizing it until it has been purged with the liquid or gas to exclude air, and so arranged to automatically de-energize the equipment when the supply of liquid or gas or vapor fails or the pressure is reduced to atmospheric

(5) A sliding contact shaft bonding device used for the purpose of maintaining the rotor at ground potential, shall be permitted where the potential discharge energy is determined to be nonincendive for the application. The shaft bonding device shall be permitted to be installed on the inside or the outside of the motor.

Section 501.125(B) requires that all motors, generators, and other rotating electric machinery with sliding contacts, centrifugal or other types of switching mechanism (including motor overcurrent, overloading, and overtemperature devices), or integral resistance devices, either while starting or while running be identified for Class I, Division 1 locations except where the sliding contacts, switching mechanisms, and resistance devices are provided with enclosures identified for Class I, Division 2 locations in accordance with 501.105(B). However the installation of open or nonexplosionproof enclosed motors, such as squirrelcage induction motors without brushes, switching mechanisms, or similar arc-producing devices that are not identified for use in, are acceptable in a Class I, Division 2 location.

Informational Note No. 1: It is important to consider the temperature of internal and external surfaces that may be exposed to the flammable atmosphere.

Section 501.125(B) Informational Note No. 1 adds an extra cautionary note that urges consideration of internal and external surface temperature of the electrical equipment that may be exposed to the flammable atmosphere.

Informational Note No. 2: It is important to consider the risk of ignition due to currents arcing across discontinuities and overheating of parts in multisection enclosures of large motors and generators. Such motors and generators might need equipotential bonding jumpers across joints in the enclosure and from enclosure to ground. Where the presence of ignitible gases or vapors is suspected, clean-air purging might be needed immediately prior to and during start-up periods.

Informational Note No. 2 urges caution in the case of multisection enclosures of large motors and generators, which may (1) arc across discontinuities and (2) overheat in some parts. Recommended precautionary action includes (1) the use of equipotential bonding jumpers across joints in the enclosures and from enclosure to ground, and (2) clean air purging immediately before and during startup periods where ignitible gases or vapors are suspected. The reason for the Informational Note 2 is that overheating of parts is not only caused by transient currents, but also may occur during motor starting, fault contribution or load changes.

Informational Note No. 3: See IEEE 1349, IEEE Guide for the Application of Electric Machines in Zone 2 and Class I, Division 2 Hazardous (Classified) Locations, for information on the application of rotating electric machines including shaft bonding devices and potential discharge energy calculations.

Due to the concerns emphasized in Informational Note No. 1 and No. 2, often motors suitable for Class I, Division 1 are selected for Class I, Division 2 applications.

Informational Note No. 4: See ANSI/UL 122001, General Requirements for Electrical Ignition Systems for Internal Combustion Engines in Class I, Division 2 or Zone 2, Hazardous (Classified) Locations, for reciprocating engine–driven generators, compressors, and other equipment installed in Class I, Division 2 locations. Reciprocating engine–driven generators, compressors, and other equipment installed in Class I, Division 2 locations might present a risk of ignition of flammable materials associated with fuel, starting, and compression due to inadvertent release or equipment malfunction by the engine ignition system and controls.

This Informational Note identifies the product standard that addresses risk of ignition with engine driven equipment due to fuel, starting, compression etc.

Informational Note No. 5: See UL 1836, Outline of Investigation for Electric Motors and Generators for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2 and Zone 22 Hazardous (Classified) Locations, for details of the evaluation process to determine incendivity. Refer to Annex A and Figure A1.

501.130 Luminaires. Luminaires shall comply with **501.130(A)** or **(B)**.

501.130(A) Class I, Division 1. In Class I, Division 1 locations, luminaires shall comply with **501.130(A)(1)** through **(A)(4)**.

Section 501.130(A) applies where lamps are of a size or type that may, under normal operating conditions, reach surface temperatures exceeding 80 percent of the ignition temperature in degrees Celsius of the gas or vapor involved, except where a type that has been tested in order to determine the marked operating temperature or temperature class (T Code) is installed.

501.130(A)(1) Luminaires. Each luminaire shall be identified as a complete assembly for the Class I, Division 1 location and shall be clearly marked to indicate the maximum wattage of lamps for which it is identified. Luminaires intended for portable use shall be specifically listed as a complete assembly for that use.

In Class I locations, luminaires must be identified for the location. They must be protected against damage by locating the luminaire so accidental damage is unlikely or by suitable guards. Appleton™ Class I, Division 1 luminaires are all factory sealed by construction, eliminating need for external seals.

The listing standard, UL 844 only requires the lamp type and maximum wattage markings for incandescent or HID luminaires.

501.130(A)(2) Physical Damage. Each luminaire shall be protected against physical damage by a suitable guard or by location.

In Class I, Division 1 locations all luminaires are required to be identified as a complete assembly and protected against physical damage by a suitable guard or by location. They must be clearly marked to indicate the maximum wattage of lamps for which it is identified. Where they are intended for portable use they must be specifically listed as a complete assembly for that use.

501.130(A)(3) Pendant Luminaires. Pendant luminaires shall be suspended by and supplied through threaded rigid metal conduit stems or threaded steel intermediate conduit stems, and threaded joints shall be provided with set-screws or other effective means to prevent loosening. For stems longer than 300 mm (12 in), permanent and effective bracing against lateral displacement shall be provided at a level not more than 300 mm (12 in) above the lower end of the stem, or flexibility in the form of a fitting or flexible connector identified for the Class I, Division 1 location shall be provided not more than 300 mm (12 in) from the point of attachment to the supporting box or fitting.

Pendant Luminaires must be suspended by and supplied through threaded Rigid Metal Conduit or steel Intermediate Metal Conduit. Stems up to 12 in (300 mm), and threaded joints are required to be provided with set-screws or other effective means to prevent loosening. Longer stems require permanent and effective bracing against lateral displacement or a Class I, Division 1 identified flexible fitting or connector.

501.130(A)(4) Supports. Boxes, box assemblies, or fittings used for the support of luminaires shall be identified for Class I locations.

501.130(B) Class I, Division 2. In Class I, Division 2 locations, luminaires shall comply with **501.130(B)(1)** through **(B)(6)**.

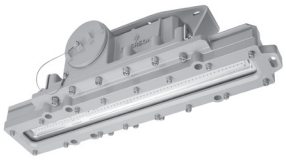
501.130(B)(1) Luminaires. Where lamps are of a size or type that may, under normal operating conditions, reach surface temperatures exceeding 80 percent of the autoignition temperature in degrees Celsius of the gas or vapor involved,

CLASS I, DIVISION 1 LED LUMINAIRES

CODE•MASTER™ LED

CODE•MASTER™ JR. LED

A-51™ LED



RIGMASTER™ LED

CLASS I, DIVISION 1 FIXTURE HANGERS

EFHU

EFHC

CPU

CLASS I, DIVISION 1 LED PORATBLE HANDLAMP

EHLED

luminaires shall comply with **501.130(A)(1)** or shall be of a type that has been tested in order to determine the marked operating temperature or temperature class (T code).

501.130(B)(2) Physical Damage. Luminaires shall be protected from physical damage by suitable guards or by location. Where there is danger that falling sparks or hot metal from lamps or luminaires might ignite localized concentrations of flammable vapors or gases, suitable enclosures or other effective protective means shall be provided.

In Class I, Division 2 locations, fixed luminaires shall be protected from physical damage by suitable guards or by location and where there is danger that falling sparks or hot metal from lamps or luminaires might ignite flammable vapors or gases they must be in suitable enclosures, other effective protective means must be provided.

CLASS I, DIVISION 2 LUMINAIRES

All Class I, Division 2 LED, HID, FLUORESCENT and INCANDESCENT Luminaires shown are enclosed and gasketed and therefore suitable for use in wet locations. Their construction makes them suitable for Class I, Division 2 locations. Such luminaires are more economical to install in areas where Class I, Division 1 luminaires are not required.

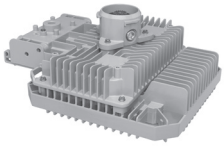
LED LUMINAIRES

MERCMASTER™ CONNECT

MERCMASTER™ GENERATION 3 LED

MERCMASTER™ LED LOW PROFILE

CONTENDER™ LED



BAYMASTER™ LED

AREAMASTER™ LED GENERATION 2

RIGMASTER™ LED

RETROMASTER LED

GLOMASTER LED

HEX

501.130(B)(3) Pendant Luminaires. Pendant luminaires shall be suspended by threaded rigid metal conduit stems, threaded steel intermediate metal conduit stems, or other approved means.

For rigid stems longer than 300 mm (12 in), permanent and effective bracing against lateral displacement shall be provided at a level not more than 300 mm (12 in) above the lower end of the stem, or flexibility in the form of an identified fitting or flexible connector shall be provided not more than 300 mm (12 in) from the point of attachment to the supporting box or fitting.

501.130(B)(4) Portable Lighting Equipment. Portable lighting equipment shall comply with **501.130(B)(4)(a)** or **(B)(4)(b)**.

(a) Portable lighting equipment shall comply with **501.130(B)(1)**.

(b) Portable lighting equipment mounted on movable stands and connected by flexible cords in accordance with 501.140 shall be permitted to comply with **501.130(B)(1)**, where mounted in any position, if it is protected from physical damage in accordance with **501.130(B)(2)**.

Section 501.130(B)(4) Exception states that portable luminaires used in Class I, Division 2 locations do not have to be approved for Class I, Division 1 if they are mounted on a movable stand and connected by an approved flexible cord. The luminaire only needs to be approved for Class I, Division 2, providing it conforms to 501.130(B)(2), which specifies:

(1) that luminaire be protected by suitable guard or location;

(2) that luminaire has suitable enclosure to prevent sparks or hot metal from lamp causing ignition of the surrounding atmosphere; and

(3) that luminaire does not exceed temperature limitations.

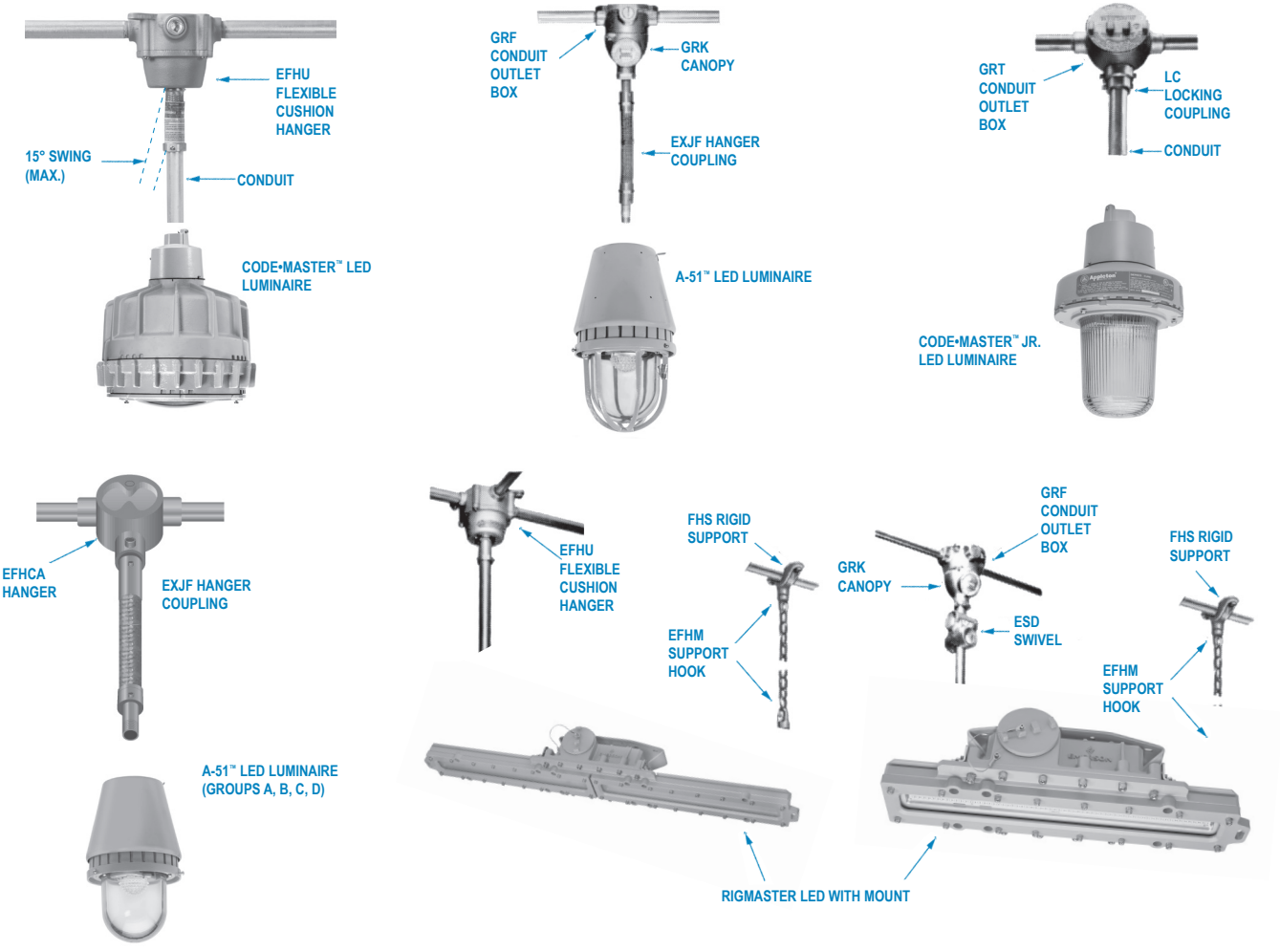
CAUTION: Restrictions on portable electric lamps are more severe in applications covered in Article 516. During spray operation in Class I [as covered in 516.4(D)] and during cleaning and repair operations in Class I (as covered in Section 501.130), portable lamps must be approved for Class I, Division 1 and/or Class II, Division 1. However, in Class I cleaning and repair operations, 501.130(B)(1) and Exception applies, meaning that a portable lamp approved for Class I, Division 2 may be used if it is mounted on a movable stand and is connected by an approved flexible cord.

CLASS I, DIVISION 1 AND 2, GROUP D.

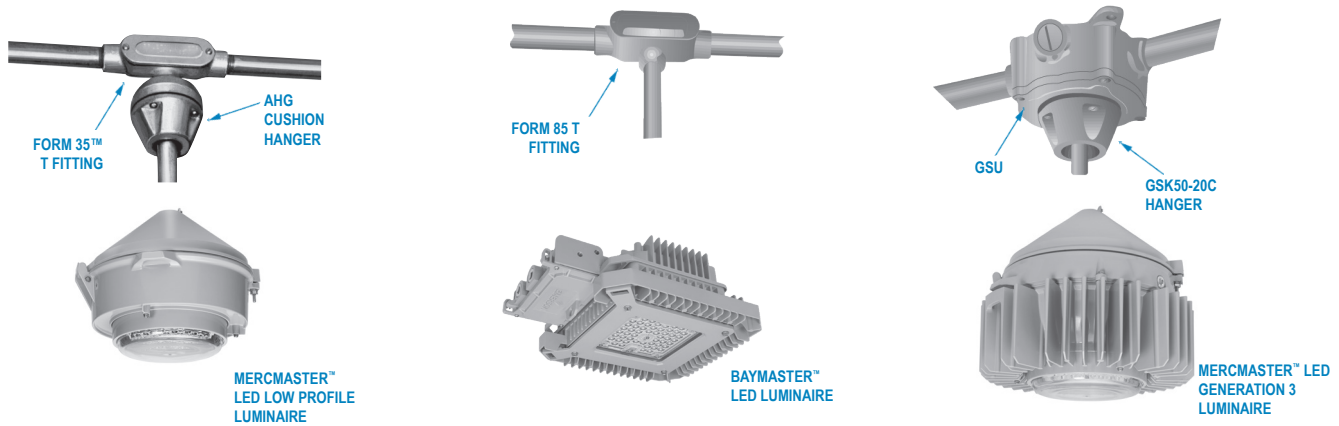
Appleton™ Reelites™ (power cable reels) are used to provide power or electrical control over long distances to movable utilization equipment, such as machinery, cranes and machine tools where constant cable tension is required to automatically take up cable slack as equipment moves. Reelites™ also provide storage and safety for these retractable power sources.

APPLETON™ EXPLOSIONPROOF AERL SERIES REELITES™ FOR USE WITH UTILIZATION EQUIPMENT.

TYPICAL FIXTURE HANGER INSTALLATIONS — CLASS I AND II, DIVISION 1 ①



TYPICAL FIXTURE HANGER INSTALLATIONS — CLASS I, DIVISION 2



① *Fixtures using stems longer than 12" must have flexible fitting.*

501.130(B)(5) Switches. Switches that are a part of a luminaire or of an individual lampholder shall comply with **501.115(B)(1)**.

501.130(B)(6) Starting Equipment. Starting and control equipment for electric-discharge lamps shall comply with **501.120(B)**.

Exception: A thermal protector potted into a thermally protected fluorescent lamp ballast if the luminaire is identified for the location.

501.135 Utilization Equipment.

501.135(A) Class I, Division 1. In Class I, Division 1 locations, all utilization equipment shall be identified for Class I, Division 1 locations.

501.135(B) Class I, Division 2. In Class I, Division 2 locations, all utilization equipment shall comply with **501.135(B)(1)** through **(B)(3)**.

501.135(B)(1) Heaters. Electrically heated utilization equipment shall meet one of the following requirements:

(1) The heater shall not exceed 80 percent of the autoignition temperature in degrees Celsius of the gas or vapor involved on any surface that is exposed to the gas or vapor when continuously energized at the maximum rated ambient temperature. If a temperature controller is not provided, these conditions shall apply when the heater is operated at 120 percent of rated voltage.

Section 501.135(B)(1) elaborates on the use of electrically heated utilization equipment in Class I, Division 2 locations. This equipment either (1) could not exceed 80 percent of the ignition temperature of the atmosphere encountered when operated at 120 percent of rated voltage or (2) it must be approved for Class I, Division 1. Section 501.135(B)(1)(1), Exception permits "electrical resistance heat tracing approved for Class I, Division 2 locations" (not Class I, Division 1).

*Exception No. 1 to (1): For motor-mounted anticondensation space heaters, see **501.125**.*

Exception No. 2 to (1): Where a current-limiting device is applied to the circuit serving the heater to limit the current in the heater to a value less than that required to raise the heater surface temperature to 80 percent of the autoignition temperature.

Section 501.135(B)(1) Exception 1 excludes motor-mounted anticondensation space heaters from the requirement that they not exceed 80 percent of the ignition temperature in degrees Celsius when operated at 120 percent of rated voltage. In such a case, 501.125(B) applies, which states that "When operated at rated voltage, the exposed surface of space heaters used to prevent condensation of moisture during shut-down periods shall not exceed 80 percent of the ignition temperature in degrees Celsius of the gas or vapor involved." In other words, 501.125(B) specified "at rated voltage."

Section 501.135(B)(1)(1), Exception 2 permits, in a Class I, Division 2 location, the use of electrically heated utilization equipment if some current-limiting means is provided to prevent the equipment temperature from exceeding 80 percent of the ignition temperature of the gas or vapor involved or be identified for Class I, Division 1 location.

(2) The heater shall be identified for Class I, Division 1 locations.

Exception to (2): Electrical resistance and skin effect heat tracing identified for Class I, Division 2 locations shall be permitted.

Informational Note No. 1: See ANSI/UL 60079-30-1, Explosive Atmospheres — Part 30-1: Electrical Resistance Trace Heating — General and Testing Requirements, for information on electric resistance heat tracing.

Informational Note No. 2: See IEEE 844.1/CSA C22.2 No. 293.1, IEEE/CSA Standard for Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — General, Testing, Marking, and Documentation Requirements, for information on electric skin effect heat tracing.

Informational Note No. 3: See IEEE 844.3/CSA C22.2 No. 293.3, IEEE/CSA Standard for Impedance Heating of Pipelines and Equipment — General, Testing, Marking, and Documentation Requirements, for information on electric impedance heating.

501.135(B)(2) Motors. Motors of motor-driven utilization equipment shall comply with **501.125(B)**.

501.135(B)(3) Switches, Circuit Breakers, and Fuses. Switches, circuit breakers, and fuses shall comply with **501.115(B)**.

501.135(B)(4) Luminaires. Luminaires shall comply with **501.130(B)**.

501.140 Flexible Cords, Class I, Divisions 1 and 2.

501.140(A) Permitted Uses. Flexible cord shall be permitted as follows:

(1) For connection between portable lighting equipment or other portable utilization equipment and the fixed portion of their supply circuit. The flexible cord shall be attached to the utilization equipment with a cord connector listed for the protection technique of the equipment wiring compartment. An attachment plug in accordance with **501.140(B)(4)** shall be employed.

Flexible cord used on portable lighting equipment or other portable utilization equipment must be attached to the utilization equipment with a cord connector that meets the rating of the portable equipment. This is regardless of what classified area the utilization equipment is being used in An example would be an explosionproof portable luminaire. The cord that connects the luminaire would be required to be explosionproof even if the luminaire was being utilized in a Class I, Division 2 location.

(2) For that portion of the circuit where the fixed wiring methods of **501.10(A)** cannot provide the necessary degree of movement for fixed and mobile electrical utilization equipment, and the flexible cord is protected by location or by a suitable guard from damage and only in a restricted industrial establishment.

(3) For electric submersible pumps with means for removal without entering the wet-pit. The extension of the flexible cord within a suitable raceway between the wet-pit and the power source shall be permitted.

(4) For electric mixers intended for travel into and out of opentype mixing tanks or vats.

(5) For temporary portable assemblies consisting of receptacles, switches, and other devices that are not considered portable utilization equipment but are individually listed for the location.

This section addresses equipment such as portable power carts where these types of equipment do not meet the definition as portable utilization equipment but provide portable power to utilization equipment.

501.140(B) Installation. Where flexible cords are used, the cords shall comply with all of the following:

(1) Be of a type listed for extra-hard usage.

(2) Contain, in addition to the conductors of the circuit, an equipment grounding conductor complying with **400.23.**

(3) Be supported by clamps or by other suitable means in such a manner that there is no tension on the terminal connections.

(4) In Division 1 locations or in Division 2 locations where the boxes, fittings, or enclosures are required to be explosionproof, the cord shall be terminated with a cord connector or attachment plug listed for the location or a listed cord connector installed with a seal listed for the location. In Division 2 locations where explosionproof equipment is not required, the cord shall be terminated with a listed cord connector or listed attachment plug.

When the cord connector is installed into a seal that is "listed for the location" the cord connector need only be listed for use with the cord. It is not also required to be "listed for the location".

This section addresses the proper methods for sealing cord entering enclosures that are required to be explosionproof and those instances where the cord is installed in a Class I, Division 2 location and is feeding equipment that is not required to be explosionproof. For non-explosionproof installation the cord connector must simply be listed for the cord, not listed for the location.

(5) Be of continuous length. Where **501.140(A)(5)** is applied, cords shall be of continuous length from the power source to the temporary portable assembly and from the temporary portable assembly to the utilization equipment.

Informational Note: See 501.20 for flexible cords exposed to liquids having a deleterious effect on the conductor insulation.

This section addresses the installation requirements for the provision in 501.140(A)(5) relating to temporary portable assemblies. In these installations both the cord from the fixed supply power source to the temporary portable assembly and the cord from the temporary portable assembly to the utilization equipment must be a continuous length.

Section 501.140 limits flexible cords to connections between portable utilization equipment, such as a lamp, and the fixed portion of a supply circuit now with the permitted use of an intermittent temporary portable assembly such as a power cart that is listed for the location. In addition, that portion of the circuit where the fixed wiring methods of 501.10(A) cannot provide the necessary degree of movement for fixed and mobile electrical utilization equipment, flexible cord may be used. The location must be in an industrial establishment where conditions of maintenance and engineering supervision ensure that only qualified persons will install and service the installation. The flexible cord must be protected from damage by location or suitable guards and must be continuous in length from the power source to the utilization equipment. A cord connector used as an extension cord, therefore, is not permitted in Class I, Division 1 locations. Where flexible cords are used they shall be a type approved for "extra hard usage" (see Table 400.4) and must include a grounding conductor identified with markings as specified in 400.23. They must be connected to terminals or supply conductors in an approved manner. They must be supported so that there will be no tension on the terminals or connections, and they must be provided with suitable seals where required.

Section 501.140 classifies an electric submersible pump with means for removal without entering the wet-pit as portable utilization equipment. Thus defined, flexible cord is permitted "between this product and the fixed portion of the supply circuit."

Section 501.140 classifies electric mixers as portable utilization "if intended for travel into and out of open-type mixing tanks or vats." Flexible cord may be used between this product and the fixed portion of the supply circuit. This permission is granted because there is no other practical method available to power this type of equipment besides the use of flexible cord.

501.141 Flexible Cables, Class I, Division 2. Flexible cables installed in Class I, Division 2 locations shall comply with **501.141(A)and (B).**

501.141(A) Permitted Uses. Flexible cables shall be permitted to be installed in accordance with **501.141(A)(1)** and **(A)(2)**.

501.141(A)(1) Other Than Nonincendive Field Wiring Applications. Flexible cables in other than nonincendive field wiring applications shall be permitted in accordance with the following:

(1) Flexible cables shall be permitted to connect two pieces of electrical equipment by means of a cable assembly installed in accordance with **501.141(B)(2)(a)** or **(B)(2)(b)**.

(2) Flexible cables shall be permitted to connect a piece of electrical equipment to the premises wiring by means of a cable assembly installed in accordance with **501.141(B)(2)(c)**.

501.141(A)(2) Nonincendive Field Wiring Applications. Flexible cables in nonincendive field wiring applications shall be permitted to be used in accordance with **501.10(B)(3)**.

RECEPTACLES AND PLUGS — CLASS I, DIVISION 1 AND 2.

U-LINE™ – 20 AMP

FSQC – 30, 60, 100 AMP

EDS CONTROL STATION

CONTENDER™ EDS MANUAL MOTOR STARTERS

CES

CPH

501.141(B) Installation. If flexible cables are used as permitted in **501.141(A)**, the associated cable assemblies shall comply with **501.141(B)(1)** through **(B)(3)**.

501.141(B)(1) Cable Types. Listed Type P cables shall comply with **501.141(A)(1)** and shall be installed as required in Part II of Article **337**. The associated cable assemblies shall comply with the requirements of **501.141(B)(2)**.

501.141(B)(2) Termination Means. Terminations shall comply with **501.141(B)(2)(a), (B)(2)(b),** or **(B)(2)(c)**.

(a) Connecting Two Devices or Pieces of Electrical Utilization Equipment Together. The cable connectors on each end of the cable shall be listed for use in Class I, Division 2 locations and listed for the type of cable being used.
(b) Connecting Two Devices or Pieces of Electrical Utilization Equipment Together. A cable connector listed for Class I, Division 2 and listed for the type of cable being used shall be used on one end and a fitting listed for the type of protection and the type of cable being used shall be used on the other end.
(c) Connecting an Electrical Device or Utilization Equipment to Premises Wiring. The cable connectors used on both ends shall be listed for Class I, Division 2 locations and for the type of cable being used. On one end of the cable, the cable connector shall also be listed for the type of protection.

501.141(B)(3) Disconnection. Flexible cable shall be installed in accordance with **501.141(B)(3)(a)** through **(B)(3)(c)** to protect against the disconnection of the cable connectors when energized.

(a) Switch. A switch complying with the requirements of **501.105(B)(2)** shall be provided to disconnect power so that cable connectors are not depended on as a disconnecting means.

(b) Cable Connectors Mechanically or Electrically Interlocked. Switches shall not be required where the cable connectors are interlocked mechanically or electrically, or are otherwise designed to ensure the cable connectors cannot be separated when energized and cannot be energized when separated.

(c) Warning Label. The fixed equipment and the cable assembly shall both carry a label warning against plugging or unplugging when energized, with both labels as close to the cable connector termination as possible.

Section 501.141 added to address requirements for flexible cable installations in Class I, Division 2 locations.

501.145 Receptacles and Attachment Plugs, Class I, Division 1 and Division 2. Receptacles and attachment plugs shall be listed for the location, except as permitted by **501.105(B)(6)**.

501.145(A) Receptacles. Receptacles shall be part of the premises wiring, except as permitted by **501.140(A).**

501.145(B)(B) Attachment Plugs. Attachment plugs shall be of the type that provides connection to the equipment grounding conductor of a permitted flexible cord.

Permitted flexible cords are identified in Section 501.105(B)(6) for connections to process control equipment such as meters, instruments, and relays.

This section clarifies that the receptacle is part of the premises wiring and the plug is part of the utilization equipment.

Arcing at exposed contacts must be prevented in Class I, Division 1 or 2 locations. Accordingly, receptacles are designed so that plug contacts are safely within an explosionproof enclosure when they are electrically engaged, confining arcing, if any, to the receptacle interior. This is accomplished in two ways:

Receptacles with Switches. In the FSQX, FSQC, EBR, EBRH, U-Line™ and N1 and N2 receptacles, the plug cannot be inserted unless the switch is in the OFF position and cannot be withdrawn with the receptacle in the ON position. This means that arcing does not occur outside the enclosure because mated parts are dead during plug insertion and withdrawal.

Receptacles without Switches. CES/CESD receptacles rely on mechanical means (Delayed Action) rather than on switches to confine arcing to the receptacle interior during plug insertion and withdrawal. To operate, insert plug to first stop, move Slide-Lok™ slide to right and push plug fully forward. The construction design used in these receptacles prevents removal of the plug until any flame, spark or hot metal from an arc has cooled sufficiently to prevent ignition of the surrounding atmosphere.

501.150 Signaling, Alarm, Remote-Control, and Communications Systems.

501.150(A) Class I, Division 1. In Class I, Division 1 locations, all apparatus and equipment of signaling, alarm, remote-control, and communications systems, regardless of voltage, shall be identified for Class I, Division 1 locations, and all wiring shall comply with **501.10(A), 501.15(A),** and **501.15(C)**.

501.150(B) Class I, Division 2. In Class I, Division 2 locations, signaling, alarm, remote-control, and communications systems shall comply with **501.150(B)(1)** through **(B)(4)**.

501.150(B)(1) Contacts. Switches, circuit breakers, and make and-break contacts of pushbuttons, relays, alarm bells, and horns shall have enclosures identified for Class I, Division 1 locations in accordance with **501.105(A)**.

Exception: General-purpose enclosures shall be permitted if current interrupting contacts are one of the following:

(1) Immersed in oil

(2) Enclosed within a chamber hermetically sealed against the entrance of gases or vapors

(3) In nonincendive circuits

(4) Part of a listed nonincendive component

501.150(B)(2) Resistors and Similar Equipment. Resistors, resistance devices, thermionic tubes, rectifiers, and similar equipment shall comply with **501.105(B)(3)**.

501.150(B)(3) Protectors. Enclosures shall be provided for lightning protective devices and for fuses. Such enclosures shall be permitted to be of the general-purpose type.

501.150(B)(4)Wiring and Sealing. All wiring shall comply with **501.10(B), 501.15(B),** and **501.15(C).**

CHANGES TO ARTICLE 502 – CLASS II LOCATIONS

The following Article 502 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 502.10: Wiring Methods. Informational Note
- 502.10(B)(1): Wiring methods. Class II, Division 2. General
- 502.30: Grounding and Bonding

ARTICLE 502 Class II Locations

Part I. General

502.1 Scope. This article covers the requirements for electrical and electronic equipment and wiring for all voltages in Class II, Division 1 and 2 locations where fire or explosion hazards may exist due to combustible dust.

502.5 Explosionproof Equipment. Explosionproof equipment and wiring shall not be required and shall not be acceptable in Class II locations unless also identified for such locations.

In Class II, Division 1 locations where dust from magnesium, aluminum, aluminum bronze powders, or other metals of similarly hazardous characteristics may be present, no transformers or capacitors shall be installed. The general rules in chapters one through four apply to the electronic wiring and equipment in locations classified as Class II in 500.5(C) unless modified by Article 502.

502.6 Zone Equipment. Equipment listed and marked in accordance with **506.9(C)(2)** for Zone 20 locations shall be permitted in Class II, Division 1 locations for the same dust atmosphere; and with a suitable temperature class.

Equipment listed and marked in accordance with **506.9(C)(2)** for Zone 20, 21, or 22 locations shall be permitted in Class II, Division 2 locations for the same dust atmosphere and with a suitable temperature class.

Part II. Wiring

502.10 Wiring Methods. Wiring methods shall comply with **502.10(A)** or **(B)**.

Informational Note: See Article 100 for the definition of restricted industrial establishment [as applied to hazardous (classified) locations].

This is not a technical revision. It simply reduces the terminology previously used in the section rules.

502.10(A) Class II, Division 1.

502.10(A)(1) General. In Class II, Division 1 locations, the following wiring methods shall be permitted:

(1) Threaded rigid metal conduit (RMC) or threaded intermediate metal conduit (IMC), including conduit systems with supplemental corrosion protection coatings.

(2) Type MI cable with termination fittings listed for the location. Type MI cable shall be installed and supported in a manner to avoid tensile stress at the termination fittings.

(3) In restricted industrial establishments Type MC-HL cable, listed for use in Class II, Division 1 locations, with a gas/vaportight continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, a separate equipment grounding conductor(s) in accordance with 250.122, and provided with termination fittings listed for the location, shall be permitted.

(4) Optical fiber cable Type OFNP, Type OFCP, Type OFNR, Type OFCR, Type OFNG, Type OFCG, Type OFN, or Type OFC shall be permitted to be installed in raceways in accordance with 502.10(A). Optical fiber cables shall be sealed in accordance with **502.15**.

These types of cables are permitted to be installed in a raceway in a Class II, Division 1 location and correlates with the permitted uses found in 770.3(A). They are required to be sealed in accordance with 502.15.

(5) In restricted industrial establishments listed Type ITC-HL cable with a gas/vaportight continuous corrugated metallic sheath and an overall jacket of suitable polymeric material, and terminated with fittings listed for the application, and installed in accordance with **727.4**.

(6) In restricted industrial establishments for applications limited to 600 volts nominal or less, and where the cable is not subject to physical damage, and terminated with fittings listed for the location, listed Type TC-ER-HL cable. When installed in ladder, ventilated trough, or ventilated channel cable trays, cables shall be installed in a single layer, with a space not less than the larger cable diameter between the two adjacent cables, unless otherwise protected against dust buildup resulting in increased heat, Type TC-ER-HL cable shall be installed in accordance with **336.10**.

Informational Note No. 1: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for construction, testing, and marking of cables and cable fittings.

Type TC-ER-HL cable is a permissible Class II, Division 1 general wiring method where the various conditions of an industrial establishment exists and where limited to 600 volts or less. Spacing requirements are included to avoid buildup of dust and increased heat in the cables.

The construction requirements for Type TC-ER-HL cable are located in Article 336.

PXSS2K-REX IS APPROVED FOR USE WITH TYPE TC-ER-HL CABLE

(8) In restricted industrial establishments listed Type P cable with metal braid armor, with an overall jacket, that is terminated with fittings listed for the location and installed in accordance with **337.10**. When installed in ladder, ventilated trough, or ventilated channel cable trays, cables shall be installed in a single layer, with a space not less than the larger cable diameter between the two adjacent cables, unless otherwise protected against dust buildup resulting in increased heat.

Informational Note No. 2: See ANSI/UL 1309,Marine Shipboard Cable, for information on construction, testing, and marking of Type P cable.

Informational Note No. 3: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cable fittings.

Type P cable is a permissible Class II, Division 1 general wiring method where the cable employs a metal armor braid and an overall polymeric jacket. Type P cable having metal braid armor has been permitted in Class II, Division 1 locations offshore for several decades. Spacing requirements are included to avoid the buildup of dust and increased heat in the cables.

PX2K-REX IS APPROVED FOR USE WITH TYPE P CABLE

502.10(A)(2) Flexible Connections. Where flexible connections are necessary, one or more of the following shall also be permitted:

(1) Dusttight flexible connectors.

(2) Liquidtight flexible metal conduit (LFMC) with listed fittings and bonded in accordance with **502.30(B)**.

(3) Liquidtight flexible nonmetallic conduit (LFNC) with listed fittings.

In Class II, Division 1 locations, liquidtight flexible nonmetallic conduit with listed fittings, may be used where flexible connections are necessary. The same permission also applies to Class III locations in 503.10(A)(3).

Appleton™ offers the EXGJH or EXLK Flexible Coupling and the ST™ Liquid Tight Connector (for use with liquidtight flexible metal conduit). Flexible cords used with the Appleton™ CG and factory sealed ECC Cord Connectors must be an S or SO type and comply with all the provisions of 502.140.

(4) Interlocked armor Type MC cable having an overall jacket of suitable polymeric material and provided with termination fittings listed for Class II, Division 1 locations.

(5) Flexible cord listed for extra-hard usage and terminated with listed dusttight cord connectors. Where used, flexible cords shall comply with **502.140**.

Flexible cord is required to be terminated with listed cord connectors. A cord connector is a type of fitting. This only means the cord connectors are to be listed for use with the specific cord. It does mean that the fitting must be listed "for the location".

Where the flexible connections are subject to oil or other corrosive conditions, the insulation of the conductors shall be a type listed for the condition or shall be protected with a suitable sheath [see 502.30(B) for grounding requirements].

(6) For elevator use, an identified elevator cable of Type EO, Type ETP, or Type ETT, shown under the "use" column in **Table 400.4** for "hazardous (classified) locations" and terminated with listed dusttight fittings.

Informational Note: See 502.30(B) for grounding requirements where flexible conduit is used.

Elevator cables are permitted to be used where flexibility is necessary. The cable shall be identified as Types EO, ETP, or ETT. The fittings used to terminate these cables shall be listed for use with these cable identifications and also maintain a dusttight joint.

(7) In restricted industrial establishments for applications limited to 600 volts nominal or less, and where the cable is not subject to physical damage, and is terminated with fittings listed for the location, listed Type TC-ER-HL cable. Type TC-ER-HL cable shall be installed in accordance with **336.10**.

Informational Note No. 1: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for construction, testing, and marking of cables and cable fittings.

This revision adds Type TC-ER-HL cable as a flexible connection method. In addition to being a permissible general wiring method for Class II, Division 1 it has also been added here as a permissible wiring method where flexible connections are necessary.

(8) In restricted industrial establishments listed Type P cable with metal braid armor, with an overall jacket, terminated with fittings listed for the location, and installed in accordance with **337.10**.

WIRING METHODS CLASS II, DIVISION 1 AND 2 GROUPS E, F AND G.

BOXES

GRU **GRSS** **GRX** **GRJS** **CPU**

FITTINGS

UNY **EXGJH/EXLK** **TMC2**

CG **ST™**

Informational Note No. 2: See UL 1309A,Outline of Investigation for Cable for Use in Mobile Installations, for information on construction, testing, and marking of Type P cable.

Informational Note No. 3: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cable fittings.

This revision adds Type P cable, having metal braid armor, as a flexible wiring method in Class II Division 1 locations. Type P cables having metal braid armor has been permitted in Class II Division 1 locations offshore for several decades.

502.10(A)(3) Boxes and Fittings. Boxes and fittings shall be provided with threaded bosses for connection to conduit or cable terminations and shall be dusttight. Boxes and fittings in which taps, joints, or terminal connections are made, or that are used in Group E locations, shall be identified for Class II locations.

Informational Note: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cables, dust-ignitionproof cable fittings, and dust-ignitionproof cord connectors for entry into enclosures required to be dust-ignitionproof.

All boxes and fittings shall be dusttight. Boxes, however, are required to be identified for Class II locations where they contain taps, joints, or terminal connections or where used in Group E locations. Note: Fittings are not permitted to contain splices or taps.

Where a box contains heat-producing devices then the box is required to be identified as Class II, Division 1 (Dust-Ignitionproof) and contain a temperature classification in accordance with 500.8(D)(2).

502.10(B) Class II, Division 2. Wiring methods installed in Class II, Division 2 locations shall be in accordance with **502.10(B)(1)**through **(B)(4).**

502.10(B)(1) General. In Class II, Division 2 locations, the following wiring methods shall be permitted:

(1) All wiring methods permitted in **502.10(A)**.

In Class II, Division 2 locations all of the wiring methods acceptable for Class II, Division 1 may be used. It is important to note that threaded conduit is not required. (RMC) Rigid Metal Conduit and (IMC) Intermediate Metal Conduit may be used with threadless fittings. Also acceptable in Division 2 applications are (EMT) Electrical Metallic Tubing, Dusttight Wireways, Type MC or MI cable with listed termination fittings, Type PLTC in cable trays, Type ITC in cable trays and Type MC, MI, or TC cable installed in ladder, ventilated trough, or ventilated channel cable trays in a single layer, with a space not less than the larger cable diameter between the two adjacent cables.

(2) Rigid metal conduit (RMC)or intermediate metal conduit (IMC) with listed threaded or threadless fittings, including conduit systems with supplemental corrosion protection coatings.

(3) Dusttight wireways or electrical metallic tubing (EMT) with listed compression-type connectors or listed compression-type couplings.

EMT with listed compression-type fittings are recognized as meeting the dusttight requirement.

(4) Type MC, Type MV, Type TC, or Type TC-ER cable, including installation in cable tray systems. Type TC-ER cable shall include an equipment grounding conductor in addition to a drain wire that might be present. The cable shall be terminated with listed fittings.

(5) Type PLTC cable or Type PLTC-ER cable used in Class 2 or Class 3 circuits, including installation in cable tray systems. The cable shall be terminated with listed fittings. Type PLTC-ER cable shall include an equipment grounding conductor in addition to a drain wire that might be present.

PLTC-ER and ITC-ER cables are permitted in Class II, Division 2 locations. The cable must be terminated with fittings that are listed for the type of cable. These fittings are not required to be listed “for the location”, in this case Class II, Division 2.

(6) Type ITC cable or Type ITC-ER cable as permitted in **335.4** and terminated with listed fittings. Type ITC-ER cable shall include an equipment grounding conductor in addition to a drain wire.

(7) In restricted industrial establishments where wiring methods in **502.10(B)(1)(1)(2)** will not provide the corrosion resistance required for the installation environment, either of the following:

a. Listed reinforced thermosetting resin conduit (RTRC), factory elbows, and associated fittings, all marked with suffix -XW

b. Schedule 80 PVC conduit, factory elbows, and associated fittings

Where the corrosion resistance of metal conduit is not sufficient, the use of RTRC-XW, PVC coated RMC and IMC are permissible. Schedule 80 PVC is permissible in industrial locations only.

(8) Optical fiber cable Type OFNP, Type OFCP, Type OFNR, Type OFCR, Type OFNG, Type OFCG, Type OFN or Type OFC shall be permitted to be installed in cable trays or any other raceway in accordance with 502.10(B). Optical fiber cables shall be sealed in accordance with **502.15**.

This section permits these types of cables to be installed in cable trays or any other raceway in a Class II, Division 2 location and correlates with the permitted uses found in 770.3(A). They are required to be sealed in accordance with 502.15.

(9) Cablebus.

Cable bus is a permissible wiring method in Class II, Division 2 locations since Cable Tray is permitted.

(10) In restricted industrial establishments, listed Type P cable with or without metal braid armor, with an overall jacket, that is terminated with listed fittings, and installed in accordance with 337.10.

Informational Note: See UL 1309A,Outline of Investigation for Cable for Use in Mobile Installations, for information on construction, testing, and marking of Type P cable.

Type P cable with or without metal braid armor has been added as a general wiring method in Class II, Division 2 locations. Type P cable has been permitted in Class II, Division 2 locations offshore for several decades. Dusttight fittings are to be considered adequate for Class II, Division 2 locations.

502.10 (B)(2) Flexible Connections. If flexibility is necessary, **502.10(A)(2)** shall apply.

Where flexibility is necessary only those wiring methods permitted for Class II, Division 1 in 502.10(A)(2) can be used. The prevalent requirement for these types of raceways and cable systems is to prevent the ingress of dust into the electrical systems.

502.10 (B)(3) Nonincendive Field Wiring. Nonincendive field wiring shall be permitted using any of the wiring methods permitted for unclassified locations. Nonincendive field wiring systems shall be installed in accordance with the control drawing(s). Simple apparatus, not shown on the control drawing, shall be permitted in a nonincendive field wiring circuit, provided the simple apparatus does not interconnect the nonincendive field wiring circuit to any other circuit.

Informational Note: See Article 100 for the definition of simple apparatus.

CLASS II, DIVISION 1 AND 2, GROUP G GRAIN ELEVATOR.

ELIMINATING DISASTERS LIKE THIS REQUIRES CAREFUL CLASSIFICATION OF AREAS AND THE USE OF THE PROPER ELECTRICAL EQUIPMENT.

Separate nonincendive field wiring circuits shall be installed in accordance with one of the following:

(1) In separate cables

(2) In multiconductor cables where the conductors of each circuit are within a grounded metal shield

(3) In multiconductor cables or in raceways where the conductors of each circuit have insulation with a minimum thickness of 0.25 mm (0.01 in)

Nonincendive field wiring is permitted using any of the wiring methods permitted for unclassified locations, however the nonincendive system must be installed in accordance with the control drawing(s). "Simple apparatus", not shown on the control drawing, is permitted in a nonincendive field wiring circuit, provided the simple apparatus does not interconnect the nonincendive field wiring circuit to any other circuit. See Article 100 for the definition of "Simple Apparatus". Separate nonincendive field wiring circuits shall be in separate cables, in multiconductor cables where the conductors of each circuit are within a grounded metal shield, or in multiconductor cables where the conductors of each circuit have insulation with a minimum thickness of 0.25 mm (0.01 in).

502.10 (B)(4) Boxes and Fittings. All boxes and fittings shall be dusttight.

These boxes and fittings are not required to be "listed" as dusttight. For guidance on dusttight ratings see NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum) – permits a rating of "dusttight" for products that are rated NEMA Types 3, 3X, 3S, 3SX, 4, 4X, 5, 6, 6P, 12, 12K, or 13.

Types 4, 4X, 6, and 6P were added as Types that are considered to comply as being "dusttight" as the performance requirements for these Types are considered to be more onerous than the other tests to determine "dusttight".

502.15 Sealing, Class II, Divisions 1 and 2. Where a raceway provides communication between an enclosure that is required to be dust-ignitionproof and one that is not, suitable means shall be provided to prevent the entrance of dust into the dust-ignitionproof enclosure through the raceway. One of the following means shall be permitted:

(1) A permanent and effective seal

(2) A horizontal raceway not less than 3.05 m (10 ft) long

(3) A vertical raceway not less than 1.5 m (5 ft) long and extending downward from the dust-ignitionproof enclosure

(4) A raceway installed in a manner equivalent to **502.15(2)** or **(3)** that extends only horizontally and downward from the dust-ignition proof enclosures

If a raceway provides communication between an enclosure that is required to be dust-ignitionproof and an enclosure in an unclassified location, seals shall not be required.

Sealing fittings shall be accessible and shall not be required to be explosionproof.

Dust-ignitionproof enclosures are designed to keep dust out and thus not permit an internal dust explosion to occur. They are not designed to withstand internal dust explosions. The intent of the Article is to prevent dust from entering the dust-ignitionproof enclosure through the raceway. Fig. 1 (below) illustrates the three different methods permitted to prevent combustible dust from entering the dust-ignitionproof enclosure through the raceway.

In Class II, Division 2 locations, the enclosures must be dusttight, which means that they must be, in accordance with the definition in Article 100, "so constructed that dust will not enter the enclosing case under specified test conditions."

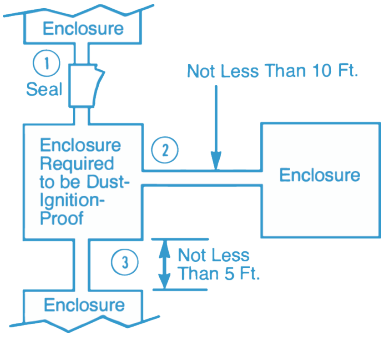


FIG. 1

The second paragraph of Section 502.15 addresses the situation where the enclosure that is not dust-ignitionproof is located in an unclassified area. In this case, no seal is required and the raceway can be any length. The reason for this is that dust cannot be transmitted through the raceway from the enclosure in the unclassified area, because, by definition, an unclassified area contains no combustible dust. Fig. 2 provides an example:

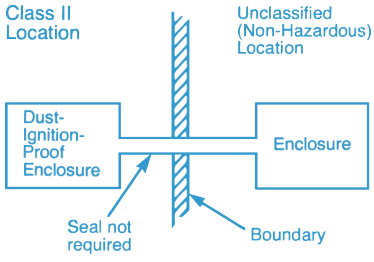


FIG. 2

NOTE: For illustrations of sealing fittings and for information on damming and pouring of sealing cement, see "Selection of Seal" commentary located in 501.15 (E) (3). of this Code Review. Note: Section 502.15 specifies that "Seals shall not be required to be explosionproof."

502.25 Uninsulated Exposed Parts, Class II, Divisions 1 and 2. There shall be no uninsulated exposed parts, such as electrical conductors, buses, terminals, or components, that operate at more than 30 volts (15 volts in wet locations). These parts shall additionally be protected by a protection technique according to **500.7(E)**, **(F)**, or **(G)** that is suitable for the location.

502.30 Grounding and Bonding, Class II, Divisions 1 and 2. Regardless of the voltage of the electrical system, wiring systems and equipment shall comply with **502.30(A)** and **(B)**.

502.30(A) Grounding. Wiring systems and equipment shall be grounded in accordance with Part I and Part VI of Article **250**, as applicable.

502.30(B) Bonding. Bonding shall comply with Part I and Part V of Article **250**, as applicable, and **502.30(B)(1)** and **(B)(2)**.

(1) Specific Bonding Means. Bonding shall comply with **502.30(B)(1)(a)** and **(B)(1)(b)**.

(a) The locknut-bushing and double-locknut types of contacts shall not be depended on for bonding purposes, but bonding jumpers with identified fittings or other approved means of bonding shall be used. These bonding means shall apply to all metal raceways, fittings, boxes, cable trays, and enclosures, and other parts of raceway systems between hazardous (classified) locations and the point of grounding for service equipment or point of grounding for a separately derived system. Metal struts, angles, or channels provided for support and mechanical or physical protection as permitted in **335.4(5)**, **336.10(7)(c)**, or **722.135(C)** shall be bonded in accordance with 250.102.

(b) Where the branch-circuit overcurrent protection is located on the load side of the disconnecting means, the specific bonding means shall be permitted to end at the nearest point where the grounded circuit conductor and the grounding electrode conductor are connected together on the line side of the building or structure disconnecting means as specified in **250.32(B)**.

(2) Liquidtight Flexible Metal Conduit. Liquidtight flexible metal conduit shall comply with **502.30(B)(2)(a)** and **(B)(2)(b)**.

(a) Liquidtight flexible metal conduit shall include an equipment bonding jumper of the wire type in accordance with **250.102**.

(b) In Class II, Division 2 locations, the bonding jumper shall not be required where all of the following conditions are met:

(1) Listed liquidtight flexible metal conduit 1.8 m (6 ft) or less in length, with fittings listed for grounding, is used.

(2) Overcurrent protection in the circuit is limited to 10 amperes or less.

(3) The load is part of a meter, instrument, or relay circuit.

Section revised to separate the requirements for Grounding from those for Bonding. The requirements for Grounding remain referenced to the general requirements of Article 250. The requirements for Bonding in a Hazardous (Classified) Location are more stringent than those in the general article 250 and therefore are presented here.

It is important to note that all the grounding and bonding requirements of Article 250 apply. In addition, the grounding and bonding requirements contained in 502.30(A) and (B) apply to wiring and equipment in Class II, Divisions 1 and 2 locations.

These specific bonding means must be used to bond all raceways, fittings, boxes or enclosures back to the service or separately derived system in accordance with 250.30 supplying grounded circuit conductor. Locknut-bushing and double-locknut types of contact shall not be depended on for bonding purposes, but bonding jumpers with proper fittings or other approved means of bonding shall be used. 250.100 contains additional bonding requirements in hazardous (classified) locations.

Where liquidtight flexible conduit is used as permitted in 502.10, an internal or external bonding jumper shall be installed in parallel with each conduit and complying with 250.102. In Class II, Division 2 locations, the bonding jumper may be deleted provided (1) listed liquidtight flexible metal conduit 1.8 m (6 ft) or less in length, with fittings listed for grounding, is used; (2) overcurrent protection in the circuit is limited to 10 amperes or less; and (3) the load is not a power utilization load.

502.35 Surge Protection — Class II, Divisions 1 and 2. Surge arresters and surge-protective devices installed in a Class II, Division 1 location shall be in suitable enclosures. Surge-protective capacitors shall be of a type designed for specific duty.

Part III. Equipment

502.100 Transformers and Capacitors.

502.100(A) Class II, Division 1. In Class II, Division 1 locations, transformers and capacitors shall comply with **502.100(A)(1)** through **(A)(3)**.

502.100(A)(1) Containing Liquid That Will Burn. Transformers and capacitors containing a liquid that will burn shall be installed only in vaults complying with **450.41** through **450.48**, and, in addition, (1), (2), and (3) shall apply.

(1) Doors or other openings communicating with the Division 1 location shall have self-closing fire doors on both sides of the wall, and the doors shall be carefully fitted and provided with suitable seals (such as weather stripping) to minimize the entrance of dust into the vault.

(2) Vent openings and ducts shall communicate only with the outside air.

(3) Suitable pressure-relief openings communicating with the outside air shall be provided.

502.100(A)(2) Not Containing Liquid That Will Burn. Transformers and capacitors that do not contain a liquid that will burn shall be installed in vaults complying with **450.41** through **450.48** or be identified as a complete assembly, including terminal connections.

502.100(A)(3) Group E. No transformer or capacitor shall be installed in a Class II, Division 1, Group E location.

502.100(B) Class II, Division 2. In Class II, Division 2 locations, transformers and capacitors shall comply with **502.100(B)(1)** through **(B)(3)**.

502.100(B)(1) Containing Liquid That Will Burn. Transformers and capacitors containing a liquid that will burn shall be installed in vaults that comply with **450.41** through **450.48**.

502.100(B)(2) Containing Askarel. Transformers containing askarel and rated in excess of 25 kVA shall be as follows:

(1) Provided with pressure-relief vents

(2) Provided with a means for absorbing any gases generated by arcing inside the case, or the pressure-relief vents shall be connected to a chimney or flue that will carry such gases outside the building

(3) Have an airspace of not less than 150 mm (6 in) between the transformer cases and any adjacent combustible material

502.100(B)(3) Dry-Type Transformers. Dry-type transformers shall be installed in vaults or shall have their windings and terminal connections enclosed in tight metal housings without ventilating or other openings and shall operate at not over 600 volts, nominal.

In Class II, Division 2 locations transformers and capacitors containing a liquid that will burn shall be installed in vaults that comply with 450.41 through 450.48. Transformers containing askarel and rated in excess of 25 kVA shall have an airspace of not less than 150 mm (6 in) between the transformer cases and any adjacent combustible material and pressure-relief vents connected to a chimney or flue that will carry such gases outside the building or a means for absorbing any gases generated by arcing inside the case. Dry-type transformers shall operate at not over 600 volts, nominal and be installed in vaults or have their windings and terminal connections enclosed in tight metal housings without ventilating or other openings.

502.115 Switches, Circuit Breakers, Motor Controllers, and Fuses.

502.115(A) Class II, Division 1. In Class II, Division 1 locations, switches, circuit breakers, motor controllers, fuses, push-buttons, relays, and similar devices shall be provided with enclosures identified for the location.

Enclosures are required to be identified for the location for Class II, Division 1, Groups E, F, and G. See Article 100 for the definition of identified.

Note: It is not necessary for a Class II enclosure with the enclosed equipment to be evaluated as a complete assembly. Class II enclosures are evaluated for their ability to prevent the entrance of dusts. This differs from Class I enclosures, which are evaluated on their ability to withstand an explosion.

GUBBM INSTRUMENT ENCLOSURES

502.115(B) Class II, Division 2. In Class II, Division 2 locations, enclosures for fuses, switches, circuit breakers, and motor controllers, including push buttons, relays, and similar devices, shall be dusttight or otherwise identified for the location.

Enclosures are required to be identified for the location or be dusttight.

In Class II, Division 2 locations switching mechanisms (including overcurrent devices) associated with control transformers, solenoids, impedance coils, and resistors shall be installed in dusttight enclosures.

The enclosure must be identified for the location regardless of the dust that is present.

APPN POWER PANEL FOR CLASS I AND CLASS II APPLICATIONS

ACSEW CUSTOM CAST CONTROL CENTER FOR CLASS I AND CLASS II APPLICATIONS

502.120 Control Transformers and Resistors.

502.120(A) Class II, Division 1. In Class II, Division 1 locations, control transformers, solenoids, impedance coils, resistors, and any overcurrent devices or switching mechanisms associated with them shall be provided with enclosures identified for the location.

502.120(B) Class II, Division 2. In Class II, Division 2 locations, transformers and resistors shall comply with **502.120(B)(1)** through **(B)(3)**.

502.120(B)(1) Switching Mechanisms. Switching mechanisms (including overcurrent devices) associated with control transformers, solenoids, impedance coils, and resistors shall be provided with enclosures that are dusttight or otherwise identified for the location.

Enclosures are required to be identified for the location or be dusttight.

502.120(B)(2) Coils and Windings. Where not located in the same enclosure with switching mechanisms, control transformers, solenoids, and impedance coils shall be provided with enclosures that are dusttight or otherwise identified for the location.

502.120(B)(3) Resistors. Resistors and resistance devices shall have dust-ignitionproof enclosures that are dusttight or otherwise identified for the location.

Resistors are required to be installed in enclosures that are identified for Class II, Division 1.

502.125 Motors and Generators.

502.125(A) Class II, Division 1. In Class II, Division 1 locations, motors, generators, and other rotating electrical machinery shall be in conformance with either of the following:

(1) Identified for the location

(2) Totally enclosed pipe-ventilated

All motors, generators, and other rotating electrical machinery installed in a Class II, Division 1 location shall be identified for Class II, Division 1 locations, or be totally enclosed pipe-ventilated to ensure they have been evaluated for their function to prevent the entrance of dust and to prevent arc and sparks from escaping that could result in the ignition of the surrounding dust atmosphere.

502.125(B) Class II, Division 2. In Class II, Division 2 locations, motors, generators, and other rotating electrical equipment shall be totally enclosed nonventilated, totally enclosed pipeventilated, totally enclosed water-air-cooled, totally enclosed fan-cooled, or dust-ignitionproof, for which maximum full-load external temperature shall be in accordance with **500.8(D)(2)** for normal operation when operating in free air (not dust blanketed) and shall have no external openings.

Exception: If the authority having jurisdiction believes accumulations of nonconductive, nonabrasive dust will be moderate and if machines can be easily reached for routine cleaning and maintenance, the following shall be permitted to be installed:

(1) Standard open-type machines without sliding contacts, centrifugal or other types of switching mechanism (including motor overcurrent, overloading, and overtemperature devices), or integral resistance devices

STARTERS ONLY

Both Magnetic and Manual Motor Starters provide across-the-line starting of polyphase AC induction motors, plus overload protection for motors and equipment. Starters are furnished with 3-pole block type overload relay; other types available on special order.

ACSE CLASS I, DIVISION 1 & 2 MANUAL MOTOR STARTER

AEB MOTOR STARTER

BREAKERS ONLY

Thermal magnetic circuit breakers provide overcurrent and short circuit protection, plus safe disconnect. Thermal time delay offers overload protection for service entrance, feeder, or branch circuits used for lighting, heating, motors and equipment.

AE CIRCUIT BREAKER

(2) Standard open-type machines with such contacts, switching mechanisms, or resistance devices enclosed within dusttight housings without ventilating or other openings

(3) Self-cleaning textile motors of the squirrel-cage type

(4) Machines with sealed bearings, bearing isolators, and seals

All motors, generators, and other rotating electrical machinery installed in a Class II, Division 2 location must be totally enclosed nonventilated, totally enclosed, pipe-ventilated, totally enclosed water-air-cooled, totally enclosed fan-cooled or dust-ignitionproof with no external openings. If the authority having jurisdiction (AHJ) believes accumulations of nonconductive, nonabrasive dust will be moderate and if machines can be easily reached for routine cleaning and maintenance the AHJ may permit standard open-type machines without sliding contacts, centrifugal or other types of switching mechanism (including motor overcurrent, overloading, and overtemperature devices), or integral resistance devices or standard open type machines with such contacts, switching mechanisms, or resistance devices enclosed within dusttight housing ventilation or other openings or self-cleaning textile motors of the squirrel-cage type.

Motors that employ sealed bearings, bearing isolators, and seals in a Class II, Division 2 should not be considered as having unused external openings.

502.128 Ventilating Piping. Ventilating pipes for motors, generators, or other rotating electrical machinery, or for enclosures for electrical equipment, shall be of metal not less than 0.53 mm (0.021 in) in thickness or of equally substantial noncombustible material and shall comply with all of the following:

(1) Lead directly to a source of clean air outside of buildings

(2) Be screened at the outer ends to prevent the entrance of small animals or birds

(3) Be protected against physical damage and against rusting or other corrosive influences

Ventilating pipes shall also comply with **502.128(A)** and **(B)**.

502.128(A) Class II, Division 1. In Class II, Division 1 locations, ventilating pipes, including their connections to motors or to the dust-ignitionproof enclosures for other equipment, shall be dusttight throughout their length. For metal pipes, seams and joints shall comply with one of the following:

(1) Be riveted and soldered

(2) Be bolted and soldered

(3) Be welded

(4) Be rendered dusttight by some other equally effective means

502.128(B) Class II, Division 2. In Class II, Division 2 locations, ventilating pipes and their connections shall be sufficiently tight to prevent the entrance of appreciable quantities of dust into the ventilated equipment or enclosure and to prevent the escape of sparks, flame, or burning material that might ignite dust accumulations or combustible material in the vicinity. For metal pipes, lock seams and riveted or welded joints shall be permitted; and tight-fitting slip joints shall be permitted where some flexibility is necessary, as at connections to motors.

All ventilating piping from electrical equipment such as enclosures, motors and generators are required to be manufactured from 0.021 metal (0.53 mm) or equal. The piping must comply with 502.128(A) for Class II, Division 1 and 501.128(B) for Class II, Division 2.

502.130 Luminaires.

502.130(A) Class II, Division 1. In Class II, Division 1 locations, luminaires for fixed and portable lighting shall comply with **502.130(A)(1)** through **(A)(4)**.

502.130(A)(1) Marking. Each luminaire shall be identified for the location and shall be clearly marked to indicate the type and maximum wattage of the lamp for which it is designed.

For HID luminaires the *Code* requires that the maximum wattage of the lamp required to be marked on the luminaire. There are several other marking requirements for listed luminaires. See the ANSI listing standard ANSI/UL 844, Standard for Luminaires for Use in Hazardous (Classified) Locations for the additional marking requirements.

The listing standard, UL 844 only requires the lamp type and maximum wattage markings for incandescent or HID luminaires.

502.130(A)(2) Physical Damage. Each luminaire shall be protected against physical damage by a suitable guard or by location.

502.130(A)(3) Pendant Luminaires. Pendant luminaires shall be suspended by threaded rigid metal conduit stems, by threaded steel intermediate metal conduit stems, by chains with approved fittings, or by other approved means. For rigid stems longer than 300 mm (12 in), permanent and effective bracing against lateral displacement shall be provided at a level not more than 300 mm (12 in) above the lower end of the stem, or flexibility in the form of a fitting or a flexible connector listed for the location shall be provided not more than 300 mm (12 in) from the point of attachment to the supporting box or fitting. Threaded joints shall be provided with set screws or other effective means to prevent loosening. Where wiring between an outlet box or fitting and a pendant luminaire is not enclosed in conduit, flexible cord listed for hard usage shall be permitted to be used in accordance with **502.10(A)(2)(5)**. Flexible cord shall not serve as the supporting means for a luminaire.

502.130(A)(4) Supports. Boxes, box assemblies, or fittings used for the support of luminaires shall be identified for Class II locations.

502.130(B) Class II, Division 2. In Class II, Division 2 locations, luminaires shall comply with **502.130(B)(1)** through **(B)(5)**.

502.130 (B)(1) Portable Lighting Equipment. Portable lighting equipment shall be identified for the location. They shall be clearly marked to indicate the maximum wattage of lamps for which they are designed.

502.130(B)(2) Fixed Lighting. Luminaires for fixed lighting shall be provided with enclosures that are dusttight or otherwise identified for the location. Each luminaire shall be clearly marked to indicate the maximum wattage of the lamp that shall be permitted without exceeding an exposed surface temperature in accordance with **500.8(D)(2)** under normal conditions of use.

This section requires a rating of "dusttight" for the fixed lighting enclosure (ballast tank). Older editions of the *Code* described the intent of minimizing the deposits of dust onto the lamp and lamp holder. It is important to note that this objective rule is now imposed on the requirements for coils and windings and contacts.

502.130(B)(3) Physical Damage. Luminaires for fixed lighting shall be protected from physical damage by suitable guards or by location.

502.130(B)(4) Pendant Luminaires. Pendant luminaires shall be suspended by threaded rigid metal conduit stems, by threaded steel intermediate metal conduit stems, by chains with approved fittings, or by other approved means. For rigid stems longer than 300 mm (12 in), permanent and effective bracing against lateral displacement shall be provided at a level not more than 300 mm (12 in) above the lower end of the stem, or flexibility in the form of an identified fitting or a flexible connector shall be provided not more than 300 mm (12 in) from the point of attachment to the supporting box or fitting. Where wiring between an outlet box or fitting and a pendant luminaire is not enclosed in conduit, flexible cord listed for hard usage shall be permitted if terminated with a listed cord connector that maintains the protection technique.

Flexible cord shall not serve as the supporting means for a luminaire.

This section requires the cord connector to be listed for use with hard usage cord.

502.130(B)(5) Electric-Discharge Lamps. Starting and control equipment for electric-discharge lamps shall comply with the requirements of **502.120(B)**.

In Class II locations each luminaire must be identified and marked with the maximum size lamp permitted in watts, or designed to minimize the deposit of dust on lamps and to prevent the escape of sparks, burning material, or hot metal. Electric-discharge lamps and starting and control equipment for electric-discharge lamps must comply with 502.120(B) and must be marked and identified for the specific location where dust from magnesium, aluminum, aluminum bronze powders, or other metals of similarly hazardous characteristics may be present. All boxes, box assemblies, or fittings used to support luminaires are required to be identified for Class II locations.

SHOWN BELOW ARE JUST A FEW OF THE MANY LUMINAIRES DESIGNED WITH FLOWING VERTICAL LINES TO MINIMIZE DEPOSITS OF DUST. ALL LUMINAIRES ARE DUST-IGNITIONPROOF, MEETING THE REQUIREMENTS OF SECTION 502.130(A)(1). THE LUMINAIRES ALSO COMPLY WITH THIS ARTICLE IN REGARD TO PROVIDING NAMEPLATES THAT SPECIFY MAXIMUM WATTAGE FOR WHICH THE LUMINAIRES ARE APPROVED. APPROVALS FOR CLASS II ARE BASED ON THE ASSUMPTION THAT THE LUMINAIRES WILL BE MOUNTED IN A VERTICAL POSITION.

CODE•MASTER™ LED

CODE•MASTER™ JR. LED

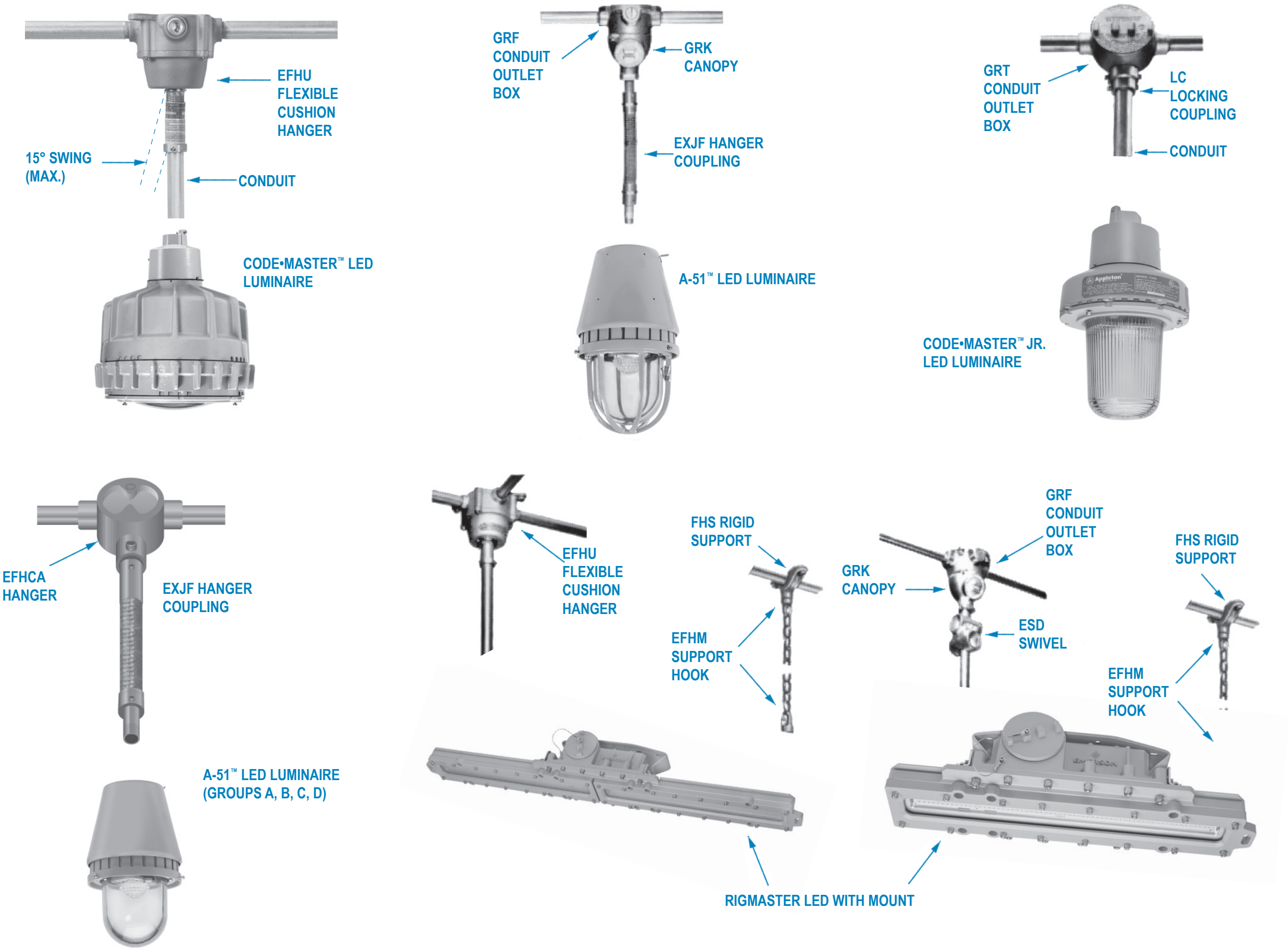
A-51™ LED

MERCMASTER™ LED LOW PROFILE

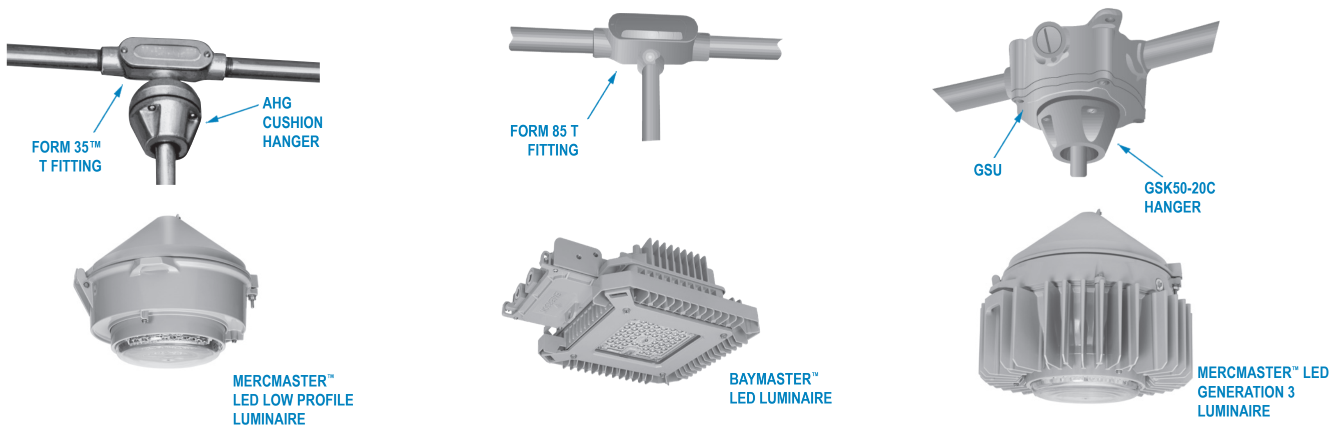
MERCMASTER™ LED GENERATION 3

FNLED

TYPICAL FIXTURE HANGER INSTALLATIONS — CLASS I AND II, DIVISION 1 ①



TYPICAL FIXTURE HANGER INSTALLATIONS — CLASS I, DIVISION 2



① *Fixtures using stems longer than 12" must have flexible fitting.*

Note: The minimum ignition temperatures of specific dusts are contained in NFPA® 499 (Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas).

There are several other marking requirements for listed luminaires. See the ANSI listing standard ANSI/UL 844, Standard for Luminaires for Use in Hazardous (Classified) Locations for the additional marking requirements.

502.135 Utilization Equipment.

502.135(A) Class II, Division 1. In Class II, Division 1 locations, all utilization equipment shall be identified for the location.

In Class II, Division 1 locations, utilization equipment must be identified for Class II locations and where dust from magnesium, aluminum, aluminum bronze powders, or other metals of similarly hazardous characteristics may be present, such equipment shall be identified for the specific location.

502.135(B) Class II, Division 2. In Class II, Division 2 locations, all utilization equipment shall comply with **502.135(B)(1)** through **(B)(4)**.

502.135(B)(1) Heaters. Electrically heated utilization equipment shall be identified for the location.

Exception: Metal-enclosed radiant heating panel equipment shall be permitted to be dusttight and marked in accordance with 500.8(C).

In Class II, Division 2 locations, electrically heated utilization equipment must be identified for a Class II location except for Metal-enclosed radiant heating panel equipment which is permitted to be dusttight where it is marked in accordance with 500.8(C).

Note: Table 500.8(C) contains the maximum surface temperatures for the "T" Codes that may appear on the utilization equipment.

502.135(B)(2) Motors. Motors of motor-driven utilization equipment shall comply with **502.125(B)**.

502.135(B)(3) Switches, Circuit Breakers, and Fuses. Enclosures for switches, circuit breakers, and fuses shall comply with **502.115(B)**.

The enclosure is required to be either identified for the location by reference to 502.115(B) or be dusttight.

MOTOR STARTERS & BREAKERS—CLASS II, DIVISION 1 AND 2

AEB MOTOR STARTER

PLEXPOWER™ MOTOR STARTER

EB CIRCUIT BREAKER

PLEXPOWER™ CIRCUIT BREAKER

502.135(B)(4) Transformers, Solenoids, Impedance Coils, and Resistors. Transformers, solenoids, impedance coils, and resistors shall comply with **502.120(B)**.

Dusttight enclosures or enclosures identified for the location are required for switches, circuit breakers, and fuses. Motors are required to comply with 502.125(B) and control transformers, solenoids, impedance coils, and resistors must comply with 502.120(B).

502.140 Flexible Cords — Class II, Divisions 1 and 2.

502.140(A) Permitted Uses. Flexible cords used in Class II locations shall be permitted as follows:

(1) For connection between portable lighting equipment or other portable utilization equipment and the fixed portion of its supply circuit. The flexible cord shall be attached to the utilization equipment with a cord connector listed for the protection technique of the equipment wiring compartment. An attachment plug in accordance with **502.145** shall be employed.

(2) Where flexible cord is permitted by **502.10(A)(2)** for fixed and mobile electrical utilization equipment; where the flexible cord is protected by location or by a suitable guard from damage; and only in a restricted industrial establishment.

(3) For electric submersible pumps with means for removal without entering the wet-pit. The extension of the flexible cord within a suitable raceway between the wet-pit and the power source shall be permitted.

(4) For electric mixers intended for travel into and out of open type mixing tanks or vats.

(5) For temporary portable assemblies consisting of receptacles, switches, and other devices that are not considered portable utilization equipment but are individually listed for the location.

502.140(B) Installation. Where flexible cords are used, the cords shall comply with all of the following:

(1) Be of a type listed for extra-hard usage.

*Exception: Flexible cord listed for hard usage as permitted by **502.130(A)(3)** and **(B)(4)**.*

(2) Contain, in addition to the conductors of the circuit, an equipment grounding conductor complying with **400.23**.

(3) Be supported by clamps or by other suitable means in such a manner that there will be no tension on the terminal connections.

(4) In Division 1 locations, the cord shall be terminated with a cord connector listed for the location or a listed cord connector installed with a seal listed for the location. In Division 2 locations, the cord shall be terminated with a listed dusttight cord connector.

(5) Be of continuous length. Where **502.140(A)(5)** is applied, cords shall be of continuous length from the power source to the temporary portable assembly and from the temporary portable assembly to the utilization equipment.

This section addresses the requirements for Flexible Cords in a Class II, Division 1 or 2 location in a similar manner/context that Section 501.140 addresses the requirements for Flexible Cords in a Class I, Division 1 or 2 location.

Since this section contains the requirement for both Class II, Division 1 and 2 the specific sealing requirements for each Division are addressed. If the cord is terminating into Class II, Division 1 equipment then the cord connector needs to be listed for the location or it may simply be listed for use with flexible cord and then it would have to go through a listed sealing fitting. If the cord is terminated into Class II, Division 2 equipment then the cord connector needs only to be listed for use with flexible cord.

Flexible cords used with plugs and cable connectors are required by 502.140 to be listed for "extra hard usage" (see Table 400.4) and include grounding conductor identified with markings specified in 400.23. Plugs and cord connectors must have cable clamps of such strength that tension on the terminal connections are eliminated, complying with 502.140(B)(4). Listed flexible cord for hard usage is permitted in accordance with 502.130(A)(3) and 502.130(B)(4).

502.145 Receptacles and Attachment Plugs. Receptacles and attachment plugs shall be identified for the location.

502.145(A) Class II, Division 1.

502.145(A)(1) Receptacles. In Class II, Division 1 locations, receptacles shall be part of the premises wiring.

502.145(A)(2) Attachment Plugs. Attachment plugs shall be of the type that provides for connection to the equipment grounding conductor of the flexible cord.

502.145(B) Class II, Division 2.

502.145(B)(1) Receptacles. In Class II, Division 2 locations, receptacles shall be part of the premises wiring.

502.145(B)(2) Attachment Plugs. Attachment plugs shall be of the type that provides for connection to the equipment grounding conductor of the flexible cord.

The Section also acknowledges that the Receptacles are part of the premises wiring and the Attachment Plugs is part of the utilization equipment. This was not clear in previous editions of the *Code*.

502.150 Signaling, Alarm, Remote-Control, and Communications Systems; and Meters, Instruments, and Relays.

SAFETY CONSTRUCTION DESIGN OF APPLETON™ RECEPTACLES AND PLUGS.

Live parts of Appleton™ receptacles and plugs are electrically dead during plug insertion and withdrawal. In the FSQX, FSQC, EBR, EBRH, DBR, U-Line™ and N1 and N2 receptacles, the plug cannot be inserted unless the switch is in the OFF position and cannot be withdrawn with the receptacle in the ON position.

U-LINE™ RECEPTACLE AND PLUG

DBR RECEPTACLE

FSQC INTERLOCKED RECEPTACLE

Informational Note: See Article 805 for rules governing the installation of communications circuits.

502.150(A) Class II, Division 1. In Class II, Division 1 locations, signaling, alarm, remote-control, and communications systems; and meters, instruments, and relays shall comply with **502.150(A)(1)** through **(A)(3)**.

502.150(A)(1) Contacts. Enclosures containing contacts shall comply with the requirements of **502.150(A)(1)(a)** or **(A)(1)(b)**.

(a) Switches, circuit breakers, relays, contactors, fuses, and current-breaking contacts for bells, horns, howlers, sirens, and other devices in which sparks or arcs might be produced shall be provided with enclosures identified for the location.

(b) Where current-breaking contacts are immersed in oil or where the interruption of current occurs within a chamber sealed against the entrance of dust, enclosures shall be permitted to be of the general-purpose type.

502.150(A)(2) Resistors and Similar Equipment. Enclosures containing resistors shall comply with the requirements of **502.150(A)(2)(a)** or **(A)(2)(b)**.

(a) Resistors, transformers, choke coils, rectifiers, thermionic tubes, and other heat-generating equipment shall be provided with enclosures identified for the location.

(b) Where resistors or similar equipment are immersed in oil or enclosed in a chamber sealed against the entrance of dust, enclosures shall be permitted to be of the general-purpose type.

502.150(A)(3) Rotating Machinery. Motors, generators, and other rotating electrical machinery shall comply with **502.125(A)**.

502.150(B) Class II, Division 2. In Class II, Division 2 locations, signaling, alarm, remote-control, and communications systems; and meters, instruments, and relays shall comply with **502.150(B)(1)** through **(B)(4)**.

502.150(B)(1) Contacts. Enclosures for contacts shall comply with the requirements of 502.150(B)(1)(a) or (B)(1)(b).

(a) Contacts shall comply with the requirements of 502.150(A)(1) or be installed in enclosures that are dusttight or otherwise identified for the location.

(b) Enclosures in nonincendive circuits shall be permitted to be of the general-purpose type

502.150(B)(2) Transformers and Similar Equipment. The windings and terminal connections of transformers, choke coils, and similar equipment shall comply with 502.120(B)(2).

502.150(B)(3) Resistors and Similar Equipment. Resistors, resistance devices, thermionic tubes, rectifiers, and similar equipment shall comply with 502.120(B)(3).

502.150(B)(4) Rotating Machinery. Motors, generators, and other rotating electrical machinery shall comply with 502.125(B).

Meters, instruments and relays for Class II, Division 1 locations must be provided with enclosures identified for such locations. Wiring methods must comply with the requirements in 502.150(A)(1) through 502.150(A)(3) for Class II, Division 1 locations and 502.150(B)(1) through 502.150(B)(4) for Class II, Division 2 locations.

For Class II, Division 2 locations, the enclosures must be dusttight or identified for Class II, Division 2. Nonincendive circuits may be contained in general purpose type enclosures. Resistors must have enclosures identified for Class II, Division 1.

502.150(B)(5) Connections. To facilitate replacements, process control instruments shall be permitted to be connected through flexible cord, attachment plug, and receptacle if all of the following conditions apply:

(1) Attachment plug and receptacle are listed for use in Class II, Division 2 locations, and listed for use with flexible cords.

Exception No. 1 to (1): A Class II, Division 2 listing shall not be required if the circuit involves only nonincendive field wiring.

Exception No. 2 to (1): In restricted industrial establishments the Class II, Division 2 listing is not required when the requirements of list items 502.150(B)(5)(2), (B)(5)(3), and (B)(5)(4) are satisfied and the receptacle carries a label warning against plugging or unplugging when energized.

(2) The flexible cord does not exceed 900 mm (3 ft), is of a type listed for extra-hard usage, or if listed for hard usage is protected by location.

(3) Only necessary receptacles are provided.

(4) Unless the attachment plug and receptacle are interlocked mechanically or electrically, or otherwise designed so that they cannot be separated when the contacts are energized, and the contacts cannot be energized when the plug and socket outlet are separated, a switch complying with 502.115(B) is provided so that the attachment plug or receptacle is not depended on to interrupt current.

Exception: The switch shall not be required if the circuit is nonincendive field wiring.

These same provisions are found in 501.105(B)(6) which permits similar connections for process connected instrumentation in Class I, Division 2 locations.

GRAIN ELEVATOR — CLASS II, DIVISIONS 1 AND 2.

CHANGES TO ARTICLE 503 – CLASS III LOCATIONS

The following Article 503 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 503.1: Scope
- 503.10(A)(1): Wiring Methods. Class III, Division 1. General
- 503.10(A)(3): Wiring Methods. Class III, Division 1, Flexible Connections

ARTICLE 503 Class III Locations

All Appleton™ products suitable for Class II, Division 1 and 2, Group G, are also suitable for Class III, Divisions 1 and 2.

Part I. General

503.1 Scope. This article covers the requirements for electrical and electronic equipment and wiring for all voltages in Class III, Division 1 and Division 2 locations where fire or explosion hazards might exist due to nonmetal combustible fibers/flyings or ignitible fibers/flyings.

Nonmetal combustible fibers/flyings has been added to the scope to correlate with the revisions to NFPA 499 - Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Area

503.5 General. Equipment installed in Class III locations shall be able to function at full rating without developing surface temperatures high enough to cause excessive dehydration or gradual carbonization of accumulated fibers/flyings.

Informational Note: For electric trucks, see NFPA 505-2018, Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations.

Informational Note No. 2: Organic material that is carbonized or excessively dry is highly susceptible to spontaneous ignition.

The requirement that the temperature class and/or operating temperature be determined when the equipment is covered with the maximum amount of dust to simulate fibers and flyings has been removed. The surface temperature requirement of 120°C limit for equipment which can be overloaded can be demonstrated without dust blanketing. The current certification standards do not require dust blanketing for Class III evaluation.

503.6 Zone Equipment. Equipment listed and marked in accordance with 506.9(C)(2) for Zone 20 locations and with a temperature marking in accordance with 500.8(D)(3) shall be permitted in Class III, Division 1 locations.

Equipment listed and marked in accordance with 506.9(C)(2) for Zone 20, Zone 21, or Zone 22 locations and with a temperature marking in accordance with 500.8(D)(3) shall be permitted in Class III, Division 2 locations.

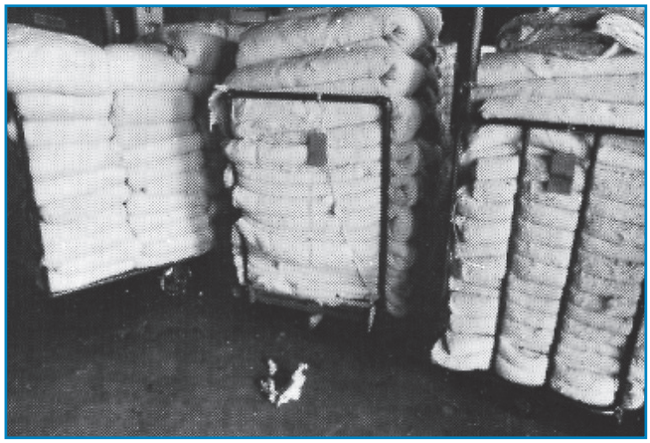
CLASS III AREAS DEFINED

LOCATIONS ARE THOSE THAT ARE HAZARDOUS BECAUSE OF THE PRESENCE OF EASILY IGNITIBLE FIBERS OR FLYINGS, BUT IN WHICH SUCH FIBERS OR FLYINGS ARE NOT LIKELY TO BE IN SUSPENSION IN THE AIR IN QUANTITIES SUFFICIENT TO PRODUCE IGNITIBLE MIXTURES. CLASS III, DIVISION 1 IS A LOCATION IN WHICH EASILY IGNITABLE FIBERS OR MATERIALS PRODUCING COMBUSTIBLE FLYINGS ARE HANDLED, MANUFACTURED, OR USED.

CLASS III, DIVISION 2. IS A LOCATION IN WHICH EASILY IGNITIBLE FIBERS ARE STORED OR HANDLED OTHER THAN IN THE PROCESS OF MANUFACTURE.

CLASS III, DIVISION 1 MANUFACTURING AREA.

THESE VIEWS OF A MATTRESS FACTORY ILLUSTRATE THE BASIC DIFFERENCES BETWEEN DIVISION 1 AND DIVISION 2 IN CLASS III LOCATIONS. LEFT, THE LOCATION IS DIVISION 1 BECAUSE COMBUSTIBLE FIBERS OR FLYINGS ARE NORMALLY PRESENT DURING THE MANUFACTURING PROCESS. BELOW (RIGHT, THE LOCATION IS DIVISION 2 BECAUSE COMBUSTIBLE FIBERS OR FLYINGS ARE NOT NORMALLY PRODUCED IN SUFFICIENT QUANTITIES TO PRODUCE IGNITIBLE MIXTURES DURING STORAGE.



CLASS III, DIVISION 2 STORAGE AREA.

Listed equipment marked for Zone 20 is permitted to be installed in Class III, Division 1 and 2 locations. In addition, equipment that is rated as Zone 20, 21, or 22 are suitable for installation in Class III, Division 2 locations. This change reflected that the *Code* already permits Zone 20, 21, and 22 locations to be alternatively classified as an appropriate Class III location, therefore the equipment is considered to meet the intended function based on their Zone 20, 21, or 22 listed rating.

Part II. Wiring

503.10 Wiring Methods. Wiring methods shall comply with **503.10(A)** or **(B)**.

Informational Note: See Article 100 for the definition of restricted industrial establishment [as applied to hazardous (classified) locations].

A new information note is added referencing the definition of "restricted industrial establishments (as applied to hazardous (classified) locations)." With the removal of the "defining" text from several places in the section, it is important to send the user to the definition to confirm that the requirement has not changed.

503.10(A) Class III, Division 1.

503.10(A)(1) General. In Class III, Division 1 locations, the following wiring methods shall be permitted:

(1) Rigid metal conduit (Type RMC), Type PVC conduit, Type RTRC conduit, intermediate metal conduit (Type IMC), electrical metallic tubing (EMT), dusttight wireways, or Type MC or Type MI cable with listed termination fittings.

(2) Type PLTC cable or Type PLTC-ER cable used in Class 2 and Class 3 circuits, including installation in cable tray systems. The cable shall be terminated with listed fittings. Type PLTC-ER cable shall include an equipment grounding conductor in addition to a drain wire that might be present.

(3) Type ITC cable or Type ITC-ER cable as permitted in **335.4** and terminated with listed fittings. Type ITC-ER cable shall include an equipment grounding conductor in addition to a drain wire.

(4) Type MV, Type TC, or Type TC-ER cable, including installation in cable tray systems. Type TC-ER cable shall include an equipment grounding conductor in addition to a drain wire that might be present. The cable shall be terminated with listed fittings.

A drain wire has not been evaluated as a grounding conductor. MC and MI were removed from list item (4) because they are permitted by list item (1). The spacing requirements in list item (4) were eliminated because blanketing is not considered for Class III locations.

(5) Cablebus.

(6) In restricted industrial establishments, listed Type P cable with metal braid armor, with an overall jacket, that is terminated with fittings listed for the location, and installed in accordance with Part II of Article **337**. If installed in ladder, ventilated trough, or ventilated channel cable trays, cables shall be installed in a single layer, with a space not less than the larger cable diameter between the two adjacent cables unless otherwise protected against dust buildup resulting in increased heat.

Informational Note No. 1: See UL 1309A, Outline of Investigation for Cable for Use in Mobile Installations, for information on construction, testing, and marking of Type P cable.

Informational Note No. 2: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cable fittings.

Type P cable has been added as a permissible general wiring method in Class III, Division 1 locations. The section details the specific cable construction and requires the termination fittings to be listed for the location.

503.10(A)(2) Boxes and Fittings. All boxes and fittings shall be dusttight.

These boxes and fittings are not required to be "listed" as dusttight. For guidance on dusttight ratings see NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum) – permits a rating of "dusttight" for products that are rated NEMA Types 3, 3X, 3S, 3SX, 4, 4X, 5, 6, 6P, 12, 12K, or 13.

Types 4, 4X, 6, and 6P were added as Types that are considered to comply as being "dusttight" as the performance requirements for these Types are considered to be more onerous than the other tests to determine "dusttight".

503.10(A)(3) Flexible Connections. Where flexible connections are necessary, one or more of the following shall be permitted:

(1) Dusttight flexible connectors

(2) Liquidtight flexible metal conduit (LFMC) with listed fittings and bonded in accordance with **503.30(B).**

(3) Liquidtight flexible nonmetallic conduit (LFNC) with listed fittings.

(4) Interlocked armor Type MC cable having an overall jacket of suitable polymeric material and installed with listed dusttight termination fittings.

(5) Flexible cord in compliance with **503.140**.

(6) For elevator use, an identified elevator cable of Type EO, Type ETP, or Type ETT, shown under the "use" column in **Table 400.4** for "hazardous (classified) locations" and terminated with listed dusttight fittings.

(7) In restricted industrial establishments, listed Type P cable with metal braid armor, with an overall jacket, that is terminated with fittings listed for the location and installed in accordance with Part II of Article **337**

Informational Note: See UL 1309A, Outline of Investigation for Cable for Use in Mobile Installations, for information on construction, testing, and marking of Type P cable.

The requirements for Flexible Connections are basically the same for Class III as for Class II, except as noted in 503.10(B)(1) for Class III, Division 2 locations. The section permits Type MC cable that employs an overall jacket of suitable polymeric material to be used in Class III, Division 1 location where flexible connections are required. In addition, Elevator Cables are now permitted with fittings that are listed for the specific type of elevator cable and that will exclude dust from entering.

503.10(A)(4) Nonincendive Field Wiring. Nonincendive field wiring shall be permitted using any of the wiring methods permitted for unclassified locations. Nonincendive field wiring systems shall be installed in accordance with the control drawing(s). Simple apparatus, not shown on the control drawing, shall be permitted in a nonincendive field wiring circuit, provided the simple apparatus does not interconnect the nonincendive field wiring circuit to any other circuit.

Informational Note: See Article 100 for the definition of simple apparatus.

Separate nonincendive field wiring circuits shall be installed in accordance with one of the following:

(1) In separate cables

(2) In multiconductor cables where the conductors of each circuit are within a grounded metal shield

(3) In multiconductor cables where the conductors of each circuit have insulation with a minimum thickness of 0.25 mm (0.01 in)

503.10(B) Class III, Division 2. Wiring methods in Class III, Division 2 locations shall be in accordance with the following:

(1) The wiring shall comply with **503.10(A)**.

(2) In sections, compartments, or areas that do not contain machinery and are used solely for storage, open wiring on insulators shall be permitted where installed in accordance with Part II of Article **398**, including the condition required by **398.15(C)** that protection be provided where conductors are not run in roof spaces and are well out of reach of sources of physical damage.

The wiring methods are similar to those for Class II, Division 2 except that RNC (rigid nonmetallic conduit) and EMT (electrical metallic tubing) are permitted in Class III, Division 1. 503.10(A) also permits RMC (rigid metal conduit), IMC (intermediate metal conduit), dusttight wireways and MC or MI cable with listed termination fitting in those locations. All boxes and fittings are required to be dusttight. RMC and IMC do not need to be threaded, permitting the use of threadless connectors. Where necessary to use flexible connections 503.10(A) (3) permits the use of dusttight flexible connectors, LFMC (liquidtight flexible metallic conduit) and LFNC (liquidtight flexible nonmetallic conduit) with listed fittings (see 503.30(B) for the grounding rules where flexible conduit is used). Flexible cord in accordance with 503.140 is also acceptable.

Section 503.10(B) in addition to the wiring methods in 503.10(A) listed above, open wiring is permitted in accordance with Article 398 under very specific and limited conditions in Class III, Division 2 locations.

503.25 Uninsulated Exposed Parts, Class III, Divisions 1 and 2. There shall be no uninsulated exposed parts, such as electrical conductors, buses, terminals, or components, that operate at more than 30 volts (15 volts in wet locations). These parts shall additionally be protected by a protection technique according to **500.7(E)**, **(F)**, or **(G)** that is suitable for the location.

Exception: As provided in 503.155.

503.30 Grounding and Bonding. Regardless of the voltage of the electrical system, wiring systems and equipment shall comply with **503.30(A)** and **(B)**.

503.30(A) Grounding. Wiring systems and equipment shall be grounded in accordance with Part I and Part VI of Article **250**, as applicable.

503.30(B) Bonding. Bonding shall comply with Part I and Part V of Article **250**, as applicable, and **503.30(B)(1)** and **(B)(2)**.

503.30(B)(1) Specific Bonding Means.

Bonding shall comply with **503.30(B)(1)(a)** and **(B)(2)(b)**.

(a) The locknut-bushing and double-locknut types of contacts shall not be depended on for bonding purposes, but bonding jumpers with identified fittings or other approved means of bonding shall be used. These bonding means shall apply to all metal raceways, fittings, boxes, cable trays, and enclosures, and other parts of raceway systems between hazardous (classified) locations and the point of grounding for service equipment or point of grounding for a separately derived system. Metal struts, angles, or channels provided for support and mechanical or physical protection as permitted in **335.4(5)**, **336.10(7)(c)**, or **722.135(C)** shall be bonded in accordance with **250.102**.

(b) Where the branch-circuit overcurrent protection is located on the load side of the disconnecting means, the specific bonding means shall be permitted to end at the nearest point where the grounded circuit conductor and the grounding electrode conductor are connected together on the line side of the building or structure disconnecting means as specified in 250.32(B).

503.30(B)(2) Liquidtight Flexible Metal Conduit. Liquidtight flexible metal conduit shall comply with **503.30(B)(2)(a)** and **(B)(2)(b)**.

(a) Liquidtight flexible metal conduit shall include an equipment bonding jumper of the wire type in accordance with **250.102**.

(b) In Class III locations, the bonding jumper shall not be required where all of the following conditions are met:

(1) Listed liquidtight flexible metal conduit 1.8 m (6 ft) or less in length, with fittings listed for grounding, is used.

(2) Overcurrent protection in the circuit is limited to 10 amperes or less.

(3) The load is part of a meter, instrument, or relay circuit.

This section clarifies that the equipment bonding jumper being described is intended to be that of the wire type.

Section revised to separate the requirements for Grounding from those for Bonding. The requirements for Grounding remain referenced to the general requirements of Article 250. The requirements for Bonding in a Hazardous (Classified) Location are more stringent than those in the general article 250 and therefore are presented here.

BONDING.

The requirements for Class III are similar to those for Class I and II in that locknut-bushing and double-locknut types of contacts are not permitted to be depended upon; bonding jumpers or other means must be used. These requirements are only required as specified in 250.100 to the point where the grounded circuit conductor is connected to the grounding electrode conductor.

EQUIPMENT GROUNDING CONDUCTORS.

Section 503.30 requirements for "Grounding Equipment" are essentially the same for Class III, Divisions 1 and 2 as for Class II, Divisions 1 and 2. In Class III locations, 503.30(B) is the same as 502.30(B) for Class II locations. However, for Class III locations, the Exception to 503.30(B) applies to both Division 1 and 2 locations, not just Division 2 as for Class II locations. Thus, the Exception is more permissible than the similar Exceptions for Class I and II.

Part III. Equipment

503.100 Transformers and Capacitors — Class III, Divisions 1 and 2. Transformers and capacitors shall comply with **502.100(B)**.

503.115 Switches, Circuit Breakers, Motor Controllers, and Fuses — Class III, Divisions 1 and 2. Switches, circuit breakers, motor controllers, and fuses, including pushbuttons, relays, and similar devices, shall be provided with dusttight enclosures.

Section 503.115 specifies "dusttight" enclosures only and makes no distinction between Division 1 and 2 of Class III.

503.120 Control Transformers and Resistors — Class III, Divisions 1 and 2. Transformers, impedance coils, and resistors used as, or in conjunction with, control equipment for motors, generators, and appliances shall be provided with dusttight enclosures complying with the temperature limitations in 503.5.

503.125 Motors and Generators — Class III, Divisions 1 and 2. In Class III, Division 1 and Division 2 locations, motors, generators, and other rotating machinery shall be totally enclosed nonventilated, totally enclosed pipe ventilated, or totally enclosed fan cooled.

Exception: In locations where, in the judgment of the authority having jurisdiction, only moderate accumulations of lint or flyings are likely to collect on, in, or in the vicinity of a rotating electrical machine and where such machine is readily accessible for routine cleaning and maintenance, one of the following shall be permitted:

(1) Self-cleaning textile motors of the squirrel-cage type

(2) Standard open-type machines without sliding contacts or centrifugal or other types of switching mechanisms, including motor overload devices

(3) Standard open-type machines having such contacts, switching mechanisms, or resistance devices enclosed within tight housings without ventilating or other openings

Section 503.125 avoids duplication by stating general requirements for both Divisions 1 and 2. It is apparent that the exceptions apply to Division 2 as well as Division 1. "Types Not Permitted" are not needed, as positive requirements on the types of motors that may be used is stated. Basically the requirements or motors and generators are the same for Class III, Divisions 1 and 2 as for Class II, Division 2 locations. Requirements in Class II, Division 2 locations are slightly more severe than in Class III, Division 1 locations (standard open type machines with contacts, switch mechanisms or resistance devices require "tight" enclosures rather than "dusttight" enclosures required in Class II, Division 2). 503.5 temperature limitations apply to Class III.

503.128 Ventilating Piping — Class III, Divisions 1 and 2. Ventilating pipes for motors, generators, or other rotating electrical machinery, or for enclosures for electric equipment, shall be of metal not less than 0.53 mm (0.021 in) in thickness, or of equally substantial noncombustible material, and shall comply with the following:

(1) Lead directly to a source of clean air outside of buildings

(2) Be screened at the outer ends to prevent the entrance of small animals or birds

(3) Be protected against physical damage and against rusting or other corrosive influences

Ventilating pipes shall be sufficiently tight, including their connections, to prevent the entrance of appreciable quantities of fibers/flyings into the ventilated equipment or enclosure and to prevent the escape of sparks, flame, or burning material that might ignite accumulations of fibers/flyings or combustible material in the vicinity. For metal pipes, lock seams and riveted or welded joints shall be permitted; and tight-fitting slip joints shall be permitted where some flexibility is necessary, as at connections to motors.

Section 503.128 requirements for Ventilating Piping are similar to those for Class III as for Class II. Section 503.128 lists the same material and installation requirements for Class III as for Class II, and joint requirements are the same as for Class II, Division 2.

503.130 Luminaires — Class III, Divisions 1 and 2.

503.130(A) Fixed Lighting. Luminaires for fixed lighting shall provide enclosures for lamps and lampholders that are designed to minimize entrance of fibers/flyings and to prevent the escape of sparks, burning material, or hot metal. Each luminaire shall be clearly marked to show the maximum wattage of the lamps that shall be permitted without exceeding an exposed surface temperature of 165°C (329°F) under normal conditions of use.

For HID luminaires the *Code* requires that the maximum wattage of the lamp required to be marked on the luminaire. There are several other marking requirements for listed luminaires. See the ANSI listing standard ANSI/UL 844, Standard for Luminaires for Use in Hazardous (Classified) Locations for the additional marking requirements.

FIXTURES FOR CLASS III, DIVISION 1 AND 2.

CODE•MASTER™ LED

CODE•MASTER™ JR. LED

MERCMASTER™ LED
LOW PROFILE

AREAMASTER™
GENERATION 2 LED

PORTABLE HANDLAMP FOR CLASS I, DIVISION 1 AND 2.

EXPLOSIONPROOF EHLED FACTORY SEALED HANDLAMP WITH ECP PLUG

The listing standard, ANSI/UL 844 only requires the lamp type and maximum wattage markings for incandescent or HID luminaires.

503.130(B) Physical Damage. A luminaire that may be exposed to physical damage shall be protected by a suitable guard.

503.130(C) Pendant Luminaires. Pendant luminaires shall be suspended by stems of threaded rigid metal conduit, threaded intermediate metal conduit, threaded metal tubing of equivalent thickness, or by chains with approved fittings. For stems longer than 300 mm (12 in), permanent and effective bracing against lateral displacement shall be provided at a level not more than 300 mm (12 in) above the lower end of the stem, or flexibility in the form of an identified fitting or a flexible connector shall be provided not more than 300 mm (12 in) from the point of attachment to the supporting box or fitting.

503.130(D) Portable Lighting Equipment. Portable lighting equipment shall be equipped with handles and protected with substantial guards. Lampholders shall be of the unswitched type with no provision for receiving attachment plugs. There shall be no exposed current-carrying metal parts, and all exposed non–current-carrying metal parts shall be grounded. In all other respects, portable lighting equipment shall comply with **503.130(A)**.

Section 503.130 (A) specifies that enclosures must be designed to "minimize the entrance of fibers and flyings". Maximum surface temperature, not lamp temperature, is the same for Class III, Divisions 1 and 2 as for Class II, Division 2, Group G; (+165 °C [+329 °F]). 503.130(C) lists the means by which pendant fixtures may be suspended. Portable luminaires are covered in 503.130(D) which states that (1) there shall be no exposed current carrying parts and (2) exposed noncurrent carrying parts shall be grounded. This wording is intended to emphasize these two important requirements in accordance with Article 410.

503.135 Utilization Equipment — Class III, Divisions 1 and 2.

503.135(A) Heaters. Electrically heated utilization equipment shall be identified for Class III locations.

503.135(B) Motors. Motors of motor-driven utilization equipment shall comply with **503.125**.

503.135(C) Switches, Circuit Breakers, Motor Controllers, and Fuses. Switches, circuit breakers, motor controllers, and fuses shall comply with **503.115**.

Electrically heated utilization equipment (heaters) must be identified for Class III locations. Motor requirements are slightly more severe for Class II, Division 2 locations than for Class III, Division 1 and 2 locations [see 502.125(B) and 502.135(B)]. Enclosures for switches, circuit breakers, motor controllers and fuses must have dusttight covers.

503.140 Flexible Cords — Class III, Divisions 1 and 2. Flexible cords shall comply with the following:

(1) Be of a type listed for extra-hard usage

(2) Contain, in addition to the conductors of the circuit, an equipment grounding conductor complying with **400.23**

(3) Be supported by clamps or other suitable means in such a manner that there will be no tension on the terminal connections

(4) Be terminated with a listed dusttight cord connector

Flexible cords must be a type listed for extra-hard usage, the same as Class II, Division 1 and 2 (502.140), except that seals and dust-ignitionproof enclosures are not required in Class III, Division 1 and 2 locations. A suitable means must however be provided to prevent the entrance of fibers and flyings. This section requires that the cord connector be listed. This cord connector is not required to be "listed for the location".

503.145 Receptacles and Attachment Plugs — Class III, Division 1 and Division 2. Receptacles and attachment plugs shall be of the grounding type, shall be designed so as to minimize the accumulation or the entry of fibers/flyings, and shall prevent the escape of sparks or molten particles.

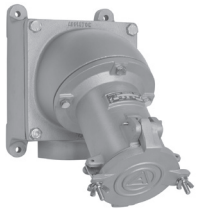
Exception: In locations where, in the judgment of the authority having jurisdiction, only moderate accumulations of lint or flyings are likely to collect in the vicinity of a receptacle, and where such receptacle is readily accessible for routine cleaning, general-purpose groundingtype receptacles mounted so as to minimize the entry of fibers/flyings shall be permitted.

Receptacles and attachment plugs in Class III, Division 1 and 2 are required to be of the grounding type and be designed so that the entry of fibers and flyings will be minimized and sparks or molten particles cannot escape. Where it can be determined that only moderate accumulations of lint or flyings will be likely to collect in the vicinity of a receptacle, and where such a receptacle is readily accessible for routine cleaning, the authority having jurisdiction may permit general-purpose grounding-type receptacles mounted so as to minimize the entry of fibers and flyings.

RECEPTACLES LISTED FOR USE IN CLASS III, DIVISION 1 OR 2 LOCATIONS.

MD2SR CAST ALUMINUM RECEPTACLES WITH INTERLOCKED SWITCH AVAILABLE FUSED OR NON-FUSED

RECEPTACLES SUITABLE FOR USE IN CLASS III, DIVISION 1 OR 2 LOCATIONS.



POWERTITE™ GENERAL PURPOSE RECEPTACLES ARE SUITABLE FOR CLASS III, DIVISION 1 AND 2 LOCATIONS IF THEY MEET THE CONDITIONS IMPOSED BY 503.145 EXCEPTION.

503.150 Signaling, Alarm, Remote-Control, and Local Loudspeaker Intercommunications Systems — Class III, Division 1 and Division 2. Signaling, alarm, remote-control, and local loudspeaker intercommunications systems shall comply with the requirements of this article regarding wiring methods, switches, transformers, resistors, motors, luminaires, and related components.

PRODUCTS SUITABLE FOR USE IN CLASS III, DIVISION 1 AND 2.

ALL PRODUCTS SUITABLE FOR USE IN CLASS II, DIVISION 2 ARE ALSO SUITABLE FOR USE IN CLASS III, DIVISION 1 AND 2 LOCATIONS. THESE PRODUCTS ARE IN ADDITION TO THOSE SPECIFICALLY APPROVED FOR CLASS III, DIVISION 1 AND 2.

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Section 503.150 requires that these systems be installed in accordance with the component requirements in other pertinent sections of Article 503; for example the wiring methods used to supply these systems must be wired in accordance with 503.10(A) and 503.10(B) and luminaires in accordance with 503.130(A) through (D).

503.155 Electric Cranes, Hoists, and Similar Equipment — Class III, Divisions 1 and 2. Where installed for operation over combustible fibers or accumulations of flyings, traveling cranes and hoists for material handling, traveling cleaners for textile machinery, and similar equipment shall comply with **503.155(A)** through **(D)**.

503.155(A) Power Supply. The power supply to contact conductors shall be electrically isolated from all other systems, ungrounded, and shall be equipped with an acceptable ground detector that gives an alarm and automatically de-energizes the contact conductors in case of a fault to ground or gives a visual and audible alarm as long as power is supplied to the contact conductors and the ground fault remains.

503.155(B) Contact Conductors. Contact conductors shall be located or guarded so as to be inaccessible to other than authorized persons and shall be protected against accidental contact with foreign objects.

503.155(C) Current Collectors. Current collectors shall be arranged or guarded so as to confine normal sparking and prevent escape of sparks or hot particles. To reduce sparking, two or more separate surfaces of contact shall be provided for each contact conductor. Reliable means shall be provided to keep contact conductors and current collectors free of accumulations of lint or flyings.

503.155(D) Control Equipment. Control equipment shall comply with **503.115** and **503.120**.

503.160 Storage Battery Charging Equipment — Class III, Divisions 1 and 2. Storage battery charging equipment shall be located in separate rooms built or lined with substantial noncombustible materials. The rooms shall be constructed to prevent the entrance of ignitible amounts of flyings or lint and shall be well ventilated.

Storage battery charging equipment is required to be located in a separate unclassified well ventilated room which must be constructed with noncombustible materials and designed to prevent the entrance of flyings or lint in ignitible quantities.

CHANGES TO ARTICLE 504 – INTRINSICALLY SAFE SYSTEMS

The following Article 504 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 504.30(A)(1): Separation of Intrinsically Safe Conductors. From Nonintrinsically Safe Conductors. In Raceways, Cable Trays, and Cables
- 504.30(A)(2): Separation of Intrinsically Safe Conductors. From Nonintrinsically Safe Conductors. Within Enclosures
- 504.30(A)(3): Separation of Intrinsically Safe Conductors. From Nonintrinsically Safe Conductors. Other (Not in Raceway or Cable Tray Systems)

ARTICLE 504 Intrinsically Safe Systems

The concept of intrinsic safety is based on insuring that a safe system, consisting of associated apparatus located in an unclassified location, intrinsically safe apparatus in the hazardous location, and the wiring that connects them, cannot store and release enough energy to ignite the flammable atmosphere present, either by spark ignition or by creating hot surfaces that could cause ignition.

504.1 Scope. This article covers the installation of intrinsically safe (I.S.) apparatus, wiring, and systems for hazardous(classified)locations.

Informational Note: See ANSI/ISARP 12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation — Part 1: Intrinsic Safety, for additional information.

The requirements for intrinsically safe systems in this Article also apply to wiring methods and applications in all hazardous location Articles of Chapter 5.

504.3 Application of Other Articles. Except as modified by this article, all applicable articles of this *Code* shall apply.

504.4 Equipment. All intrinsically safe apparatus and associated apparatus shall be listed.

Exception: Simple apparatus, as described on the control drawing, shall not be required to be listed.

Because of the extensive analysis and testing that is necessary for intrinsic safety verification, intrinsically safe apparatus and associated apparatus are required to be listed. Simple apparatus would normally not be listed.

504.10 Equipment Installation.

504.10(A) Control Drawing. Intrinsically safe apparatus, associated apparatus, and other equipment shall be installed in accordance with the control drawing(s).

A simple apparatus, whether or not shown on the control drawing(s), shall be permitted to be installed provided the simple apparatus does not interconnect intrinsically safe circuits.

Informational Note No. 1: The control drawing identification is marked on the apparatus.

Informational Note No. 2: Associated apparatus with a marked Um of less than 250 V may require additional overvoltage protection at the inputs to limit any possible fault voltages to less than the Um marked on the product.

Intrinsically safe systems cannot be safely installed unless the proper control drawings are available. Control drawings are required to be supplied by both the manufacturers of associated apparatus and intrinsically safe apparatus. These two control drawings, used together, provide the necessary information for the user to correctly configure and install the intrinsically safe system. If one manufacturer provides both the associated apparatus and the intrinsically safe apparatus as a system, the information for the whole system may be contained on one control drawing.

504.10(B) Location. Intrinsically safe apparatus shall be permitted to be installed in any hazardous (classified) location for which it has been identified.

Associated apparatus shall be permitted to be installed in any hazardous (classified) location for which it has been identified.

Simple apparatus shall be permitted to be installed in any hazardous (classified) location in accordance with 504.10(D).

504.10(C) Enclosures. General-purpose enclosures shall be permitted for intrinsically safe apparatus and associated apparatus unless otherwise specified in the manufacturer's documentation.

504.10(D) Simple Apparatus. Simple apparatus shall be permitted to be installed in any hazardous (classified) location in which the maximum surface temperature of the simple apparatus does not exceed the ignition temperature of the flammable gases or vapors, flammable liquids, combustible dusts, or ignitible fibers/flyings present. The maximum surface temperature can be determined from the values of the output power from the associated apparatus or apparatus to which it is connected to obtain the temperature class. The temperature class can be determined by:

(1) Reference to Table 504.10(D)

(2) Calculation using the following equation:

$T = P_o R_{th} X T_{amb}$ *[504.10(D)]*
T = surface temperature
P_o *= output power marked on the associated apparatus or intrinsically safe apparatus*
R_{th} *= thermal resistance of the simple apparatus*
T_{amb} *= ambient temperature (normally 40°C) and reference Table 500.8(C)*

In addition, components with a surface area smaller than 10 cm^2 (excluding lead wires) may be classified as T5 if their surface temperature does not exceed 150°C.

To avoid causing a thermal ignition hazard using simple apparatus, this clause gives a method to calculate the temperature likely to be generated, using information available on the control drawing provided for the associated apparatus. Higher temperatures are allowed for very small surfaces, since testing has proven that it takes higher temperatures from devices with very small surface areas to thermally ignite flammable atmospheres.

The thermal resistance of a device is a parameter that tells you how much something will heat up as a function of how much power is applied to it, and the units need to be in °C/ (°F) Watt to work with Table 504.10(D).

The requirements to consider the temperature of simple apparatus, as well as the calculations for simple apparatus temperature determination, is included in 504.10(D). Table 504.10(D) was also added to permit temperature allowances for small components. Allowing any component to heat up to a level over the autoignition temperature of the flammable gas present may not seem the right thing to do, but testing has determined that a higher temperature is necessary to ignite a flammable atmosphere when a hot surface also has a very small surface area.

Table 504.10(D) *Assessment for T4 Classification According to Component Size and Temperature*

Total Surface Area Excluding Lead Wires	Requirement for T4 Classification
<20 mm^2	Surface temperature ≤275°C
≥20 mm^2 ≤10 cm^2	Surface temperature ≤200°C
≥20 mm^2	Power not exceeding 1.3 W*

*Based on 40°C ambient temperature. Reduce to 1.2 W with an ambient of 60°C or 1.0 W with 80°C ambient temperature.

504.20 Wiring Methods. Any of the wiring methods suitable for unclassified locations, including those covered by Chapter 7 and Chapter 8, shall be permitted for installing intrinsically safe apparatus. Sealing shall be as provided in **504.70**, and separation shall be as provided in **504.30**.

Since intrinsically safe wiring does not carry enough energy to ignite the flammable atmospheres that it is listed for, any wiring method allowed by the NEC® can be used in Division 1 and Division 2 to connect associated apparatus and intrinsically safe apparatus. To avoid accidental connection to other nonintrinsically safe circuits or picking up induced currents from other higher power wiring, there are wiring separation requirements imposed by 504.30.

504.30 Separation of Intrinsically Safe Conductors.

504.30(A) From Nonintrinsically Safe Circuit Conductors.

504.30(A)(1) In Raceways, Cable Trays, and Cables. Conductors of intrinsically safe circuits shall not be placed in any raceway, cable tray, or cable with conductors of any nonintrinsically safe circuit, unless they meet the requirements of one of the following methods:

(1) Separated from conductors of nonintrinsically safe circuits in accordance with one of the following:

a. By a distance of at least 50 mm (2 in) and secured

b. By a grounded metal partition that is 0.91 mm (0.0359 in) or thicker

c. An approved insulating partition

(2) All of the intrinsically safe circuit conductors or nonintrinsically safe circuit conductors are in Type MC cable, Type MI cable, or other approved grounded metal-sheathed or metal-clad cables where the sheathing or cladding is capable of carrying fault current to ground

(3) In a Division 2 or Zone 2 location, installed in a raceway, cable tray, or cable along with nonincendive field wiring circuits when installed in accordance with 504.30(B)

(4) Where passing through a Division 2 or Zone 2 location to supply apparatus that is located in a Division 1, Zone 0 or Zone 1 location, installed in a raceway, cable tray, or cable along with nonincendive field wiring circuits when installed in accordance with 504.30(B)

Section revised to remove the Exceptions and place into the rule in positive code language. Informational Notes have also been converted into positive code language as they had contained recommendations which are not permitted for Informational Notes.

504.30(A)(2) Within Enclosures. Conductors of intrinsically safe circuits shall be secured so that any conductor that might come loose from a terminal is unlikely to come into contact with another terminal. The conductors shall be separated from conductors of nonintrinsically safe circuits by one of the following methods:

(1) Separation by at least 50 mm (2 in) from conductors of any nonintrinsically safe circuits, and secured

(2) Separation from conductors of nonintrinsically safe circuits by use of a grounded metal partition 0.91 mm (0.0359 in) or thicker or approved restricted access wiring ducts separated from other wiring ducts by a minimum of 19 mm (3⁄4 in)

(3) Separation from conductors of nonintrinsically safe circuits by use of rigid insulating partition 0.91 mm (0.0359 in,) or thicker that extends to within 1.5 mm (0.0625 in) of the enclosure walls

(4) Use of separate wiring compartments for intrinsically safe and nonintrinsically safe terminals

(5) Either all intrinsically safe circuit conductors or all nonintrinsically safe circuit conductors are installed in grounded metal-sheathed or metal-clad cables, where the sheathing or cladding is capable of carrying fault current to ground

Informational Notes have also been converted into positive code language as they had contained recommendations which are not permitted for Informational Notes.

504.30(A)(3) Other (Not in Raceway or Cable Tray Systems). Conductors and cables of intrinsically safe circuits run in other than raceway or cable tray systems shall be separated by at least 50 mm (2 in) and secured from conductors and cables of any nonintrinsically safe circuits unless one of the following applies:

(1) All of the intrinsically safe circuit conductors are in Type MI or MC cables.

(2) All of the nonintrinsically safe circuit conductors are in raceways or Type MI or Type MC cables where the sheathing or cladding is capable of carrying fault current to ground.

Section revised to remove the Exception and place into the rule in positive code language.

504.30(B) From Different Intrinsically Safe Circuit Conductors. The clearance between two terminals for connection of field wiring of different intrinsically safe circuits shall be at least 6 mm (0.25 in), unless this clearance is permitted to be reduced by the control drawing. Different intrinsically safe circuits shall be separated from each other by one of the following means:

(1) The conductors of each circuit are within a grounded metal shield.

(2) The conductors of each circuit have insulation with a minimum thickness of 0.25 mm (0.01 in).

Exception: Unless otherwise identified.

504.30(C) From Grounded Metal. The clearance between the uninsulated parts of field wiring conductors connected to terminals and grounded metal or other conducting parts shall be at least 3 mm (0.125 in).

Separation of intrinsically safe circuits, both terminations and conductors, from all other circuits, including other intrinsically safe circuits, must be maintained in order to ensure the safety of the system. Separation is accomplished by using separate raceways for intrinsically safe wiring, keeping a certain distance between intrinsically safe circuits and other circuits, or in some cases, by making sure the conductors are separated by a minimum thickness of solid insulation.

Section 504.30(B) provides a default field wiring terminal clearance requirement of 6 mm for intrinsically safe circuits, unless the control drawing permits a smaller clearance.

504.50 Grounding.

504.50(A) Intrinsically Safe Apparatus, Enclosures, and Raceways. Intrinsically safe apparatus, enclosures, and raceways, if of metal, shall be connected to the equipment grounding conductor.

Informational Note: See ANSI/ISA RP 12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation — Part 1: Intrinsic Safety. In addition to an equipment grounding conductor connection, a connection to a grounding electrode might be needed for some associated apparatus, such as zener diode barriers, if specified in the control drawing.

504.50(B) Associated Apparatus and Cable Shields. Associated apparatus and cable shields shall be grounded in accordance with the required control drawing. See 504.10(A).

Informational Note: See ANSI/ISA RP 12.06.01,Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation — Part 1: Intrinsic Safety. In addition to an equipment grounding conductor connection, a connection to a grounding electrode might be needed for some associated apparatus, such as zener diode barriers, if specified in the control drawing.

504.50(C) Connection to Grounding Electrodes. Where connection to a grounding electrode is required, the grounding electrode shall be as specified in 250.52(A)(1), (A)(2), (A)(3), and (A)(4) and shall comply with 250.30(A)(4). Sections 250.52(A)(5), (A)(7), and (A)(8) shall not be used if any of the electrodes specified in 250.52(A)(1), (A)(2), (A)(3), or (A)(4) are present.

504.60 Bonding.

504.60(A) Intrinsically Safe Apparatus. Intrinsically safe apparatus, if of metal, shall be bonded in the hazardous (classified) location in accordance with **501.30(B)**, **502.30(B)**, **503.30(B)**, **505.30(B)**, or **506.30(B)**, as applicable.

504.60(B) Metal Raceways. Where metal raceways are used for intrinsically safe system wiring, bonding at all ends of the raceway, regardless of the location, shall be in accordance with **501.30(B)**, **502.30(B)**, **503.30(B)**, **505.30(B)**, or **506.30(B)**, as applicable.

Section 504.60(A) and (B) provides clarity that metal raceways shall be bonded in accordance with the hazardous location rules.

504.70 Sealing. Conduits and cables that are required to be sealed by **501.15**, **502.15**, **505.16**, and **506.16** shall be sealed to minimize the passage of gases, vapors, or dusts. Such seals shall not be required to be explosionproof or flameproof but shall be identified for the purpose of minimizing passage of gases, vapors, or dusts under normal operating conditions and shall be accessible.

*Exception: Seals shall not be required for enclosures that contain only intrinsically safe apparatus, except as required by **501.17**.*

Unlike explosionproof enclosures, where listed explosionproof seals are necessary to keep an explosion generated inside the enclosure from traveling through the raceway, seals on intrinsically safe enclosures do not need to be explosionproof, since intrinsically safe equipment cannot cause an ignition. The seals used do not need to be listed, and only need to provide environmental protection. These seals are required to be identified for the purpose of minimizing the passage of gases, vapors or dusts under normal operating conditions. This rule requires that these seals be accessible. (See Article 100 for the definition of Identified.)

504.80 Identification. Labels required by this section shall be suitable for the environment where they are installed, with consideration given to exposure to chemicals and sunlight.

504.80(A) Terminals. Intrinsically safe circuits shall be identified at terminal and junction locations in a manner that is intended to prevent unintentional interference with the circuits during testing and servicing.

504.80(B) Wiring. Raceways, cable trays, and other wiring methods for intrinsically safe system wiring shall be identified with permanently affixed labels with the wording “Intrinsic Safety Wiring” or equivalent. The labels shall be located so as to be visible after installation and placed so that they may be readily traced through the entire length of the installation. Intrinsic safety circuit labels shall appear in every section of the wiring system that is separated by enclosures, walls, partitions, or floors. Spacing between labels shall not be more than 7.5 m (25 ft).

Exception: Circuits run underground shall be permitted to be identified where they become accessible after emergence from the ground.

Informational Note No. 1: Wiring methods permitted in unclassified locations may be used for intrinsically safe systems in hazardous (classified) locations. Without labels to identify the application of the wiring, enforcement authorities cannot determine that an installation is in compliance with this *Code*

Informational Note No. 2: In unclassified locations, identification is necessary to ensure that nonintrinsically safe wire will not be inadvertently added to existing raceways at a later date.

504.80(C) Color Coding. Color coding shall be permitted to identify intrinsically safe conductors where they are colored light blue and where no other conductors colored light blue are used. Likewise, color coding shall be permitted to identify raceways, cable trays, and junction boxes where they are colored light blue and contain only intrinsically safe wiring.

Terminals and wiring for intrinsically safe circuits need to be identified to keep them adequately separated from all other wiring. Light blue is designated as a color Code for intrinsically safe wiring if color-coding is desired and light blue has not been used as a color Code for any other wiring.

CHANGES TO ARTICLE 505 – ZONE 0, 1, AND 2 LOCATIONS

The following Article 505 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 505.1: Scope
- 505.3: Other Articles
- 505.4: Documentation
- 505.8: Protection Techniques
- 505.9(C)(2): Equipment. Marking. Zone Equipment
- 505.9(E)(3): Threading. Unused Openings
- 505.9(F): Equipment. Optical Fiber Cables
- 505.25: Grounding and Bonding

ARTICLE 505 Zone 0, 1, and 2 Locations

505.1 Scope.

505.1(A) Covered. This article covers the requirements for the zone classification system as an alternative to the division classification system covered in **500.1** for electrical and electronic equipment and wiring for all voltages where fire or explosion hazards might exist due to flammable gases, vapors, or liquids for the following:

(1) Zone 0 hazardous (classified) locations

(2) Zone 1 hazardous (classified) locations

(3) Zone 2 hazardous (classified) locations

Informational Note No. 1: The term "Class I" was originally included as a prefix to Zone 0, Zone 1, and Zone 2 locations and references as an identifier for flammable gases, vapors, or liquids to differentiate from Class II and Class III locations. Zone 0, Zone 1, and Zone 2 only apply to flammable gases, vapors, or liquids, so the "Class I" prefix is redundant and has been deleted. However, the marking of "Class I" is left as an optional marking within this Article.

Informational Note No. 2: See NFPA 497-2021, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, for extracted text that is followed by a reference in brackets. Only editorial changes were made to the extracted text to make it consistent with this Code.

Informational Note No. 3: See Article 100 for the definition of restricted industrial establishment [as applied to hazardous (classified) locations].

505.1(B) Not Covered. This article does not cover electrical and electronic equipment and wiring in the following:

(1) Class I, Class II, or Class III, Division 1 or Division 2 hazardous (classified) locations

(2) Zone 20, Zone 21, or Zone 22 hazardous (classified) locations

(3) Locations subject to the unique risk and explosion hazards associated with explosives, pyrotechnics, and blasting agents

(4) Locations where pyrophoric materials are the only materials used or handled

(5) Features of equipment that involve nonelectrical potential sources of ignition (e.g., couplings, pumps, gearboxes, brakes, hydraulic and pneumatic motors, fans, engines, compressors)

Informational Note No. 1: Common nonelectrical potential sources of ignition include hot surfaces and mechanically generated sparks.

Informational Note No. 2: See ANSI/UL 80079-36, Explosive Atmospheres — Part 36: Non-Electrical Equipment for Explosive Atmospheres — Basic Method and Requirements, and ANSI/UL 80079-37, Explosive Atmospheres — Part 37: Non-Electrical Equipment for Explosive Atmospheres — Non-Electrical Type of Protection Constructional Safety "c" Control of Ignition Source "b", Liquid Immersion "k", for additional information.

The Scope has been rewritten to better identify what is covered and what is not covered in Article 505.

The "Class I" designation is no longer a required marking although it may continue to be used. This was revised in the *Code* as the Zone designations identify the material as being gases and vapors and therefore the "Class I" designation is redundant.

To correlate the two systems, Division 1 would contain both Zone 0 and Zone 1; and Division 2 and Zone 2 are equivalent.

Division 1	Zone 0
	Zone 1
Division 2	Zone 2

Although conductors in raceways can be used to install Zone equipment, equipment standards for Zone hazardous location protection techniques assume that cable, rather than conductors in conduit, is the preferred wiring method for installation in the hazardous location. The types of cable now allowed by the NEC® for use in Zone 1 installations are MI, MC-HL, ITC-HL, TC-ER-HL and Type P cable. Flexible Cord is permitted with certain restrictions. There are many more types of cable available outside the U.S. for use in IEC® Zone installations, but they are not allowed in Zone installations covered by the NEC®. The only types of conduit now allowed by the NEC® for use in Class I, Zone 1 installations are Threaded Rigid Metal Conduit and Threaded Steel Intermediate Metal Conduit. Types PVC and RTRC Conduits are permitted with certain restrictions. These types of Cables and Conduit are also permitted for installation in Class I, Zone 2 locations. In addition to these, Types MC, MV, TC, TC-ER, ITC, ITC-ER, PLTC, PLTC-ER, and Type P cables, Flexible Metal Conduit, Liquidtight Flexible Metal Conduit, Liquidtight Flexible Nonmetallic Conduit, and Flexible Cord are also permitted in Class I, Zone 2 locations with certain restrictions.

Section 505.3 Other Articles was deleted as it was redundant to 90.3 which is general to all Code articles.

505.4 Documentation. Areas designated as hazardous (classified) locations or as unclassified shall be documented on an area classification drawing and other associated documentation. This documentation shall be made available to the AHJ and those authorized to design, install, inspect, maintain, or operate electrical equipment at the location.

Informational Note No. 1: See ANSI/API RP 505, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2; ANSI/ISA60079-10-1 (12.24.01),Explosive Atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres; and EI 15, Model Code of Safe Practice, Part 15: Area Classification for Installations Handling Flammable Fluids, for examples of area classification drawings.

Informational Note No. 2: See 505.8(I)(2), (I)(3), or (I)(4) for information on where gas detection equipment is used as a means of protection. The documentation typically includes the type of detection equipment, its listing, the installation location(s), the alarm and shutdown criteria, and the calibration frequency.

Informational Note No. 3: See NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas; ANSI/API RP 505, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2; ANSI/ISA60079-10-1 (12.24.01), Explosive Atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres; and EI 15, Model Code of Safe Practice, Part 15: Area Classification for Installations Handling Flammable Fluids, for information on the classification of locations.

Informational Note No. 4: See NFPA 77, Recommended Practice on Static Electricity; NFPA 780, Standard for the Installation of Lightning Protection Systems, and API RP 2003, Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents, for information on protection against static electricity and lightning hazards in hazardous (classified) locations.

Informational Note No. 5: See NFPA 30, Flammable and Combustible Liquids Code, and ANSI/API RP 505, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2, for information on ventilation.

Informational Note No. 6: See ANSI/API RP 14FZ, Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations, for information on electrical systems for hazardous (classified) locations on offshore oil and gas producing platforms, drilling rigs, and workover rigs.

Informational Note No. 7: See UL 120101, Definitions and Information Pertaining to Electrical Apparatus in Hazardous Locations, and ANSI/UL 60079-0, Explosive Atmospheres — Part 0: Equipment — General Requirements, for further information on the general application of electrical equipment in hazardous (classified) locations.

Informational Note No. 8: See ANSI/UL 121203, Portable/Personal Electronic Products Suitable for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2, Class III, Division 1, Class III, Division 2, Zone 21 and Zone 22 Hazardous (Classified) Locations, for information on whether portable or transportable equipment having self-contained power supplies, such as battery-operated equipment, could potentially become an ignition source in hazardous (classified) locations.

Informational Note No. 9: See ANSI/UL 60079-28,Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, for information concerning the installation of equipment utilizing optical emissions technology (such as laser equipment) that could potentially become an ignition source in hazardous (classified) locations.

Informational Note No. 10: See IEC/IEEE 60079-30-2,Explosive Atmospheres — Part 30-2: Electrical Resistance Trace Heating — Application Guide for Design, Installation and Maintenance, for information on electrical resistance trace heating for hazardous (classified) locations.

Informational Note No. 11: See IEEE 844.2/CSA C293.2,IEEE/CSA Standard for Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — Application Guide for Design, Installation, Testing, Commissioning, and Maintenance, for information on electric skin effect trace heating for hazardous (classified) locations.

Informational Note No. 12: See IEEE 844.4/CSA C293.4, IEEE/CSA Standard for Impedance Heating of Pipelines and Equipment — Application Guide for Design, Installation, Testing, Commissioning, and Maintenance, for information on electric impedance heating for hazardous (classified) locations.

505.4 has been revised to require the documentation to include an area classification drawing. This requirement had not been specifically addressed before, however was intended.

505.5 Classifications of Locations.

505.5(A) General. Locations shall be classified depending on the properties of the flammable gases, flammable liquid–produced vapors, combustible liquid–produced vapors, combustible dusts, or fibers/flyings that could be present and the likelihood that a flammable or combustible concentration or quantity is present. Each room, section, or area shall be considered individually in determining its classification. Where pyrophoric materials are the only materials used or handled, these locations are outside the scope of this article.

NFPA® 497 and NFPA® 499 do not address the requirements for the use of pyrophoric materials.

Informational Note No. 1: See 505.7 for restrictions on area classification.

Informational Note No. 2: Through the exercise of ingenuity in the layout of electrical installations for hazardous (classified) locations, it is frequently possible to locate much of the equipment in reduced level of classification or in an unclassified location and, thus, to reduce the amount of special equipment required.

Refrigerant machinery rooms that contain ammonia refrigeration systems and are equipped with adequate mechanical ventilation that operates continuously or is initiated by a detection system at a concentration not exceeding 150 ppm shall be permitted to be classified as “unclassified” locations.

Informational Note: For further information regarding classification and ventilation of areas involving closed-circuit ammonia refrigeration systems, see ANSI/IIAR 2-2014, Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems.

505.5(B) Zone 0, 1, and 2 Locations. Zone 0, 1, and 2 locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitible mixtures. Zone 0, 1, and 2 locations shall include those specified in **505.5(B)(1)**, **(B)(2)**, and **(B)(3)**.

505.5(B)(1) Zone 0. A Zone 0 location is a location in which one of the following conditions exists:

(1) Ignitible concentrations of flammable gases or vapors are present continuously

(2) Ignitible concentrations of flammable gases or vapors are present for long periods of time

Informational Note No. 1: See ANSI/API RP 505, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2, and ANSI/ISA 60079-10-1 (12.24.01), Explosive Atmospheres — Part 10-1: Classification of Areas — explosive gas atmospheres, for information for when flammable gases or vapors are present continuously or for long periods of time.

Informational Note No. 2: This classification includes the following locations:

(1) Inside vented tanks or vessels that contain volatile flammable liquids

(2) Inside inadequately vented spraying or coating enclosures where volatile flammable solvents are used

(3) Between the inner and outer roof sections of a floating roof tank containing volatile flammable liquids

(4) Inside open vessels, tanks, and pits containing volatile flammable liquids

(5) Interior of an exhaust duct used to vent ignitible concentrations of gases or vapors

(6) Inside inadequately ventilated enclosures that contain normally venting instruments using or analyzing flammable fluids and venting to the inside of the enclosures

505.5(B)(2) Zone 1. A Zone 1 location is a location

(1) In which ignitible concentrations of flammable gases or vapors are likely to exist under normal operating conditions; or

(2) In which ignitible concentrations of flammable gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or

(3) In which equipment is operated or processes are carried on, of such a nature that equipment breakdown or faulty operations could result in the release of ignitible concentrations of flammable gases or vapors and also cause simultaneous failure of electrical equipment in a mode to cause the electrical equipment to become a source of ignition; or

(4) That is adjacent to a Zone 0 location from which ignitible concentrations of vapors could be communicated, unless communication is prevented by adequate positive pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.

Informational Note No. 1:Normal operation is considered the situation when plant equipment is operating within its design parameters. Minor releases of flammable material may be part of normal operations. Minor releases include the releases from mechanical packings on pumps. Failures that involve repair or shutdown (such as the breakdown of pump seals and flange gaskets, and spillage caused by accidents) are not considered normal operation.

Informational Note No. 2: This classification usually includes the following locations:

(1) Where volatile flammable liquids or liquefied flammable gases are transferred from one container to another

(2) Areas in the vicinity of spraying and painting operations where flammable solvents are used

(3) Adequately ventilated drying rooms or compartments for evaporation of flammable solvents

(4) Adequately ventilated locations containing fat and oil extraction equipment using volatile flammable solvents

(5) Portions of cleaning and dyeing plants where volatile flammable liquids are used

(6) Adequately ventilated gas generator rooms and other portions of gas manufacturing plants where flammable gas might escape

(7) Inadequately ventilated pump rooms for flammable gas or for volatile flammable liquids

(8) Interiors of refrigerators and freezers in which volatile flammable materials are stored in the open, lightly stoppered, or in easily ruptured containers

(9) Other locations where ignitible concentrations of flammable vapors or gases are likely to occur in the course of normal operation but are not classified Zone 0

505.5(B)(3) Zone 2. A Zone 2 location is a location

(1) In which ignitible concentrations of flammable gases or vapors are not likely to occur in normal operation and, if they do occur, will exist only for a short period; or

(2) In which volatile flammable liquids, flammable gases, or flammable vapors are handled, processed, or used but in which the liquids, gases, or vapors normally are confined within closed containers of closed systems from which they can escape, only as a result of accidental rupture or breakdown of the containers or system, or as a result of the abnormal operation of the equipment with which the liquids or gases are handled, processed, or used; or

(3) In which ignitible concentrations of flammable gases or vapors normally are prevented by positive mechanical ventilation but which may become hazardous as a result of failure or abnormal operation of the ventilation equipment; or

(4) That is adjacent to a Zone 1 location, from which ignitible concentrations of flammable gases or vapors could be communicated, unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.

Informational Note: The Zone 2 classification usually includes locations where volatile flammable liquids or flammable gases or vapors are used but which would become hazardous only in case of an accident or of some unusual operating condition.

505.6 Material Groups. For purposes of testing, approval, and area classification, various air mixtures (not oxygen enriched) shall be grouped as required in **505.6(A)**, **(B)**, and **(C)**.

Informational Note No. 1: See 90.2(D). This Code does not apply to installations underground in mines. Group I is intended for use in describing atmospheres that contain firedamp: a mixture of gases, composed mostly of methane, found underground, usually in mines.

Informational Note No. 2: See ANSI/UL 60079-11, Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i". The gas and vapor subdivision is based on the maximum experimental safe gap (MESG), minimum igniting current (MIC), or both.

Informational Note No. 3: See ISO/IEC 80079-20-1, Explosive atmospheres — Part 20-1: Material characteristics for gas and vapour classification — Test methods and data, for information on the test equipment for determining MIC in the classification of gases or vapors according to their maximum experimental safe gaps and minimum igniting currents.

Informational Note No. 4: Group II is currently subdivided into Group IIA, Group IIB, and Group IIC. Prior marking requirements permitted some types of protection to be marked without a subdivision, showing only Group II.

Informational Note No. 5: It is necessary that the meanings of the different equipment markings and Group II classifications be carefully observed to avoid confusion with Class I, Division 1 and Division 2, Groups A, B, C, and D.

Zone 0, 1, and 2, groups shall be as follows:

505.6(A) Group IIC. Atmospheres containing acetylene, hydrogen, or flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value less than or equal to 0.50 mm or minimum igniting current (MIC) ratio less than or equal to 0.45. [**497**:3.3.5.2.3]

Informational Note: See 500.6(A)(1) and (A)(2) for Class I, Group A and Class I, Group B classifications. Group IIC is equivalent to a combination of Class I, Group A and Class I, Group B.

505.6(B) Group IIB. Atmospheres containing acetaldehyde, ethylene, or flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either maximum experimental safe gap (MESG) values greater than 0.50 mm and less than or equal to 0.90 mm or minimum igniting current ratio (MIC ratio) greater than 0.45 and less than or equal to 0.80. [**497**:3.3.5.2.2]

Informational Note No. 1: See 500.6(A)(3). Class I, Group C is equivalent to Group IIB.

Informational Note No. 2: Class I, Group B is equivalent to Group IIB + H_2.

505.6(C) Group IIA. Atmospheres containing acetone, ammonia, ethyl alcohol, gasoline, methane, propane, or flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.90 mm or minimum igniting current (MIC) ratio greater than 0.80. [**497**:3.3.5.2.1]

Informational Note: See 500.6(A)(4). Class I, Group D is equivalent to Group IIA.

As in the Class/Division system the grouping of flammable gases in the Zone system is also done by ranking them by ignition energy and MESG. Group I gases are those found in underground mines, and are not covered by the scope of the NEC®. Group II gases are those not in mining situations, and are divided into three groups:

Group IIC, Group IIB and Group IIA, from lowest ignition energy to highest. The correlation of the Zone gas groups to the division gas Groups is shown in the following table.

Comparison of Material Group Classification

Typical Material	Article 500 Division Group	Article 505 Zone Group
Acetylene	A	IIC
Hydrogen	B	IIC *
Ethylene	C	IIB
Gasoline-Propane-Methane	D	IIA

* Products rated and marked for IIB +H_2 are suitable for use in hydrogen atmospheres.

505.7 Special Precaution. This article requires equipment construction and installation that ensures safe performance under conditions of proper use and maintenance.

Informational Note No. 1: It is important that inspection authorities and users exercise more than ordinary care regarding to the installation and maintenance of electrical equipment in hazardous (classified) locations.

Informational Note No. 2: Electrical equipment that is dependent on the protection technique permitted by 505.8(A) might not be suitable for use at temperatures lower than -20°C (-4°F) unless they are identified for use at lower temperatures. Low ambient conditions require special consideration. At low ambient temperatures, flammable concentrations of vapors might not exist in a location classified at normal ambient temperature.

505.7(A) Implementation of Zone Classification System. Classification of areas, engineering and design, selection of equipment and wiring methods, installation, and inspection shall be performed by qualified persons.

The Section requires that the total process of implementation of the Zone Classification System be conducted by qualified persons. (See Article 100 for the definition of qualified persons). The older rule requiring that the classification of areas and the selection of equipment and wiring methods be the sole authority of a registered professional engineer had been removed.

505.7(B) Dual Classification. In instances of areas within the same facility classified separately, Zone 2 locations shall be permitted to abut, but not overlap, Class I, Division 2 locations. Zone 0 or Zone 1 locations shall not abut Class I, Division 1 or Division 2 locations.

505.7(C) Reclassification Permitted. A Class I, Division 1 or Division 2 location shall be permitted to be reclassified as a Zone 0, Zone 1, or Zone 2 location, provided all of the space that is classified because of a single flammable gas or vapor source is reclassified under the requirements of this article.

505.7(D) Solid Obstacles. Flameproof equipment with flanged joints shall not be installed such that the flange openings are closer than the distances shown in **Table 505.7(D)** to any solid obstacle that is not a part of the equipment (such as steelworks, walls, weather guards, mounting brackets, pipes, or other electrical equipment) unless the equipment is listed for a smaller distance of separation.

Table 505.7(D) *Minimum Distance of Obstructions from Flameproof "d" Flange Openings*

Gas Group	Minimum Distance	
	mm	in.
IIC	40	$1\frac{37}{64}$
IIB	30	$1\frac{3}{16}$
IIA	10	$\frac{25}{64}$

Section 505.7(D) is necessary as testing of enclosures with flanged joints showed that smaller clearances than those currently in the type "d" equipment standards are necessary to stop ignition transmission of a hydrogen flammable atmosphere, if the outside edge of the flange is too close to a solid object. Precautions need to be taken so that type "d" enclosures with flanged joints are not installed with a solid object too close to the outside of the flange, unless that enclosure has been tested with a solid obstruction in front of the flange and rated for that condition.

505.7(E) Simultaneous Presence of Flammable Gases and Combustible Dusts or Fibers/Flyings. Where flammable gases, combustible dusts, or fibers/flyings are or may be present at the same time, the simultaneous presence shall be considered during the selection and installation of the electrical equipment and the wiring methods, including the determination of the safe operating temperature of the electrical equipment.

This section addresses the issue of simultaneous presence since Article 506 had addressed this issue. This section correlates with the requirements of Article 506.

505.7(F) Available Fault Current for Type of Protection "e". Unless listed and marked for connection to circuits with higher available fault current, the available fault current for electrical equipment using type of protection "e" for the field wiring connections in Zone 1 locations shall be limited to 10,000 rms symmetrical amperes to reduce the likelihood of ignition of a flammable atmosphere by an arc during a short-circuit event.

Informational Note: Limitation of the available fault current to this level may require the application of current-limiting fuses or current-limiting circuit breakers.

This section and Informational Note is necessary as ANSI/UL 508A limits the short circuit current rating of terminals and terminal blocks to 10,000 rms Amps unless otherwise specified. These terminals are also employed in applications other than those covered by ANSI/UL 508A.

505.8 Protection Techniques. Acceptable protection techniques for electrical and electronic equipment in hazardous (classified) locations shall be as described in **505.8(A)** through (**Q**).

Informational Note No. 1: See ANSI/UL 120101, Definitions and Information Pertaining to Electrical Equipment in Hazardous Locations, and ANSI/UL 60079-0, Explosive Atmospheres — Part 0: Equipment — General Requirements, for additional information.

Informational Note No. 2: See Chapter 9, Table 13 for descriptions of subdivisions of protection techniques.

505.8(A) Flameproof Enclosure "d". This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations.

505.8(B) Pressurized Enclosure "p". This protection technique shall be permitted for equipment in those Zone 1 or Zone 2 locations for which it is identified.

505.8(C) Intrinsic Safety "i". This protection technique shall be permitted for apparatus and associated apparatus for Zone 0, Zone 1, or Zone 2 locations for which it is listed.

505.8(D) Type of Protection "n". This protection technique shall be permitted for equipment in Zone 2 locations. Type of protection "n" is further subdivided into nA, nC, and nR.

505.8(E) Liquid Immersion "o". This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations.

505.8(F) Increased Safety "e". This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations.

505.8(G) Encapsulation "m". This protection technique shall be permitted for equipment in Zone 0, Zone 1, or Zone 2 locations for which it is identified.

505.8(H) Powder Filling "q". This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations.

505.8(I) Detection Systems for Flammable Gases. A detection system for flammable gases shall be permitted as a means of protection in restricted industrial establishments.

505.8(I)(1) General. Any gas detection system used as a protection technique shall meet all of the requirements in **505.8(I)(1)(a)** through **(I)(1)(e)**.

(a) The gas detection equipment used shall be listed for Zone 1 and listed for the detection of the specific gas or vapor to be encountered.

(b) The gas detection system shall not use portable or transportable equipment, or temporary wiring methods.

(c) The gas detection system shall only use point-type sensors. The system shall be permitted to be augmented with open-path (line-of-sight)–type sensors, but open-path type sensors shall not be the basis for this protection technique.

(d) The type of detection equipment, its listing, the installation location(s), the alarm and shutdown criteria, and the calibration frequency shall be documented where combustible gas detectors are used as a protection technique.

(e) The applications for the use of combustible gas detection systems as a protection technique shall be limited to **505.8(I)(2)**, **(I)(3)**, or **(I)(4)**.

Informational Note No. 1: See ANSI/UL 121303, Guide for Use of Detectors for Flammable Gases, or ANSI/FM 121303, Guide for Use of Detectors for Flammable Gases, for additional information.

Informational Note No. 2: See ANSI/UL 60079-29-1, Explosive Atmospheres — Part 29-1: Gas Detectors — Performance Requirements of Detectors for Flammable Gases, or ANSI/FM 60079-29-1, Explosive Atmospheres — Part 29-1: Gas Detectors — Performance Requirements of Detectors for Flammable Gases, for additional information.

Informational Note No. 3: See ANSI/API RP 505, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2, for additional information.

Informational Note No. 4: See ANSI/UL 60079-29-2,Explosive Atmospheres — Part 29-2: Gas Detectors — Selection, Installation, Use and Maintenance of Detectors for Flammable Gases and Oxygen, or ANSI/FM 60079-29-2, Explosive Atmospheres — Part 29-2: Gas Detectors — Selection, Installation, Use and Maintenance of Detectors for Flammable Gases and Oxygen, for additional information.

505.8(I)(2) Inadequate Ventilation. A location, enclosed space, or building that is classified as a Zone 1 location due to inadequate ventilation and that is provided with a combustible gas detection system for flammable gases shall be permitted to use electrical equipment, installation methods, and wiring practices suitable for Zone 2 installations. Sensing a gas concentration of not more than 40 percent of the lower flammable limit or a gas detector system malfunction shall activate an alarm (audible or visual, or both, as most appropriate for the area).

505.8(I)(3) Interior of a Building or Enclosed Space. Any building or enclosed space that does not contain a source of flammable gas or vapors that is located in, or with an opening into, a Zone 2 hazardous (classified) location that is provided with a combustible gas detection system for flammable gases shall be permitted to use electrical equipment, installation methods, and wiring practices suitable for unclassified installations under all of the following conditions:

(1) An alarm (audible or visual, or both) shall be sounded at not more than 20 percent of the lower flammable limit.

(2) Sensing a gas concentration of not more than 40 percent of the lower flammable limit or a gas detector system malfunction shall both activate an alarm (audible or visual, or both, as most appropriate for the area) and initiate automatic disconnection of power from all electrical devices in the area that are not suitable for Zone 2.

(3) The power disconnecting device(s) shall be suitable for Zone 1 if located inside the building or enclosed space. If the disconnecting device(s) is located outside the building or enclosed space, it shall be suitable for the location in which it is installed.

Redundant or duplicate equipment (such as sensors) shall be permitted to be installed to avoid disconnecting electrical power when equipment malfunctions are indicated.

When automatic shutdown could introduce additional or increased hazard, this technique shall not be permitted.

505.8(I)(4) Interior of a Control Panel. Inside the interior of a control panel containing instrumentation or other equipment using or measuring flammable liquids, gases, or vapors and that is provided with a detection system for flammable gases equipment shall be allowed to use electrical equipment, installation methods, and wiring practices suitable for Zone 2 installations.

An alarm (audible or visual, or both) shall be sounded at not more than 40 percent of the lower flammable limit.

Since Division 1 contains Zone 0, which is the most dangerous of the hazardous locations, equipment used in Division 1 has to be built to handle the worst-case conditions. In a Division 1 location, the only protection techniques available are explosionproof enclosures, purging or pressurizing, and intrinsic safety for very low power applications.

By splitting Division 1 into two parts, Zone 0 and Zone 1, the Zone system allows the use of some additional protection techniques such as increased safety, encapsulation, and powder filling, that are not possible for Division 1 equipment. Intrinsic safety and encapsulation "ma" are the only protection techniques allowed in Zone 0.

In 505.8(I), a documentation requirement for listing information, the types of detectors used, installation locations, alarm and shutdown criteria and calibration frequency is included in the Combustible Gas Detection System protection technique.

Informational Note No. 1 in 505.8(I) references ANSI/API RP 505 instead of ANSI/API RP 500. API RP 505 covers area classifications for the Zone system in petroleum facilities, and API RP 500 covers classifications for the Division system.

Section 505.8(I) requires that combustible gas detection equipment be listed for the appropriate gas group and for the specific gas or vapor encountered.

This section was revised to provide sufficient detail to install and operate the gas detection system in order to adequately function as an equipment protection technique for electrical equipment that would not independently be suitable for the hazardous location.

505.8(J) Protection by Electrical Resistance Trace Heating "60079-30-1". This protection technique shall be permitted for electrical resistance trace heating equipment in Zone 1 or Zone 2 for which it is listed.

A new product standard has been introduced for the examination, testing, and marking of electrical resistance trace heating. This equipment is now identified as Type of Protection "60079-30-1" in accordance with ANSI/UL 60079-30-1:2017.

505.8(K) Inherently Safe Optical Radiation "op is". This protection technique shall be permitted for equipment in Zone 0, Zone 1, or Zone 2 locations for which the equipment is identified.

505.8(L) Protected Optical Radiation "op pr". This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations for which the equipment is identified.

505.8(M) Optical System With Interlock "op sh". This protection technique shall be permitted for equipment in Zone 0, Zone 1, or Zone 2 locations for which the equipment is identified.

Non-convergent LED light sources such as luminaires are not considered to be a source of optical radiation that would create dangerous isolated temperature rises on surfaces in a hazardous (classified) location. For other light sources that do not apply to the hazardous condition refer to ANSI/UL 60079-28 "Explosive Atmospheres – Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation".

505.8(N) Protection by Skin Effect Trace Heating "IEEE 844.1". This protection technique shall be permitted for skin effect trace heating equipment in Zone 1 or Zone 2 for which it is listed.

505.8(O) Protection by Impedance Heating "IEEE 844.3". This protection technique shall be permitted for impedance heating of pipelines, and equipment in Zone 2 locations for which it is listed.

This Protection Technique has been added in the 2023 Code.

505.8(P) Pressurized Room "p". This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations for which it is identified.

This Protection Technique has been added in the 2023 Code.

505.8(Q) Special Protection "s". This protection technique shall be permitted for equipment in Zone 0, Zone 1, or Zone 2 locations for which it is listed.

This Protection Technique has been added in the 2023 Code.

505.9 Equipment.

505.9(A) Suitability. Suitability of identified equipment shall be determined by one of the following:

(1) Equipment listing or labeling

(2) Evidence of equipment evaluation from a qualified testing laboratory or inspection agency concerned with product evaluation

(3) Evidence acceptable to the authority having jurisdiction such as a manufacturer's self-evaluation or an owner's engineering judgment

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

505.9(B) Listing.

(1) Equipment that is listed for a Zone 0 location shall be permitted in a Zone 1 or Zone 2 location of the same gas or vapor, provided that it is installed in accordance with the requirements for the marked type of protection. Equipment that is listed for a Zone 1 location shall be permitted in a Zone 2 location of the same gas or vapor, provided that it is installed in accordance with the requirements for the marked type of protection.

(2) Equipment shall be permitted to be listed for a specific gas or vapor, specific mixtures of gases or vapors, or any specific combination of gases or vapors.

Informational Note: One common example is equipment marked for "IIB. + H_2."

Equipment intended to be installed in NEC® Zone hazardous locations needs to be evaluated to determine its suitability. Equipment that is certified to standards other than those adapted to meet U.S. requirements, may not be suitable for use when installed using NEC® installation techniques, and the electrical portions of the equipment may not even meet the minimum U.S. requirements for use in unclassified locations.

For example, type "db" enclosures evaluated to the IEC® standards assume that cables will be used to connect them to the wiring system, and will be sealed by a cable gland within 50 mm (2 in) of the enclosure. If the enclosure is connected using conduit, with a seal within 18 inches to NEC® rules, the internal explosion pressure could be higher. The IEC® test gas mixtures used for the explosion transmission testing are also different from those specified in the standards for Division explosionproof equipment. These factors taken together could cause a type "db" enclosure to fail when installed with conduit according to the NEC® rules.

The Informational Note for this section notes the gas group rating IIB +H_2 is often used. This is because IIB +H_2 in the Zone system corresponds to the Division system Gas Group B.

Intrinsically safe apparatus listed and marked only for Zone 0 needs to be used with the associated apparatus for Zone 0 specified on its control drawing, even if the intrinsically safe apparatus is installed in Zone 1 or Zone 2. If the installation for Zone 1 and/or Zone 2 uses different associated apparatus, it needs to be separately listed and marked for Zone 1 and/or Zone 2, and the specifications for the Zone 1 and/or Zone 2 associated apparatus need to be listed on the control drawing as well.

505.9(C) Marking. Equipment shall be marked in accordance with **505.9(C)(1)** or **(C)(2)**.

505.9(C)(1) Division Equipment. Equipment identified for Class I, Division 1 or Class I, Division 2 shall, in addition to being marked in accordance with **500.8(C)**, be permitted to be marked with all of the following:

(1) Class I, Zone 1 or Zone 1; Class I, Zone 2 or Zone 2 (as applicable)

(2) Applicable gas classification group(s) in accordance with **Table 505.9(C)(1)(2)**

(3) Temperature classification in accordance with **505.9(D)(1)**

Table 505.9(C)(1) *Material Groups*

Material Group	Comment
IIC	See 505.6(A)
IIB	See 505.6(B)
IIA	See 505.6(C)

505.9(C)(2) Zone Equipment. Equipment meeting one or more of the protection techniques described in **505.8** shall be marked with all of the following in the order shown:

This section includes all of the current Zone 0, 1, and 2 protection techniques based on the revised product standards.

(1) Class I shall be an optional marking. If it is included in the equipment marking, the Class I marking shall precede the zone marking.

"Class I" term is no longer a mandatory marking requirement since the Zone marking identifies the type of material.

(2) Zone in accordance with **Chapter 9, Table 13.**

Item (2) had been revised to make it clear that the Zone number must be identified on the equipment. Chapter 9, Table 13 replaces Table 505.9(C)(2)(4).

(3) Symbol "AEx".

(4) Protection technique(s) in accordance with **Chapter 9, Table 13.**

(5) Applicable material group in accordance with **Table 505.9(C)(1)** or a specific gas or vapor.

(6) Temperature classification in accordance with **505.9(D)**.

(7) Equipment protection level (EPL)

Item (7) now requires the EPL marking. Equipment Protection Levels (EPL) were added to align with the introduction of the concept in the product standards. The EPL is aligned with the Zone.

EPL's were introduced as a result of extensive revisions to the 60079 series of Ex standards. These standards were revised to identify the different performance, construction, and marking requirements for each Zone. A suffix "a" to the Protection Method indicates evaluation to Zone 0 with an EPL of Ga. A suffix "b" to the Protection Method indicates evaluation to Zone 1 with an EPL of Gb. A suffix "c" to the Protection Method indicates evaluation to Zone 2 with an EPL of Gc.

*Exception No. 1: Associated apparatus NOT suitable for installation in a hazardous (classified) location shall be required to be marked only with **505.9(C)(2)(3)**, **(C)(2)(4)**, and **(C)(2)(5)**, but BOTH the symbol AEx (3) and the symbol for the type of protection (4) shall be enclosed within the same square brackets, for example, [AEx ia Ga] IIC.*

Exception No. 1 to 505.9(C)(2)(6) clarifies the use of the square brackets in the marking requirements for intrinsically safe associated apparatus. If the associated apparatus is designed to be installed in the hazardous location, it has to use another method of protection to protect the associated apparatus, and only the output of the hazardous area terminals is intrinsically safe and can use intrinsically safe wiring methods. For example, associated apparatus that is inside a flameproof housing with an intrinsically safe output suitable for Zone 0 would be marked AEx d [ia]. Since the associated apparatus is flameproof, or AEx d, the equipment can be installed in a Zone 1 location. The intrinsically safe output is acceptable for Zone 0, so it can be wired from the Zone 1 location into a Zone 0 location; using intrinsically safe wiring methods from the AEx d Zone 1 installation into the Zone 0 location (after passing through an explosionproof seal to leave the AEx d enclosure). Zone 1 wiring methods must be used to connect the AEx d installation to the unclassified location.

*Exception No. 2: Simple apparatus as defined in Article **100** Part III shall not be required to have a marked operating temperature or temperature class.*

Table 505.9(C)(2)(4) *Equipment Suitability*

Type of Protection	Marking	Permitted Location
Associated apparatus for Zone 0	[ia]	Unclassified[1]
Associated apparatus for Zone 1	[ib]	Unclassified[1]
Associated apparatus for Zone 2	[ic]	Unclassified[1]
Associated pressurization equipment	[p]	Unclassified[1]
Intrinsic safety	ia; Class I, Division 1 Intrinsic Safety	
Encapsulation	ma	
Optical radiation, inherently safe	op is, with EPL Ga[2]	Zone 0
Optical radiation, with interlock	op sh, with EPL Ga[2]	
EPL Ga, with suitable type of protection[3]		
Equipment Suitable for Use in Zone 0		
Equipment Suitable for Use in Class I, Division 1		
Flameproof enclosure	d; db	
Intrinsic safety	ib	
Increased safety	e; eb	
Pressurized enclosure	p; px, pxb; py; pyb	
Encapsulation	m; mb	
Powder filling	q; qb	Zone 1
Liquid immersion	o; ob	
Electrical resistance trace heating	60079-30-1, with EPL Gb[2]	
Skin effect trace heating	IEEE 844.1, with EPL Gb[2]	
Optical radiation, inherently safe	op is, with EPL Gb[2]	
Optical radiation, with interlock	op sh, with EPL Gb[2]	
Optical radiation, protected	op pr, with EPL Gb[2]	
EPL Gb, with suitable type of protection[3]		
Equipment Suitable for Use in Zone 1		
Equipment Suitable for Use in Class I, Division 2		
Type of protection “n”	nA; nC; nR	
Pressurized enclosure	pz, pzc	
Intrinsic safety	ic	
Flameproof enclosure	dc	
Increased safety	ec	
Liquid immersion	oc	Zone 2
Encapsulation	mc	
Electrical resistance trace heating	60079-30-1, with EPL Gc[2]	
Skin effect trace heating	IEEE 844.1, with EPL Gc[2]	
Optical radiation, inherently safe	op is, with EPL Gc[2]	
Optical radiation, with interlock	op sh, with EPL Gc[2]	
Optical radiation, protected	op pr, with EPL Gc[2]	
EPL Gc, with suitable type of protection[3]		
Other electrical equipment — general purpose motors[4]		

[1]Permitted to be installed in a hazardous (classified) location if suitably protected using another type of protection.

[2]Equipment marked with these types of protection is available in multiple levels of protection that are not specifically identified within the AEx marking.

[3]The EPL takes precedence over the types of protection. For example, “ia Gb” is suitable for Zone 1 (not Zone 0). “60079-30-1 Gc” is suitable for Zone 2 (not Zone 1). Selection according to the marked EPL is critical to the safe application of this equipment.

[4]“Other electrical equipment — general purpose motors” refers to motors in accordance with Exception No. 4 to 505.20(C).

The Table is replaced by an updated applicability Table. Equipment Protection Levels (EPL) are added to align with the introduction of the concept in the product standards.

CONTROL STATIONS LISTED FOR CLASS I, ZONE 1 AEX DEM IIC T6

UNICODE™ 2 SERIES POLYESTER

UNICODE™ 2 SERIES STAINLESS STEEL

Exception No. 2 of 505.9(C)(2)(6) clarifies that simple apparatus, as defined in Article 504, is not marked for use in hazardous locations. Even though the potential temperature rise of the simple apparatus must be evaluated using information from the associated apparatus control drawing, a temperature class or operating temperature is not marked.

Exception No. 3: Fittings for the termination of cables shall not be required to have a marked operating temperature or temperature class.

Exception No. 3 of 505.9(C)(2)(6) clarifies that cable fittings are not required to be marked with a temperature classification as they are non-heat producing equipment.

Informational Note No. 1: See Informational Note Figure 505.9(C)(2), for an explanation of the marking that is required. An example of the required marking for intrinsically safe apparatus for installation in Zone 0 is "Class I, Zone 0, AEx ia IIC T6 Ga" or "Zone 0, AEx, ia, IIC T6 Gb."

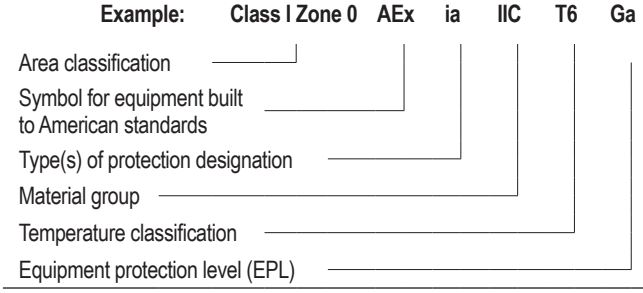
Informational Note No. 2: An example of the required marking for intrinsically safe associated apparatus mounted in a flameproof enclosure for installation in Zone 1 is "Class I, Zone 1 AEx db[ia] IIC T4 Gb" or "Zone 1, AEx, db[ia Ga] IIC T4 Gb."

Informational Note No. 3: An example of the required marking for intrinsically safe associated apparatus NOT for installation in a hazardous (classified) location is "[AEx ia Ga] IIC."

Informational Note No. 4: EPLs (or equipment protection levels) are designated as G for gas or D for dust and are then followed by a letter (a, b, or c) to give the user a better understanding as to whether the equipment provides either (a) a "very high," (b) a "high," or (c) an "enhanced" level of protection against ignition of an explosive atmosphere. For example, a Zone 1, AEx db IIC T4 Gb motor (which is suitable by protection concept for application in Zone 1) is marked with an EPL of "Gb" to indicate that it was provided with a high level of protection.

Informational Note No. 5: See ANSI/UL 60079-26,Explosive Atmospheres — Part 26: Equipment with Equipment Protection Level (EPL) Ga, for additional information. Equipment installed outside a Zone 0 location and electrically connected to equipment located inside a Zone 0 location might be marked Zone 0/1. The "/" indicates that equipment contains a separation element and can be installed at the boundary between a Zone 0 and a Zone 1 location.

Informational Note Figure 505.9(C)(2), No. 1, *Zone Equipment Marking.*



The table includes the EPL (Equipment Protection Levels) for the relevant Types of Protection Designations. This was required as the product standards now contain these markings.

505.9(D) Temperature Classification Marking. The temperature marking specified in 505.9(D)(1) shall not exceed the autoignition temperature of the specific gas or vapor to be encountered.

Informational Note No. 1: See ANSI/UL 60079-26, Explosive Atmospheres — Part 26: Equipment with Equipment Protection Level (EPL) Ga , for more information. Equipment installed outside a Zone 0 location and electrically connected to equipment located inside a Zone 0 location might be marked Zone 0/1. The "/" indicates that equipment contains a separation element and can be installed at the boundary between a Zone 0 and a Zone 1 location.

Table 505.9(D)(1) *Classification of Maximum Surface Temperature for Group II Electrical Equipment*

Temperature Class (T Code)	Maximum Surface Temperature (°C)
T1	≤ 450
T2	≤ 300
T3	≤ 200
T4	≤ 135
T5	≤ 100
T6	≤ 85

EQUIPMENT LABELED TO SHOW TEMPERATURE CLASS

CODE•MASTER™ LED LUMINAIRES

NEC/CEC:
- *CLASS I, DIVISION 1 AND 2, GROUPS B, C, D*
- *CLASS I, ZONE 1, GROUPS IIA, IIB, IIB + H_2*
- *CLASS II, DIVISION 1, GROUP E, F, G*
- *CLASS II, DIVISION 2, GROUP F, G*
- *CLASS III*
- *SIMULTANEOUS EXPOSURE*
- *TYPE 3R, 4X*
- *IP66/67*
- *SUITABLE FOR USE IN WET LOCATIONS*
- *MARINE OUTSIDE TYPE (SALT WATER)*
- *APPROVED FOR USE IN PAINT SPRAY BOOTHS*

Type	*Ambient Temperature C° (F°)*	*Supply Wire Temperature C° (F°)*	*Class I, Division 1 (Gas)*	*Class I, Zone 1 (Gas)*	*Class II Division 1 (Dust) & Simultaneous Exposure*
CMLED40	*+40 (+104)*	*+90 (+194)*	*T6*	*T6*	*T6*
	+55 (+131)	*+90 (+194)*	*T5*	*T5*	*T5*
	+65 (+149)	*+90 (+194)*	*T4A*	*T4*	*T4A*

Equipment shall be marked to show the operating temperature or temperature class referenced to a 40°C ambient, or at the higher ambient temperature if the equipment is rated and marked for an ambient temperature of greater than 40°C. The temperature class, if provided, shall be indicated using the temperature class (T code) shown in Table 505.9(D).

Electrical equipment designed for use in the ambient temperature range between −20°C and +40°C shall require no ambient temperature marking.

Electrical equipment that is designed for use in a range of ambient temperatures other than −20°C to +40°C is considered to be special; and the ambient temperature range shall then be marked on the equipment, including either the symbol "Ta" or "Tamb" together with the special range of ambient temperatures, in degrees Celsius.

Informational Note No. 2: For example, such a marking might be "−30°C to +40°C."

Exception No. 1: Equipment of the non–heat-producing type, such as conduit fittings, and equipment of the heat-producing type having a maximum temperature of not more than 100°C (212°F) shall not be required to have a marked operating temperature or temperature class.

*Exception No. 2: Equipment identified for Class I, Division 1 or Division 2 locations as permitted by **505.20(A), (B),** and **(C)** shall be permitted to be marked in accordance with **505.8(C)** and **Table 500.8(C)(4).***

505.9(E) Threading. The supply connection entry thread form shall be NPT or metric. Conduit and fittings shall be made wrenchtight to prevent sparking when fault current flows through the conduit system, and to ensure the explosionproof or flameproof integrity of the conduit system where applicable. Equipment provided with threaded entries for field wiring connections shall be installed in accordance with **505.9(E)(1)** or **(E)(2)** and with **(E)(3)**.

505.9(E)(1) Equipment Provided with Threaded Entries for NPT Threaded Conduit or Fittings. For equipment provided with threaded entries for NPT threaded conduit or fittings, listed conduit, listed conduit fittings, or listed cable fittings shall be used.

Section clarifies that not only is the conduit required to be "listed" but also the conduit fittings and cable fittings.

All NPT threaded conduit and fittings shall be threaded with a National (American) Standard Pipe Taper (NPT) thread.

NPT threaded entries into explosionproof or flameproof equipment shall be made up with at least five threads fully engaged.

Exception: For listed explosionproof or flameproof equipment, factory-threaded NPT entries shall be made up with at least 4-1⁄2 threads fully engaged.

Informational Note No. 1: See ASME B1.20.1, Pipe Threads, General Purpose (Inch), for thread specifications for male NPT threads.

Informational Note No. 2: See ANSI/UL 60079-1,Explosive Atmospheres — Part 1: Equipment Protection by Flameproof Enclosures "d", and ASME B1.20.1, Pipe Threads, General Purpose (Inch), for information on female NPT threaded entries using modified National Standard Pipe Taper (NPT) thread.

505.9(E)(2) Equipment Provided with Threaded Entries for Metric Threaded Conduit or Fittings. For equipment with metric threaded entries, listed conduit fittings or listed cable fittings shall be used. Such entries shall be identified as being metric, or listed adapters to permit connection to conduit or NPT threaded fittings shall be provided with the equipment and shall be used for connection to conduit or NPT threaded fittings.

Metric threaded fittings installed into explosionproof or flameproof equipment entries shall have a class of fit of at least 6g/6H and be made up with at least five threads fully engaged.

Informational Note: See ISO 965-1, ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data, and ISO 965-3, ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads, for threading specifications for metric threaded entries.

This section requires that metric threaded entries shall have a specified class of fit of 6g/gH and that a minimum required number of threads are engaged based on the Group Classifications. The intended requirement is that the thread engagement shall be no less than 5 threads made up wrenchtight for Groups C, D, IIB, and IIA and no less than 8 threads made up wrenchtight for Groups A, B, IIC, and IIB +H_2. This metric fit Class Is similar to the unified straight thread Class 2 fit. The end-user does not need to be concerned with this class of fit where the product is listed. This requirement is controlled between the equipment manufacturer and the listing agency.

505.9(E)(3) Unused Openings. All unused openings shall be closed with blanking elements or close-up plugs that are listed for the location and will maintain the type of protection. Thread engagement shall comply with **505.9(E)(1)** or (E)(2).

This section addresses the requirements for close-up plugs used to close unused openings. The section requires these plugs to be "listed" and that a specified thread engagement is provided.

Close-up plugs are commonly referred to as "blanking elements" and visa-versa. These plugs may not independently be marked with the listing and classification information, however they have been evaluated as part of the full box and enclosure listing.

505.9(F) Optical Fiber Cables. An optical fiber cable, with or without current-carrying conductors (hybrid optical fiber cable), shall be installed to address the associated fire hazard and sealed to address the associated explosion hazard in accordance with **505.15** and **505.16**.

Composite revised to Hybrid to reflect changes to the definition in article 100 as well as referenced to this cable in Article 770, Chapter 8, and Article 640.

505.9(G) Equipment Involving Optical Radiation. For equipment involving sources of optical radiation (such as laser or LED sources) in the wavelength range from 380 nm to 10 µm, the risk of ignition from optical radiation shall be considered for all electrical parts and circuits that may be exposed to the radiation, both inside and outside the optical equipment. This includes optical equipment, which itself is located outside the explosive atmosphere, but its emitted optical radiation enters such atmospheres.

Informational Note: See ANSI/UL 60079-28, Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, for information on types of protection to minimize the risk of ignition in explosive atmospheres from optical radiation.

Exception: All luminaires (fixed, portable, or transportable) and hand lights, intended to be supplied by mains (with or without galvanic isolation) or powered by batteries, with any continuous divergent light source, including LEDs, shall be excluded from this requirement.

Non-convergent LED light sources such as luminaires are not considered to be a source of optical radiation that would create dangerous isolated temperature rises on surfaces in a hazardous (classified) location. For other light sources that do not apply to the hazardous condition refer to ANSI/UL 60079-28 "Explosive Atmospheres – Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation".

505.15 Wiring Methods. Wiring methods shall maintain the integrity of protection techniques and shall comply with **505.15(A)** through **(C)**.

505.15(A) Zone 0. In Zone 0 locations, equipment protected by intrinsic safety "ia" and equipment protected by encapsulation "ma" shall be connected using intrinsically safe "ia" circuits with wiring methods in accordance with **504.20.**

Types "ia" Intrinsic Safety and "ma" are the Zone 0 Protections Methods". If the equipment also produces non continuous or continuous convergent light it must also meet Types "op is" and "op sh" with EPL of "Ga" for Optical Radiation safety. LED luminaires do not produce this type of light.

505.15(B) Zone 1.

505.15(B)(1) General. In Zone 1 locations, the following wiring methods shall be permitted:

Informational Note No. 1: See Article 100 for the definition of restricted industrial establishment [as applied to hazardous (classified) locations].

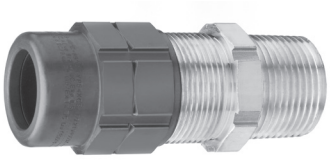
A new information note is added referencing the definition of "restricted industrial establishments (as applied to hazardous (classified) locations)." With the removal of the "defining" text from several places in the section, it is important to send the user to the definition to confirm that the requirement has not changed.

(1) All wiring methods permitted by **505.15(A)**.

Class I, Zone 0 wiring methods are permitted in Class I, Zone 1 locations.

(2) In restricted industrial establishments where the cable is not subject to physical damage, Type MC-HL cable listed for use in Zone 1 or Class I, Division 1 locations, with a gas/vaportight continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, and a separate equipment grounding conductor(s) in accordance with **250.122**. Type MC-HL cable shall be terminated with fittings listed for the application and installed in accordance with Part II of Article 330.

(3) In restricted industrial establishments where the cable is not subject to physical damage, Type ITC-HL cable listed for use in Zone 1 or Class I, Division 1 locations, with a gas/vaportight continuous corrugated metallic sheath and an overall jacket of suitable polymeric material. Type ITC-HL cable shall be terminated with fittings listed for the application and installed in accordance with 335.4



TMC2X CABLE CONNECTOR
CLASS I, ZONE 1 AEX D IIC

Revised to change "listed for the location" to "listed for the application".

(4) Type MI cable terminated with fittings listed for Zone 1 or Class I, Division 1 locations. Type MI cable shall be installed and supported in a manner to avoid tensile stress at the termination fittings.

(5) Threaded rigid metal conduit (RMC) or threaded steel intermediate metal conduit (IMC) including RMC or IMC conduit systems with supplemental corrosion protection coatings.

(6) Where encased in a concrete envelope a minimum of 50 mm (2 in) thick and provided with not less than 600 mm (24 in) of cover measured from the top of the conduit to grade, PVC or RTRC conduit. RMC or IMC conduit shall be used for the last 600 mm (24 in) of the underground run to emergence or to the point of connection to the aboveground raceway. An equipment grounding conductor shall be included to provide for electrical continuity of the raceway system and for grounding of non–current-carrying metal parts.

(7) Intrinsic safety type of protection "ib" shall be permitted using the wiring methods in accordance with 504.20.

(8) Optical fiber cable Type OFNP, Type OFCP, Type OFNR, Type OFCR, Type OFNG, Type OFCG, Type OFN, or Type OFC installed in raceways in accordance with **505.15(B)**. Optical fiber cable shall be sealed in accordance with **505.16**.

Section 770.3(A) permits the use of listed optical fiber cables in Hazardous (Classified) Locations providing they are sealed in accordance with the requirements in Chapter 5. Subsection (h) ensures that the specific requirements for sealing these cables are known.

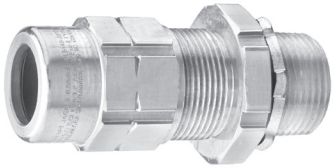
(9) In restricted industrial establishments for applications limited to 600 volts nominal or less where the cable is not subject to physical damage, Type TC-ER-HL shall be terminated with fittings listed for the location and installed in accordance with 336.10.

Informational Note No. 2: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cables and cable fittings.

(10) In restricted industrial establishments, listed Type P cable with metal braid armor and an overall jacket. Type P cable shall be terminated with fittings listed for the location and installed in accordance with Part II of Article **337**.

Informational Note No. 3: See UL 1309A,Outline of Investigation for Cable for use in Mobile Installations, for information on construction, testing, and marking of Type P cable.

Informational Note No. 4: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cable fittings.



TMC2 CABLE CONNECTOR
CLASS I, ZONE 1 AEX E II

The 1 inch diameter restriction previously placed on the use of TC-ER-HL cable has been removed. If Type TC-ER-HL is installed and terminated with fittings listed for the location, the wiring method is safe at any diameter.

Many types of wiring methods permitted in 505.15(B)(1) are not a practical method for connection to equipment that is rated for Class I, Zone 1. Types TC-ER-HL and Type P cables are a good method to make these connections and meet crush resistance requirements. These types of cables were added to the *Code* as a Zone 1 general wiring method. Note: Type P cables having metal braid armor have been permitted in Class I, Zone 1 locations offshore.

505.15(B)(2) Flexible Connections. If flexibility is necessary to minimize the transmission of vibration from equipment during operation or to allow for movement after installation during maintenance, one of the following shall be permitted:

This section requires that the listed terminations (connectors) are rated to the same protection method as the terminal compartment (enclosure) such as increased safety, flameproof etc.

(1) Flexible fittings listed for the location.

(2) Flexible cord in accordance with **505.17(A)**, terminated with cord connectors listed for the location.

(3) In restricted industrial establishments for applications limited to 600 volts nominal or less, and where the cable is not subject to physical damage, and terminated with fittings listed for the location, Type TC-ER-HL cable. Type TC-ER-HL cable shall be listed for use in Class I, Division 1 or Zone 1 locations and shall be installed in accordance with **336.10**.

Informational Note No. 1: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cables and cable fittings.

(4) In restricted industrial establishments listed Type P cable with metal braid armor and an overall jacket. Type P cable shall be terminated with fittings listed for the location and installed in accordance with Part II of Article **337**.

Informational Note No. 2: See UL 1309A,Outline of Investigation for Cable for Use in Mobile Installations, for information on construction, testing, and marking of Type P cable.

Informational Note No. 3: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cable fittings.

Adds the permitted use of Type P or Types TC-ER-HL cables for flexible connections.

505.15(C) Zone 2.

505.15(C)(1) General. In Zone 2 locations, the following wiring methods shall be permitted:

Informational Note No. 1: See Article 100 for the definition of restricted industrial establishment [as applied to hazardous (classified) locations].

(1) All wiring methods permitted by **505.15(B)**.

(2) Type MC, Type MV, Type TC, or Type TC-ER cable, including installation in cable tray systems. Type TC-ER shall include a separate equipment grounding conductor in addition to a drain wire that might be present. The cable shall be terminated with listed fittings. Single conductor Type MV cables shall be shielded or metallic-armored.

(3) Type ITC or Type ITC-ER cable as permitted in **335.4** and terminated with listed fittings. Type ITC-ER shall include a separate insulated equipment grounding conductor in addition to a drain wire.

Shielding of metal armored single conductor cable is required to prevent it from inducing currents in adjacent conductors. Section 727.4 identifies the permitted uses of Instrumentation Tray Cable (ITC). These include permitted uses for ITC-ER.

(4) Type PLTC cable or Type PLTC-ER cable used for Class 2 or Class 3 circuits, including installation in cable tray systems. The cable shall be terminated with listed fittings. Type PLTC-ER shall include a separate insulated equipment grounding conductor in addition to a drain wire that might be present.

Part II of Article 725 identifies the requirements for Class I Circuits and Part III of Article 725 identifies the requirements for Class 2 and Class 3 Circuits.

(5) Enclosed gasketed busways or enclosed gasketed wireways.

(6) In restricted industrial establishments and where metal conduit does not provide the corrosion resistance needed for the environment where it is installed, listed reinforced thermosetting resin conduit (Type RTRC), factory elbows, and associated fittings, all marked with the suffix -XW, and Schedule 80 PVC conduit, factory elbows, and associated fittings shall be permitted. Where seals are required for boundary conditions as defined in **505.16(C)(1)(b)**, the Zone 1 wiring method shall extend into the Zone 2 area to the seal, which shall be located on the Zone 2 side of the Zone 1/Zone 2 boundary. Separate intrinsic safety type of protection "ic" systems shall be installed in accordance with one of the following:

(a) In separate cables
(b) In multiconductor cables where the conductors of each circuit are within a grounded metal shield
(c) In multiconductor cables where the conductors of each circuit have insulation with a minimum thickness of 0.25 mm (0.01 in)

Informational Note No. 2: See Article 100 for the definition of simple apparatus.

This section permits RTRC conduit and Schedule 80 PVC conduit in Class I, Zone 2 areas of industrial establishments and where additional corrosion resistance is required. RTRC conduit is required to be "listed".

(7) Optical fiber cable of Type OFNP, Type OFCP, Type OFNR, Type OFCR, Type OFNG, Type OFCG, Type OFN, or Type OFC installed in cable trays or any other raceway in accordance with 505.15(C). Optical fiber cable shall be sealed in accordance with 505.16.

(8) Cablebus.

(9) In restricted industrial establishments, listed Type P cable with or without metal braid armor and an overall jacket. Type P cable shall be terminated with fittings listed for the location and installed in accordance with Part II of Article **337**.

Informational Note No. 3: See UL 1309A,Outline of Investigation for Cable for Use in Mobile Installations, for information on construction, testing, and marking of Type P cable.

Informational Note No. 4: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cable fittings.

This section permits a relatively new protection technique for Zone 2 locations. The "ic" and "[ic]" methods are contained in the ANSI standard for Intrinsic Safety.

Type "-ER" cable constructions used in a hazardous (classified) locations must include an equipment grounding conductor and the drain or shield conductor may not be used for that purpose.

505.15(C)(2) Flexible Connections. Where flexibility is necessary to minimize the transmission of vibration from equipment during operation or to allow for movement after installation during maintenance, one or more of the following wiring methods shall be permitted:

(1) Listed flexible metal fittings.

(2) Flexible metal conduit with listed fittings.

(3) Interlocked armor Type MC cable with listed fittings.

(4) Type P cable.

(5) Type TC-ER or Type TC-ER-HL cable.

(6) Type ITC-ER or Type ITC-HL cable.

(7) Type PLTC-ER cable.

(8) Liquidtight flexible metal conduit with listed fittings.

(9) Liquidtight flexible nonmetallic conduit with listed fittings.

(10) Flexible cord in accordance with the provisions of 505.17 terminated with a listed cord connector that maintains the type of protection of the terminal compartment shall be permitted.

(11) For elevator use, an identified elevator cable of Type EO, ETP, or ETT, shown under the "use" column in Table 400.4 for "hazardous (classified) locations" and terminated with listed fittings.

If flexible conduit is used, it shall be grounded in accordance with 505.30(A) and bonded in accordance with 505.30(B).

Type EO, ETP, or ETT are now ~~specifically~~ permitted in the section for elevator use as these are recognized in Table 400.4 for hazardous (classified) locations.

505.16 Sealing and Drainage. Seals in conduit and cable systems shall comply with **505.16(A)** through **(E)**. Sealing compound shall be used in Type MI cable termination fittings to exclude moisture and other fluids from the cable insulation.

Informational Note No. 1: See 505.16(C)(2)(c). Seals are provided in conduit and cable systems to minimize the passage of gases and vapors and prevent the passage of flames from one portion of the electrical installation to another through the conduit. Such communication through Type MI cable is inherently prevented by construction of the cable. Unless specifically designed and tested for the purpose, conduit and cable seals are not intended to prevent the passage of liquids, gases, or vapors at a continuous pressure differential across the seal. Even at differences in pressure across the seal equivalent to a few inches of water, there might be a slow passage of gas or vapor through a seal and through conductors passing through the seal.

Informational Note No. 2: See 505.16(D)(2). Temperature extremes and highly corrosive liquids and vapors can affect the ability of seals to perform their intended function.

Informational Note No. 3: Gas or vapor leakage and propagation of flames might occur through the interstices between the strands of standard stranded conductors larger than 2 AWG. Special conductor constructions, for example, compacted strands or sealing of the individual strands, are means of reducing leakage and preventing the propagation of flames.

505.16(A) Zone 0. In Zone 0 locations, seals shall be located according to **505.16(A)(1)**, **(A)(2)**, and **(A)(3)**.

505.16(A)(1) Conduit Seals. Seals shall be provided within 3.05 m (10 ft) of where a conduit leaves a Zone 0 location. There shall be no unions, couplings, boxes, or fittings, except listed reducers at the seal, in the conduit run between the seal and the point at which the conduit leaves the location.

Exception: A rigid unbroken conduit that passes completely through the Zone 0 location with no fittings less than 300 mm (12 in) beyond each boundary shall not be required to be sealed if the termination points of the unbroken conduit are in unclassified locations.

505.16(A)(2) Cable Seals. Seals shall be provided on cables at the first point of termination after entry into the Zone 0 location.

505.16(A)(3) Not Required to Be Explosionproof or Flameproof. Seals shall not be required to be explosionproof or flameproof.

505.16(B) Zone 1. In Zone 1 locations, seals shall be located in accordance with **505.16(B)(1)** through **(B)(8)**.

505.16(B)(1) Type of Protection "d", "db", "e", or "eb" Enclosures. Conduit seals shall be provided within 50 mm (2 in) for each conduit entering enclosures having type of protection "d", "db", "e", or "eb".

Exception No. 1: Where the enclosure having type of protection "d" or "db" is marked to indicate that a seal is not required.

Exception No. 2: For type of protection "e" or "eb", conduit and fittings employing only NPT to NPT raceway joints or fittings listed for type of protection "e" or "eb" shall be permitted between the enclosure and the seal, and the seal shall not be required to be within 50 mm (2 in) of the entry.

Informational Note: Examples of fittings employing other than NPT threads include conduit couplings, capped elbows, unions, and breather drains.

Exception No. 3: For conduit installed between type of protection "e" or "eb" enclosures employing only NPT to NPT raceway joints or conduit fittings listed for type of protection "e" or "eb", a seal shall not be required.

ANSI/UL 60079-1 now recognizes and marks equipment as "db" for Zone 1, replacing the former marking of "d". ANSI/UL 60079-7 now recognizes and marks equipment as "eb" for Zone 1, replacing the former marking of "e".

505.16(B)(1) requires a conduit seal within 50 mm (2 in) of a type "d" or "e" enclosure, instead of just stating that seals are required.

Exceptions 2 and 3 are to make type "e" equipment easier to install in Zone 1 locations.

Exception 2 to 505.16(B)(1) allows a close nipple, elbow, or other NPT threaded fitting to be used between a type "e" enclosure and the conduit seal, thus allowing the seal to be more than 50 mm (2 in) from the enclosure. This is allowable because type "e" equipment is designed to prevent ignitions from occurring by using widely spaced terminals that are mechanically protected from loosening in service. The enclosures of type "e" equipment are not designed to contain an explosion like type "d" enclosures are. The distance that a conduit seal is located from the enclosure can affect the explosion pressure inside a type "d" enclosure, but is not a factor in a type "e" enclosure. There are often many connections made to type "e" junction boxes, and allowing the conduit seal to be further away from the type "e" enclosure makes installation much easier.

Because of the fact that explosions do not occur in type "e" enclosures and explosion pressure is not an issue, Exception 3 to Section 505.16(B)(1) allows the conduit seal to be eliminated when type "e" enclosures are connected only to each other, using conduit and fittings with NPT joints only. Seals are still required if one end of the conduit is connected to a type "d" enclosure or crosses an area classification boundary.

505.16(B)(2) Explosionproof Equipment. Conduit seals shall be provided for each conduit entering explosionproof equipment according to **505.16(B)(2)(a)**, **(B)(2)(b)**, and **(B)(2)(c)**.

In each conduit entry into an explosionproof enclosure where either of the following conditions apply:

(1) The enclosure contains apparatus, such as switches, circuit breakers, fuses, relays, or resistors that may produce arcs, sparks, or high temperatures that are considered to be an ignition source in normal operation. For the purposes of this section, high temperatures shall be considered to be any temperatures exceeding 80 percent of the autoignition temperature in degrees Celsius of the gas or vapor involved.

Exception: Seals shall not be required for conduit entering an enclosure where such switches, circuit breakers, fuses, relays, or resistors comply with one of the following:

(a) Are enclosed within a chamber hermetically sealed against the entrance of gases or vapors.

(b) Are immersed in oil.

(c) Are enclosed within an enclosure, identified for the location, and marked "Leads Factory Sealed," "Factory Sealed," "Seal not Required," or equivalent.

(2) The entry is metric designator 53 (trade size 2) or larger and the enclosure contains terminals, splices, or taps.

An enclosure, identified for the location, and marked "Leads Factory Sealed," or "Factory Sealed," Seal not Required," or equivalent shall not be considered to serve as a seal for another adjacent explosionproof enclosure that is required to have a conduit seal.

(b) Conduit seals shall be installed within 450 mm (18 in) from the enclosure. Only threaded couplings, or explosionproof fittings such as unions, reducers, elbows, and capped elbows that are not larger than the trade size of the conduit, shall be permitted between the sealing fitting and the explosionproof enclosure.

Adds clarification as to what types of fittings are permitted to be installed between the sealing fittings and the explosionproof enclosure.

(c) Where two or more explosionproof enclosures for which conduit seals are required under **505.16(B)(2)** are connected by nipples or by runs of conduit not more than 900 mm (36 in) long, a single conduit seal in each such nipple connection or run of conduit shall be considered sufficient if located not more than 450 mm (18 in) from either enclosure.

505.16(B)(3) Pressurized Enclosures and Pressurized Rooms. Conduit seals shall be provided in each conduit entry into a pressurized enclosure or pressurized room where the conduit is not pressurized as part of the protection system. Conduit seals shall be installed within 450 mm (18 in) from the pressurized enclosure or pressurized room.

Informational Note No. 1: Installing the seal as close as possible to the enclosure reduces problems with purging the dead airspace in the pressurized conduit.

Informational Note No. 2: See NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment, for information on pressurized equipment.

Informational Note No. 3: See UL 60079-13, Explosive Atmospheres — Part 13: Equipment Protection by Pressurized Room "p" and Artificially Ventilated Room "v", for additional information.

505.16(B)(4) Zone 1 Boundary. Conduit seals shall be provided in each conduit run leaving a Zone 1 location. The sealing fitting shall be permitted on either side of the boundary of such location within 3.05 m (10 ft) of the boundary and shall be designed and installed so as to minimize the amount of gas or vapor within the Zone 1 portion of the conduit from being communicated to the conduit beyond the seal. Except for listed explosionproof reducers at the conduit seal, there shall be no union, coupling, box, or fitting between the conduit seal and the point at which the conduit leaves the Zone 1 location.

Exception: Metal conduit containing no unions, couplings, boxes, or fittings and passing completely through a Zone 1 location with no fittings less than 300 mm (12 in) beyond each boundary shall not require a conduit seal if the termination points of the unbroken conduit are in unclassified locations.

505.16(B)(5) Cables Capable of Transmitting Gases or Vapors. Conduits containing cables with a gas/vaportight continuous sheath capable of transmitting gases or vapors through the cable core shall be sealed in the Zone 1 location after removing the jacket and any other coverings so that the sealing compound surrounds each individual insulated conductor or optical fiber tube and the outer jacket.

Exception: Multiconductor cables with a gas/vaportight continuous sheath capable of transmitting gases or vapors through the cable core shall be permitted to be considered as a single conductor by sealing the cable in the conduit within 450 mm (18 in) of the enclosure and the cable end within the enclosure by an approved means to minimize the entrance of gases or vapors and prevent the propagation of flame into the cable core, or by other approved methods. For shielded cables and twisted pair cables, it shall not be required to remove the shielding material or separate the twisted pair.

505.16(B)(6) Cables Incapable of Transmitting Gases or Vapors. Each multiconductor or optical multifiber cable in conduit shall be considered as a single conductor or single optical fiber tube if the cable is incapable of transmitting gases or vapors through the cable core. These cables shall be sealed in accordance with **505.16(D)**.

505.16(B)(7) Cables Entering Enclosures. Cable seals shall be provided for each cable entering flameproof or explosionproof enclosures. The seal shall comply with **505.16(D)**.

505.16(B)(8) Zone 1 Boundary. Cables shall be sealed at the point at which they leave the Zone 1 location.

Exception: Where cable is sealed at the termination point.

505.16(C) Zone 2. In Zone 2 locations, seals shall be located in accordance with **505.16(C)(1)** and **(C)(2)**.

505.16(C)(1) Conduit Seals. Conduit seals shall be provided in accordance with **505.16(C)(1)(a)** through **(C)(1)(f)**.

(a) Flameproof and Explosionproof Enclosures. Conduit seals shall be required for connections to enclosures that are required to be flameproof or explosionproof, in accordance with 505.16(B)(1) and (B)(2). All portions of the conduit run or nipple between the seal and enclosure shall comply with 505.16(B).

(b) Conduits Between Zone 2 and Unclassified Locations. Conduit seals shall be required in each conduit run passing from a Zone 2 location into an unclassified location. The conduit seals and conduit run shall comply with all the following:

(1) The sealing fitting shall be permitted on either side of the boundary of the location within 3.05 m (10 ft) of the boundary.

(2) The sealing fitting shall be designed and installed to minimize the amount of gas or vapor within the Zone 2 portion of the conduit from being communicated to the conduit beyond the seal.

(3) Threaded rigid metal conduit (RMC) or threaded intermediate metal conduit (IMC) shall be used between the sealing fitting and the point at which the conduit leaves the Zone 2 location, and a threaded connection shall be used at the sealing fitting.

(4) There shall be no union, coupling, box, or fitting between the conduit seal and the point at which the conduit leaves the Zone 2 location except for listed explosionproof reducers at the conduit seal.

(5) Conduits shall be sealed to minimize the amount of gas or vapor within the Zone 2 portion of the conduit from being communicated to the conduit beyond the seal.

(6) Such seals shall not be required to be flameproof or explosionproof but shall be identified for the purpose of minimizing passage of gases under normal operating conditions and shall be accessible.

(c) Conduits Passing Through a Zone 2 Location. Metal conduit containing no unions, couplings, boxes, or fittings and passing completely through a Zone 2 location with no fittings less than 300 mm (12 in) beyond each boundary shall not be required to be sealed if the termination points of the unbroken conduit are in unclassified locations.

(d) Conduit Systems Ending in an Unclassified Location. Conduit systems terminating in an unclassified location where a wiring method transition is made to cable tray, cablebus, ventilated busway, Type MI cable, or cable that is not installed in a raceway or cable tray system shall not be required to be sealed where passing from the Zone 2 location into the unclassified location. The unclassified location shall be outdoors or, if the conduit system is all in one room, it shall be permitted to be indoors. The conduits shall not terminate at an enclosure containing an ignition source in normal operation.

(e) Pressurized Enclosures or Pressurized Rooms. Conduit systems passing from enclosures or rooms that permit general-purpose equipment as a result of pressurization into a Zone 2 location shall not require a seal at the boundary.

Informational Note: See NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment, for information on purged and pressurized equipment.

(f) Outdoor Conduit System Segments. Segments of aboveground conduit systems shall not be required to be sealed where passing from a Zone 2 location into an unclassified location if all the following conditions are met:

(1) The conduit system segment shall not pass through a Zone 0 or Zone 1 location where the conduit contains unions, couplings, boxes, or fittings within 300 mm (12 in) of the Zone 0 or Zone 1 location.

(2) The conduit system segment shall be located entirely in an outdoor location.

(3) The conduit system segment shall not be directly connected to canned pumps, process or service connections for flow, pressure, or analysis measurement, and so forth, that depend on a single compression seal, diaphragm, or tube to prevent flammable or combustible fluids from entering the conduit system.

(4) The conduit system segment shall only have threaded rigid metal conduit (RMC) and threaded intermediate metal conduit (IMC) with threaded unions, couplings, conduit bodies, and fittings in the unclassified location.

(5) The conduit system segment shall be sealed at its entry to each enclosure or fitting housing terminals, splices, or taps in Zone 2 locations.

This section correlates with the purpose and explanation of seals that is also found in Article 501.

505.16(C)(2) Cable Seals. Cable seals shall be installed in accordance with **505.16(C)(2)(a)** through **(C)(2)(c)**.

(a) Explosionproof and Flameproof Enclosures. Cables entering enclosures required to be flameproof or explosionproof shall be sealed at the point of entrance. The seal shall comply with 505.16(D). Multiconductor or optical multifiber cables with a gas/vaportight continuous sheath capable of transmitting gases or vapors through the cable core shall be sealed in the Zone 2 location after removing the jacket and any other coverings so that the sealing compound surrounds each individual insulated conductor or optical fiber tube to minimize the passage of gases and vapors. Multiconductor or optical multifiber cables in conduit shall be sealed as described in 505.16(B)(4).

Exception No. 1: Cables passing from an enclosure or room that is unclassified as a result of Type Z pressurization into a Zone 2 location shall not require a seal at the boundary.

Exception No. 2: Shielded cables and twisted pair cables shall not require removal of the shielding material or separation of the twisted pairs if the termination is by an approved means to minimize the entrance of gases or vapors and prevent propagation of flame into the cable core.

(b) Restricted Breathing Enclosures "nR". Cables entering restricted breathing enclosures required to be restricted breathing shall be sealed at the point of entrance into the enclosure. These seals shall be installed in accordance with **505.16(D)**. Multiconductor cables or multifiber optical fiber cables with a gas/vaportight continuous sheath capable of transmitting gases or vapors through the cable core shall be sealed in the Zone 2 location. The jacket and any other coverings shall be removed to allow the sealing compound to surround each individual insulated conductor or optical fiber tube to minimize the passage of gases and vapors. Multiconductor cables or optical fiber cables in conduit shall be sealed as described in **505.16(C)(1)(b)**.

Exception No. 1: Cables passing from an enclosure or room that is unclassified as a result of Type Z pressurization into a Zone 2 location shall not require a seal at the boundary.

Exception No. 2: Shielded cables and twisted pair cables terminated with fittings listed for the location shall not require removal of the shielding material or separation of the twisted pairs.

(c) Cables That Will Not Transmit Gases or Vapors. Cables with a gas/vaportight continuous sheath that will not transmit gases or vapors through the cable core in excess of the quantity permitted for seal fittings shall not be required to be sealed except as required in **505.16(C)(2)(b)**. The minimum length of such cable run shall not be less than the length that limits gas or vapor flow through the cable core to the rate permitted for seal fittings [200 cm3/hr (0.007 ft3/hr) of air at a pressure of 1500 pascals (6 in of water)].

Informational Note No. 1: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for further information on construction, testing, and marking of cables, cable fittings, and cord connectors.

Informational Note No. 2: The cable core does not include the interstices of the conductor strands.

(d) Cables Capable of Transmitting Gases or Vapors. Cables with a gas/vaportight continuous sheath capable of transmitting gases or vapors through the cable core shall not be required to be sealed except as required in **505.16(C)(2)(b)**, unless the cable is attached to process equipment or devices that might cause a pressure in excess of 1500 pascals (6 in of water) to be exerted at a cable end, in which case a seal, barrier, or other means shall be provided to prevent migration of flammables into an unclassified area.

Exception: Cables with an unbroken gas/vaportight continuous sheath shall be permitted to pass through a Zone 2 location without seals.

(e) Cables Without a Gas/Vaportight Continuous Sheath. Cables that do not have a gas/vaportight continuous sheath shall be sealed at the boundary of the Zone 2 and unclassified location to minimize the passage of gases or vapors into an unclassified location.

Informational Note: The cable sheath can be either metal or a nonmetallic material.

505.16(D) Zones 0, 1, and 2. Where required, seals in Zones 0, 1, and 2 locations shall comply with 505.16(D)(1) through (D)(5).

505.16(D)(1) Fittings. Enclosures for connections or equipment shall be provided with an integral means for sealing, or sealing fittings listed for the location shall be used. Sealing fittings shall be listed for use with one or more specific compounds and shall be accessible.

505.16(D)(2) Compound. The compound shall provide a seal against passage of gas or vapors through the seal fitting, shall not be affected by the surrounding atmosphere or liquids, and shall not have a melting point less than 93°C (200°F).

505.16(D)(3) Thickness of Compounds. In a completed seal, the minimum thickness of the sealing compound shall not be less than the trade size of the sealing fitting and, in no case, less than 16 mm (5⁄8 in).

Exception: Listed cable sealing fittings shall not be required to have a minimum thickness equal to the trade size of the fitting.

The exception recognizes that the seal and the intended seal thickness would have been an aspect of the listing evaluation.

505.16(D)(4) Splices and Taps. Splices and taps shall not be made in fittings intended only for sealing with compound, nor shall other fittings in which splices or taps are made be filled with compound.

505.16(D)(5) Conductor or Optical Fiber Fill. The cross-sectional area of the conductors or optical fiber tubes (metallic or nonmetallic) permitted in a seal shall not exceed 25 percent of the cross-sectional area of a rigid metal conduit of the same trade size unless it is specifically listed for a higher percentage of fill.

505.16(E) Drainage.

505.16(E)(1) Control Equipment. Where there is a probability that liquid or other condensed vapor may be trapped within enclosures for control equipment or at any point in the raceway system, approved means shall be provided to prevent accumulation or to permit periodic draining of such liquid or condensed vapor.

505.16(E)(2) Motors and Generators. Where liquid or condensed vapor may accumulate within motors or generators, joints and conduit systems shall be arranged to minimize entrance of liquid. If means to prevent accumulation or to permit periodic draining are necessary, such means shall be provided at the time of manufacture and shall be considered an integral part of the machine.

505.17 Flexible Cables, Cords and Connections.

505.17(A) Flexible Cords, Zone 1 and Zone 2. A flexible cord shall be permitted for connection between portable lighting equipment or other portable utilization equipment and the fixed portion of their supply circuit. Flexible cord shall also be permitted in restricted industrial establishments for any segment of the circuit where installation of one of the fixed wiring methods of 505.15(B) and (C) will not provide the flexibility needed to minimize the transmission of vibration from equipment during operation or to allow for movement after installation during maintenance operations. The flexible cord shall be protected against physical damage and be continuous for the entire length of the cord from equipment connection to equipment connection. Where flexible cords are used, the cords shall comply with the following:

(1) Be of a type listed for extra-hard usage.

See Table 400.4 to determine which flexibles cords are for extra-hard usage. Note: Cord Connectors are not listed for a specific type of flexible cord. They are just listed for flexible cord in general and therefore they are suitable for all cord types.

(2) Contain, in addition to the conductors of the circuit, an equipment grounding conductor complying with 400.23.

(3) Be connected to terminals or to supply conductors in an approved manner.

(4) Be supported by clamps or by other suitable means in such a manner that there will be no tension on the terminal connections.

(5) Where the flexible cord enters boxes, fittings, or enclosures that are required to be explosionproof or flameproof, be terminated with a listed cord connector that maintains the type of protection.

(6) Where entering an increased safety "e" enclosure, be terminated with a listed increased safety "e" cord connector.

Informational Note: See 400.10 for permitted uses of flexible cords.

Informational Note: See 505.18 for flexible cords exposed to liquids having a deleterious effect on the conductor insulation.

Informational Note No. 2: See Article 100 for the definition of restricted industrial establishment [as applied to hazardous (classified) locations].

Electric submersible pumps with means for removal without entering the wet-pit shall be considered portable utilization equipment. The extension of the flexible cord within a suitable raceway between the wet-pit and the power source shall be permitted.

Electric mixers intended for travel into and out of open-type mixing tanks or vats shall be considered portable utilization equipment.

This section requires the cord connectors to be not only be listed, but to be listed for the purpose of maintaining the type of protection where the cord connector enters equipment that is required to be explosionproof or flameproof.

505.17(B) Instrumentation Connections for Zone 2. To facilitate replacements, process control instruments shall be permitted to be connected through flexible cords, attachment plugs, and receptacles, provided that all of the following conditions apply:

(1) A switch listed for Zone 2 is provided so that the attachment plug is not depended on to interrupt current, unless the circuit is type "ia," "ib," or "ic" protection, in which case the switch is not required.

(2) The current does not exceed 3 amperes at 120 volts, nominal.

(3) The power-supply cord does not exceed 900 mm (3 ft), is of a type listed for extra-hard usage or for hard usage if protected by location, and is supplied through an attachment plug and receptacle of the locking and grounding type.

(4) Only necessary receptacles are provided.

(5) The receptacle carries a label warning against unplugging under load.

505.18 Conductors and Conductor Insulation.

505.18(A) Conductors. For type of protection "e," field wiring conductors shall be copper. Every conductor (including spares) that enters Type "e" equipment shall be terminated at a Type "e" terminal.

Type "e" terminals rely on spacing and protection from loosening, so that sparks or high terminal temperatures are not generated that could cause an explosion; spare unterminated conductors could decrease terminal spacings and possibly cause sparks or increased terminal temperatures to occur. This would not be a problem in a type "d" enclosure, since the enclosure would contain an explosion, but causing sparking or increased terminal temperatures would completely negate the type "e" protection method.

505.18(B) Conductor Insulation. Where condensed vapors or liquids may collect on, or come in contact with, the insulation on conductors, such insulation shall be of a type identified for use under such conditions, or the insulation shall be protected by a sheath of lead or by other approved means.

505.19 Uninsulated Exposed Parts. There shall be no uninsulated exposed parts, such as electrical conductors, buses, terminals, or components, that operate at more than 30 volts (15 volts in wet locations). These parts shall additionally be protected by type of protection "ia", "ib", or "ic" that is suitable for the location.

Revised to include type of protection "ic". The reference to the old type of protection "nA" was removed because it is not a type of protection suitable for exposed live parts.

Intrinsically safe "ia" or "ib" apparatus and nonincendive "nA" equipment, operating at no more than 30 volts, are permissible. Some types of instrumentation that employ this method of protection, such as pH sensors, have bare live parts that must be in direct contact with the process in order to operate.

505.20 Equipment Requirements.

505.20(A) Zone 0. In Zone 0 locations, only equipment specifically listed and marked as suitable for the location shall be permitted.

*Exception: Intrinsically safe apparatus listed for use in Class I, Division 1 locations for the same gas, or as permitted by **505.9(B)(2)**, and with a suitable temperature class shall be permitted.*

505.20(B) Zone 1. In Zone 1 locations, only equipment specifically listed and marked as suitable for the location shall be permitted.

*Exception No. 1: Equipment identified for use in Class I, Division 1 or listed for use in Zone 0 locations for the same gas, or as permitted by **505.9(B)(2)**, and with a suitable temperature class shall be permitted.*

Exception No. 2: Equipment identified for Zone 1 or Zone 2 type of protection "p" shall be permitted.

505.20(C) Zone 2. In Zone 2 locations, only equipment specifically listed and marked as suitable for the location shall be permitted.

Exception No. 1: Equipment listed for use in Zone 0 or Zone 1 locations for the same gas, or as permitted by 505.9(B)(2), and with a suitable temperature class, shall be permitted.

Exception No. 2: Equipment identified for Zone 1 or Zone 2 type of protection "p" shall be permitted.

*Exception No. 3: Equipment identified for use in Class I, Division 1 or Division 2 locations for the same gas, or as permitted by **505.9(B)(2)**, and with a suitable temperature class shall be permitted.*

Exception No. 4: In Zone 2 locations, the installation of open or nonexplosionproof or nonflameproof enclosed motors, such as squirrel-cage induction motors without brushes, switching mechanisms, or similar arc-producing devices that are not identified for use in a Zone 2 location shall be permitted.

Exception No. 5: The exposed surface of space heaters used to reduce condensation of moisture during shutdown periods shall not exceed 80 percent of the autoignition temperature in degrees Celsius of the gas or vapor involved when operated at rated voltage, and the maximum space heater surface temperature [based on a 40°C or higher marked ambient] shall be permanently marked on a visible nameplate mounted on the motor. Otherwise, space heaters shall be identified for Class I, Division 2 or Zone 2 locations.

Exception No. 6: A sliding contact shaft bonding device used for the purpose of maintaining the rotor at ground potential shall be permitted where the potential discharge energy is determined to be nonincendive for the application. The shaft bonding device shall be permitted to be installed on the inside or the outside of the motor.

Informational Note No. 1: It is important to consider the temperature of internal and external surfaces that might be exposed to the flammable atmosphere.

Informational Note No. 2: It is important to consider the risk of ignition due to currents arcing across discontinuities and overheating of parts in multisection enclosures of large motors and generators. Such motors and generators might need equipotential bonding jumpers across joints in the enclosure and from enclosure to ground. Where the presence of ignitible gases or vapors is suspected, clean air purging may be needed immediately prior to and during start-up periods.

Informational Note No. 3: See IEEE STD 1349, IEEE Guide for the Application of Electric Machines in Zone 2 and Class I, Division 2 Hazardous (Classified) Locations, for information on the application of rotating electric machines including shaft bonding devices and potential discharge energy calculations.

505.20(D) Materials. Equipment marked Group IIC shall be permitted for applications requiring Group IIA or Group IIB equipment. Similarly, equipment marked Group IIB shall be permitted for applications requiring Group IIA equipment.

Equipment marked for a specific gas or vapor shall be permitted for applications where the specific gas or vapor may be encountered.

Informational Note: One common example combines these markings with equipment marked IIB +H_2. This equipment is suitable for applications requiring Group IIA equipment, Group IIB equipment, or equipment for hydrogen atmospheres.

Section 505.20(D) clarifies that IIC equipment is suitable for applications requiring IIA or IIB equipment. Similarly, it clarifies that IIB equipment is suitable for applications requiring IIA equipment. This correlates with the marking requirements in the product standards.

505.20(E) Manufacturer's Instructions. Electrical equipment installed in hazardous (classified) locations shall be installed in accordance with the instructions (if any) provided by the manufacturer.

505.22 Increased Safety "e" Motors and Generators. In Zone 1 locations, increased safety "e" motors and generators of all voltage ratings shall be listed for Zone 1 locations, and shall comply with all of the following:

(1) Motors shall be marked with the current ratio, I_A/I_N, and time, t_E.

(2) Motors shall have controllers marked with the model or identification number, output rating (horsepower or kilowatt), full-load amperes, starting current ratio (I_A/I_N), and time (t_E) of the motors that they are intended to protect; the controller marking shall also include the specific overload protection type (and setting, if applicable) that is listed with the motor or generator.

(3) Connections shall be made with the specific terminals listed with the motor or generator.

(4) Terminal housings shall be permitted to be of substantial, nonmetallic, nonburning material, provided an internal grounding means between the motor frame and the equipment grounding connection is incorporated within the housing.

(5) The provisions of Part III of Article 430 shall apply regardless of the voltage rating of the motor.

(6) The motors shall be protected against overload by a separate overload device that is responsive to motor current. This device shall be selected to trip or shall be rated in accordance with the listing of the motor and its overload protection.

(7) Sections **430.32(C)** and **430.44** shall not apply to such motors.

(8) The motor overload protection shall not be shunted or cut out during the starting period.

Since type "e" motors and generators are designed to not cause an explosion, and do not rely on their enclosures to contain explosions like type "d" equipment, the hottest temperature that occurs anywhere in the motor or generator needs to be measured and marked, not just the outside surface temperature. Overload protection devices are required to keep these internal temperatures from exceeding those determined during the testing process.

Informational Note: See ANSI/UL 122001, General Requirements for Electrical Ignition Systems for Internal Combustion Engines in Class I, Division 2 or Zone 2, Hazardous (Classified) Locations, for information on ignition systems for reciprocating engines installed in Zone 2 hazardous (classified) locations. Reciprocating engine–driven generators, compressors, and other equipment installed in Zone 2 locations might present a risk of ignition of flammable materials associated with fuel, starting, and compression due to inadvertent release or equipment malfunction by the engine ignition system and controls.

The Informational Note references the product standard for electrical ignition systems for engines that may become a source of ignition in a classified location. The standard employs Class I, Zone 2 protection techniques utilizing non-shielded technology for ignition systems in these applications.

505.26 Process Sealing. Process-connected equipment including, but not limited to, canned pumps, submersible pumps, and flow, pressure, temperature, or analysis measurement instruments shall be sealed with a process seal to prevent the migration of process fluids from the designed containment into the external electrical system. Process-connected electrical equipment that incorporates a single process seal, such as a single compression seal, diaphragm, or tube to prevent flammable or combustible fluids from entering a conduit or cable system capable of transmitting fluids, shall be provided with an additional means to mitigate a single process seal failure. The additional means might include, but is not limited to, the following:

(1) A suitable barrier meeting the process temperature and pressure conditions to witch the barrier is subjected to upon failure of the single process seal. There shall be a vent or drain between the single process seal and the suitable barrier. Indication of the single process seal failure shall be provided by visible leakage, an audible whistle, or other means of monitoring.

(2) A listed Type MI cable assembly, rated at not less than 125 percent of the process pressure and not less than 125 percent of the maximum process temperature (in degrees Celsius), installed between the cable or conduit and the single process seal.

(3) A drain or vent located between the single process seal and a conduit or cable seal. The drain or vent shall be sufficiently sized to prevent overpressuring the conduit or cable seal above 6 in water column (1493 Pa). Indication of the single process seal failure shall be provided by visible leakage, an audible whistle, or other means of monitoring.

(4) An add-on secondary seal marked "secondary seal" and rated for the pressure and temperature conditions to which it will be subjected upon failure of the single process seal.

Process-connected electrical equipment that does not rely on a single process seal or is listed and marked "single seal", "dual seal", or "dual seal without annunciation" shall not be required to be provided with an additional means of sealing.

Process-connected electrical equipment marked "single seal — install conduit or cable seal" shall be sealed in accordance with **505.16**.

This subsection was included to address the secondary seal method that is now covered in the product standard ANSI/UL 122701.

Revisions are made to reflect recent revisions to ANSI/UL 122701 standard which now includes the markings "dual seal without annunciation" and "single seal – install conduit or cable seal".

Informational Note: See ANSI/UL 122701,Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids, for construction and testing requirements for process sealing of listed and marked single seal, dual seal, or secondary seal equipment.

505.30 Grounding and Bonding. Regardless of the voltage of the electrical system, wiring systems and equipment shall comply with **505.30(A)** and **(B)**.

505.30(A) Grounding. Wiring systems and equipment shall be grounded in accordance with Part I and Part VI of Article **250**, as applicable.

505.30(B) Bonding. Wiring systems and equipment shall be bonded in accordance with Part I and Part V of Article **250**, as applicable, and **505.30(B)(1)** and **(B)(2)**.

505.30(B)(1) Specific Bonding Means. Bonding shall comply with **505.30(B)(1)(a)** and **(B)(1)(b)**.

(a) The locknut-bushing and double-locknut types of contacts shall not be depended on for bonding purposes, but bonding jumpers with identified fittings or other approved means of bonding shall be used. These bonding means shall apply to all metal raceways, fittings, boxes, cable trays, and enclosures, and other parts of raceway systems between hazardous (classified) locations and the point of grounding for service equipment or point of grounding for a separately derived system. Metal struts, angles, or channels provided for support and mechanical or physical protection as permitted in **335.4(5)**, **336.10(7)(c)**, or **722.135(C)** shall be bonded in accordance with **250.102**.

(b) Where the branch-circuit overcurrent protection is located on the load side of the disconnecting means, the specific bonding means shall be permitted to end at the nearest point where the grounded circuit conductor and the grounding electrode conductor are connected together on the line side of the building or structure disconnecting means as specified in **250.32(B)**.

505.30(B)(2) Flexible Metal Conduit and Liquidtight Flexible Metal Conduit. Flexible metal conduit and liquidtight flexible metal conduit shall comply with **505.30(B)(2)(a)** and **(B)(2)(b)**.

(a) Flexible metal conduit and liquidtight flexible metal conduit shall include an equipment bonding jumper of the wire type in accordance with **250.102**.

(b) In Zone 2 locations, the bonding jumper shall not be required where all of the following conditions are met:

(1) Listed liquidtight flexible metal conduit 1.8 m (6 ft) or less in length, with fittings listed for grounding, is used.

(2) Overcurrent protection in the circuit is limited to 10 amperes or less.

(3) The load is part of a meter, instrument, or relay circuit.

The section number has been revised for consistency throughout the hazardous (classified) location articles.

CHANGES TO ARTICLE 506 – ZONE 20, 21, AND 22 LOCATIONS FOR COMBUSTIBLE DUSTS OR IGNITIBLE FIBERS/FLYINGS

The following Article 506 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 506.1: Scope
- 506.3: Other Articles
- 506.4: Documentation
- 506.6: Material Groups
- 506.7(D): Special Precaution. Simultaneous Presence of Flammable Gases and Combustible Dusts or Fibers/Flyings
- 506.8 Protection Techniques
- 506.9(C)(2): Equipment Requirements. Marking. Zone Equipment
- 506.9(E)(3): Threading. Unused Openings
- 506.15: Wiring Methods
- 506.25: Grounding and Bonding

ARTICLE 506 - Zone 20, 21, and 22 Locations for Combustible Dusts or Ignitible Fibers/Flyings

506.1 Scope.

(A) Covered. This article covers the requirements for the zone classification system for electrical and electronic equipment and wiring for all voltages where fire and explosion hazards might exist due to combustible dusts, combustible fibers/flyings, or ignitible fibers/flyings for the following:

(1) Zone 20 hazardous (classified) locations

(2) Zone 21 hazardous (classified) locations

(3) Zone 22 hazardous (classified) locations

Informational Note No. 1: See 505.20 or 505.22 for Zone 0, Zone 1, or Zone 2 hazardous (classified) locations where fire or explosion hazards might exist due to flammable gases, flammable vapors, or flammable liquids.

Informational Note No. 2: Zone 20, Zone 21, and Zone 22 area classifications are based on the modified IEC area classification system as defined in ANSI/ISA 60079-10-2 (12.10.05), Explosive Atmospheres — Part 10-2: Classification of Areas — Combustible Dust Atmospheres.

Informational Note No. 3: See NFPA 499, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, for information regarding classification of hazardous (classified) locations using Zone methodology.

(B) Not Covered. This article does not cover electrical and electronic equipment and wiring of all voltages in the following:

(1) Class I, Class II, or Class III, Division 1 or Division 2 hazardous (classified) locations.

(2) Zone 0, Zone 1, or Zone 2 hazardous (classified) locations.

(3) Locations subject to the unique risk and explosion hazards associated with explosives, pyrotechnics, or blasting agents.

(4) Locations where pyrophoric materials are the only materials used or handled.

(5) Features of equipment that involve nonelectrical potential sources of ignition (e.g., couplings, pumps, gearboxes, brakes, hydraulic and pneumatic motors, fan, engine, compressor).

Informational Note No. 1: Common nonelectrical potential sources of ignition include hot surfaces and mechanically generated sparks.

Informational Note No. 2: See ANSI/UL 80079-36, Explosive Atmospheres — Part 36: Non-Electrical Equipment for Explosive Atmospheres — Basic Method and Requirements, and ANSI/UL 80079-37, Explosive Atmospheres — Part 37: Non-Electrical Equipment for Explosive Atmospheres — Non-Electrical Type of Protection Constructional Safety "c" Control of Ignition Source "b", Liquid Immersion "k", for additional information.

The Scope has been rewritten to better identify what is covered and what is not covered in Article 505.

Article 506 addresses the Zone system for combustible dust, fibers and flyings. Like the Zone system for flammable gas, the Zone dust classification has three Zones (Zone 20, Zone 21, and Zone 22), and is the primary system used for combustible dust hazardous locations outside North America. More information on how the dust Zones are classified can be found in ANSI/ISA 60079-10-2 (12.10.05)-2013, Explosive Atmospheres – Part 10-2: Classification of Areas – Combustible Dust Atmospheres. Combustible metallic dusts are now incorporated into the scope of Article 506. The primary purpose of Article 506 is to allow installations using Zone based area classifications for combustible dust. Article 506 also provides a cross reference to the Class II and Class III protection techniques allowed in Articles 502 and 503, and how equipment using those Class II and III, Division 1 and Division 2 based techniques can be safely installed and used in Zone 20, 21, and 22 hazardous locations.

506.3 Other Articles has been removed as it was redundant to 90.3.

506.4 Documentation. Areas designated as hazardous (classified) or unclassified locations shall be documented on an area classification drawing and other associated documentation. This documentation shall be made available to the AHJ and to those authorized to design, install, inspect, maintain, or operate electrical equipment.

Informational Note No. 1: See ANSI/UL 60079-28,Explosive Atmospheres — Part 28: Protection of equipment and transmission systems using optical radiation, for information concerning the installation of equipment using optical emissions technology (such as laser equipment) that could potentially become an ignition source in hazardous (classified) locations.

Informational Note No. 2: See IEC/IEEE 60079-30-2, Explosive atmospheres — Part 30-2: Electrical Resistance Trace Heating — Application Guide for Design, Installation and Maintenance, for information on electrical resistance trace heating for hazardous (classified) locations.

Informational Note No. 3: See IEEE 844.2/CSA C293.2, IEEE/CSA Standard for Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — Application Guide for Design, Installation, Testing, Commissioning, and Maintenance, for information on electric skin effect trace heating for hazardous (classified) locations.

Informational Note No. 4: See IEEE 844.4/CSA C293.4, IEEE/CSA Standard for Impedance Heating of Pipelines and Equipment — Application Guide for Design, Installation, Testing, Commissioning, and Maintenance, for information on electric impedance heating for hazardous (classified) locations.

Revised to require that the documentation provided be an area classification drawing. The change creates a consistent method of documenting hazardous (classified) locations and clearly indicate the boundaries between the classified areas and unclassified areas.

506.5 Classification of Locations.

Revised for correlation with the revised definitions for combustible fibers/flyings and ignitible fibers/flyings and provides necessary correlation with changes to Articles 502 and 503.

The dust zones are classified using the same philosophy as for the gas zones. The dust Zone 20 is where a hazard is present much of the time in normal operation, Zone 21 is where the hazard is present at least part of the time, and Zone 22 is where the dust hazard exists only during abnormal operation or leaks.

506.5(A) Classifications of Locations. Locations shall be classified on the basis of the properties of the combustible dust, combustible fibers/flyings, or ignitible fibers/flyings that might be present, and the likelihood that a combustible or ignitible concentration or quantity is present. Each room, section, or area shall be considered individually in determining its classification.

506.5(B) Zone 20, Zone 21, and Zone 22 Locations. Zone 20, Zone 21, and Zone 22 locations are those in which combustible dust, combustible fibers/flyings, or ignitible fibers/flyings are or might be present in the air or in layers, in quantities sufficient to produce explosible or ignitible mixtures. Zone 20, Zone 21, and Zone 22 locations shall include those specified in **506.5(B)(1)**, **(B)(2)**, and **(B)(3)**.

Informational Note: Through the exercise of ingenuity in the layout of electrical installations for hazardous (classified) locations, it is frequently possible to locate much of the equipment in a reduced level of classification to reduce the amount of special equipment required.

506.5(B)(1) Zone 20. A Zone 20 location is a location where one of the following apply:

(1) Ignitible concentrations of combustible dust, combustible fibers/flyings, or ignitible fibers/flyings are present continuously or for long periods of time.

(2) Group IIIC combustible dusts are present in hazardous quantities continuously or for long periods of time.

(3) Group IIIC combustible dusts are present in quantities sufficient to be hazardous continuously or for long periods of time.

Group IIIC combustible dusts were added as a Zone 20 location due to the high risk of explosion of Group IIIC materials.

506.5(B)(2) Zone 21. A Zone 21 location is a location where one of the following apply:

(1) Ignitible concentrations of combustible dust, combustible fibers/flyings, or ignitible fibers/flyings are likely to exist occasionally under normal operating conditions.

(2) Ignitible concentrations of combustible dust, combustible fibers/flyings, or ignitible fibers/flyings might exist frequently because of repair or maintenance operations or because of leakage.

(3) Equipment is operated or processes are carried on of such a nature that equipment breakdown or faulty operations could result in the release of ignitible concentrations of combustible dust, combustible fibers/flyings, or ignitible fibers/flyings and also cause simultaneous failure of electrical equipment in a mode to cause the electrical equipment to become a source of ignition.

(4) The location is adjacent to a Zone 20 location from which ignitible concentrations of combustible dust, combustible fibers/flyings, or ignitible fibers/flyings could be communicated.

Exception: When communication from an adjacent Zone 20 location is minimized by adequate positive pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

(5) Group IIIC combustible dusts are present in hazardous quantities occasionally, under normal or abnormal operating conditions, or frequently because of repair or maintenance operations or because of leakage.

Informational Note No. 1: See ANSI/ISA 60079-10-2 (12.10.05), Explosive Atmospheres — Part 10-2: Classification of Areas — Combustible Dust Atmospheres, regarding the classification of Zone 21 locations.

Informational Note No. 2: This classification usually includes the following:

(1) Locations outside dust containment and in the immediate vicinity of access doors subject to frequent removal or opening for operation purposes when internal combustible mixtures are present

(2) Locations outside dust containment in the proximity of filling and emptying points, feed belts, sampling points, truck dump stations, belt dump over points, and so on, where no measures are employed to prevent the formation of combustible mixtures

(3) Locations outside dust containment where dust accumulates and where, due to process operations, the dust layer is likely to be disturbed and form combustible mixtures

(4) Locations inside dust containment where explosible dust clouds are likely to occur (but neither continuously, nor for long periods, nor frequently), for example, silos (if filled and/or emptied only occasionally) and the dirty side of filters if large self-cleaning intervals are occurring

Class II, Division 1 equipment is permitted for Zone 20 and 21 installations.

506.5(B)(3) Zone 22. A Zone 22 location is a location where one of the following apply:

(1) Ignitible concentrations of combustible dust or ignitible fibers/flyings are not likely to occur in normal operation and, if they do occur, will only persist for a short period.

(2) Combustible dust or fibers/flyings are handled, processed, or used but in which the dust or fibers/flyings are normally confined within closed containers of closed systems from which they can escape only as a result of the abnormal operation of the equipment with which the dust or fibers/flyings are handled, processed, or used.

(3) The location is adjacent to a Zone 21 location, from which ignitible concentrations of dust or fibers/flyings could be communicated.

Exception No. 1: When communication from an adjacent Zone 21 location is minimized by adequate positive pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

Exception No. 2: For Group IIIC combustible dusts, there are only Zone 20 or 21 locations.

Informational Note No. 1: See ANSI/ISA 60079-10-2 (12.10.05), Explosive Atmospheres — Part 10-2: Classification of Areas — Combustible Dust Atmospheres, regarding the classification of Zone 22 locations.

Informational Note No. 2: Zone 22 locations usually include the following:

(1) Outlets from bag filter vents (in the event of a malfunction, there can be emission of combustible mixtures)

(2) Locations near equipment that has to be opened at infrequent intervals or equipment that from experience can easily form leaks where, due to pressure above atmospheric, dust will blow out

(3) Pneumatic equipment or flexible connections that can become damaged

(4) Storage locations for bags containing dusty product (failure of bags can occur during handling, causing dust leakage)

(5) Locations where controllable dust layers are formed that are likely to be raised into explosible dust–air mixtures

Only if the layer is removed by cleaning before hazardous dust–air mixtures can be formed is the area designated unclassified.

Informational Note No. 3: Protective measures to reduce the formation of explosible dust–air mixtures can often result in a Zone 21 location being classified as a Zone 22 location, or possibly unclassified. Such measures include local exhaust ventilation.

Class II, Division 1 and 2 equipment is permitted for Zone 22 installations.

506.6 Material Groups. For the purposes of testing, approval, and area classification, various air mixtures (not oxygen enriched) shall be grouped as follows:

(1) Group IIIC: Combustible metal dust, including combustible metal fibers/flyings. [**499**:3.3.8.2.1]

(2) Group IIIB: Combustible dust other than combustible metal dust. [**499**:3.3.8.2.2]

(3) Group IIIA: Combustible fibers/flyings or ignitible fibers/flyings other than metal. [**499**:3.3.8.2.3]

Informational Note No. 1: Group IIIA materials are larger particle-size Group IIIB materials and do not include metal dust or metal fibers/flyings. [**499**:A.3.3.8.2.3]

Informational Note No. 2: Examples of ignitible fibers/flyings include rayon, cotton (including cotton linters and cotton waste), sisal, jute, hemp, cocoa fiber, oakum, and baled waste kapok.

Informational Note No. 3: Combustible fibers/flyings include flat platelet-shaped particulates, such as metal flakes, and fibrous board, such as particle board.

The material groups have been revised to correlate with NFPA 499.

Product standards include marking requirements for the dust group. Article 506 now defines the dust groups to better ensure proper selection of the equipment.

506.7 Special Precaution. This article shall require equipment construction and installation that ensures safe performance under conditions of proper use and maintenance.

506.7(A) Implementation of Zone Classification System. Classification of areas, engineering and design, selection of equipment and wiring methods, installation, and inspection shall be performed by qualified persons.

Zone dust installations require the use of qualified personnel. Those individuals who are qualified to perform Class II installations should not have any trouble with the Zone system, since the general requirements of Chapters 1 through 4 apply for both the Class and Zone classification systems.

506.7(B) Dual Classification. In instances of areas within the same facility classified separately, Zone 22 locations shall be permitted to abut, but not overlap, Class II or Class III, Division 2 locations. Zone 20 or Zone 21 locations shall not abut Class II or Class III, Division 1 or Division 2 locations.

506.7(C) Reclassification Permitted. A Class II or Class III, Division 1 or Division 2 location shall be permitted to be reclassified as a Zone 20, Zone 21, or Zone 22 location if all of the space that is classified because of a single combustible dust or ignitible fiber/flying source is reclassified under the requirements of this article.

The reclassification and dual classification rules parallel those applied to Zone flammable gas locations.

506.7(D) Simultaneous Presence of Flammable Gases and Combustible Dusts or Fibers/Flyings. Where flammable gases, combustible dusts, or fibers/flyings are or may be present at the same time, the simultaneous presence shall be considered during the selection and installation of the electrical equipment and the wiring methods, including the determination of the safe operating temperature of the electrical equipment.

Revised for correlation with the revised definitions for combustible fibers/flyings and ignitible fibers/flyings and provides necessary correlation with changes to Articles 502 and 503.

As with Class II installations, care must be taken when flammable gas and combustible dust are present at the same time. The temperature rating is usually more critical for dust than gas, and the equipment temperature can go higher, since dust can have an insulating effect on heat dissipation. This is especially true with high heat producing equipment like luminaires, where dust can both insulate radiated heat and absorb radiated light energy so as to produce heat.

506.8 Protection Techniques. Acceptable protection techniques for electrical and electronic equipment in hazardous (classified) locations shall be as described in **506.8(A)** through **(P)**.

Informational Note No. 1: See ANSI/UL 120101, Definitions and Information Pertaining to Electrical Equipment in Hazardous Locations; and ANSI/UL 60079–0, Explosive Atmospheres — Part 0: Equipment — General Requirements, for additional information.

Informational Note No. 2: See Chapter 9, Table 13 for descriptions of subdivisions of protection techniques.

506.8(A) Dust Ignitionproof. This protection technique shall be permitted for equipment in Zone 20, Zone 21, and Zone 22 locations for which it is identified.

Dust-ignitionproof protection is acceptable for Class II, Division 1, and therefore is acceptable for any dust Zone location based on the equivalent material groups. The construction and testing requirements for Class II, Division 1 dust-ignitionproof enclosures are considered technically equivalent to those required in the parallel Zone system standards.

506.8(B) Pressurized. This protection technique shall be permitted for equipment in Zone 21 and Zone 22 locations for which it is identified.

Pressurization to Class I, Division 1 or Zone 1 standards are acceptable for Zone 21, and pressurization to Class I, Division 2 and Zone 2 standards are acceptable for Zone 22, since the process of pressurizing an enclosure keeps flammable gas and dust out of the enclosure.

506.8(C) Intrinsic Safety. This protection technique shall be permitted for equipment in Zone 20, Zone 21, and Zone 22 locations for which it is identified.

Intrinsic safety for Divisions or Zones will almost always be acceptable for combustible dust, since the ignition energy of dusts is usually above the ignition energies of all the gases. Very fine dust and some of the new "nanodusts" may be an exception to this, but very little data is available at this time on these substances. Dust ingress can cause operational problems with intrinsically safe equipment that is not designed to exclude dust from entering the enclosure,

and in particular, metallic dust can cause severe problems with intrinsically safe equipment, Intrinsic safety works in part by maintaining certain spacing between different parts of the circuit, and conductive metal dust can violate these spacings.

506.8(D) Dusttight. This protection technique shall be permitted for equipment in Zone 22 locations for which it is identified.

Dusttight protection is suitable for Class II, Division 2, and therefore is also suitable for Zone 22.

506.8(E) Protection by Encapsulation "m". This protection technique shall be permitted for equipment in Zone 20, Zone 21, and Zone 22 locations for which it is identified.

506.8(F) Nonincendive Equipment. This protection technique shall be permitted for equipment in Zone 22 locations for which it is identified.

Nonincendive circuits also work in dust environments for the same reason that intrinsically safe circuits do. The ignition energy available from equipment certified for gas atmospheres is not sufficient to ignite combustible dust atmospheres. As with intrinsically safe equipment, care should be taken with equipment that will not exclude dust from the equipment enclosure, making sure the ingress of dust will not adversely affect equipment operation.

506.8(G) Protection by Enclosure "t". This protection technique shall be permitted for equipment in Zone 20, Zone 21, and Zone 22 locations for which it is identified.

506.8(H) Protection by Pressurized Enclosure "p". This protection technique shall be permitted for equipment in Zone 21 and Zone 22 locations for which it is identified.

506.8(I) Protection by Intrinsic Safety "i". This protection technique shall be permitted for equipment in Zone 20, Zone 21, and Zone 22 locations for which it is listed.

506.8(J) Protection by Electrical Resistance Trace Heating "60079-30-1". This protection technique shall be permitted for electrical resistance trace heating equipment in Zone 21 or Zone 22 for which it is listed.

Electrical Resistance Trace Heaters are now marked as "60079-30-1" and is available in EPL Db for Zone 21 and EPL Dc for Zone 22.

506.8(K)Inherently Safe Optical Radiation "op is". This protection technique shall be permitted for equipment in Zone 20, 21, or 22 locations for which the equipment is identified.

506.8(L) Protected Optical Radiation "op pr". This protection technique shall be permitted for equipment in Zone 21 or 22 locations for which the equipment is identified.

506.8(M) Optical System with Interlock "op sh". This protection technique shall be permitted for equipment in Zone 20, 21, or 22 locations for which the equipment is identified.

Types of protection revisions for optical radiation have been added based on ANSI/UL 60079-28:2017. Optical radiation as a potential "non-electrical" risk of ignition in a hazardous (classified) location is largely generated by electrical means. Although most optical radiation is not a source of ignition, this standard allows determination of those that are a source of ignition. Note: LED luminaire light sources are not considered as a means of ignition as they are divergent light sources.

506.8(N) Protection by Skin Effect Trace Heating "IEEE 844.1". This protection technique shall be permitted for skin effect trace heating equipment in Zone 21 or Zone 22 for which it is listed.

506.8(O) Pressurized Room "p". This protection technique shall be permitted in Zone 21 and Zone 22 locations for which it is identified.

This Protection Technique was added in the 2023 Code.

506.8(P) Special Protection "s". This protection technique shall be permitted for equipment in Zone 20, Zone 21, or Zone 22 locations for which they are listed.

This Protection Technique was added in the 2023 Code.

506.9 Equipment Requirements.

506.9(A) Suitability. Suitability of identified equipment shall be determined by one of the following:

(1) Equipment listing or labeling

(2) Evidence of equipment evaluation from a qualified testing laboratory or inspection agency concerned with product evaluation

(3) Evidence acceptable to the authority having jurisdiction such as a manufacturer's self-evaluation or an owner's engineering judgment

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

506.9(B) Listing. Equipment that is listed for Zone 20 shall be permitted in a Zone 21 or Zone 22 location of the same dust or ignitible fiber/flying. Equipment that is listed for Zone 21 may be used in a Zone 22 location of the same dust or ignitible fiber/flyings.

506.9(C) Marking.

506.9(C)(1) Division Equipment. Equipment identified for Class II, Division 1 or Class II, Division 2 shall, in addition to being marked in accordance with 500.8(C), be permitted to be marked with all of the following:

(1) Zone 20, 21, or 22 (as applicable)

(2) Material group in accordance with 506.6

(3) Maximum surface temperature in accordance with 506.9(D), marked as a temperature value in degrees C, preceded by "T" and followed by the symbol ""C"

506.9(C)(2) Zone Equipment.

Equipment meeting one or more of the protection techniques described in **506.8** shall be marked with the following in the order shown:

(1) Zone in accordance with Chapter 9, Table 13

(2) Symbol "AEx"

(3) Protection technique(s) in accordance with Chapter 9, Table 13

(4) Material group in accordance with **506.6**

Table 13 *Equipment Suitable for Hazardous (Classified) Locations*

Area Classification	Type (Level) of Protection	
Zone 0	Intrinsically safe	Intrinsically safe for Class I, Division 1
	Intrinsic safety (Group II)	ia
	Encapsulation (Group II)	ma
	Flameproof (Group II)	da1
	Inherently safe optical radiation	op is, with EPL Ga2
	Optical system with interlock	op sh, with EPL Ga2
	Special protection (Group II)	sa
	EPL3	Ga
Zone 1	Equipment suitable for use in Zone 0	
	Equipment suitable for use in Class I, Division 1	
	Flameproof (Group II)	d, db
	Intrinsic safety (Group II)	ib
	Increased safety (Group II)	e, eb
	Pressurized enclosure (Group II)	p, px, pxb, py, pyb
	Encapsulation (Group II)	m, mb
	Pressurized room (Group II)	pb
	Powder filling (Group II)	q, qb
	Liquid immersion (Group II)	o, ob
	Electrical resistance trace heating	60079-30-1, with EPL Gb2
	Skin effect trace heating	IEEE 844.1, with EPL Gb2
	Inherently safe optical radiation	op is, with EPL Gb2
	Optical system with interlock	op sh, with EPL Gb2
	Protected optical radiation	op pr, with EPL Gb2
	Special protection (Group II)	sb
	EPL3	Gb
Zone 2	Equipment suitable for use in Zone 0	
	Equipment suitable for use in Zone 1	
	Equipment suitable for use in Class I, Division 1	
	Equipment suitable for use in Class I, Division 2	
	Type of protection “n” (Group II)	nA, nC, nL, nR
	Pressurized enclosure (Group II)	pz, pzc
	Intrinsic safety (Group II)	ic
	Flameproof (Group II)	dc
	Increased safety (Group II)	ec
	Liquid immersion (Group II)	oc
	Encapsulation (Group II)	mc
	Pressurized room (Group II)	pc
	Electrical resistance trace heating	60079-30-1, with EPL Gc2
	Skin effect trace heating	IEEE 844.1, with EPL Gc2
	Impedance heating	IEEE 844.3, with EPL Gc2
	Inherently safe optical radiation	op is, with EPL Gc2
	Optical system with interlock	op sh, with EPL Gc2
	Protected optical radiation	op pr, with EPL Gc2
	Special protection (Group II)	sc
	EPL3	Gc
	Other electrical apparatus4	
	Equipment suitable for use in Zone 0	
	Equipment suitable for use in Zone 1	
Zone 2	Equipment suitable for use in Class I, Division 1	
	Equipment suitable for use in Class I, Division 2	
	Type of protection “n” (Group II)	nA, nC, nL, nR
	Pressurized enclosure (Group II)	pz, pzc
	Intrinsic safety (Group II)	ic
	Flameproof (Group II)	dc
	Increased safety (Group II)	ec
	Liquid immersion (Group II)	oc
	Encapsulation (Group II)	mc
	Pressurized room (Group II)	pc
	Electrical resistance trace heating	60079-30-1, with EPL Gc2
	Skin effect trace heating	IEEE 844.1, with EPL Gc2
	Impedance heating	IEEE 844.3, with EPL Gc2
	Inherently safe optical radiation	op is, with EPL Gc2
	Optical system with interlock	op sh, with EPL Gc2
Unclassified	Associated apparatus for Zone 0 (Group II)	[ia]
	Associated apparatus for Zone 1 (Group II)	[ib]
	Associated apparatus for Zone 2 (Group II)	[ic]
	Associated pressurization equipment (Group II)	[p]
	Associated optical radiation equipment (Group II)	[op is]
	Associated optical radiation equipment (Group II)	[op sh]
	Associated apparatus for Zone 0 (Group II)	[ia]
	Associated apparatus for Zone 1 (Group II)	[ib]
	Associated apparatus for Zone 2 (Group II)	[ic]
	Associated pressurization equipment (Group II)	[p]
	Associated optical radiation equipment (Group II)	[op is]
	Associated optical radiation equipment (Group II)	[op sh]
	Associated apparatus for Zone 0 (Group II)	[ia]
	Associated apparatus for Zone 1 (Group II)	[ib]
	Associated apparatus for Zone 2 (Group II)	[ic]
Zone 20	Equipment suitable for use in Class II, Division 1	
	Intrinsic safety (Group III)	ia
	Intrinsically safe	Intrinsically safe for Class II Division 1
	Protection by enclosure (Group III)	ta
	Encapsulation (Group III)	ma
	Inherently safe optical radiation	op is, with EPL Da2
	Optical system with interlock	op sh, with EPL Da2
	Special protection (Group III)	sa
	EPL3	Da

Table 13 *Equipment Suitable for Hazardous (Classified) Locations (cont.)*

Area Classification	Type (Level) of Protection	
Zone 20	Equipment suitable for use in Class II, Division 1	
	Intrinsic safety (Group III)	ia
	Intrinsically safe	Intrinsically safe for Class II Division 1
Group IIIA Only	Equipment suitable for use in Class III, Division 1	
Zone 21	Equipment suitable for use in Zone 20	
	Equipment suitable for use in Class II, Division 1	
	Intrinsic safety (Group III)	ib
	Protection by enclosure (Group III)	tb
	Pressurized enclosure (Group III)	p, px, pxb, py, pyb
	Encapsulation (Group III)	mb
	Pressurized room (Group III)	pb
	Electrical resistance trace heating	60079-30-1, with EPL Db2
	Skin effect trace heating	IEEE 844.1, with EPL Db2
	Impedance heating	IEEE 844.3, with EPL Db2
	Inherently safe optical radiation	op is, with EPL Db2
	Optical system with interlock	op sh, with EPL Db2
	Protected optical radiation	op pr, with EPL Db2
	Special protection (Group III)	sb
	EPL3	Db
	Equipment suitable for use in Zone 20	
	Equipment suitable for use in Class II, Division 1	
	Intrinsic safety (Group III)	ib
	Protection by enclosure (Group III)	tb
	Pressurized enclosure (Group III)	p, px, pxb, py, pyb
	Encapsulation (Group III)	mb
	Pressurized room (Group III)	pb
	Electrical resistance trace heating	60079-30-1, with EPL Db2
	Skin effect trace heating	IEEE 844.1, with EPL Db2
	Impedance heating	IEEE 844.3, with EPL Db2
	Inherently safe optical radiation	op is, with EPL Db2
	Optical system with interlock	op sh, with EPL Db2
	Protected optical radiation	op pr, with EPL Db2
	Special protection (Group III)	sb
	EPL3	Db
	Equipment suitable for use in Zone 20	
	Equipment suitable for use in Class II, Division 1	
	Intrinsic safety (Group III)	ib
	Protection by enclosure (Group III)	tb
Group IIIA Only	Equipment suitable for use in Class III, Division 1	
Zone 22	Equipment suitable for use in Zone 20	
	Equipment suitable for use in Zone 21	
	Equipment suitable for use in Class II, Division 1	
	Equipment suitable for use in Class II, Division 2	
	Intrinsic safety (Group III)	ic
	Protection by enclosure (Group III)	tc
	Pressurized enclosure (Group III)	pz, pzc
	Encapsulation (Group III)	mc
	Pressurized room (Group III)	pc
	Electrical resistance trace heating	60079-30-1, with EPL Dc2
	Skin effect trace heating	IEEE 844.1, with EPL Dc2
	Impedance heating	IEEE 844.3, with EPL Dc2
	Inherently safe optical radiation	op is, with EPL Dc2
	Optical system with interlock	op sh, with EPL Dc2
	Protected optical radiation	op pr, with EPL Dc2
	Type 22 vacuum cleaners and dust collectors	62784
	Special protection (Group III)	sc
	EPL3	Dc
	Other electrical apparatus4	
	Equipment suitable for use in Zone 20	
	Equipment suitable for use in Zone 21	
	Equipment suitable for use in Class II, Division 1	
	Equipment suitable for use in Class II, Division 2	
	Intrinsic safety (Group III)	ic
	Protection by enclosure (Group III)	tc
	Pressurized enclosure (Group III)	pz, pzc
	Encapsulation (Group III)	mc
	Pressurized room (Group III)	pc
	Electrical resistance trace heating	60079-30-1, with EPL Dc2
Group IIIA Only	Equipment suitable for use in Class III, Division 2	
Unclassified	Associated apparatus for Zone 20 (Group III)	[ia]
	Associated apparatus for Zone 21 (Group III)	[ib]
	Associated apparatus for Zone 22 (Group III)	[ic]
	Associated pressurization equipment (Group III)	[p]
	Associated optical radiation equipment (Group III)	[op is]
	Associated optical radiation equipment (Group III)	[op sh]
	Associated apparatus for Zone 20 (Group III)	[ia]
	Associated apparatus for Zone 21 (Group III)	[ib]
	Associated apparatus for Zone 22 (Group III)	[ic]
	Associated pressurization equipment (Group III)	[p]
	Associated optical radiation equipment (Group III)	[op is]

Table 13 *Equipment Suitable for Hazardous (Classified) Locations (cont.)*

Area Classification	Type (Level) of Protection	
	Associated optical radiation equipment (Group III)	[op sh]
	Associated apparatus for Zone 20 (Group III)	[ia]
	Associated apparatus for Zone 21 (Group III)	[ib]
	Associated apparatus for Zone 22 (Group III)	[ic]
	Associated pressurization equipment (Group III)	[p]
	Associated optical radiation equipment (Group III)	[op is]
Class I, Division 1	Equipment marked for use in Class I, Division 15	
	Intrinsically safe	Intrinsically safe for Class I
	Pressurized enclosure	Type X, for Class I
	Pressurized enclosure	Type Y, for Class I
	Equipment suitable for use in Zone 0	
	Intrinsic safety (Group II)	ia
	Encapsulation (Group II)	ma
	Inherently safe optical radiation	op is, with EPL Ga2
	Optical system with interlock	op sh, with EPL Ga2
	Special protection (Group II)	sa
	Equipment marked for use in Class I, Division 15	
	Intrinsically safe	Intrinsically safe for Class I
	Pressurized enclosure	Type X, for Class I
	Pressurized enclosure	Type Y, for Class I
Class I, Division 2	Equipment suitable for use in Class I, Division 1	
	Equipment marked for use in Class I, Division 25	
	Pressurized enclosure	Type Z, for Class I
	Equipment suitable for use in Zone 0, Zone 1 or Zone 2	
	Type of protection “n” (Group II)	nA, nC, nL, nR
	Pressurized enclosure (Group II)	px, pxb, py, pyb, pz, pzc
	Intrinsic safety (Group II)	ia, ib, ic
	Flameproof (Group II)	da, db, dc
	Increased safety (Group II)	eb, ec
	Liquid immersion (Group II)	ob, oc
	Encapsulation (Group II)	ma, mb, mc
	Pressurized room (Group II)	pb
	Pressurized room (Group II)	pc
	Electrical resistance trace heating	60079-30-1, with EPL Gb or Gc2
	Skin effect trace heating	IEEE 844.1, with EPL Gb or Gc2
	Impedance heating	IEEE 844.3, with EPL Gb or Gc2
	Inherently safe optical radiation	op is, with EPL Ga, Gb or Gc2
	Optical system with interlock	op sh, with EPL Ga, Gb or Gc2
	Protected optical radiation	op pr, with EPL Gb or Gc2
	Special protection (Group II)	sa, sb, sc
	Other electrical apparatus4	
	Equipment suitable for use in Class I, Division 1	
Class I, Division 2	Equipment marked for use in Class I, Division 25	
	Pressurized enclosure	Type Z, for Class I
	Equipment suitable for use in Zone 0, Zone 1 or Zone 2	
	Type of protection “n” (Group II)	nA, nC, nL, nR
	Pressurized enclosure (Group II)	px, pxb, py, pyb, pz, pzc
	Intrinsic safety (Group II)	ia, ib, ic
	Flameproof (Group II)	da, db, dc
	Increased safety (Group II)	eb, ec
	Liquid immersion (Group II)	ob, oc
	Encapsulation (Group II)	ma, mb, mc
	Pressurized room (Group II)	pb
	Pressurized room (Group II)	pc
	Electrical resistance trace heating	60079-30-1, with EPL Gb or Gc2
	Skin effect trace heating	IEEE 844.1, with EPL Gb or Gc2
	Impedance heating	IEEE 844.3, with EPL Gb or Gc2
	Inherently safe optical radiation	op is, with EPL Ga, Gb or Gc2
	Optical system with interlock	op sh, with EPL Ga, Gb or Gc2
	Protected optical radiation	op pr, with EPL Gb or Gc2
	Special protection (Group II)	sa, sb, sc
	Other electrical apparatus4	
Unclassified	Associated apparatus for Class I, Division 1	
Class II, Division 16	Equipment marked for use in Class II, Division 15	
	Intrinsically safe	Intrinsically safe for Class II
	Pressurized enclosure	Type X, for Class II
	Pressurized enclosure	Type Y, for Class II
	Equipment suitable for use in Zone 20	
	Intrinsic safety (Group III)	ia
	Protection by enclosure (Group III)	ta
	Encapsulation (Group III)	ma
	Inherently safe optical radiation	op is, with EPL Da22
	Optical system with interlock	op sh, with EPL Da2
	Special protection (Group III)	sa
	Equipment marked for use in Class II, Division 15	
	Intrinsically safe	Intrinsically safe for Class II
	Pressurized enclosure	Type X, for Class II
	Pressurized enclosure	Type Y, for Class II
	Equipment suitable for use in Zone 20	
	Intrinsic safety (Group III)	ia
Class II, Division 26	Equipment suitable for use in Class II, Division 1	
	Equipment marked for use in Class II, Division 25	
	Pressurized enclosure	Type Z, for Class II
	Equipment suitable for use in Zone 20, Zone 21 or Zone 22	
	Intrinsic safety (Group III)	ia, ib, ic

Table 13 *Equipment Suitable for Hazardous (Classified) Locations (cont.)*

Area Classification	Type (Level) of Protection	
Class II, Division 26	Protection by enclosure (Group III)	ta, tb, tc
	Pressurized enclosure (Group III)	px, pxb, py, pyb, pz, pzc
	Encapsulation (Group III)	ma, mb, mc
	Pressurized room (Group III)	pb
	Pressurized room (Group III)	pc
	Electrical resistance trace heating	60079-30-1, with EPL Db or Dc2
	Skin effect trace heating	IEEE 844.1, with EPL Db or Dc2
	Impedance heating	IEEE 844.3, with EPL Db or Dc2
	Inherently safe optical radiation	op is, with EPL Da, Db or Dc2
	Optical system with interlock	op sh, with EPL Da, Db or Dc2
	Protected optical radiation	op pr, with EPL Db or Dc2
	Special protection (Group III) Other electrical apparatus4	sa, sb, sc
Unclassified	Associated apparatus for Class II, Division 1	
Class III, Division 2	Equipment suitable for use in Class II, Division 1	
	Equipment suitable for use in Class II, Division 2	
	Equipment suitable for use in Class III, Division 1	
	Equipment marked for use in Class III, Division 25	
	Intrinsically safe	Intrinsically safe for Class II or Class III
	Equipment suitable for use in Zone 20, Zone 21 or Zone 22	
	Intrinsic safety (Group III)	ia, ib, ic
	Protection by enclosure (Group III)	ta, tb, tc
	Pressurized enclosure (Group III)	px, pxb, py, pyb, pz, pzc
	Encapsulation (Group III)	ma, mb, mc
	Electrical resistance trace heating	60079-30-1, with EPL Db or Dc2
	Skin effect trace heating	IEEE 844.1, with EPL Db or Dc2
	Impedance heating	IEEE 844.3, with EPL Db or Dc2
	Inherently safe optical radiation	op is, with EPL Da, Db or Dc2
	Optical system with interlock	op sh, with EPL Da, Db or Dc2
	Protected optical radiation	op pr, with EPL Db or Dc2
	Special protection (Group III)	sa, sb, sc
	Other electrical apparatus4	
	Equipment suitable for use in Class II, Division 1	
	Equipment suitable for use in Class II, Division 2	
	Equipment suitable for use in Class III, Division 1	
	Equipment marked for use in Class III, Division 25	
	Intrinsically safe	Intrinsically safe for Class II or Class III
	Equipment suitable for use in Zone 20, Zone 21 or Zone 22	
	Intrinsic safety (Group III)	ia, ib, ic
	Protection by enclosure (Group III)	ta, tb, tc
	Pressurized enclosure (Group III)	px, pxb, py, pyb, pz, pzc
	Encapsulation (Group III)	ma, mb, mc
	Electrical resistance trace heating	60079-30-1, with EPL Db or Dc2
	Skin effect trace heating	IEEE 844.1, with EPL Db or Dc2
	Impedance heating	IEEE 844.3, with EPL Db or Dc2
	Inherently safe optical radiation	op is, with EPL Da, Db or Dc2
	Optical system with interlock	op sh, with EPL Da, Db or Dc2
	Protected optical radiation	op pr, with EPL Db or Dc2
Unclassified	Associated apparatus for Class III, Division 1	

Note: This table is structured to show the area classification on the left side and the permitted equipment on the right side. Zone equipment is suitable for use in some class/division locations and vice versa. This is indicated by the phrase "Equipment suitable for use in…", for example, in Class I, Division 1 locations, "Equipment suitable for use in Zone 0" means all equipment listed under Zone 0 can be used with an appropriate equipment group and temperature class.

(5) Maximum surface temperature in accordance with **506.9(D)**, marked as a temperature value in degrees Celsius, preceded by "T" and followed by the symbol "°C"

(6) Ambient temperature marking in accordance with **506.9(D)**

(7) Equipment protection level (EPL)

Informational Note: EPLs (or equipment protection levels) are designated as G for gas, or D for dust, and are then followed by a letter (a, b, or c) to give the user a better understanding as to whether the equipment provides (a) a "very high," (b) a "high," or (c) an "enhanced" level of protection against ignition of an explosive atmosphere. For example, a Zone 21 AEx pb IIIB T165°C Db motor is marked with an EPL of "Db".

This informational Note identifies the product standards that provide for the EPL marking. This is to help the user make better decisions on what type of equipment for a given protection technique is needed for their application. Refer to ANSI/UL 60079-31-2015 for more detailed information.

*Exception: Associated apparatus NOT suitable for installation in a hazardous (classified) location shall be required to be marked only with **506.9(C)(2)(2)** and **(C)(2)(3)**, and where applicable **(C)(2)(4)**, but BOTH the symbol AEx in **506.9(C)(2)(2)** and the symbol for the type of protection in **506.9(C)(2)(3)** shall be enclosed within the same square brackets; for example, [AEx ia] IIIC.*

The material group and ambient temperature limitations are not required to be marked for associated apparatus.

Informational Note: The "D" suffix on the type of protection designation was employed prior to the introduction of Group IIIA, IIIB, and IIIC, which is now used to distinguish between the type of protection employed for Group II (Gases) or Group III (Dusts).

Table 506.9(C)(2)(3) deleted and replaced by new Table 13 in Chapter 9.

The prefix of the "III" in the Group marking makes it clear that these ratings are for Dusts.

Equipment Protection Levels (EPL) were added to align with the introduction of the concept in the product standards. It should be noted that the EPL is aligned with the Zone.

The term for Type of Protection "p" has been changed to "pressurized enclosure" in ANSI/UL 60079-2:2017. The designations for optical radiation have been added based on ANSI/UL 60079-28:2017. Optical radiation as a potential "nonelectrical" risk of ignition in a hazardous (classified) location is largely generated by electrical means. Although most optical radiation is not a source of ignition, this standard allows determination of those that are a source of ignition.

Note: LED luminaire light sources are considered as diverted light and therefore are not required to have a protection method for optical radiation.

506.9(D) Temperature Classifications. Equipment shall be marked to show the maximum surface temperature referenced to a 40°C ambient, or at the higher marked ambient temperature if the equipment is rated and marked for an ambient temperature of greater than 40°C. For equipment installed in a Zone 20 or Zone 21 location, the operating temperature shall be based on operation of the equipment when blanketed with the maximum amount of dust (or with dust-simulating fibers/flyings) that can accumulate on the equipment. Electrical equipment designed for use in the ambient temperature range between -20°C and +40°C shall require no additional ambient temperature marking. Electrical equipment that is designed for use in a range of ambient temperatures other than -20°C and +40°C is considered to be special; and the ambient temperature range shall then be marked on the equipment, including either the symbol "Ta" or "Tamb" together with the special range of ambient temperatures.

Informational Note: As an example, such a marking might be "–30°C ≤ Ta ≤ +40°C."

The Section clarifies the required elements for the Temperature Classification marking and correlates with the requirements that are contained in the product standards.

Exception No. 1: Equipment of the non–heat-producing type, such as conduit fittings, shall not be required to have a marked operating temperature.

*Exception No. 2: Equipment identified for Class II, Division 1 or Class II, Division 2 locations as permitted by **506.20(B)** and **(C)(4)** shall be permitted to be marked in accordance with **500.8(C)** and **Table 500.8(C)**.*

506.9(E) Threading. The supply connection entry thread form shall be NPT or metric. Conduit and fittings shall be made wrenchtight to prevent sparking when the fault current flows through the conduit system and to ensure the integrity of the conduit system. Equipment provided with threaded entries for field wiring connections shall be installed in accordance with **506.9(E)(1)** or **(E)(2)** and with **(E)(3)**.

506.9(E)(1) Equipment Provided with Threaded Entries for NPT-Threaded Conduit or Fittings. For equipment provided with threaded entries for NPT-threaded conduit or fittings, listed conduit fittings or listed cable fittings shall be used. All NPT threaded conduit and fittings shall be threaded with a National (American) Standard Pipe Taper (NPT) thread.

Informational Note: See ASME B1.20.1, Pipe Threads, General Purpose (Inch), for thread specifications for NPT threads.

506.9(E)(2) Equipment Provided with Threaded Entries for Metric-Threaded Fittings. For equipment with metric-threaded entries, listed conduit fittings or listed cable fittings shall be used. Such entries shall be identified as being metric, or listed adapters to permit connection to conduit or NPT-threaded fittings shall be provided with the equipment and shall be used for connection to conduit or NPT-threaded fittings. Metric-threaded fittings installed into equipment entries shall be made up with at least five threads fully engaged.

Fittings are required to be listed when used in metric threaded entries and that there be a minimum of 5 threads engaged. If it is a conduit fitting, it must be listed for use with that conduit type. If it is a cable fitting, it must be listed for use with that cable type.

506.9(E)(3) Unused Openings. All unused openings shall be closed with blanking elements or close-up plugs that are listed for the location and will maintain the type of protection. Thread engagement shall comply with the requirements of **506.9(E)(1)** or **(E)(2)**.

Revised to make "close-up plug" the term "blanking element".

All unused openings are required to be closed in a manner that maintains the level of protection. Although this appears to be self-evident it was not previously addressed in Article 506.

These plugs may not independently be marked with the listing and classification information, however they would have been evaluated as part of the full box and enclosure listing.

506.9(F) Optical Fiber Cables. An optical fiber cable, with or without current-carrying conductors (hybrid optical fiber cable), shall be installed to address the associated fire hazard and sealed to address the associated explosion hazard in accordance with the requirements of **506.15** and **506.16**.

This section clarifies that the cable needs to be sealed to address the fire and explosion hazards regardless if the cable contains current carrying conductors or not.

506.9(G) Equipment Involving Optical Radiation. For equipment involving sources of optical radiation (such as laser or LED sources) in the wavelength range from 380 nm to 10 µm, the risk of ignition from optical radiation shall be considered for all electrical parts and circuits that might be exposed to the radiation, both inside and outside the optical equipment. This includes optical equipment, which itself is located outside the explosive atmosphere, but its emitted optical radiation enters such atmospheres.

Informational Note: See ANSI/UL 60079-28,Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, for information on types of protection that can be applied to minimize the risk of ignition in explosive atmospheres from optical radiation.

Exception: All luminaires (fixed, portable, or transportable) and hand lights intended to be supplied by mains (with or without galvanic isolation) or powered by batteries, with any continuous divergent light source, including LEDs, shall be excluded from this requirement.

All Appleton™ LED Luminaires comply with this exception

506.15 Wiring Methods. Wiring methods shall maintain the integrity of the protection techniques and shall comply with **506.15(A)**, **(B)**, or **(C)**.

Informational Note: See Article 100 for the definition of restricted industrial establishment [as applied to hazardous (classified) locations].

A new information note is added referencing the definition of "restricted industrial establishments (as applied to hazardous (classified) locations)." With the removal of the "defining" text from several places in the section, it is important to send the user to the definition to confirm that the requirement has not changed.

506.15(A) Zone 20. In Zone 20 locations, the following wiring methods shall be permitted:

"iaD" is no longer recognized as a protection concept.

(1) Threaded rigid metal conduit (Type RMC) or threaded steel intermediate metal conduit (Type IMC).

(2) Type MI cable terminated with fittings listed for the location. Type MI cable shall be installed and supported in a manner to avoid tensile stress at the termination fittings.

Exception No. 1: Type MI cable and fittings listed for Class II, Division 1 locations shall be permitted to be used.

*Exception No. 2: Equipment identified as intrinsically safe "ia" shall be permitted to be connected using the wiring methods identified in **504.20**.*

The wiring methods permitted for intrinsically safe apparatus in explosive dust atmospheres classified under the Zone system are different from those permitted under the Division scheme. The wiring methods for intrinsically safe apparatus were previously addressed in 506.8 – Protection techniques.

(3) In restricted industrial establishments with limited public access, where the conditions of maintenance and supervision ensure that only qualified persons service the installation, Type MCHL cable listed for use in Zone 20 locations, with a continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, and a separate equipment grounding conductor(s) in accordance with **250.122**, and terminated with fittings listed for the application, shall be permitted. Type MC-HL cable shall be installed in accordance with Part II of Article **330**.

Exception: Type MC-HL cable and fittings listed for Class II, Division 1 locations shall be permitted to be used.

(4) In restricted industrial establishments with restricted public access and where the conditions of maintenance and supervision ensure that only qualified persons service the installation, and where the cable is not subject to physical damage, Type ITC-HL cable listed for use in Zone 1 or Class I, Division 1 locations, with a gas/vaportight continuous corrugated metallic sheath and an overall jacket of suitable polymeric material, and terminated with fittings listed for the application. Type ITC-HL cable shall be installed in accordance with **335.4**.

The use of ITC-HL cable is permitted in a Zone 20 location. The cable must be terminated with fittings that are listed for the application. In other words the fitting must provide the required level of protection to maintain the protection technique.

(5) Fittings and boxes shall be identified for use in Zone 20 locations.

Exception: Boxes and fittings listed for Class II, Division 1 locations shall be permitted to be used.

(6) If flexible connections are necessary, liquidtight flexible metal conduit (LFMC) with listed fittings, liquidtight flexible nonmetallic conduit (LFNC) with listed fittings, or flexible cord listed for extra-hard usage and provided with listed fittings. Where flexible cords are used, they shall also comply with **506.17** and be terminated with a listed cord connector that maintains the type of protection of the terminal compartment. If flexible connections are subject to oil or other corrosive conditions, the insulation of the conductors shall be of a type listed for the condition or be protected by means of a suitable sheath.

Cord connectors are required to be listed for the location to maintain the protection level of the terminal compartment.

Exception No. 1: Liquidtight flexible conduit (Type LFMC or LFNC), flexible conduit fittings, and cord fittings listed for Class II, Division 1 locations shall be permitted.

*Exception No. 2: For elevator use, an identified elevator cable of Type EO, Type ETP, or Type ETT, shown under the "use" column in **Table 400.4** for "hazardous (classified) locations," and terminated with listed connectors that maintain the type of protection of the terminal compartment shall be permitted.*

Informational Note No. 1: See 506.25 for grounding requirements where flexible conduit is used.

Informational Note No. 2: See ANSI/UL 2225,Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cables, cable fittings, and cord connectors.

Type EO, ETP, or ETT are now specifically permitted in the Section for elevator use as these are recognized in Table 400.4 for hazardous (classified) locations.

The wiring methods suitable for Class II, Division 1 are suitable for Zone 20.

(7) Optical fiber cable Type OFNP, Type OFCP, Type OFNR, Type OFCR, Type OFNG, Type OFCG, Type OFN, and Type OFC shall be permitted to be installed in raceways in accordance with **506.15(A)**. Optical fiber cables shall be sealed in accordance with **506.16**.

This section correlates with the permitted uses for these types of cables in 770.3(A).

506.15(B) Zone 21. In Zone 21 locations, the following wiring methods shall be permitted:

"iaD" is no longer recognized as a protection technique.

(1) All wiring methods permitted in **506.15(A)**.

(2) Fittings and boxes that are dusttight, that are provided with threaded bosses for connection to conduit, and in which taps, joints, or terminal connections are not made and are not used in locations where metal dust is present.

Informational Note: See ANSI/UL 2225,Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cables, cable fittings, and cord connectors. Exception: Equipment identified as intrinsically safe "ib" shall be permitted to be connected using the wiring methods identified in 504.20.

*Exception: Equipment identified as intrinsically safe "ib" shall be permitted to be connected using the wiring methods identified in **504.20**.*

In Zone 21, all the methods for Zone 20 are permitted as well as dusttight fittings and boxes, since the area is not as hazardous as Zone 20.

These boxes and fittings are not required to be "listed" as dusttight. For guidance on dusttight ratings see NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum) – permits a rating of "dusttight" for products that are rated NEMA Types 3, 3X, 3S, 3SX, 4, 4X, 5, 6, 6P, 12, 12K, or 13.

506.15(C) Zone 22. In Zone 22 locations, the following wiring methods shall be permitted:

The permitted wiring methods have been reorganized to clarify the requirements. Requirements for grounding conductors were added for an equipment grounding conductor in hazardous locations. A drain wire cannot act as a equipment grounding conductor.

(1) All wiring methods permitted in **506.15(B)**.

(2) Rigid metal conduit (Type RMC) or intermediate metal conduit (Type IMC) with listed threaded or threadless fittings.

(3) Electrical metallic tubing (Type EMT) or dusttight wireways.

(4) Type MC or Type MI cable with listed termination fittings.

(5) Type PLTC cable or Type PLTC-ER cable used in Class 2 or Class 3 circuits, including installation in cable tray systems. The cable shall be terminated with listed fittings. Type PLTC-ER cable shall include an equipment grounding conductor in addition to a drain wire that might be present.

Type PLTC-ER cable is permitted to be used in a Zone 22 location and where terminated with listed fittings. This simply means the fittings must be listed for the cable type. The fittings are not required to be listed for the location.

(6) Type ITC cable or Type ITC-ER cable as permitted in **335.4** and terminated with listed fittings. Type ITC-ER cable shall include an equipment grounding conductor in addition to a drain wire.

Type TC-ER cable terminated with listed fittings is permitted as other Extended Run cable constructions are currently permitted. Type PLTC-ER, Type ITC-ER and Type TC-ER are all built to the same strength requirements.

(7) Type MV, Type TC, or Type TC-ER cable, including installation in cable tray systems. Type TC-ER cable shall include an equipment grounding conductor in addition to a drain wire that might be present. The cable shall be terminated with listed fittings.

(8) Intrinsic safety type of protection "ic" shall be permitted using any of the wiring methods permitted for unclassified locations. Intrinsic safety type of protection "ic" systems shall be installed in accordance with the control drawing(s). Simple apparatus, not shown on the control drawing, shall be permitted in a circuit of intrinsic safety type of protection "ic", provided that the simple apparatus does not interconnect the intrinsic safety type of protection "ic" circuit to any other circuit. Separation of circuits of intrinsic safety type of protection "ic" shall be in accordance with one of the following:

a. Be in separate cables

b. Be in multiconductor cables where the conductors of each circuit are within a grounded metal shield

c. Be in multiconductor cables where the conductors have insulation with a minimum thickness of 0.25 mm (0.01 in)

Informational Note: See Article 100 for the definition of simple apparatus.

(9) Boxes and fittings shall be dusttight.

In Zone 22, any Class II, Division 1 or Division 2 wiring method is acceptable.

These boxes and fittings are not required to be "listed" as dusttight. For guidance on dusttight ratings see NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum) – permits a rating of "dusttight" for products that are rated NEMA Types 3, 3X, 3S, 3SX, 5, 12, 12K, or 13.

(10) Optical fiber cable Type OFNP, Type OFCP, Type OFNR, Type OFCR, Type OFNG, Type OFCG, Type OFN, and Type OFC shall be permitted to be installed in cable trays or any raceway in accordance with **506.15(C)**. Optical fiber cables shall be sealed in accordance with 506.16.

(11) Cablebus.

Cablebus is permitted when installed in accordance with Article 370. Cablebus provides a safety level equivalent to the other wiring methods permitted.

This section correlates with the permitted uses for these types of cables in Section 770.3(A).

506.16 Sealing. Where necessary to protect against the ingress of combustible dust, combustible fibers/flyings, or ignitible fibers/flyings, or to maintain the type of protection, seals shall be provided. The seal shall be identified as capable of preventing the ingress of combustible dust, combustible fiber/flying, or ignitible fiber/flying and maintaining the type of protection but need not be explosionproof or flameproof.

As with seals on intrinsically safe equipment, the seals on Zone dust equipment do not have to be explosionproof to prevent the ingress of dust. The only time explosionproof seals would be required is when the location is also classified as Zone 0, 1, or 2 as well as for Zone 20, 21, or 22, and the enclosure is rated as explosionproof for flammable gas as well as suitable for use with combustible dust.

506.17 Flexible Cords. Flexible cords used in Zone 20, Zone 21, and Zone 22 locations shall comply with all of the following:

(1) Be of a type listed for extra-hard usage

(2) Contain, in addition to the conductors of the circuit, an equipment grounding conductor complying with **400.23**

(3) Be connected to terminals or to supply conductors in an approved manner

(4) Be supported by clamps or by other suitable means in such a manner to minimize tension on the terminal connections

(5) Be terminated with a listed cord connector that maintains the protection technique of the terminal compartment

The use of flexible cords is the same as that allowed for Class II locations.

Informational Note: See ANSI/UL 2225, Cables and Cable-Fittings for Use in Hazardous (Classified) Locations, for information on construction, testing, and marking of cables, cable fittings, and cord connectors.

506.20 Equipment Installation.

506.20(A) Zone 20. In Zone 20 locations, only equipment listed and marked as suitable for the location shall be permitted.

Exception: Equipment listed for use in Class II, Division 1 locations with a suitable temperature class shall be permitted.

Exception No. 2: For locations involving Group IIIA materials, equipment listed for use in Class III, Division 1 locations with a suitable temperature in accordance with 500.8(D)(3) shall be permitted.

506.20(B) Zone 21. In Zone 21 locations, only equipment listed and marked as suitable for the location shall be permitted.

Exception No. 1: Apparatus listed for use in Class II, Division 1 locations with a suitable temperature class shall be permitted.

Exception No. 2: Pressurized equipment identified for Class II, Division 1 shall be permitted.

Exception No. 3: For locations involving Group IIIA materials, equipment listed for use in Class III, Division 1 locations with a suitable temperature in accordance with 500.8(D)(3) shall be permitted.

506.20(C) Zone 22. In Zone 22 locations, only equipment listed and marked as suitable for the location shall be permitted.

Exception No. 1: Apparatus listed for use in Class II, Division 1 or Class II, Division 2 locations with a suitable temperature class shall be permitted.

Exception No. 2: Pressurized equipment identified for Class II, Division 1 or Division 2 shall be permitted.

Exception No. 3: For Group IIIA materials, equipment listed for use in Class III, Division 1 or Class III, Division 2 locations with a suitable temperature in accordance with 500.8(D)(3) shall be permitted.

506.20(D) Material Group. Equipment marked Group IIIC shall be permitted for applications requiring Group IIIA or Group IIIB equipment. Similarly, equipment marked Group IIIB shall be permitted for applications requiring Group IIIA equipment.

This section clarifies the elements of the material group markings that are also contained in the product standards.

506.20(E) Manufacturer's Instructions. Electrical equipment installed in hazardous (classified) locations shall be installed in accordance with the manufacturer's instructions, if provided.

506.20(F) Temperature. The temperature marking specified in **506.9(C)(2)(5)** shall comply with **506.20(F)(1)** or **(F)(2)**:

(1) For combustible dusts, less than the lower of either the layer or cloud ignition temperature of the specific combustible dust. For organic dusts that may dehydrate or carbonize, the temperature marking shall not exceed the lower of either the ignition temperature or 165°C (329°F).

(2) For ignitible fibers/flyings, less than 165°C (329°F) for equipment that is not subject to overloading, or 120°C (248°F) for equipment (such as motors or power transformers) that may be overloaded.

Informational Note: See NFPA 499-2017, Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, for minimum ignition temperatures of specific dusts.

506.30 Grounding and Bonding. Regardless of the voltage of the electrical system, grounding and bonding shall comply with Article 250 and the requirements in 506.25(A) and (B).

506.30(A) Bonding. The locknut-bushing and double-locknut types of contacts shall not be depended on for bonding purposes, but bonding jumpers with proper fittings or other approved means of bonding shall be used. Such means of bonding shall apply to all intervening raceways, fittings, boxes, enclosures, and so forth, between Zone 20, Zone 21, and Zone 22 locations and the point of grounding for service equipment or point of grounding of a separately derived system.

Exception: The specific bonding means shall be required only to the nearest point where the grounded circuit conductor and the grounding electrode conductor are connected together on the line side of the building or structure disconnecting means as specified in 250.32(B) if the branch side overcurrent protection is located on the load side of the disconnecting means.

506.30 Grounding and Bonding. Regardless of the voltage of the electrical system, wiring systems and equipment shall comply with **506.30(A)** and **(B)**.

506.30(A) Grounding. Wiring systems and equipment shall be grounded in accordance with Part I and Part VI of Article **250**, as applicable.

506.30(B) Bonding. Bonding shall comply with Part I and Part V of Article **250**, as applicable, and **506.30(B)(1)** and **(B)(2)**.

(1) Specific Bonding Means. Bonding shall comply with 506.30(B)(1)(a) and (B)(1)(b).

(a) The locknut-bushing and double-locknut types of contacts shall not be depended on for bonding purposes, but bonding jumpers with identified fittings or other approved means of bonding shall be used. These bonding means shall apply to all metal raceways, fittings, boxes, cable trays, and enclosures, and other parts of raceway systems between hazardous (classified) locations and the point of grounding for service equipment or point of grounding for a separately derived system. Metal struts, angles, or channels provided for support and mechanical or physical protection as permitted in 335.4(5), 336.10(7)(c), or 722.135(C) shall be bonded in accordance with 250.102.

(b) Where the branch-circuit overcurrent protection is located on the load side of the disconnecting means, the specific bonding means shall be permitted to end at the nearest point where the grounded circuit conductor and the grounding electrode conductor are connected together on the line side of the building or structure disconnecting means as specified in 250.32(B).

(2) Liquidtight Flexible Metal Conduit. Liquidtight flexible metal conduit shall comply with **506.30(B)(2)(a)** and **(B)(2)(b)**.

(a) Liquidtight flexible metal conduit shall include an equipment bonding jumper of the wire type in accordance with **250.102**.

(b) In Zone 22 locations, the bonding jumper shall not be required where all of the following conditions are met:

(1) Listed liquidtight flexible metal conduit 1.8 m (6 ft) or less in length, with fittings listed for grounding, is used.

(2) Overcurrent protection in the circuit is limited to 10 amperes or less.

(3) The load is part of a meter, instrument, or relay circuit.

The section number has been revised for consistency throughout the hazardous (classified) location articles.

CHANGES TO ARTICLE 510 – HAZARDOUS (CLASSIFIED) LOCATIONS — SPECIFIC

Article 510 has been deleted in the 2023 Code. The necessary text has been added to Articles 511-516 to ensure compliance with Articles 500, 505 and 506.

CHANGES TO ARTICLE 511 – COMMERCIAL GARAGES, REPAIR AND STORAGE

The following Article 511 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 511.2: Other Articles
- 511.4(A): Wiring and Equipment in Class I Locations. Wiring Located in Class I Locations

ARTICLE 511 Commercial Garages, Repair and Storage

511.1 Scope. These occupancies shall include locations used for service and repair operations in connection with self-propelled vehicles (including, but not limited to, passenger automobiles, buses, trucks, and tractors) in which volatile flammable liquids or flammable gases are used for fuel or power.

Informational Note: See NFPA 30A-2021, Code for Motor Fuel Dispensing Facilities and Repair Garages, for extracted text that is followed by a reference in brackets. Only editorial changes were made to the extracted text to make it consistent with this Code.

The scope of Article 511 includes occupancies used for the service and repair operations in connection with self-propelled vehicles (such as, passenger automobiles, buses, trucks, and tractors.) But it is not limited to these examples. It covers occupancies in which volatile flammable liquids or flammable gases are used for fuel or power. These include gasoline, propane, compressed natural gas and liquefied natural gas.

511.2 Other Articles. In addition to the requirements of this article, these occupancies shall comply with Table 511.2, as applicable, except as modified by this article.

Section was added to provide the necessary link from Article 511 to Articles 500 and 505 which became necessary with the deletion of Article 510.

Table 511.2 *Other Articles*

Requirement	Division Classified Locations	Zone Classified Locations
Area classification	500.5, 500.6	505.5, 505.6, 505.7
Equipment	Part III of 501, 500.7, 500.8, 501.5	505.8, 505.9, 505.20, 505.22
Wiring	Part II of 501	505.15, 505.16, 505.17, 505.18, 505.19, 505.26, 505.30

511.3 Area Classification, General. Where Class I liquids or gaseous fuels are stored, handled, or transferred, electrical wiring and electrical utilization equipment shall be designed in accordance with the requirements for Class I, Division 1 or 2 hazardous (classified) locations as classified in accordance with **500.5** and **500.6**, and this article. A Class I location shall not extend beyond an unpierced wall, roof, or other solid partition that has no openings. [**30A**:8.3.1, 8.3.3]

Where the term "Class I" is used with respect to Zone classifications within this article of the *Code*, it shall apply to Zone 0, Zone 1, and Zone 2 designations.

Informational Note: The term "Class I" was originally included as a prefix to Zone 0, Zone 1, and Zone 2 locations and references as an identifier for flammable gases, vapors, or liquids to differentiate from Class II and Class III locations. Zone 0, Zone 1, and Zone 2 only apply to flammable gases, vapors, or liquids so the "Class I" prefix is redundant and has been deleted, except for text that is extracted from other documents or to remain consistent throughout this article.

The added text clarifies the application of what was the "Class I" prefix to Zones 0, 1, and 2. The new text provides clarification that those designations with the prefix "Class I" are applied as Zones 0, 1, and 2 per Article 505.

The term "Class I" is now an optional equipment marking, as the Zone designations are specific to Class I areas.

511.3(A) Parking Garages. Parking garages used for parking or storage shall be permitted to be unclassified.

Informational Note: See NFPA 88A,Standard for Parking Structures, and NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages, for additional information.

511.3(B) Repair Garages, with Dispensing. Major and minor repair garages that dispense motor fuels into the fuel tanks of vehicles, including flammable liquids having a flash point below 38°C (100°F) such as gasoline, or gaseous fuels such as natural gas, hydrogen, or LPG, shall have the dispensing functions and components classified in accordance with **Table 514.3(B)(1)** in addition to any classification required by this section. Where Class I liquids, other than fuels, are dispensed, the area within 900 mm (3 ft) of any fill or dispensing point, extending in all directions, shall be a Class I, Division 2 location.

511.3(C) Repair Garages, Major and Minor. Where vehicles using Class I liquids or heavier-than-air gaseous fuels (such as LPG) are repaired, hazardous area classification shall be in accordance with **Table 511.3(C).**

Informational Note: See NFPA 30A,Code for Motor Fuel Dispensing Facilities and Repair Garages, Table 8.3.2, for additional information.

511.3(D) Repair Garages, Major. Where vehicles using lighter-than-air gaseous fuels (such as hydrogen and natural gas) are repaired or stored, hazardous area classification shall be in accordance with **Table 511.3(D).**

Informational Note: See NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages, Table 8.3.2, for additional information.

511.3(E) Modifications to Classification.

511.3(E)(1) Specific Areas Adjacent to Classified Locations. Areas adjacent to classified locations in which flammable vapors are not likely to be released, such as stock rooms, switchboard rooms, and other similar locations, shall be unclassified where mechanically ventilated at a rate of four or more air changes per hour, designed with positive air pressure, or separated by an unpierced wall, roof, or other solid partition.

511.3(E)(2) Alcohol-Based Windshield Washer Fluid. The area used for storage, handling, or dispensing into motor vehicles of alcohol-based windshield washer fluid in repair garages shall be unclassified unless otherwise classified by a provision of **511.3**. [**30A**:8.3.1, Exception]

The classification of locations includes the requirements based on the garage categories.

Table 511.3(C) *Extent of Classified Locations for Major and Minor Repair Garages with Heavier-Than-Air Fuel*

Location	Class I		Extent of Classified Location
	Division (Group D)	Zone (Group IIA)	
Repair garage, major (where Class I liquids or gaseous fuels are transferred or dispensed*)	1	1	Entire space within any pit, belowgrade work area, or subfloor work area that is not ventilated
	2	2	Entire space within any pit, belowgrade work area, or subfloor work area that is provided with ventilation of at least 0.3 $m^3/min/m^2$ (1 $ft^3/min/ft^2$) of floor area, with suction taken from a point within 300 mm (12 in) of floor level
	2	2	Up to 450 mm (18 in) above floor level of the room, except as noted below, for entire floor area
	Unclassified	Unclassified	Up to 450 mm (18 in) above floor level of the room where room is provided with ventilation of at least 0.3 $m^3/min/m^2$ (1 $ft^3/min/ft^2$) of floor area, with suction taken from a point within 300 mm (12 in) of floor level
	2	2	Within 0.9 m (3 ft) of any fill or dispensing point, extending in all directions
Specific areas adjacent to classified locations	Unclassified	Unclassified	Areas adjacent to classified locations where flammable vapors are not likely to be released, such as stock rooms, switchboard rooms, and other similar locations, where mechanically ventilated at a rate of four or more air changes per hour or designed with positive air pressure or where effectively cut off by walls or partitions
Repair garage, minor (where Class I liquids or gaseous fuels are not transferred or dispensed*)	2	2	Entire space within any pit, belowgrade work area, or subfloor work area that is not ventilated
	2	2	Up to 450 mm (18 in) above floor level, extending 0.9 m (3 ft) horizontally in all directions from opening to any pit, belowgrade work area, or subfloor work area that is not ventilated
	Unclassified	Unclassified	Entire space within any pit, belowgrade work area, or subfloor work area that is provided with ventilation of at least 0.3 $m^3/min/m^2$ (1 $ft^3/min/ft^2$) of floor area, with suction taken from a point within 300 mm (12 in) of floor level
Specific areas adjacent to classified locations	Unclassified	Unclassified	Areas adjacent to classified locations where flammable vapors are not likely to be released, such as stock rooms, switchboard rooms, and other similar locations, where mechanically ventilated at a rate of four or more air changes per hour or designed with positive air pressure, or where effectively cut off by walls or partitions

*Includes draining of Class I liquids from vehicles.

Table 511.3(D) *Extent of Classified Locations for Major Repair Garages with Lighter-than-Air Fuel*

Location	Class I		Extent of Classified Location
	Division[2]	Zone[3]	
Repair garage, major (where lighter-than-air gaseous fueled[1] vehicles are repaired or stored)	2	2	Within 450 mm (18 in.) of ceiling, except as noted below
	Unclassified	Unclassified	Within 450 mm (18 in.) of ceiling where ventilation of at least 0.3 $m^3/min/m^2$ (1 $ft^3/min/ft^2$) of floor area, with suction taken from a point within 450 mm (18 in.) of the highest point in the ceiling
Specific areas adjacent to classified locations	Unclassified	Unclassified	Areas adjacent to classified locations where flammable vapors are not likely to be released, such as stock rooms, switchboard rooms, and other similar locations, where mechanically ventilated at a rate of four or more air changes per hour or designed with positive air pressure, or where effectively cut off by walls or partitions

[1]Includes fuels such as hydrogen and natural gas, but not LPG.

[2]For hydrogen (lighter than air) Group B, or natural gas Group D.

[3]For hydrogen (lighter than air) Group IIC or IIB+H_2, or natural gas Group IIA.

511.4 Wiring and Equipment in Class I Locations.

511.4(A) Wiring Located in Class I Locations. Wiring located within Class I locations as classified in **511.3** shall conform with the requirements of Part II of Article **501** or **504.20**, as applicable.

Section revised to include Intrinsically Safe article reference.

511.4(B) Equipment Located in Class I Locations. Within Class I locations as defined in **511.3**, equipment shall conform with the requirements of Part III of Article **501** or **504.10**, as applicable.

Section revised to include Intrinsically Safe article reference.

511.4(B)(1) Fuel-Dispensing Units. Where fuel-dispensing units (other than liquid petroleum gas, which is prohibited) are located within buildings, **514.1** shall apply.

Where mechanical ventilation is provided in the dispensing area, the control shall be interlocked so that the dispenser cannot operate without ventilation, in accordance with **500.5(B)(2)**.

511.4(B)(2) Portable Lighting Equipment. Portable lighting equipment shall be equipped with handle, lampholder, hook, and substantial guard attached to the lampholder or handle. All exterior surfaces that might come in contact with battery terminals, wiring terminals, or other objects shall be of nonconducting material or shall be effectively protected with insulation. Lampholders shall be of an unswitched type and shall not provide means for plug-in of attachment plugs. The outer shell shall be of molded composition or other suitable material. Unless the lamp and its cord are supported or arranged in such a manner that they cannot be used in the locations classified in **511.3**, they shall be of a type identified for Class I, Division 1 locations.

511.7 Wiring and Equipment Installed Above Hazardous (Classified) Locations.

511.7(A) Wiring in Spaces Above Hazardous (Classified) Locations.

511.7(A)(1) Fixed Wiring Above Hazardous (Classified) Locations. Fixed wiring above hazardous (classified) locations shall be permitted to be one or more of the following:

(1) Rigid metal conduit (RMC) or intermediate metal conduit (IMC) with listed threaded or threadless fittings, or electrical metallic conduit (EMT) with listed fittings.

(2) Rigid polyvinyl chloride conduit (PVC), reinforced thermosetting resin conduit (RTRC), or electrical nonmetallic tubing (ENT).

(3) Flexible metal conduit (FMC), liquidtight flexible metal conduit (LFMC), or liquidtight flexible nonmetallic conduit (LFNC), with listed fittings.

(4) Type MC cable, Type AC cable, Type TC cable, or Type TC-ER cable, including installation in cable trays. Type TC-ER cable shall include an equipment grounding conductor (EGC) in addition to any drain wire. All cable types shall have listed fittings.

(5) Type MI cable terminated with listed fittings and supported in a manner to avoid tensile stress.

(6) Manufactured wiring systems.

(7) Type PLTC cable or Type PLTC-ER cable in Class I, Class 2, or Class 3 circuits. Type PLTC-ER cable shall include an equipment grounding conductor (EGC) in addition to any drain wire.

(8) Type ITC cable or Type ITC-ER cable in accordance with **335.4** and **335.5**, terminated with listed fittings. Type ITC-ER cable shall include an equipment grounding conductor (EGC) in addition to any drain wire.

(9) Cellular metal floor raceways or cellular concrete floor raceways only for supplying ceiling outlets or extensions to the area below the floor. Such raceways shall have no connections leading into or through any Class I location above the floor.

511.7(A)(2) Pendant. For pendants, flexible cord suitable for the type of service and listed for hard usage shall be used.

511.7(B) Electrical Equipment Installed Above Hazardous (Classified) Locations.

511.7(B)(1) Fixed Electrical Equipment. Electrical equipment in a fixed position shall be located above the level of any defined hazardous (classified) location or shall be identified for the location.

(a) *Arcing Equipment*. Equipment that is less than 3.7 m (12 ft) above the floor level and that might produce arcs, sparks, or particles of hot metal, such as cutouts, switches, charging panels, generators, motors, or other equipment (excluding receptacles, lamps, and lampholders) having make-and-break or sliding contacts, shall be of the totally enclosed type or constructed so as to prevent the escape of sparks or hot metal particles.

(b) *Fixed Lighting.* Lamps and lampholders for fixed lighting that is located over lanes through which vehicles are commonly driven or that might otherwise be exposed to physical damage shall be located not less than 3.7 m (12 ft) above floor level, unless of the totally enclosed type or constructed so as to prevent escape of sparks or hot metal particles.

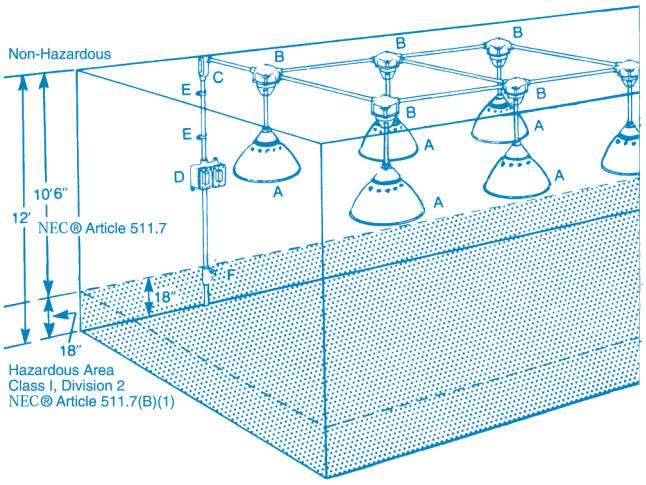
511.8 Underground Wiring Below Hazardous (Classified) Locations. Underground wiring shall be installed in accordance with one of the following wiring methods:

(1) Threaded rigid metal conduit (RMC) or threaded intermediate metal conduit (IMC) with listed threaded fittings.

Revised to make clear that the IMC must be threaded.

(1) Rigid polyvinyl chloride conduit (PVC), reinforced thermosetting resin conduit (RTRC), or high-density polyethylene conduit (HDPE) where buried under not less than 600 mm (2 ft) of cover. Where PVC conduit, RTRC conduit, or HDPE conduit is used, threaded rigid metal conduit or threaded intermediate metal conduit shall be used for the last 600 mm (2 ft) of the underground run to emergence or to the point of connection to the aboveground raceway, and an equipment grounding conductor shall be included to provide electrical continuity of the raceway system and for grounding of non–current-carrying metal parts.

Section 511.8 permits Type PVC, Type RTRC, and Type HDPE Conduits to be installed where buried at least with 2 feet of cover under a commercial garage. Where under less than 2 feet of cover, for instance, where the run terminates, then the other wiring methods of Article 511 apply.



LUMINAIRES (A) AND FS OR FD BOXES (D) ILLUSTRATED HERE MAY BE INSTALLED LESS THAN 12 FEET FROM THE FLOOR LEVEL BECAUSE THEY MEET SECTION 511.7(B)(1) REQUIREMENT OF BEING "TOTALLY ENCLOSED." THE LUMINAIRES (A) ARE ENCLOSED AND GASKETED AND THE FS/FD (D) UNITS ARE ENCLOSED WITH GASKETED COVERS. SPARKS OR HOT METAL PARTICLES ARE CONTAINED BY THE COVERS OR ENCLOSURES (B) AND CANNOT BE TRANSMITTED THROUGH THE CONDUIT TO THE HAZARDOUS AREA NEAR THE FLOOR BECAUSE OF THE SEAL (F).

A—CLASS I, DIVISION 2 LUMINAIRES

B—ENCLOSED AND GASKETED FIXTURE HANGERS

C—CONDUIT BODY

D—FS OR FD WEATHERPROOF COVER

E—MALLEABLE IRON CLAMPS AND CLAMP BACKS

F—EXPLOSIONPROOF SEALS

511.9 Sealing. Seals complying with the requirements of **501.15** and **501.15(B)(2)** shall be provided and shall apply to horizontal as well as vertical boundaries of the defined Class I locations.

511.10 Special Equipment.

511.10(A) Battery Charging Equipment. Battery chargers and their control equipment, and batteries being charged, shall not be located within locations classified in **511.3**.

511.10(B) Electric Vehicle Charging Equipment.

511.10(B)(1) General. All electrical equipment and wiring shall be installed in accordance with Part III of Article **625**, except as required by **511.10(B)(2)** and **(B)(3)**. Flexible cords shall be of a type identified for extra-hard usage.

511.10(B)(2) Connector Location. No connector shall be located within a Class I location as defined in 511.3.

511.10(B)(3) Plug Connections to Vehicles. Where the cord is suspended from overhead, it shall be arranged so that the lowest point of sag is at least 150 mm (6 in) above the floor. Where an automatic arrangement is provided to pull both cord and plug beyond the range of physical damage, no additional connector shall be required in the cable or at the outlet.

TOTALLY ENCLOSED FITTINGS

FM7™ SERIES

FM8™ SERIES

FORM 85

FORM 35™

FIXTURE HANGERS

GS CUSHION TYPE

AHG CUSHION TYPE

T FITTING WITH AHG TYPE HANGER

T FITTING

TOTALLY ENCLOSED DEVICES

FS BOX AND COVER

GFI COVER

TOTALLY ENCLOSED LUMINAIRES

MERCMASTER™ LED GENERATION 3

MERCMASTER™ LED LOW PROFILE

RETROMASTER LED

RIGMASTER™ LED

511.12 Ground-Fault Circuit-Interrupter Protection for Personnel. Ground-fault circuit-interrupter protection for personnel shall be provided as required in **210.8(B)**.

This section was revised to remove the specific requirements as they were already addressed in General Articles. The requirements are found in 210.8(B).

511.16 Grounding and Bonding Requirements.

511.16(A) General Grounding Requirements. All metal raceways, the metal armor or metallic sheath on cables, and all non–current-carrying metal parts of fixed or portable electrical equipment, regardless of voltage, shall be grounded.

511.16(B) Supplying Circuits with Grounded and Grounding Conductors in Class I Locations. Grounding in Class I locations shall comply with **501.30**.

511.16(B)(1) Circuits Supplying Portable Equipment or Pendants. Where a circuit supplies portables or pendants and includes a grounded conductor in accordance with **200.3**, receptacles, attachment plugs, connectors, and similar devices shall be of the grounding type and the grounded conductor of the flexible cord shall be connected to the screw shell of any lampholder or to the grounded terminal of any utilization equipment supplied.

511.16(B)(2) Approved Means. Approved means shall be provided for maintaining continuity of the equipment grounding conductor between the fixed wiring system and the non–current-carrying metal portions of pendant luminaires, portable luminaires, and portable utilization equipment.

INTERPRETATION OF ARTICLE 512: CANNABIS OIL EQUIPMENT and CANNABIS OIL SYSTEMS USING FLAMMABLE MATERIALS

This is a new Article for the 2023 Code.

Article 512 Cannabis Oil Equipment and Cannabis Oil Systems Using Flammable Materials

Part I. General

512.1 Scope. This article covers cannabis oil preparatory equipment, extraction equipment, booths, post-processing equipment, and systems using flammable materials (flammable gas, flammable liquid–produced vapor, combustible liquid–produced vapor) in commercial and industrial facilities.

Informational Note No. 1: See ANSI/UL 1389, Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations, for information on cannabis oil equipment and systems for hazardous (classified) locations.

Informational Note No. 2: See NFPA 1, Fire Code; NFPA 55, Compressed Gases and Cryogenic Fluids Code; NFPA 58, Liquefied Petroleum Gas Code; and ICC IFC, International Fire Code, together with the manufacturer's installation instructions, for information on the installation of cannabis oil equipment and systems.

512.2 Other Articles. In addition to the requirements of this article, cannabis oil equipment and cannabis oil systems using flammable materials shall comply with **Table 512.2**, as applicable, except as modified by this article.

Table 512.2 *Other Articles*

Requirement	Division Classified Locations	Zone Classified Locations
Area classification	500.5, 500.6	505.5, 505.6, 505.7
Equipment	Part III of 501, 500.7, 500.8, 501.5	505.8, 505.9, 505.20, 505.22
Wiring	Part II of 501	505.15, 505.16, 505.17, 505.18, 505.19, 505.26, 505.30

512.3 Classified Locations. Cannabis oil equipment and systems that can release flammable materials during operation shall be classified in accordance with **512.3(A) and (B)**.

Informational Note No. 1: Some cannabis oil applications can result in the release of heavier-than-air flammable gases or vapors into the surrounding atmosphere as a normal part of the overall extraction process (e.g., during disconnecting or opening of vessels containing flammable solvents, or during off-gassing of spent material or extracted plant oil). Cannabis oil equipment and systems can also include the connection of external containers, or other external sources, of flammable solvent.

Informational Note No. 2: See NFPA 30, Flammable and Combustible Liquids Code; NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials; and NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, for information on area classification.

Informational Note No. 3: See NFPA 36, Standard for Solvent Extraction Plants, for information on area classification in commercial-scale extraction processes.

512.3(A) Cannabis Oil Equipment and Systems Other Than Booths.

512.3(A)(1)Where Flammable Gases or Vapors Are Released. For sources of gases or vapors from a flammable material, the location shall be classified in accordance with the following and as shown in **Figure 512.3(A)(1):**

(1) The space within 915 mm (3 ft) in all directions from any such equipment or container and extending to the floor or grade level shall be classified as Class I, Division 1 or Zone 1, whichever is applicable.

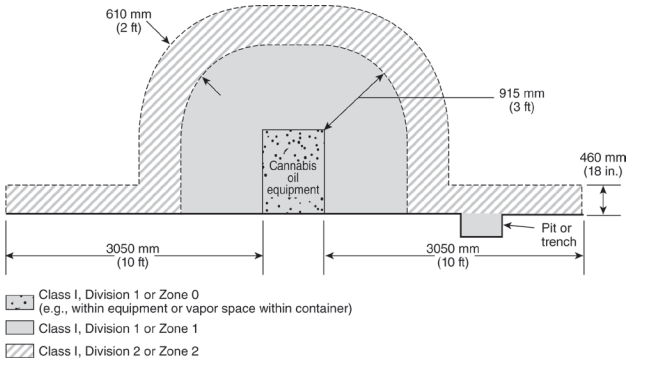
(2) The space extending 610 mm (2 ft) beyond the Class I, Division 1 or Zone 1 location shall be classified as Class I, Division 2 or Zone 2, whichever is applicable.

(3) The space extending 1525 mm (5 ft) horizontally beyond the space described in **512.3(A)(1)(2)** up to a height of 460 mm (18 in) above the floor or grade level shall be classified as Class I, Division 2 or Zone 2, whichever is applicable.

(4) The space inside of a tank or container and the inside of equipment that contains a flammable material shall be classified as Class I, Division 1 or Zone 0, whichever is applicable.

(5) Sumps, pits, or below grade channels within 3.05 m (10 ft) horizontally of a vapor source shall be classified as Class I, Division 1 or Zone 1. If the sump, pit, or channel extends beyond 3.05 m (10 ft) horizontally from the vapor source, it shall be provided with a vapor stop or classified as Class I, Division 1 or Zone 1 for its entire length.

FIGURE 512.3(A)(1) *Area Classification for Equipment and Systems Other than Booths, Where Flammable Gases or Vapors Are Released.*



512.3(A)(2) Where Flammable Gases or Vapors Are Not Released, Except During Disconnection or Opening. Where listed equipment is marked to indicate that the level of release during disconnection or opening is maintained below 25 percent LFL without ventilation, flammable solvents shall not be released during the extraction process except during disconnecting or opening of vessels containing flammable solvents, or during off-gassing of spent material or extracted plant oil.

For sources of gas or vapor from a flammable material, the location shall be classified in accordance with the following and as shown in **Figure 512.3(A)(2)**:

(1) The space within 915 mm (3 ft) in all directions from any such equipment or container and extending to the floor or grade level shall be classified as Class I, Division 2 or Zone 2, whichever is applicable.

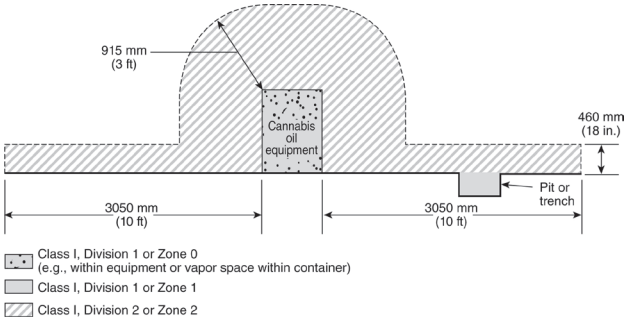
(2) The space extending beyond the Division 2 or Zone 2 area shall be unclassified.

(3) The space inside of a tank or container and the inside of equipment that contains a flammable material shall be classified as Class I, Division 1 or Zone 0, whichever is applicable.

(4) The space extending 2134 mm (7 ft) horizontally beyond the space described in **512.3(A)(2)(1)** up to a height of 460 mm (18 in) above the floor or grade level shall be classified as Class I, Division 2 or Zone 2, whichever is applicable.

(5) Sumps, pits, or below grade channels within 3.05 m (10 ft) horizontally of a vapor source shall be classified as Class I, Division 1 or Zone 1. If the sump, pit, or channel extends beyond 3.05 m (10 ft) horizontally from the vapor source, it shall be provided with a vapor stop or it shall be classified as Class I, Division 1 or Zone 1 for its entire length.

FIGURE 512.3(A)(2) *Area Classification for Equipment and Systems Other than Booths, Where Flammable Gases or Vapors Are Not Released Except During Disconnection or Opening.*



512.3(B) Cannabis Oil Booths. Air exhausted from the booths shall not be recirculated or exhausted from the booths into the room in which the booths are installed. Ventilation other than exhaust ventilation can be provided to the booth, but cannot be recirculated or exhausted from the booth into the room in which the booth is installed.

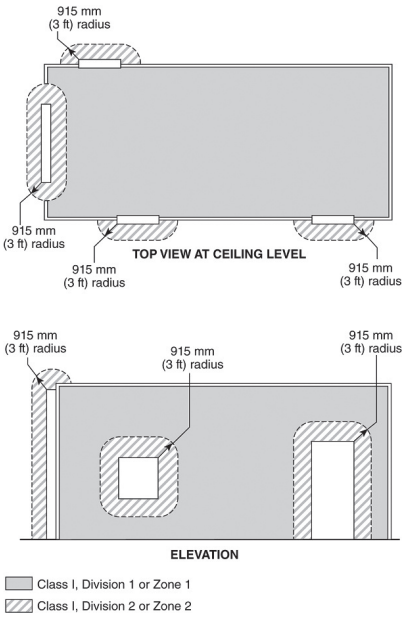
512.3(B)(1) Where Flammable Gases or Vapors Are Released. For sources of gas or vapor from a flammable material, the location shall be classified in accordance with the following and as shown in **Figure 512.3(B)(1):**

(1) The space within the booth shall be classified as Class I, Division 1 or Zone 1, whichever is applicable.

(2) The space within 915 mm (3 ft) of any opening shall be classified as Class I, Division 2 or Zone 2, whichever is applicable.

(3) The interior of fresh air supply ducts and fresh air supply plenums shall be unclassified.

FIGURE 512.3(B)(1) *Area Classification for Booths Where Flammable Gases or Vapors Are Released.*



512.3(B)(2) Where Flammable Gases or Vapors Are Not Released, Except During Disconnection or Opening. Where listed equipment is marked to indicate that the level of release during disconnection or opening is maintained below 25 percent LFL without ventilation, flammable solvents shall not be released during the extraction process except during disconnecting or opening of vessels containing flammable solvents, or during off-gassing of spent material or extracted plant oil.

For sources of gas or vapor from a flammable material, the location shall be classified in accordance with the following and as shown in Figure **512.3(B)(2)**:

(1) The space within the booth shall be classified as Class I, Division 2 or Zone 2, whichever is applicable.

(2) The space outside any opening shall be unclassified.

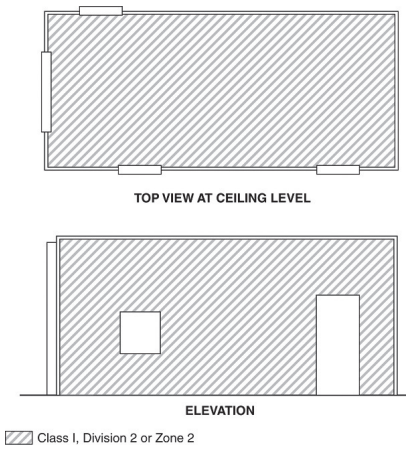
(3) The interior of fresh air supply ducts and fresh air supply plenums shall be unclassified.

Part II. Wiring

512.10 Wiring Installation and Operation. All wiring installed or operated within any of the hazardous (classified) locations defined in **512.3** shall comply with the requirements of Part II of Article **501** or **505.15**, as applicable, for the division or zone location in which it is installed.

512.13 Wiring Installed Above Hazardous (Classified) Locations. Other than above cannabis oil booths, all fixed wiring installed at an elevation above hazardous (classified) locations [see **Figure 512.3(A)(1)** and **Figure 512.3(A)(2)**] shall be in metal raceways, PVC conduit, RTRC conduit, or ENT conduit. Where used, cables shall be Type MI, Type TC, or Type MC.

FIGURE 512.3(B)(2) *Area Classification for Booths Where Flammable Gases or Vapors Are Not Released Except During Disconnection or Opening.*



Part III. Equipment

512.20 Equipment and Systems. Installation of cannabis oil equipment and systems shall be in a distinct room or area located at commercial or industrial facilities. Where all electrical equipment within cannabis oil booths is listed for Class I, Division 1 or Zone 1 locations, gas detection shall not be required to be provided within the booth. Where gas detection in accordance with **500.7(K)** is provided within booths listed for Class I, Division 2 or Zone 2 locations, electrical equipment shall be permitted.

512.20(A) Cannabis Oil Preparatory Equipment. Equipment that is used to prepare the plant material for subsequent extraction of the plant oil (e.g., trimming, deseeding, drying/curing) shall be listed for the location.

512.20(B) Cannabis Oil Extraction Equipment. Equipment that uses flammable materials (solvents) in the process of extracting the plant oil from the plant material shall be listed for the location.

Informational Note: Extraction equipment can use flammable materials as solvents to extract the plant oil from the plant material by saturating the plant material in a vented container, sealed container, or pressure vessel. Typical flammable materials used in the extraction process include butane, ethanol, hexane, pentane, propane, and LPG.

512.20(C) Cannabis Oil Booths. Enclosed areas used to house cannabis oil equipment and systems shall be listed for the location.

Informational Note: Cannabis oil booths can be designed to house a single piece or multiple pieces of cannabis oil equipment. Booths range in size and can be large enough to permit entrance of personnel to perform the processing tasks.

512.20(D) Cannabis Oil Post-Processing Equipment. Equipment that is used in the final processing stages of the extracted plant oil (e.g., vacuum ovens, rotary evaporators, solvent recovery pumps) shall be listed for the location.

512.20(E) Cannabis Oil Systems. Any combination of cannabis oil equipment needed for the overall extraction process (e.g., cannabis oil preparatory equipment, cannabis oil extraction equipment, cannabis oil booths, cannabis oil post-processing equipment) shall be listed for the location.

Informational Note: See NFPA 70B, Recommended Practice for Electrical Equipment Maintenance, for information related to general electrical equipment maintenance and developing an effective electrical preventive maintenance (EPM) program.

512.22 Equipment Installed in Hazardous (Classified) Locations. All equipment installed or operated within any of the classified locations defined in **512.3** shall comply with the requirements of Part III of Article **501** or **505.9**, as applicable, for the division or zone area in which they are used.

512.30 Equipment Installed Above Hazardous (Classified) Locations. Equipment that could produce arcs, sparks, or hot metal particles, such as lamps and lampholders for fixed lighting, cutouts, switches, receptacles, motors, or other equipment having make-and-break or sliding contacts, where installed above a classified location other than cannabis oil booths, shall be of the totally enclosed type or be constructed to prevent the escape of sparks or hot metal particles.

512.32 Marking. Cannabis oil preparatory equipment, extraction equipment, booths, and post-processing equipment shall be listed and marked to show the hazardous (classified) location for which it is permitted to be installed.

512.32(A) Division Equipment. Equipment for Class I, Division 1 or Class I, Division 2 shall be marked in accordance with **500.8(C)**.

512.32(B) Zone Equipment. Equipment for Zone 1 or Zone 2 shall be marked in accordance with **500.8(C)(2)**.

CHANGES TO ARTICLE 513 – AIRCRAFT HANGARS

The following Article 513 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 513.2: Other Articles
- Table 513.2: Other Articles

ARTICLE 513 Aircraft Hangars

513.1 Scope. This article shall apply to buildings or structures in any part of which aircraft containing Class I (flammable) liquids or Class II (combustible) liquids whose temperatures are above their flash points are housed or stored and in which aircraft might undergo service, repairs, or alterations. It shall not apply to locations used exclusively for aircraft that have never contained fuel or unfueled aircraft.

Informational Note No. 1: See NFPA 409,Standard on Aircraft Hangars, for definitions of aircraft hangar and unfueled aircraft.

Informational Note No. 2: See NFPA 30, Flammable and Combustible Liquids Code, for information on fuel classification.

Article 513 allows use of the Zone classification system as described in Article 505. This is possible since aircraft hangars are not open to the general public.

513.2 Other Articles. In addition to the requirements of this article, aircraft hangars shall comply with Table 513.2, as applicable, except as modified by this article.

This new requirement provides the necessary link from Article 513 to Articles 500 and 505 which became necessary with the deletion of Article 510.

Table 513.2 *Other Articles*

Requirement	Division Classified Locations	Zone Classified Locations
Area classification	500.5, 500.6	505.5, 505.6, 505.7
Equipment	Part III of 501, 500.7, 500.8, 501.5	505.8, 505.9, 505.20, 505.22
Wiring	Part II of 501	505.15, 505.16, 505.17, 505.18, 505.19, 505.26, 505.30

New Table 513.2 has been created to identify the specific sections of other Articles that are applicable to aircraft hangars

513.3 Classification of Locations. Where the term "Class I" is used with respect to Zone classifications within this article of the *Code*, it shall apply to Zone 0, Zone 1, and Zone 2 designations.

Informational Note: The term "Class I" was originally included as a prefix to Zone 0, Zone 1, and Zone 2 locations and references as an identifier for flammable gases, vapors, or liquids to differentiate from Class II and Class III locations. Zone 0, Zone 1, and Zone 2 only apply to flammable gases, vapors, or liquids so the "Class I" prefix is redundant and has been deleted, except for text that is extracted from other documents or to remain consistent throughout this article.

The added text clarifies the application of what was the "Class I" prefix to Zones 0, 1, and 2. The new text provides clarification that those designations with the prefix "Class I" are applied as Zones 0, 1, and 2 per Article 505.

The term "Class I" is now an optional equipment marking, as the Zone designations are specific to Class I areas.

513.3(A) Below Floor Level. Any pit or depression below the level of the hangar floor shall be classified as a Class I, Division 1 or Zone 1 location that shall extend up to said floor level.

513.3(B) Areas Not Separated or Ventilated. The entire area of the hangar, including any adjacent and communicating areas not suitably separated from the hangar, shall be classified as a Class I, Division 2 or Zone 2 location up to a level 450 mm (18 in) above the floor.

513.3(C) Vicinity of Aircraft.

513.3(C)(1) Aircraft Maintenance and Storage Hangars. The area within 1.5 m (5 ft) horizontally from aircraft power plants or aircraft fuel tanks shall be classified as a Class I, Division 2 or Zone 2 location that shall extend upward from the floor to a level 1.5 m (5 ft) above the upper surface of wings and of engine enclosures.

513.3(C)(2) Aircraft Painting Hangars. The area within 3 m (10 ft) horizontally from aircraft surfaces from the floor to 3 m (10 ft) above the aircraft shall be classified as Class I, Division 1 or Zone 1. The area horizontally from aircraft surfaces between 3.0 m (10 ft) and 9.0 m (30 ft) from the floor to 9.0 m (30 ft) above the aircraft surface shall be classified as Class I, Division 2 or Zone 2.

Informational Note: See NFPA 33-2015, Standard for Spray Application Using Flammable or Combustible Materials, for information on ventilation and grounding for static protection in spray painting areas.

513.3(D) Areas Suitably Separately and Ventilated. Adjacent areas in which flammable liquids or vapors are not likely to be released, such as stock rooms, electrical control rooms, and other similar locations, shall be unclassified where mechanically ventilated at a rate of four or more air changes per hour, or designed with positive air pressure, or where effectively separated from the hangar itself by walls or partitions.

513.4 Wiring and Equipment in Class I Locations.

513.4(A) General. All wiring and equipment that is installed or operated within any of the hazardous (classified) locations defined in **513.3** shall comply with the applicable requirements of the hazardous (classified) locations.

Attachment plugs and receptacles in Class I locations shall be identified for the location or shall be designed so that they cannot be energized while the connections are being made or broken.

513.4(B) Stanchions, Rostrums, and Docks. Electrical wiring, outlets, and equipment (including lamps) on or attached to stanchions, rostrums, or docks that are located in a hazardous (classified) location as defined in **513.3(C)** shall comply with the applicable requirements of Parts II and III of Article **501** or **505.17** through **505.30**, as applicable.

513.7 Wiring and Equipment Not Installed in Class I Locations.

513.7(A) Fixed Wiring. All fixed wiring in a hangar but not installed in a Class I location as classified in **513.3** shall be installed in metal raceways or shall be Type MI, TC, or MC cable.

*Exception: Wiring in unclassified locations, as described in **513.3(D)**, shall be permitted to be any suitable type wiring method recognized in Chapter 3.*

The exception in 513.7(A) states that wiring methods used shall be any Chapter 3 method that is suitable, instead of any recognized method from Chapter 3.

513.7(B) Pendants. For pendants, flexible cord suitable for the type of service and identified for hard usage or extra-hard usage shall be used. Each such cord shall include a separate equipment grounding conductor.

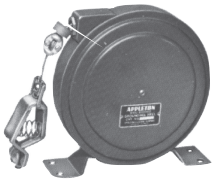
513.7(C) Arcing Equipment. In locations above those described in **513.3**, equipment that is less than 3.0m (10 ft) above wings and engine enclosures of aircraft and that may produce arcs, sparks, or particles of hot metal, such as lamps and lampholders for fixed lighting, cutouts, switches, receptacles, charging panels, generators, motors, or other equipment having make-and-break or sliding contacts, shall be of the totally enclosed type or constructed so as to prevent the escape of sparks or hot metal particles.

*Exception: Equipment in areas described in **513.3(D)** shall be permitted to be of the general-purpose type.*

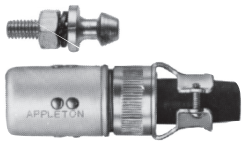
513.7(D) Lampholders. Lampholders of metal-shell, fiber-lined types shall not be used for fixed incandescent lighting.

STATIC ELECTRICITY.

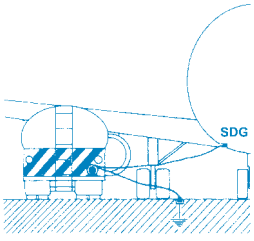
THE FLOW OF FLAMMABLE LIQUIDS THROUGH NON-CONDUCTING MATERIALS CAN GENERATE STATIC ELECTRICITY. THEREFORE THE AIRCRAFT AND TRUCK DISPENSING THE FUEL NEED TO BE GROUNDED TO SAFELY DISSIPATE THE STATIC CHARGE. AN EFFECTIVE METHOD OF PROVIDING SUCH SAFETY IS THROUGH THE USE OF AN APPLETON™ STATIC GROUNDING REEL.



SD SERIES STATIC DISCHARGE GROUNDING REEL



SDG GROUNDING STUD AND SDP GROUNDING PLUG



GROUNDING REEL INSTALLED ON A TRUCK.

513.7(E) Stanchions, Rostrums, or Docks. Where stanchions, rostrums, or docks are not located or likely to be located in a Class I location, as defined in **513.3(C)**, wiring and equipment shall comply with **513.7**, except that such wiring and equipment not more than 457 mm (18 in) above the floor in any position shall comply with **513.4(B)**. Receptacles and attachment plugs shall be of a locking type that will not readily disconnect.

513.7(F) Mobile Stanchions. Mobile stanchions with electrical equipment complying with **513.7(E)** shall carry at least one permanently affixed warning sign with the following words or equivalent:

WARNING
KEEP 5 FT CLEAR OF AIRCRAFT
ENGINES AND FUEL TANK AREAS
or
WARNING
KEEP 1.5 METERS CLEAR OF AIRCRAFT
ENGINES AND FUEL TANK AREAS

513.8 Underground Wiring.

513.8(A)Wiring and Equipment Embedded, Under Slab, or Underground. All wiring installed in or under the hangar floor shall comply with the requirements for Class I, Division 1 locations. Where such wiring is located in vaults, pits, or ducts, adequate drainage shall be provided.

513.8(B) Uninterrupted Raceways, Embedded, Under Slab, or Underground. Uninterrupted raceways that are embedded in a hangar floor or buried beneath the hangar floor shall be considered to be within the Class I location above the floor, regardless of the point at which the raceway descends below or rises above the floor.

513.9 Sealing. Seals shall be provided in accordance with **501.15** or **505.16**, as applicable. Sealing requirements specified shall apply to horizontal as well as to vertical boundaries of the defined Class I locations.

The sealing section reflects the harmonized sealing language used in the other Articles.

513.10 Special Equipment.

513.10(A) Aircraft Electrical Systems.

513.10(A)(1) De-energizing Aircraft Electrical Systems. Aircraft electrical systems shall be de-energized when the aircraft is stored in a hangar and, whenever possible, while the aircraft is undergoing maintenance.

513.10(A)(2) Aircraft Batteries. Aircraft batteries shall not be charged where installed in an aircraft located inside or partially inside a hangar.

513.10(B) Aircraft Battery Charging and Equipment. Battery chargers and their control equipment shall not be located or operated within any of the Class I locations defined in **513.3** and shall preferably be located in a separate building or in an area such as defined in **513.3(D)**. Mobile chargers shall carry at least one permanently affixed warning sign with the following words or equivalent:

WARNING
KEEP 5 FT CLEAR OF AIRCRAFT ENGINES
AND FUEL TANK AREAS
or
WARNING
KEEP 1.5 METERS CLEAR OF AIRCRAFT
ENGINES AND FUEL TANK AREAS

Tables, racks, trays, and wiring shall not be located within a Class I location and shall comply with the requirements of **480.9** and **480.10**.

513.10(C) External Power Sources for Energizing Aircraft.

513.10(C)(1) Not Less Than 450 mm (18 in) Above Floor. Aircraft energizers shall be designed and mounted such that all electrical equipment and fixed wiring will be at least 450 mm (18 in) above floor level and shall not be operated in a Class I location as defined in **513.3(C)**.

513.10(C)(2) Marking for Mobile Units. Mobile energizers shall carry at least one permanently affixed warning sign with the following words or equivalent:

WARNING
KEEP 5 FT CLEAR OF AIRCRAFT
ENGINES AND FUEL TANK AREAS
or
WARNING
KEEP 1.5 METERS CLEAR OF AIRCRAFT
ENGINES AND FUEL TANK AREAS

513.10(C)(3) Cords. Flexible cords for aircraft energizers and ground support equipment shall be identified for the type of service and extra-hard usage and shall include an equipment grounding conductor.

513.10(D) Mobile Servicing Equipment with Electrical Components.

513.10(D)(1) General. Mobile servicing equipment (such as vacuum cleaners, air compressors, air movers) having electrical wiring and equipment not suitable for Class I, Division 2 or Zone 2 locations shall be so designed and mounted that all such fixed wiring and equipment will be at least 450 mm (18 in) above the floor. Such mobile equipment shall not be operated within the Class I location defined in **513.3(C)** and shall carry at least one permanently affixed warning sign with the following words or equivalent:

WARNING
KEEP 5 FT CLEAR OF AIRCRAFT ENGINES
AND FUEL TANK AREAS
or
WARNING
KEEP 1.5 METERS CLEAR OF AIRCRAFT ENGINES
AND FUEL TANK AREAS

513.10(D)(2) Cords and Connectors. Flexible cords for mobile equipment shall be suitable for the type of service and identified for extra-hard usage and shall include an equipment grounding conductor. Attachment plugs and receptacles shall be identified for the location in which they are installed and shall provide for connection of the equipment grounding conductor.

513.10(D)(3) Restricted Use. Equipment that is not identified as suitable for Class I, Division 2 locations shall not be operated in locations where maintenance operations likely to release flammable liquids or vapors are in progress.

513.10(E) Portable Equipment.

513.10(E)(1) Portable Lighting Equipment. Portable lighting equipment that is used within a hangar shall be identified for the location in which they are used. For portable luminaires, flexible cord suitable for the type of service and identified for extra-hard usage shall be used. Each such cord shall include a separate equipment grounding conductor.

513.10(E)(2) Portable Utilization Equipment. Portable utilization equipment that is or may be used within a hangar shall be of a type suitable for use in Class I, Division 2 or Zone 2 locations. For portable utilization equipment, flexible cord suitable for the type of service and approved for extra-hard usage shall be used. Each such cord shall include a separate equipment grounding conductor.

513.12 Ground-Fault Circuit-Interrupter Protection for Personnel. Ground-fault circuit-interrupter protection for personnel shall be provided as required in **210.8(B)**.

Section 513.12 brings aircraft hangars in line with commercial garages in requiring ground-fault circuit interrupter protection for personnel. Receptacles that provide 400 Hz power for aircraft equipment are not covered by this requirement.

This section was revised to remove the specific requirements as they were already addressed in General Articles. The requirements are found in 210.8(B).

513.16 Grounding and Bonding Requirements.

513.16(A) General Grounding Requirements. All metal raceways, the metal armor or metallic sheath on cables, and all non–current-carrying metal parts of fixed or portable electrical equipment, regardless of voltage, shall be grounded. Grounding in Class I locations shall comply with **501.30** for Class I, Division 1 and 2 locations and **505.25** for Zone 0, 1, and 2 locations.

513.16(B) Supplying Circuits with Grounded and Equipment Grounding Conductors in Class I Locations.

513.16(B)(1) Circuits Supplying Portable Equipment or Pendants. Where a circuit supplies portables or pendants and includes a grounded conductor, receptacles, attachment plugs, connectors, and similar devices shall be of the grounding type, and the grounded conductor of the flexible cord shall be connected to the screw shell of any lampholder or to the grounded terminal of any utilization equipment supplied.

513.16(B)(2) Approved Means. Approved means shall be provided for maintaining continuity of the equipment grounding conductor between the fixed wiring system and the non–current-carrying metal portions of pendant luminaires, portable luminaires, and portable utilization equipment.

CHANGES TO ARTICLE 514 – MOTOR FUEL DISPENSING FACILITIES

The following Article 514 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- **514.2:** Other Articles

ARTICLE 514 Motor Fuel Dispensing Facilities

514.1 Scope. This article shall apply to motor fuel dispensing facilities, marine/motor fuel dispensing facilities, motor fuel dispensing facilities located inside buildings, and fleet vehicle motor fuel dispensing facilities.

Informational Note: See NFPA 30A-2021, Code for Motor Fuel Dispensing Facilities and Repair Garages, for information regarding safeguards for motor fuel dispensing facilities and for extracted text that is followed by a reference in brackets. Only editorial changes were made to the extracted text to make it consistent with this Code.

The scope specifically includes marine fuel dispensing facilities and motor fuel dispensing facilities located inside buildings, such as those in commercial garages.

514.2 Other Articles. In addition to the requirements of this article, motor fuel dispensing facilities shall comply with **Table 514.2**, as applicable, except as modified by this article.

This new requirement provides the necessary link from Article 514 to Articles 500 and 505 which became necessary with the deletion of Article 510.

Table 514.2 *Other Articles*

Requirement	Division Classified Locations	Zone Classified Locations
Area classification	500.5, 500.6	505.5, 505.6, 505.7
Equipment	Part III of 501, 500.7, 500.8, 501.5	505.8, 505.9, 505.20, 505.22
Wiring	Part II of 501	505.15, 505.16, 505.17, 505.18, 505.19, 505.26, 505.30

514.3 Classification of Locations. Where the term "Class I" is used with respect to Zone classifications within this article of the *Code*, it shall apply to Zone 0, Zone 1, and Zone 2 designations.

Informational Note: The term "Class I" was originally included as a prefix to Zone 0, Zone 1, and Zone 2 locations and references as an identifier for flammable gases, vapors, or liquids to differentiate from Class II and Class III locations. Zone 0, Zone 1, and Zone 2 only apply to flammable gases, vapors, or liquids so the "Class I" prefix is redundant and has been deleted, except for text that is extracted from other documents or to remain consistent throughout this article.

The added text clarifies the application of what was the "Class I" prefix to Zones 0, 1, and 2. The new text provides clarification that those designations with the prefix "Class I" are applied as Zones 0, 1, and 2 per Article 505.

The term "Class I" is now an optional equipment marking, as the Zone designations are specific to Class I areas.

514.3(A) Unclassified Locations. Where the authority having jurisdiction can satisfactorily determine that flammable liquids having a flash point below 38°C (100°F), such as gasoline, will not be handled, such location shall not be required to be classified.

514.3(B) Classified Locations. [See Figure 514.3(B).]

514.3(B)(1) Class I Locations. Table 514.3(B)(1) shall be applied where Class I liquids are stored, handled, or dispensed and shall be used to delineate and classify motor fuel dispensing facilities and commercial garages as defined in Article **100**. **Table 515.3** shall be used for the purpose of delineating and classifying aboveground tanks. A Class I location shall not extend beyond an unpierced wall, roof, or other solid partition. [**30A**:8.1, 8.2, 8.3]

FIGURE 514.3 *Classified Areas Adjacent to Dispensers. [30A: Figure 8.3.3(a)]*

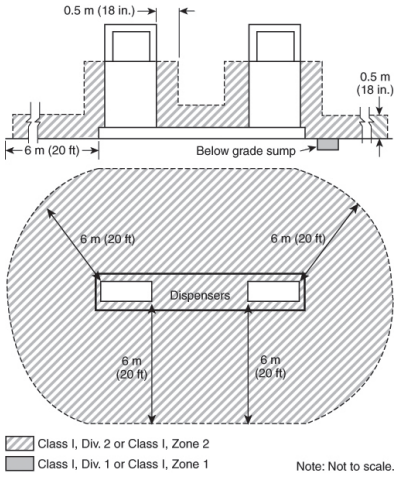


FIGURE 514.3(B) *Classified Areas Adjacent to Dispenser Mounted on Aboveground Storage Tank. [30A: Figure 8.3.3(b)]*

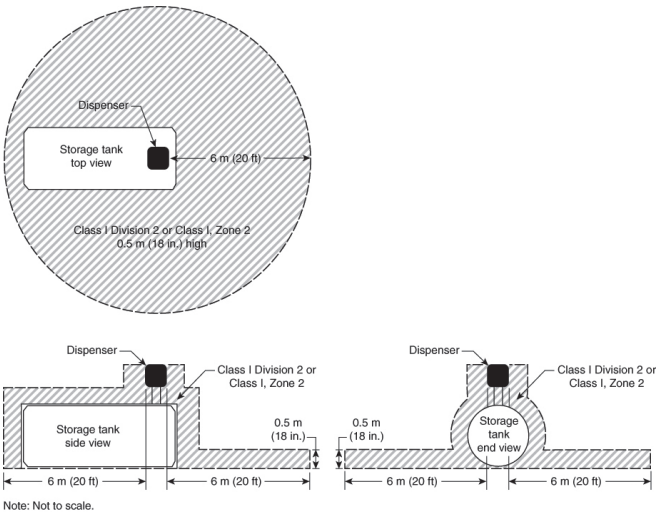
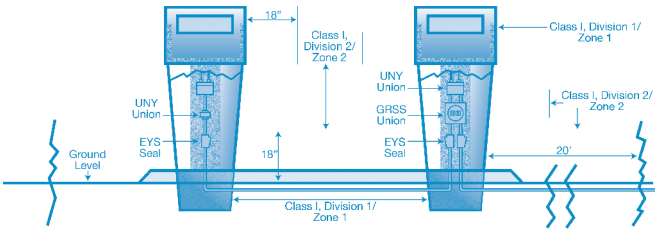


Table 514.3(B)(1) contains precise delineation of Class I, Division 1/Class I, Zone 1 spaces, referencing the product standard publication ANSI/UL 87, Power Operated Dispensing Devices for Petroleum Products. This publication is also referenced to indicate Class I, Division 2/Class I, Zone 2 spaces. The Table is based on Table 8.3.1 of NFPA® 30A, *Code* for Motor Fuel Dispensing Facilities and Repair Garages. Note that in accordance with 514.9 seals are the first fittings installed after the conduit emerges from the concrete and that seals are installed in each conduit entering the dispensers.

OUTDOOR/INDOOR DISPENSERS.

Any outdoor area or any indoor area with mechanical ventilation within 20 feet of a gas pump up to 18 inches above grade level is Class I, Division 2/Class I, Zone 2. If the indoor area has gravity ventilation, a 25-foot horizontal distance from any edge of the enclosure is required. For "Dispensing Units" see sketch below.

Figure 514.3 depicts Class I, Division 1 and Class I, Division 2 and now also includes the Class I, Zone 1 and Class I, Zone 2 spaces in service stations.



These outdoor gasoline pumps illustrate the concept of Class I, Division 2/ Zone 2 as being "a transition zone" between a Class I, Division 1/Zone 1 location and a non-hazardous one. This principle also applies to indoor areas where gases or vapors are released from highly volatile flammable liquids, but where there are no un-pierced walls to contain the vapors or gases. In this drawing, there is no "transition zone" at top of pumps, even though there is no partition, because the vapors (typically gasoline) are heavier than air, tending to settle toward ground level.

REMOTE PUMPING SYSTEMS.

Where Class I liquids are transferred from storage to individual or multiple dispensing units by pumps located elsewhere than at the dispensing units.

Outdoor. Any pit, box or space below grade level is Class I, Division 1/Class I, Zone 1 if any part is within a 10-foot horizontal distance from any edge of a pump.

Indoor. Entire space within a pit is Class I, Division 1/Class I, Zone 1.

ABOVE GROUND STORAGE TANKS.

Figure 514.3(B) depicts the classified areas adjacent to a dispenser mounted on aboveground storage tanks. This figure is extracted from NFPA® 30A.

WIRING AND EQUIPMENT NOT WITHIN Class I DISPENSING AREAS.

Wiring and equipment used in other areas such as service bays, sales areas, storage and restrooms must comply with Article 514, Table 514-3(B)(1). The service bays and adjacent areas not cut off by walls would need to comply with Article 511 and may be unclassified by "special permission". Other rooms outside the Class I area that are properly cut off by walls would be unclassified.

The use of arc-producing equipment less than 12 feet above a Class I location if the enclosure is capable of containing sparks or hot metal particles is permitted [Section 511.7(B)].

514.3(B)(2) Compressed Natural Gas, Liquefied Natural Gas, and Liquefied Petroleum Gas Areas.

Table 514.3(B)(2) shall be used to delineate and classify areas where CNG, LNG, compressed or liquefied hydrogen, LP-Gas, or combinations of these, are dispensed as motor vehicle fuels along with Class I or Class II liquids that are also dispensed as motor vehicle fuels. [**30A**:12.1]

Where CNG or LNG dispensers are installed beneath a canopy or enclosure, either the canopy or enclosure shall be designed to prevent accumulation or entrapment of ignitible vapors or all electrical equipment installed beneath the canopy or enclosure shall be suitable for Class I, Division 2 hazardous (classified) locations. [**30A**:12.4]

Dispensing devices for LP-Gas shall be located as follows:

(1) At least 3 m (10 ft) from any dispensing device for Class I liquids

(2) At least 1.5 m (5 ft) from any dispensing device for Class I liquids where the following conditions exist:

a. The LP-Gas deliver nozzle and filler valve release no more than 4 cm^3 (0.1 oz) of liquid upon disconnection.

b. The fixed maximum liquid level gauge remains closed during the entire refueling process.

[**30A**:12.5.2]

Informational Note No. 1: See NFPA 58,Liquefied Petroleum Gas Code, for requirements on dispensing devices for LP-Gas.

Informational Note No. 2: See NFPA 58,Liquefied Petroleum Gas Code, and NFPA 59, Utility LP-Gas Plant Code, for information on classified areas pertaining to LP-Gas systems other than residential or commercial.

Informational Note No. 3: See 514.3(C) for motor fuel dispensing stations in marinas and boatyards.

514.3(B)(3) Fuel Storage.

(a) Aboveground tanks storing CNG or LNG shall be separated from any adjacent property line that is or can be built upon, any public way, and the nearest important building on the same property. [**30A**:12.3.1]

Informational Note: See NFPA 52,Vehicular Natural Gas Fuel Systems Code, Section 8.4, for the relevant distances for CNG and LNG.

(b) Aboveground tanks storing hydrogen shall be separated from any adjacent property line that is or can be built upon, any public way, and the nearest important building on the same property. [**30A**:12.3.2]

Table 514.3(B)(1) *Class I Locations — Motor Fuel Dispensing Facilities*

Location	Division (Group D)	Zone (Group IIA)	Extent of Classified Location[1]
Dispensing Device (except Overhead Type) [2, 3]			
Under dispenser containment	1	1	Entire space within and under dispenser pit or containment
Dispenser	2	2	Within 450 mm (18 in.) of dispenser enclosure or that portion of dispenser enclosure containing liquid handling components, extending horizontally in all directions and down to grade level
Outdoor	2	2	Up to 450 mm (18 in.) above grade level, extending 6 m (20 ft) horizontally in all directions from dispenser enclosure
Indoor			
- with mechanical ventilation	2	2	Up to 450 mm (18 in.) above floor level, extending 6 m (20 ft) horizontally in all directions from dispenser enclosure
- with gravity ventilation	2	2	Up to 450 mm (18 in.) above floor level, extending 7.5 m (25 ft) horizontally in all directions from dispenser enclosure
Dispensing Device — Overhead Type[4]	1	1	Space within dispenser enclosure and all electrical equipment integral with dispensing hose or nozzle
	2	2	Within 450 mm (18 in.) of dispenser enclosure, extending horizontally in all directions and down to grade level
	2	2	Up to 450 mm (18 in.) above grade level, extending 6 m (20 ft) horizontally in all directions from a point vertically below edge of dispenser enclosure
Remote Pump —			
Outdoor	1	1	Entire space within any pit or box below grade level, any part of which is within 3 m (10 ft) horizontally from any edge of pump
	2	2	Within 900 mm (3 ft) of any edge of pump, extending horizontally in all directions
	2	2	Up to 450 mm (18 in.) above grade level, extending 3 m (10 ft) horizontally in all directions from any edge of pump
Indoor	1	1	Entire space within any pit
	2	2	Within 1.5 m (5 ft) of any edge of pump, extending in all directions
	2	2	Up to 900 mm (3 ft) above floor level, extending 7.5 m (25 ft) horizontally in all directions from any edge of pump
Sales, Storage, Rest Rooms including structures (such as the attendant's kiosk) on or adjacent to dispensers	unclassified	unclassified	Except as noted below
	1	1	Entire volume, if there is any opening to room within the extent of a Division 1 or Zone 1 location
	2	2	Entire volume, if there is any opening to room within the extent of a Division 2 or Zone 2 location
Tank, Aboveground			
Inside tank	1	0	Entire inside volume
Shell, ends, roof, dike area	1	1	Entire space within dike, where dike height exceeds distance from tank shell to inside of dike wall for more than 50 percent of tank circumference
	2	2	Entire space within dike, where dike height does not exceed distance from tank shell to inside of dike wall for more than 50 percent of tank circumference
Vent	2	2	Within 3 m (10 ft) of shell, ends, or roof of tank
	1	1	Within 1.5 m (5 ft) of open end of vent, extending in all directions
	2	2	Between 1.5 m and 3 m (5 ft and 10 ft) from open end of vent, extending in all directions

[1]For marine application, grade level means the surface of a pier, extending down to water level.
[2]Refer to Figure 514.3(a) and Figure 514.3(b) for an illustration of classified location around dispensing devices.
[3]Area classification inside the dispenser enclosure is covered in UL 87, *Standard for Power-Operated Dispensing Devices for Petroleum Products*.
[4]Ceiling-mounted hose reel. [**30A**: Table 8.3.1]

Table 514.3(B)(1) *Class I Locations — Motor Fuel Dispensing Facilities — Continued*

Location	Division (Group D)	Zone (Group IIA)	Extent of Classified Location[1]
Tank, Underground			
Inside tank	1	0	Entire inside volume
Fill Opening	1	1	Entire space within any pit or box below grade level, any part of which is within a Division 1 or Division 2 classified location or within a Zone 1 or Zone 2 classified location
	2	2	Up to 450 mm (18 in.) above grade level, extending 1.5 m (5 ft) horizontally in all directions from any tight-fill connection and extending 3 m (10 ft) horizontally in all directions from any loose-fill connection
Vent	1	1	Within 1.5 m (5 ft) of open end of vent, extending in all directions
	2	2	Between 1.5 m and 3 m (5 ft and 10 ft) from open end of vent, extending in all directions
Vapor Processing System			
Pits	1	1	Entire space within any pit or box below grade level, any part of which: (1) is within a Division 1 or Division 2 classified location; (2) is within a Zone 1 or Zone 2 classified location; (3) houses any equipment used to transfer or process vapors 514.3 514.3 514.3 514.3 514.3 514.3 514.3 514.3 514.3 514.3 514.3
Equipment in protective enclosures	2	2	Entire space within enclosure
Equipment *not* within protective enclosure	2	2	Within 450 mm (18 in.) of equipment containing flammable vapors or liquid, extending horizontally in all directions and down to grade level
	2	2	Up to 450 mm (18 in.) above grade level within 3 m (10 ft) horizontally of the vapor processing equipment
- Equipment enclosure	1	1	Entire space within enclosure, if flammable vapor or liquid is present under normal operating conditions
	2	2	Entire space within enclosure, if flammable vapor or liquid is not present under normal operating conditions
- Vacuum assist blower	2	2	Within 450 mm (18 in.) of blower, extending horizontally in all directions and down to grade level
	2	2	Up to 450 mm (18 in.) above grade level, extending 3 m (10 ft) horizontally in all directions
Vault	1	1	Entire interior space, if Class I liquids are stored within

[1]For marine application, grade level means the surface of a pier, extending down to water level.
[2]Refer to Figure 514.3(a) and Figure 514.3(b) for an illustration of classified location around dispensing devices.
[3]Area classification inside the dispenser enclosure is covered in UL 87, *Standard for Power-Operated Dispensing Devices for Petroleum Products*.
[4]Ceiling-mounted hose reel. [**30A**: Table 8.3.1]

Table 514.3(B)(2) *Electrical Equipment Classified Areas for Dispensing Devices*

	Extent of Classified Area	
Dispensing Device	**Class I, Division 1**	**Class I, Division 2**
Compressed natural gas (CNG)	Entire space within the dispenser enclosure	1.5 m (5 ft) in all directions from dispenser enclosure
Liquefied natural gas (LNG)	Entire space within the dispenser enclosure and 1.5 m (5 ft) in all directions from the dispenser enclosure	3.0 m (10 ft) in all directions from the dispenser enclosure
Liquefied petroleum gas (LP-Gas)	Entire space within the dispenser enclosure; 450 mm (18 in.) from the exterior surface of the dispenser enclosure to an elevation of 1.2 m (4 ft) above the base of the dispenser; the entire pit or open space beneath the dispenser and within 6.0 m (20 ft) horizontally from any edge of the dispenser when the pit or trench is not mechanically ventilated	Up to 450 mm (18 in.) above ground and within 6.0 m (20 ft) horizontally from any edge of the dispenser enclosure, including pits or trenches within this area when provided with adequate mechanical ventilation

[**30**A:Table 12.6.2]

Informational Note: See NFPA 2, Hydrogen Technologies Code, for the relevant distances for hydrogen.

(c) Aboveground tanks storing LP-Gas shall be separated from any adjacent property line that is or can be built upon, any public way, and the nearest important building on the same property. [**30A**:12.3.3]

Informational Note: See NFPA 58, Liquefied Petroleum Gas Code, Section 6.3, for the relevant distances for LP-Gas.

(d) Aboveground tanks storing CNG, LNG, or LP-Gas shall be separated from each other by at least 6 m (20 ft) and from dispensing devices that dispense liquid or gaseous motor vehicle fuels by at least 6 m (20 ft). [**30A**:12.3.3]

Exception No. 1: The required separation shall not apply to tanks or dispensers storing or handling fuels of the same chemical composition.

Exception No. 2: The required separation shall not apply when both the gaseous fuel storage and dispensing equipment are at least 15 m (50 ft) from any other aboveground motor fuel storage or dispensing equipment.

Informational Note: See NFPA 52, Vehicular Natural Gas Fuel Systems Code, or NFPA 58, Liquefied Petroleum Gas Code, for additional information.

(e) Dispenser Installations Beneath Canopies. Where CNG or LNG dispensers are installed beneath a canopy or enclosure, either the canopy or enclosure shall be designed to prevent accumulation or entrapment of ignitible vapors or all electrical equipment installed beneath the canopy or enclosure shall be suitable for Class I, Division 2 hazardous (classified) locations. [**30A**:12.4]

(f) Specific Requirements for LP-Gas Dispensing Devices. [**30A**:12.5]. Dispensing devices for LP-Gas shall be located as follows:

(1) At least 3 m (10 ft) from any dispensing device for Class I liquids

(2) At least 1.5 m (5 ft) from any dispensing device for Class I liquids where the following conditions exist:

a. The LP-Gas deliver nozzle and filler valve release no more than 4 cm^3 (0.1 oz) of liquid upon disconnection.

b. The fixed maximum liquid level gauge remains closed during the entire refueling process. [**30A**:12.5.2]

Table 514.3(B)(2) shall be used to delineate and classify areas for the purpose of installation of electrical wiring and electrical utilization equipment.

514.3(C) Motor Fuel Dispensing Stations in Boatyards and Marinas.

Informational Note: See NFPA 303, Fire Protection Standard for Marinas and Boatyards, and NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages, for additional information.

514.3(C)(1) General. Electrical wiring and equipment located at or serving motor fuel dispensing locations shall be installed on the side of the wharf, pier, or dock opposite from the liquid piping system.

514.3(C)(2) Classification of Class I, Division 1 and 2 Areas. The criteria provided in 514.3(C)(2)(a) and (C)(2)(b) shall be used for the purposes of applying **Table 514.3(B)(1)** and **Table 514.3(B)(2)** to motor fuel dispensing equipment on floating or fixed piers, wharfs, or docks.

(a) *Closed Construction.* Where the construction of floating docks, piers, or wharfs is closed so that there is no space between the bottom of the dock, pier, or wharf and the water, as in the case of concrete-enclosed expanded foam or similar construction, and the construction includes integral service boxes with supply chases, the following shall apply:

(1) The space above the surface of the floating dock, pier, or wharf shall be a Class I, Division 2 location with distances in accordance with **Table 514.3(B)(1)** for dispenser and outdoor locations.

(2) Spaces below the surface of the floating dock, pier, or wharf that have areas or enclosures, such as tubs, voids, pits, vaults, boxes, depressions, fuel piping chases, or similar spaces, where flammable liquid or vapor can accumulate shall be a Class I, Division 1 location.

*Exception No. 1: Dock, pier, or wharf sections that do not support fuel dispensers and abut, but are located 6.0 m (20 ft) or more from, dock sections that support a fuel dispenser(s) shall be permitted to be Class I, Division 2 locations where documented air space is provided between dock sections to allow flammable liquids or vapors to dissipate without traveling to such dock sections. The documentation shall comply with the requirements of **500.4**.*

*Exception No. 2: Dock, pier, or wharf sections that do not support fuel dispensers and do not directly abut sections that support fuel dispensers shall be permitted to be unclassified where documented air space is provided and where flammable liquids or vapors cannot travel to such dock sections. The documentation shall comply with the requirements of **500.4**.*

(b) *Open Construction.* Where the construction of piers, wharfs, or docks is open, as in the case of decks built on stringers supported by pilings, floats, pontoons, or similar construction, the following shall apply:

(1) The area 450 mm (18 in) above the surface of the dock, pier, or wharf and extending 6.0 m (20 ft) horizontally in all directions from the outside edge of the dispenser and down to the water level shall be a Class 1, Division 2 location.

(2) Enclosures such as tubs, voids, pits, vaults, boxes, depressions, piping chases, or similar spaces where flammable liquids or vapors can accumulate within 6.0 m (20 ft) of the dispenser shall be a Class I, Division 1 location.

514.4 Wiring and Equipment Installed in Hazardous (Classified) Locations. All electrical equipment and wiring installed in the hazardous (classified) locations specified in **514.3** shall comply with Parts II and III of Article **501**. Conductor insulation in these locations shall comply with **501.20**.

Requirements are somewhat different than for indoor pumps, as liquids dispensed are not typically gasoline.

Table 514.3(B)(1) gives requirements for a lubrication or service room where no dispensing takes place. An unventilated pit in such an area has been determined to be Class I, Division 2/Class I, Zone 2. The area is unclassified when ventilated in accordance with NFPA® 30A, 5-3.1.

Flammable liquids shall be known as Class I liquids. Class I liquids are divided into three Classes as follows:

Class IA shall include liquids having flash points below +22.8 °C (+73 °F) and having a boiling point below +37.8 °C (+100 °F).

Class IB shall include liquids having flash points below +22.8 °C (+73 °F) and having a boiling point at or above +37.8 °C (+100 °F).

Class IC shall include liquids having flash points at or above +22.8 °C (+73 °F) and having a boiling point below +37.8 °C (+100 °F).

The flash point was selected as the basis for classification of flammable and combustible liquids because it is directly related to a liquid's ability to generate vapor, i.e., its volatility. Since it is the vapor of the liquid, not the liquid itself that burns, vapor generation becomes the primary factor in determining the fire hazard. The expression "low flash - high hazard" applies. Liquids having flash points below ambient storage temperatures generally display a rapid rate of flame spread over the surface of the liquid, since it is not necessary for the heat of the fire to expend its energy in heating the liquid to generate more vapor.

VAPOR PROCESSING EQUIPMENT NOT WITHIN PROTECTIVE ENCLOSURES AND VACUUM ASSIST BLOWERS.

For "Vapor Processing Equipment Located Within Protective Enclosures," see NFPA® 30A, *Code* for Motor Fuel Dispensing Facilities and Repair Garages, Section 10.1. Any of the equipment within the protective enclosure is Class I, Division 2, Group D/Class I, Zone 2 IIA.

514.7 Wiring and Equipment Above Hazardous (Classified) Locations. Fixed wiring and equipment above hazardous (classified) locations shall be installed in accordance with **514.3** and shall be one or more of the following:

(1) Rigid metal conduit (RMC) or intermediate metal conduit (IMC) with listed threaded or threadless fittings, or electrical metallic tubing (EMT) with listed fittings.

(2) Rigid polyvinyl chloride conduit (PVC), reinforced thermosetting resin conduit (RTRC), or electrical nonmetallic tubing (ENT).

(3) Flexible metal conduit (FMC), liquidtight flexible metal conduit (LFMC), or liquidtight flexible nonmetallic conduit (LFNC), with listed fittings.

(4) Type MC cable, Type AC cable, Type TC cable, or Type TC-ER cable, including installation in cable trays, with listed fittings. Type TC-ER cable shall include an equipment grounding conductor (EGC) in addition to any drain wire.

(5) Type MI cable terminated with listed fittings and supported to avoid tensile stress.

(6) Manufactured wiring systems.

(7) Type PLTC cable or Type PLTC-ER cable used in Class 2 or Class 3 circuits. Type PLTC-ER cable shall include an equipment grounding conductor (EGC) in addition to any drain wire.

(8) Type ITC cable or ITC-ER cable in accordance with **335.4** and **335.5** and terminated with listed fittings. Type ITC-ER cable shall include an equipment grounding conductor (EGC) in addition to any drain wire.

(9) Cellular metal floor raceways or cellular concrete floor raceways only for supplying ceiling outlets or extensions to the area below the floor. Such raceways shall have no connections leading into or through any Class I location above the floor.

514.8 Underground Wiring. All underground wiring shall comply with **514.8(A)**, (B), or **(C)**.

514.8(A) Metal Conduit. Threaded rigid metal conduit (RMC) or threaded intermediate metal conduit (IMC) with listed threaded fittings shall be permitted. Any portion of electrical wiring that is below the surface of a Class I, Division 1 or Division 2 location [as classified in **Table 514.3(B)(1)** and **Table 514.3(B)(2)**] shall be sealed within 3.05 m (10 ft) of the point of emergence above grade. The conduit shall not contain any unions, couplings, boxes, or fittings between the conduit seal and the point of emergence above grade.

514.8(B) Type MI Cable. Type MI cable shall be permitted where it is installed in accordance with Part II of Article 332.

514.8(C) Nonmetallic Conduit. Rigid polyvinyl chloride conduit (PVC), reinforced thermosetting resin conduit (RTRC), or high-density polyethylene conduit (HDPE) shall be permitted where buried under not less than 600 mm (2 ft) of cover. Where PVC conduit, RTRC conduit, or HDPE conduit is used, threaded rigid metal conduit (RMC) or threaded intermediate metal conduit (IMC) shall be used for the last 600 mm (2 ft) of the underground run to emergence or to the point of connection to the aboveground raceway. An equipment grounding conductor (EGC) shall be included to provide electrical continuity of the raceway system and for grounding of non–current-carrying metal parts.

Section 514.8 prohibits joints between where a conduit emerges from the grade and the conduit seal, except for listed reducers. In addition, the seal must be within 10 ft of the point of emergence from grade. The section now specifies what specific types of rigid nonmetallic conduit are permissible.

Type HDPE conduit is considered as providing the same level of protection as Type PVC or Type RTRC when buried 24 inches in the earth. It is important to understand that when transitioning to threaded rigid conduit or threaded steel intermediate metal conduit that the transition fitting be identified as being suitable for wet locations as this transition is required underground before emergence from the earth.

514.9 Sealing.

514.9(A) At Dispenser. A listed seal shall be provided in each conduit run entering or leaving a dispenser or any cavities or enclosures in direct communication therewith. The sealing fitting or listed explosionproof reducer at the seal shall be the first fitting after the conduit emerges from the earth or concrete.

514.9(B) At Boundary. Additional seals shall be provided in accordance with **501.15**. Sections **501.15(A)(4)** and **(B)(2)** shall apply to horizontal as well as to vertical boundaries of the defined Class I locations.

514.11 Circuit Disconnects.

514.11(A) Emergency Electrical Disconnects. Fuel dispensing systems shall be provided with one or more clearly identified emergency shutoff devices or electrical disconnects. Such devices or disconnects shall be installed in approved locations but not less than 6 m (20 ft) or more than 30 m (100 ft) from the fuel dispensing devices that they serve. Emergency shutoff devices or electrical disconnects shall disconnect power to all dispensing devices; to all remote pumps serving the dispensing devices; to all associated power, control, and signal circuits; and to all other electrical equipment in the hazardous (classified) locations surrounding the fuel dispensing devices. When more than one emergency shutoff device or electrical disconnect is provided, all devices shall be interconnected. Resetting from an emergency shutoff condition shall require manual intervention and the manner of resetting shall be approved by the authority having jurisdiction. [**30A**:6.7]

The emergency shutoff device shall disconnect simultaneously from the source of supply, all conductors of the circuits, including the grounded conductor, if any. Equipment grounding conductors shall remain connected.

Exception: Intrinsically safe systems shall not be required to meet this requirement.

Section 514.11 was revised to clarify that the grounded conductor should be disconnected simultaneously with all of the other conductors when the emergency disconnect is activated. The revision also clarifies that the equipment grounding conductors should not be disconnected.

514.11(B) Attended Self-Service Motor Fuel Dispensing Facilities. At attended motor fuel dispensing facilities, the devices or disconnects shall be readily accessible to the attendant. [**30A**:6.7.1]

514.11(C) Unattended Self-Service Motor Fuel Dispensing Facilities. At unattended motor fuel dispensing facilities, the devices or disconnects shall be readily accessible to patrons and at least one additional device or disconnect shall be readily accessible to each group of dispensing devices on an individual island. [**30A**:6.7.2]

514.13 Provisions for Maintenance and Service of Dispensing Equipment. Each dispensing device shall be provided with a means to remove all external voltage sources, including power, communications, data, and video circuits and including feedback, during periods of maintenance and service of the dispensing equipment. The location of this means shall be permitted to be other than inside or adjacent to the dispensing device. The means shall be capable of being locked in the open position in accordance with **110.25**.

Section 514.13 requires a lock out means to remove all voltages from dispensing equipment during service and maintenance. The section specifies all of the types of circuits that are required to have provisions that remove all voltage sources to the dispensing device during maintenance and service operations. Section 110.25 consolidates requirements for disconnecting means that are capable of being locked in the open position. This is intended to also address any circuits that are not power circuits.

514.16 Grounding and Bonding. All metal raceways, the metal armor or metallic sheath on cables, and all non–current-carrying metal parts of fixed and portable electrical equipment, regardless of voltage, shall be grounded and bonded. Grounding and bonding in Class I locations shall comply with **501.30**.

CHANGES TO ARTICLE 515 – BULK STORAGE PLANTS

The following Article 515 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- 515.2: Other Articles
- Table 515.2: Other Articles

ARTICLE 515 Bulk Storage Plants

515.1 Scope. This article covers a property or portion of a property where flammable liquids are received by tank vessel, pipelines, tank car, or tank vehicle and are stored or blended in bulk for the purpose of distributing such liquids by tank vessel, pipeline, tank car, tank vehicle, portable tank, or container.

Informational Note: See NFPA 30-2021,Flammable and Combustible Liquids Code, for extracted text that is followed by a reference in brackets. Only editorial changes were made to the extracted text to make it consistent with this Code.

515.2 Other Articles. In addition to the requirements of this article, bulk storage plants shall comply with **Table 515.2**, as applicable, except as modified by this article.

New section provides the necessary link from Article 515 to Articles 500 and 505 which became necessary with the deletion of Article 510.

Table 515.2 *Other Articles*

Requirement	Division Classified Locations	Zone Classified Locations
Area classification	500.5, 500.6	505.5, 505.6, 505.7
Equipment	Part III of 501, 500.7, 500.8, 501.5	505.8, 505.9, 505.20, 505.22
Wiring	Part II of 501	505.15, 505.16, 505.17, 505.18, 505.19, 505.26, 505.30

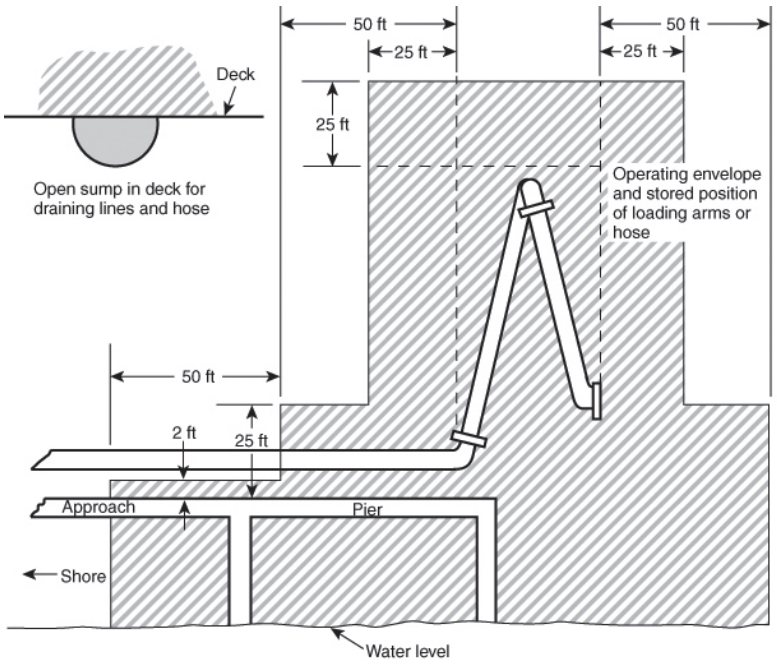
New Table 515.2 has been created to identify the specific sections of other Articles that are applicable to bulk storage plants.

515.3 Classified Locations. Where the term "Class I" is used with respect to Zone classifications within this article of the *Code*, it shall apply to Zone 0, Zone 1, and Zone 2 designations.

Informational Note: The term "Class I" was originally included as a prefix to Zone 0, Zone 1, and Zone 2 locations and references as an identifier for flammable gases, vapors, or liquids to differentiate from Class II and Class III locations. Zone 0, Zone 1, and Zone 2 only apply to flammable gases, vapors, or liquids so the "Class I" prefix is redundant and has been deleted, except for text that is extracted from other documents or to remain consistent throughout this article.

The added text clarifies the application of what was the "Class I" prefix to Zones 0, 1, and 2. The new text provides clarification that those designations with the prefix "Class I" are applied as Zones 0, 1, and 2 per Article 505.

Figure 515.3 *Area Classification for a Marine Terminal Handling Flammable Liquids. [30:Figure 29.3.22]*



Key:
Division 1 Division 2 Nonclassified

Notes:
(1) For SI units, 1 in. = 25 mm; 1 ft = 0.3 m.
(2) The "source of vapor" is the operating envelope and stored position of the outboard flange connection of the loading arm (or hose).
(3) The berth area adjacent to tanker and barge cargo tanks is to be Division 2 to the following extent:
(a) 25 ft (7.6 m) horizontally in all directions on the pier side from the portion of the hull containing cargo tanks.
(b) From the water level to 25 ft (7.6 m) above the cargo tanks at their highest position.
(4) Additional locations can be classified as required by the presence of other sources of flammable liquids on the berth, or by Coast Guard or other regulations.

Table 515.3 *Electrical Area Classifications*

Location	Division	Zone	Extent of Classified Area
Indoor equipment installed where flammable vapor–air mixtures can exist under normal operation (see Informational Note)	1	0	The entire area associated with such equipment where flammable gases or vapors are present continuously or for long periods of time
	1	1	Area within 1.5 m (5 ft) of any edge of such equipment, extending in all directions
	2	2	Area between 1.5 m and 2.5 m (5 ft and 8 ft) of any edge of such equipment, extending in all directions; also, space up to 900 mm (3 ft) above floor or grade level within 1.5 m to 7.5 m (5 ft to 25 ft) horizontally from any edge of such equipment[1]
Outdoor equipment installed where flammable vapor–air mixtures can exist under normal operation	1	0	The entire area associated with such equipment where flammable gases or vapors are present continuously or for long periods of time
	1	1	Area within 900 mm (3 ft) of any edge of such equipment, extending in all directions
	2	2	Area between 900 mm (3 ft) and 2.5 m (8 ft) of any edge of such equipment, extending in all directions; also, space up to 900 mm (3 ft) above floor or grade level within 900 mm to 3.0 m (3 ft to 10 ft) horizontally from any edge of such equipment
Tank storage installations inside buildings	1	1	All equipment located below grade level
	2	2	Any equipment located at or above grade level
Tank – aboveground, fixed roof	1	0	Inside fixed roof tank
	1	1	Area inside dike where dike height is greater than the distance from the tank to the dike for more than 50 percent of the tank circumference
	2	2	Within 3.0 m (10 ft) from shell, ends, or roof of tank; also, area inside dike to level of top of dike wall
	1	0	Area inside of vent piping or opening
	1	1	Within 1.5 m (5 ft) of open end of vent, extending in all directions
	2	2	Area between 1.5 m and 3.0 m (5 ft and 10 ft) from open end of vent, extending in all directions
Tank — aboveground, floating roof			
With fixed outer roof	1	0	Area between the floating and fixed roof sections and within the shell
With no fixed outer roof	1	1	Area above the floating roof and within the shell
Tank vault — interior	1	1	Entire interior volume, if Class I liquids are stored within
Underground tank fill opening	1	1	Any pit, box, or space below grade level, if any part is within a Division 1 or 2, or Zone 1 or 2, classified location
	2	2	Up to 450 mm (18 in.) above grade level within a horizontal radius of 3.0 m (10 ft) from a loose fill connection, and within a horizontal radius of 1.5 m (5 ft) from a tight fill connection
Vent – discharging upward	1	0	Area inside of vent piping or opening
	1	1	Within 900 mm (3 ft) of open end of vent, extending in all directions
	2	2	Area between 900 mm and 1.5 m (3 ft and 5 ft) of open end of vent, extending in all directions
Drum and container filling – outdoors or indoors	1	0	Area inside the drum or container
	1	1	Within 900 mm (3 ft) of vent and fill openings, extending in all directions
	2	2	Area between 900 mm and 1.5 m (3 ft and 5 ft) from vent or fill opening, extending in all directions; also, up to 450 mm (18 in.) above floor or grade level within a horizontal radius of 3.0 m (10 ft) from vent or fill opening
Pumps, bleeders, withdrawal fittings			
Indoor	2	2	Within 1.5 m (5 ft) of any edge of such devices, extending in all directions; also, up to 900 mm (3 ft) above floor or grade level within 7.5 m (25 ft) horizontally from any edge of such devices
Outdoor	2	2	Within 900 mm (3 ft) of any edge of such devices, extending in all directions. Also, up to 450 mm (18 in.) above grade level within 3.0 m (10 ft) horizontally from any edge of such devices

[1] The release of Class I liquids can generate vapors to the extent that the entire building, and possibly an area surrounding it, should be considered a Class I, Division 2 or Zone 2 location.

[2] When classifying extent of area, consideration shall be given to the fact that tank cars or tank vehicles can be spotted at varying points. Therefore, the extremities of the loading or unloading positions shall be used. [**30:**Table 7.3.3]

Informational Note: See Section 7.3 of NFPA 30-2018, Flammable and Combustible Liquids Code, for additional information.

Table 515.3 *Electrical Area Classifications — Continued*

Location	Division	Zone	Extent of Classified Area
Pits and sumps			
Without mechanical ventilation	1	1	Entire area within a pit or sump if any part is within a Division 1 or 2, or Zone 1 or 2, classified location
With adequate mechanical ventilation	2	2	Entire area within a pit or sump if any part is within a Division 1 or 2, or Zone 1 or 2, classified location
Containing valves, fittings, or piping, and not within a Division 1 or 2, or Zone 1 or 2, classified location	2	2	Entire pit or sump
Drainage ditches, separators, impounding basins			
Outdoor	2	2	Area up to 450 mm (18 in.) above ditch, separator, or basin; also, area up to 450 mm (18 in.) above grade within 4.5 m (15 ft) horizontally from any edge
Indoor			Same as pits and sumps
Tank vehicle and tank car[2]			
Loading through open dome	1	0	Area inside of the tank
	1	1	Within 900 mm (3 ft) of edge of dome, extending in all directions
	2	2	Area between 900 mm and 4.5 m (3 ft and 15 ft) from edge of dome, extending in all directions
Loading through bottom connections with atmospheric venting	1	0	Area inside of the tank
	1	1	Within 900 mm (3 ft) of point of venting to atmosphere, extending in all directions
	2	2	Area between 900 mm and 4.5 m (3 ft and 15 ft) from point of venting to atmosphere, extending in all directions; also, up to 450 mm (18 in.) above grade within a horizontal radius of 3.0 m (10 ft) from point of loading connection
Loading through closed dome with atmospheric venting	1	1	Within 900 mm (3 ft) of open end of vent, extending in all directions
	2	2	Area between 900 mm and 4.5 m (3 ft and 15 ft) from open end of vent, extending in all directions; also, within 900 mm (3 ft) of edge of dome, extending in all directions
Loading through closed dome with vapor control	2	2	Within 900 mm (3 ft) of point of connection of both fill and vapor lines extending in all directions
Bottom loading with vapor control or any bottom unloading	2	2	Within 900 mm (3 ft) of point of connections, extending in all directions; also up to 450 mm (18 in.) above grade within a horizontal radius of 3.0 m (10 ft) from point of connections
Storage and repair garage for tank vehicles	1	1	All pits or spaces below floor level
	2	2	Area up to 450 mm (18 in.) above floor or
Garages for other than tank vehicles	Unclassified		If there is any opening to these rooms within the extent of an outdoor classified location, the entire room shall be classified the same as the area classification at the point of the opening.
Outdoor drum storage	Unclassified		
Inside rooms or storage lockers used for the storage of Class I liquids	2	2	Entire room or locker
Indoor warehousing where there is no flammable liquid transfer	Unclassified		If there is any opening to these rooms within the extent of an indoor classified location, the classified location shall extend through the opening to the same extent as if the wall, curb, or partition did not exist.
Office and rest rooms	Unclassified		If there is any opening to these rooms within the extent of an indoor classified location, the room shall be classified the same as if the wall, curb, or partition did not exist.
Piers and wharves			See Figure 515.3.

[1] The release of Class I liquids can generate vapors to the extent that the entire building, and possibly an area surrounding it, should be considered a Class I, Division 2 or Zone 2 location.

[2] When classifying extent of area, consideration shall be given to the fact that tank cars or tank vehicles can be spotted at varying points. Therefore, the extremities of the loading or unloading positions shall be used. [**30:**Table 7.3.3]

Informational Note: See Section 7.3 of NFPA 30-2018, Flammable and Combustible Liquids Code, for additional information.

The term "Class I" is now an optional equipment marking, as the Zone designations are specific to Class I areas.

Table 515.3 shall be applied where Class I flammable liquids are stored, handled, or dispensed and shall be used to delineate and classify bulk storage plants. The classified location shall not extend beyond a floor, wall, roof, or other solid partition that has no communicating openings.

Where the installation does not meet the requirements found in **Table 515.3**, the authority having jurisdiction shall have the authority to classify the extent of the classified space.

Informational Note No. 2: See NFPA 30, Flammable and Combustible Liquids Code, Chapter 5, for the area classifications listed in Table 515.3 that are based on the premise that the installation meets all the applicable requirements.

Informational Note No. 2: See 514.3(C) through (E) for gasoline dispensing stations in marinas and boatyards.

515.4 Wiring and Equipment Located in Hazardous (Classified) Locations. All electrical wiring and equipment within the hazardous (classified) locations specified in **515.3** shall comply with the applicable requirements of **Table 515.2**.

515.7 Wiring and Equipment Above Class I Locations.

515.7(A) Fixed Wiring. All fixed wiring above hazardous (classified) locations shall comply with **501.10(B)** or **505.15(C)**, as applicable.

Wiring methods currently included in 515.7(A) are consistent with Class I, Division 2 wiring methods, however the list is not consistent with the full list of wiring methods permitted for Division 2 in 501.10(B). The section was revised to reference those wiring methods in 501.10(B).

515.7(B) Fixed Equipment. Fixed equipment that might produce arcs, sparks, or particles of hot metal, such as lamps and lampholders for fixed lighting, cutouts, switches, receptacles, motors, or other equipment having make-and-break or sliding contacts, shall be of the totally enclosed type or be constructed so as to prevent the escape of sparks or hot metal particles.

515.7(C) Portable Luminaires or Other Utilization Equipment. Portable luminaires or other utilization equipment and their flexible cords shall comply with Part III of Article **501** or **505.17** for the class of location above which they are connected or used.

Wiring methods currently included in 515.7(C) are consistent with Class I, Division 2 wiring methods, however the list is not consistent with the full list of wiring methods permitted for Division 2 in 501.10(B). The section was revised to reference those wiring methods in 501.10(B).

515.8 Underground Wiring.

515.8(A) Wiring Method. Underground wiring shall be installed in threaded rigid metal conduit or threaded steel intermediate metal conduit or, where buried under not less than 600 mm (2 ft) of cover, shall be permitted in PVC conduit, RTRC conduit, or a listed cable. Where PVC conduit or RTRC conduit is used, threaded rigid metal conduit or threaded steel intermediate metal conduit shall be used for not less than the last 600 mm (2 ft) of the conduit run to the conduit point of emergence from the underground location or to the point of connection to an aboveground raceway. Where cable is used, it shall be enclosed in threaded rigid metal conduit or threaded steel intermediate metal conduit from the point of lowest buried cable level to the point of connection to the aboveground raceway.

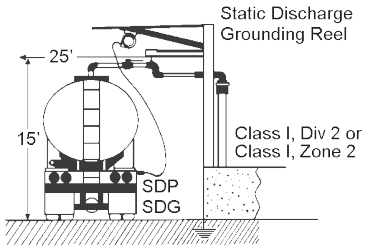
515.8(B)Insulation. Conductor insulation shall comply with **501.20.**

515.8(C) Nonmetallic Wiring. Where PVC conduit, RTRC conduit, or cable with a nonmetallic sheath is used, an equipment grounding conductor shall be included to provide for electrical continuity of the raceway system and for grounding of non–current-carrying metal parts.

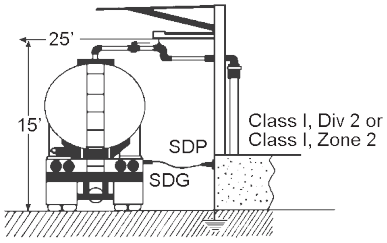
515.9 Sealing. Sealing requirements shall apply to horizontal as well as to vertical boundaries of the defined Class I locations. Buried raceways and cables under defined Class I locations shall be considered to be within a Class I, Division 1 or Zone 1 location.

STATIC ELECTRICITY.

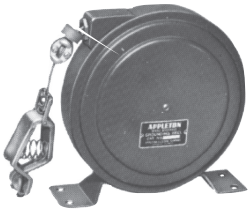
STATIC ELECTRICITY CAN BUILD UP TO DANGEROUS LEVELS. SHOWN HERE ARE TWO SAFE WAYS TO DISCHARGE STATIC ELECTRICITY WITH APPLETON™ PRODUCTS.



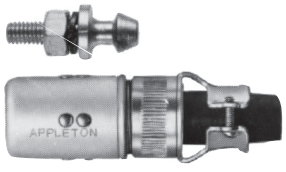
GROUNDING REEL INSTALLED ON BUILDING. HERE SDP PLUG REPLACES ALLIGATOR CLIP FURNISHED AS STANDARD WITH REEL.



SDG STUDS AND SDP PLUG USED AT GASOLINE BULK STATION. STUDS PERMANENTLY INSTALLED ON TRUCK AND BUILDING.



SD SERIES STATIC DISCHARGE GROUNDING REEL



SDG GROUNDING STUD AND SDP GROUNDING PLUG

GROUNDING REEL INSTALLED ON BUILDING. HERE SDP PLUG REPLACES ALLIGATOR CLIP FURNISHED AS STANDARD WITH REEL. SDG STUDS AND SDP PLUG USED AT GASOLINE BULK STATION. STUDS PERMANENTLY INSTALLED ON TRUCK AND BUILDING. SDG GROUNDING STATIC DISCHARGE STUD AND SDP GROUNDING REEL GROUNDING PLUG.

515.10 Special Equipment — Motor Fuel Dispensers. In addition to the requirements of this article, dispensers for gasoline or other volatile flammable liquids or liquified flammable gases shall comply with the requirements for motor fuel dispensing facilities, as applicable, except as modified by this article.

515.16 Grounding and Bonding. All metal raceways, the metal armor or metallic sheath on cables, and all non–current-carrying metal parts of fixed or portable electrical equipment, regardless of voltage, shall be grounded and bonded.

Grounding and bonding in Class I locations shall comply with 501.30 for Class I, Division 1 and 2 locations and 505.25 for Zone 0, 1, and 2 locations.

Informational Note: See NFPA 30, Flammable and Combustible Liquids Code, 6.5.4, for information on grounding for static protection.

BULK PLANT OR TERMINAL. 515.1 DEFINES SUCH A PLANT AS A LOCATION "WHERE FLAMMABLE LIQUIDS ARE RECEIVED AND ARE STORED OR BLENDED IN BULK FOR THE PURPOSE OF DISTRIBUTING SUCH LIQUIDS BY TANK VESSEL," ETC.

TYPICALLY, PRODUCTS FROM BULK STORAGE PLANTS ARE DISTRIBUTED BY TANK TRUCKS.

CHANGES TO ARTICLE 516 – Spray Application, Dipping, Coating, and Printing Processes Using Flammable or Combustible Materials

The following Article 516 sections have been revised during the 2023 NEC® *Code* cycle. These changes are those that are substantive and should be noted. This list does not include those changes that are editorial in nature.

Underlined text indicates a section that has been revised from the previous NEC® edition. It is not intended to indicate legislation text detailing the word-for-word revisions to the section. Where minor revisions have been made to a section, these will include underlined text for select words to indicate the minor revision.

- Table 516.2: Other Articles
- 516.4: Open Containers. Area Classification
- 516.7: Wiring and Equipment Not Within Hazardous (Classified) Locations.
- 516.38: Wiring and Equipment Not Within Hazardous (Classified) Locations.

ARTICLE 516 Spray Application, Dipping, Coating, and Printing Processes Using Flammable or Combustible Materials

Part I. General

516.1 Scope. This article covers the regular or frequent application of flammable liquids, combustible liquids, and combustible powders by spray operations and the application of flammable liquids or combustible liquids at temperatures above their flashpoint by spraying, dipping, coating, printing, or other means.

Informational Note No. 1: See NFPA 33-2021, Standard for Spray Application Using Flammable or Combustible Materials, or NFPA 34-2021, Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids, for extracted text that is followed by a reference in brackets. Only editorial changes were made to the extracted text to make it consistent with this Code.

Informational Note No. 2: See NFPA 91, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids, for information regarding ventilation.

516.2 Other Articles. In addition to the requirements of this article, spray application, dipping, coating, and printing processes using flammable or combustible materials shall comply with **Table 516.2**, as applicable, except as modified by this article.

New section provides the necessary link from Article 515 to Articles 500 and 505 which became necessary with the deletion of Article 510.

Table 516.2 *Other Articles*

Requirement	Division Classified Locations	Zone Classified Locations
Area classification	500.5, 500.6	505.5, 505.6, 505.7
Equipment	Part III of 501, 500.7, 500.8, 501.5	505.8, 505.9, 505.20, 505.22
Wiring	Part II of 501	505.15, 505.16, 505.17, 505.18, 505.19, 505.26, 505.30

New Table 516.2 has been created to identify the specific sections of other Articles that are applicable to spray application, dipping, coating and printing processes using flammable or combustible materials.

516.3 Class I Locations. Where the term Class I is used with respect to Zone classifications within this article of the *Code*, it shall apply to Zone 0, Zone 1, and Zone 2 designations.

Informational Note: The term Class I was originally included as a prefix to Zone 0, Zone 1, and Zone 2 locations and references as an identifier for flammable gases, vapors, or liquids to differentiate from Class II and Class III locations. Zone 0, Zone 1, and Zone 2 only apply to flammable gases, vapors, or liquids so the Class I prefix is redundant and has been deleted, except for text that is extracted from other documents or to remain consistent throughout this article.

Section 516.3 is new. The added text clarifies the application of what was the "Class I" prefix to Zones 0, 1, and 2. The new text provides clarification that those designations with the prefix "Class I" are applied as Zones 0, 1, and 2 per Article 505.

The term "Class I" is now an optional equipment marking, as the Zone designations are specific to Class I areas.

Part II. Open Containers

516.4 Area Classification. Area classification for open containers, supply containers, waste containers, spray gun cleaners, and solvent distillation units that contain Class I liquids and are located in ventilated areas shall be in accordance with the following:

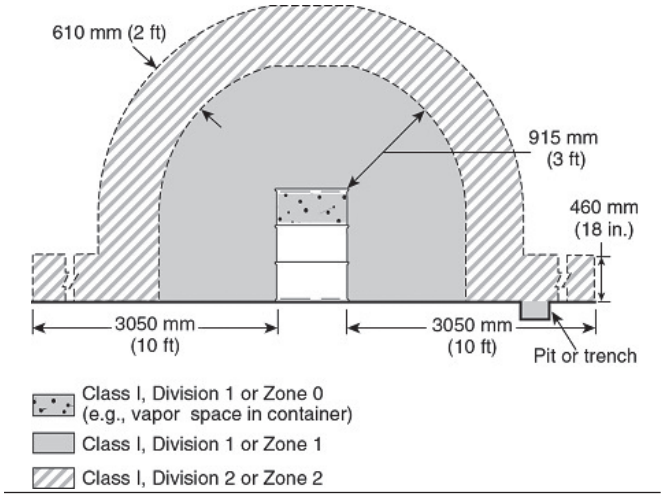
(1) The area within 915 mm (3 ft) in all directions from any such container or equipment and extending to the floor or grade level shall be classified as Class I, Division 1 or Class I, Zone 1, whichever is applicable. [**33**:6.5.5.1(1)]

(2) The area extending 610 mm (2 ft) beyond the Division 1 or Zone 1 location shall be classified as Class I, Division 2 or Class I, Zone 2, whichever is applicable. [**33**:6.5.5.1(2)]

(3) The area extending 1525 mm (5 ft) horizontally beyond the area described in 516.4(2) up to a height of 460 mm (18 in) above the floor or grade level shall be classified as Class I, Division 2 or Class I, Zone 2, whichever is applicable. [**33**:6.5.5.1(3)]

(4) The area inside any tank or container shall be classified as Class I, Division 1 or Class I, Zone 0, whichever is applicable. [**33**:6.5.5.1(4)]

Figure 516.4 *Electrical Area Classification for Class I Liquid Operations Around Open Containers, Supply Containers, Waste Containers, Spray Gun Cleaners, and Solvent Distillation Units. [**33**:Figure 6.5.5.2]*



(5) Sumps, pits, or belowgrade channels within 3.05 m (10 ft) horizontally of a vapor source shall be classified as Class I, Division 1 or Zone 1. If the sump, pit, or channel extends beyond 3.05 m (10 ft) from the vapor source, it shall be provided with a vapor stop or it shall be classified as Class I, Division 1 or Zone 1 for its entire length.

The 3.05 m dimension has been corrected from 3.50 m.

For the purposes of electrical area classification, the Division system and the Zone system shall not be intermixed for any given source of release. [**33**:6.2.3]

Electrical wiring and utilization equipment installed in these areas shall be suitable for the location, as shown in **Figure 516.4**. [**33**:6.5.5.2]

Part III. Spray Application Processes

516.5 Area Classification. For spray application processes, the area classification is based on quantities of flammable vapors, combustible mists, residues, dusts, or deposits that are present or might be present in quantities sufficient to produce ignitable or explosive mixtures with air.

516.5(A) Zone Classification of Locations.

516.5(A)(1) Classification of Locations. The Zone system of electrical area classification shall be applied as follows:

(1) The inside of closed containers or vessels shall be considered a Class I, Zone 0 location.

(2) A Class I, Division 1 location shall be permitted to be alternatively classified as a Class I, Zone 1 location.

(3) A Class I, Division 2 location shall be permitted to be alternatively classified as a Class I, Zone 2 location.

(4) A Class II, Division 1 location shall be permitted to be alternatively classified as a Zone 21 location.

(5) A Class II, Division 2 location shall be permitted to be alternatively classified as a Zone 22 location. [**33**:6.2.2]

516.5(A)(2) Classification Systems. For the purposes of electrical area classification, the Division system and the Zone system shall not be intermixed for any given source of release. [**33**:6.2.3]

In instances of areas within the same facility classified separately, Class I, Zone 2 locations shall be permitted to abut, but not overlap, Class I, Division 2 locations. Class I, Zone 0 or Zone 1 locations shall not abut Class I, Division 1 or Division 2 locations. [**33**:6.2.4]

516.5(A)(3) Equipment. Open flames, spark-producing equipment or processes, and equipment whose exposed surfaces exceed the autoignition temperature of the material being sprayed shall not be located in a spray area or in any surrounding area that is classified as Division 2, Zone 2, or Zone 22. [**33**:6.2.5]

Exception: This requirement shall not apply to drying, curing, or fusing apparatus.

Any utilization equipment or apparatus that is capable of producing sparks or particles of hot metal and that is located above or adjacent to either the spray area or the surrounding Division 2, Zone 2, or Zone 22 areas shall be of the totally enclosed type or shall be constructed to prevent the escape of sparks or particles of hot metal. [**33**:6.2.6]

516.5(B) Class I, Division 1 or Class I, Zone 0 Locations. The interior of any open or closed container or vessel of a flammable liquid shall be considered Class I, Division 1, or Class I, Zone 0, as applicable.

Informational Note: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials, Chapter 6, for additional information.

516.5(C) Class I, Division 1; Class I, Zone 1; Class II, Division 1; or Zone 21 Locations. The following spaces shall be considered Class I, Division 1; Class I, Zone 1; Class II, Division 1; or Zone 21 locations, as applicable:

(1) The interior of spray booths and rooms except as specifically provided in 516.5(D).

(2) The interior of exhaust ducts.

(3) Any area in the direct path of spray operations.

(4) Sumps, pits, or below grade channels within 7620 mm (25 ft) horizontally of a vapor source. If the sump, pit, or channel extends beyond 7620 mm (25 ft) from the vapor source, it shall be provided with a vapor stop or it shall be classified as Class I, Division 1 for its entire length. [**34**:6.4.1]

(5) All space in all directions outside of but within 900 mm (3 ft) of open containers, supply containers, spray gun cleaners, and solvent distillation units containing flammable liquids.

Interiors of Enclosed Coating or Dipping Process. This statement is extracted from NFPA® 34, Standard for Dipping and Coating Process Using Flammable and Combustible Liquids. These Division 1 locations include any enclosed coating or dipping operations.

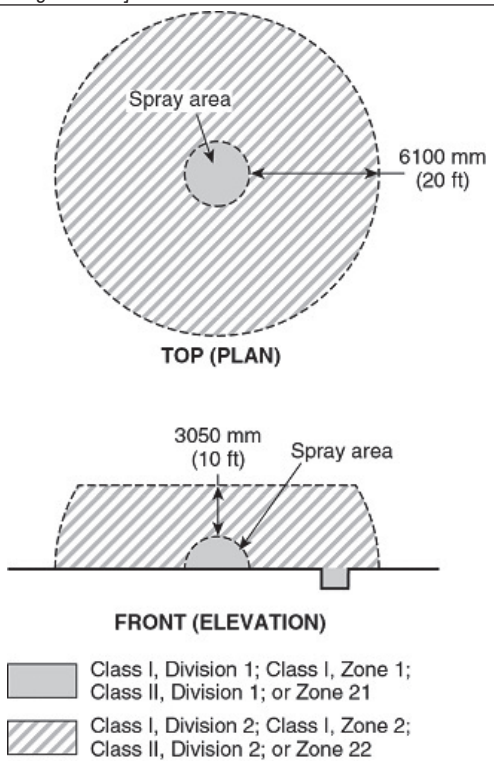
(6) For limited finishing workstations, the area inside the curtains or partitions. [See **Figure 516.5(D)(5)**.]

516.5(D) Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 Locations. The spaces listed in **516.5(D)(1)** through **(D)(5)** shall be considered Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 as applicable.

516.5(D)(1) Unenclosed Spray Processes. Electrical wiring and utilization equipment located outside but within 6100 mm (20 ft) horizontally and 3050 mm (10 ft) vertically of an enclosed spray area and not separated from the spray area by partitions extending to the boundaries of the area designated as Division 2, Zone 2 or Zone 22 in **Figure 516.5(D)(1)** shall be suitable for Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 locations, whichever is applicable. [**33**:6.5.1] [See Figure 516.5(D)(1).]

516.5(D)(2) Closed-Top, Open-Face, and Open-Front Spray Booths and Spray Rooms. If spray application operations are conducted within a closed-top, open-face, or open-front booth or room, as shown in **Figure 516.5(D)(2)**, any electrical wiring or utilization equipment located outside of the booth or room but within 915 mm (3 ft) of any opening shall be suitable for Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 locations, whichever is applicable. The Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 locations shown in **Figure 516.5(D)(2)** shall extend from the edges of the open face or open front of the booth or room.

FIGURE 516.5(D)(1) *Electrical Area Classification for Unenclosed Spray Areas. [**33**:Figure 6.5.1]*



516.5(D)(3) Open-Top Spray Booths. For spraying operations conducted within an open top spray booth, the space 915 mm (3 ft) vertically above the booth and within 915 mm (3 ft) of other booth openings shall be considered Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 whichever is applicable. [**33**:6.5.3]

516.5(D)(4) Enclosed Spray Booths and Spray Rooms. For spray application operations confined to an enclosed spray booth or room, electrical area classification shall be as follows:

FIGURE 516.5(D)(2) *Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 Locations Adjacent to a Closed Top, Open Face, or Open Front Spray Booth or Room. [**33**:Figure 6.5.2]*

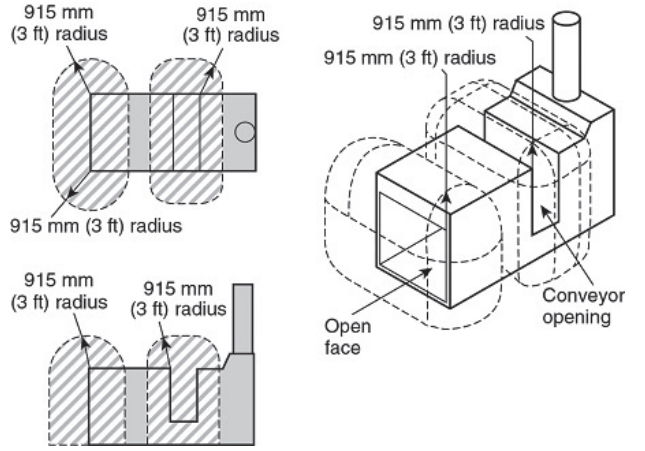
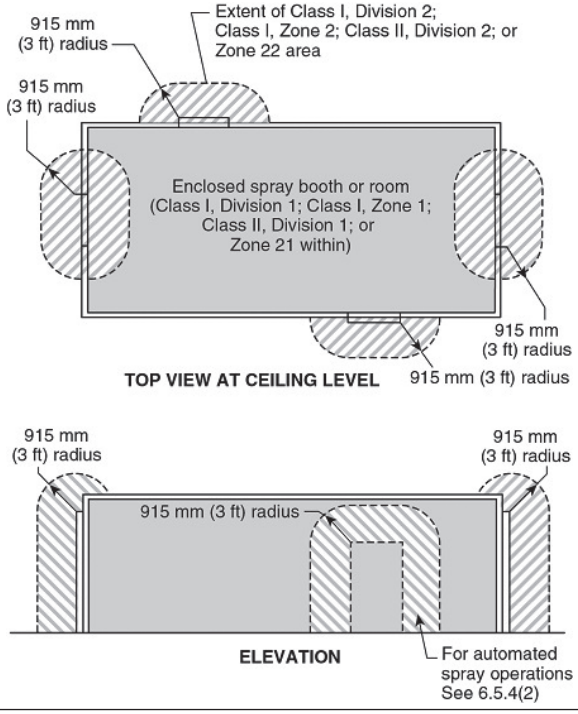


FIGURE 516.5(D)(4) *Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 Locations Adjacent to an Enclosed Spray Booth or Spray Room. [**33**:Figure 6.5.4]*



(1) The area within 915 mm (3 ft) of any opening shall be classified as Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 locations, whichever is applicable, as shown in **Figure 516.5(D)(4)**.

(2) Where automated spray application equipment is used, the area outside the access doors shall be unclassified provided the door interlock prevents the spray application operations when the door is open.

(3) Where exhaust air is permitted to be recirculated, both of the following shall apply:

a. The interior of any recirculation path from the secondary particulate filters up to and including the air supply plenum shall be classified as Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 locations, whichever is applicable.

b. The interior of fresh air supply ducts shall be unclassified.

(4) Where exhaust air is not recirculated, the interior of fresh air supply ducts and fresh air supply plenums shall be unclassified. [**33**:6.5.4]

516.5(D)(5) Limited Finishing Workstations.

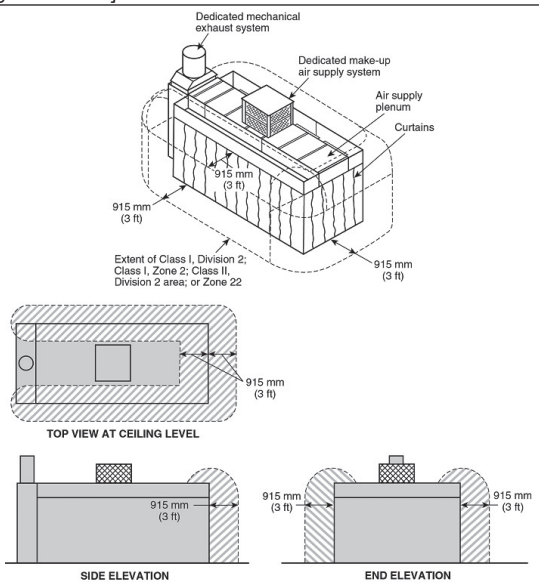
(a) For limited finishing workstations, the area inside the 915 mm (3 ft) space horizontally and vertically beyond the volume enclosed by the outside surface of the curtains or partitions shall be classified as Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22, as shown in **Figure 516.5(D)(5)**.

(b) A limited finishing workstation shall be designed and constructed to have all of the following:

(1) A dedicated make-up air supply

(2) Curtains or partitions that are noncombustible or limited combustible

FIGURE 516.5(D)(5) *Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 Locations Adjacent to a Limited Finishing Workstation. [**33**:Figure 14.3.5.1]*



(3) A dedicated mechanical exhaust and filtration system

(4) An approved automatic extinguishing system [**33**:14.3.1]

Informational Note: For limited combustible curtains or partitions see NFPA 701-2019, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

(c) The amount of material sprayed in a limited finishing workstation shall not exceed 3.8 L (1 gal) in any 8-hour period. [**33**:14.3.2]

(d) Curtains or partitions shall be fully closed during any spray operations. [**33**:14.3.4]

(e) The equipment within the limited finishing workstation shall be interlocked such that the spray application equipment cannot be operated unless the exhaust ventilation system is operating and functioning properly and spray application is automatically stopped if the exhaust ventilation system fails.

(f) Any limited finishing workstation used for spray application operations shall not be used for any operation that is capable of producing sparks or particles of hot metal or for operations that involve open flames or electrical utilization equipment capable of producing sparks or particles of hot metal. [**33**:14.3.6]

(g) Where industrial air heaters are used to elevate the air temperature for drying, curing, or fusing operations, a high limit switch shall be provided to automatically shut off the drying apparatus if the air temperature in the limited finishing workstation exceeds the maximum discharge-air temperature allowed by the standard that the heater is listed to or 93°C (200°F), whichever is less. [**33**:14.3.7.1]

(h) A means shall be provided to show that the limited finishing workstation is in the drying or curing mode of operation and that the limited finishing workstation is to be unoccupied. [**33**:14.3.7.2]

(i) Any containers of flammable or combustible liquids shall be removed from the limited finishing workstation before the drying apparatus is energized. [**33**:14.3.7.3]

(j) Portable spot-drying, curing, or fusion apparatus shall be permitted to be used in a limited finishing workstation, provided that it is not located within the hazardous (classified) location defined in 14.3.5 of NFPA 33 when spray application operations are being conducted. [**33**:14.3.8]

(k) Recirculation of exhaust air shall be permitted when the provisions of 516.5(D)(4)(3) are both met. [**33**:14.3.9]

516.6 Wiring and Equipment in Class I Locations.

516.6(A) Wiring and Equipment — Vapors. All electrical wiring and equipment within the hazardous (classified) locations (containing vapor only — not residues) defined in **516.5** shall comply with the requirements of Part II and Part III of Article **501** or with **505.17** through **505.30**, as applicable.

516.6(B) Wiring and Equipment — Vapors and Residues. Unless specifically listed for locations containing deposits of dangerous quantities of flammable or combustible vapors, mists, residues, dusts, or deposits (as applicable), there shall be no electrical equipment in any spray area as herein defined whereon deposits of combustible residue could readily accumulate, except wiring in rigid metal conduit, intermediate metal conduit, Type MI cable, or in metal boxes or fittings containing no taps, splices, or terminal connections. [**33**:6.4.2]

516.6(C) Illumination. Luminaires shall be permitted to be installed as follows:

(1) Luminaires, like that shown in **Figure 516.6(C)(a)**, that are attached to the walls or ceiling of a spray area but that are outside any classified area and are separated from the spray area by glass panels shall be suitable for use in unclassified locations. Such fixtures shall be serviced from outside the spray area. [**33**:6.6.1]

(2) Luminaires, like that shown in **Figure 516.6(C)(a)**, that are attached to the walls or ceiling of a spray area; that are separated from the spray area by glass panels and that are located within a Class I, Division 2; a Class I, Zone 2; a Class II, Division 2; or a Zone 22 location shall be suitable for such location. Such fixtures shall be serviced from outside the spray area. [**33**:6.6.2]

FIGURE 516.6(C)(a) *Example of a Luminaire that is Mounted Outside of the Spray Area and is Serviced from Outside the Spray Area. [**33**:Figure 6.6.1]*

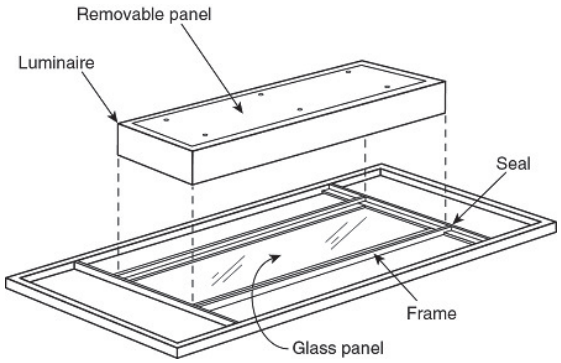
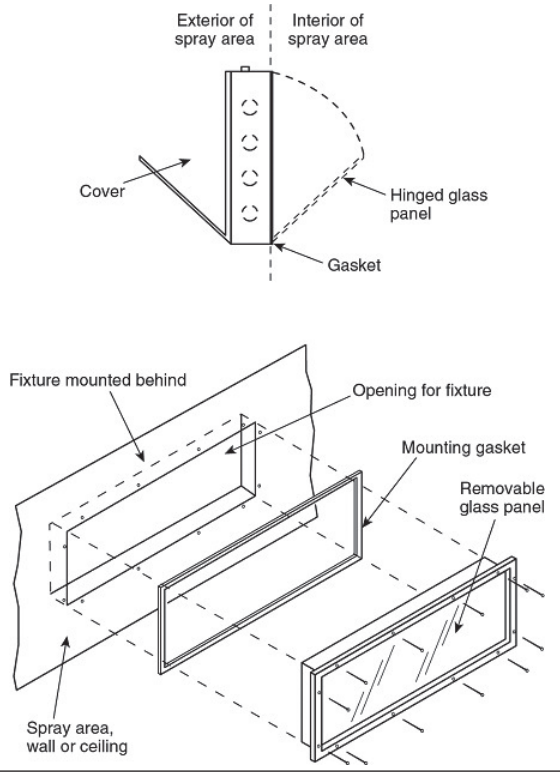


FIGURE 516.6(C)(b) *Example of a Luminaire that is an Integral Part of the Spray Area and is Serviced from Inside the Spray Area. [**33**:Figure 6.6.3]*



(3) Luminaires, like that shown in **Figure 516.6(C)(b)**, that are an integral part of the walls or ceiling of a spray area shall be permitted to be separated from the spray area by glass panels that are an integral part of the fixture. Such fixtures shall be listed for use in Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 locations, whichever is applicable, and also shall be listed for accumulations of deposits of combustible residues. Such fixtures shall be permitted to be serviced from inside the spray area. [**33**:6.6.3]

(4) Glass panels used to separate luminaires from the spray area or that are an integral part of the luminaire shall meet the following requirements:

a. Panels for light fixtures or for observation shall be of heattreated glass, laminated glass, wired glass, or hammered-wired glass and shall be sealed to confine vapors, mists, residues, dusts, and deposits to the spray area. [**33**:5.5.1]

Exception: Listed spray booth assemblies that have vision panels constructed of other materials shall be permitted.

b. Panels for light fixtures shall be separated from the fixture to prevent the surface temperature of the panel from exceeding 93°C (200°F). [**33**:5.5.2]

c. The panel frame and method of attachment shall be designed to not fail under fire exposure before the vision panel fails. [**33**:5.5.3]

516.6(D) Portable Equipment. Portable electric luminaires or other utilization equipment shall not be used in a spray area during spray operations.

*Exception No. 1: Where portable electric luminaires are required for operations in spaces not readily illuminated by fixed lighting within the spraying area, they shall be of the type identified for Class I, Division 1 or Class 1, Zone 1 locations where readily ignitible residues could be present. [**33**:6.9 Exception]*

Exception No. 2: Where portable electric drying apparatus is used in spray booths and the following requirements are met:

(1) The apparatus and its electrical connections are not located within the spray enclosure during spray operations.

(2) Electrical equipment within 450 mm (18 in) of the floor is identified for Class I, Division 2 or Class I, Zone 2 locations.

(3) All metallic parts of the drying apparatus are electrically bonded and grounded.

(4) Interlocks are provided to prevent the operation of spray equipment while drying apparatus is within the spray enclosure, to allow for a 3-minute purge of the enclosure before energizing the drying apparatus and to shut off drying apparatus on failure of ventilation system.

516.6(E) Electrostatic Equipment. Electrostatic spraying or detearing equipment shall be installed and used only as provided in **516.10**.

Informational Note: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials, for additional information.

516.6(F) Static Electric Discharges. All persons and all electrically conductive objects, including any metal parts of the process equipment or apparatus, containers of material, exhaust ducts, and piping systems that convey flammable or combustible liquids, shall be electrically grounded. [**34**:6.8.1]

516.7 Wiring and Equipment Not Within Hazardous Classified Locations.

516.7(A) Wiring. All fixed wiring above hazardous (classified) locations shall be permitted to be one or more of the following:

(1) Rigid metal conduit (RMC) or intermediate metal conduit (IMC) with listed threaded or threadless fittings, or electrical metallic tubing (EMT) with listed fittings.

(2) Rigid polyvinyl chloride conduit (PVC), reinforced thermosetting resin conduit (RTRC), or electrical nonmetallic tubing (ENT).

The requirement for RTRC to include the suffix -XW was deleted as it was redundant. The application of RTRC is covered by Article 355, the need for RTRC with the suffix -XW is based on whether it is subject to physical damage as covered by 355.12(C).

(3) Type MC cable, Type TC cable, or Type TC-ER cable, including installation in cable trays, terminated with listed fittings. Type TC-ER cable shall include an equipment grounding conductor (EGC) in addition to any drain wire.

(4) Type MI cable terminated with listed fittings and installed and supported to avoid tensile stress.

(5) Type PLTC cable or Type PLTC-ER cable used in Class 2 or Class 3 circuits. Type PLTC-ER cable shall include an equipment grounding conductor (EGC) in addition to any drain wire.

The references to Article 725 have been removed and replaced with circuit Class references as the Article 725 was split, removing Class 1 Circuits and moving that language to a new Article 724 during the First Draft

(6) Type ITC cable or Type ITC-ER cable in accordance with **335.4** and **335.5** and terminated with listed fittings. Type ITC-ER cable shall include an EGC in addition to any drain wire.

The references to Article 727 have been updated to 335 based on relocation of the article in the First Draft

(7) Cellular metal raceways supplying ceiling outlets or as extensions to the area below the floor of a hazardous (classified) location. If cellular metal raceways are used, they shall not have connections leading into or passing through the hazardous (classified) location unless suitable seals are provided.

516.7(B) Equipment. Equipment that could produce arcs, sparks, or particles of hot metal, such as lamps and lampholders for fixed lighting, cutouts, switches, receptacles, motors, or other equipment having make-and-break or sliding contacts, where installed above a classified location or above a location where freshly finished goods are handled, shall be of the totally enclosed type or be constructed so as to prevent the escape of sparks or hot metal particles.

516.10 Special Equipment.

516.10(A) Fixed Electrostatic Equipment. This section shall apply to any equipment using electrostatically charged elements for the atomization, charging, and/or precipitation of hazardous materials for coatings on articles or for other similar purposes in which the charging or atomizing device is attached to a mechanical support or manipulator, including robotic devices. This section shall not apply to devices that are held or manipulated by hand. Where robot or programming procedures involve manual manipulation of the robot arm while spraying with the high voltage on, the requirements of **516.10(B)** shall apply. The installation of electrostatic spraying equipment shall comply with the requirements of **516.10(A)(1)** through **(A)(10)**. Spray equipment shall be listed. All automatic electrostatic equipment systems shall comply with the requirements of **516.6(B)** through **(D)** and **516.6(F)**.

516.10(A)(1) Power and Control Equipment. Transformers, high-voltage supplies, control apparatus, and all other electrical portions of the equipment shall be installed outside of the Class I location or be of a type identified for the location.

Exception: High-voltage grids, electrodes, electrostatic atomizing heads, and their connections shall be permitted within the Class I location.

516.10(A)(2) Electrostatic Equipment. Electrodes and electrostatic atomizing heads shall be adequately supported in permanent locations and shall be effectively insulated from ground. Electrodes and electrostatic atomizing heads that are permanently attached to their bases, supports, reciprocators, or robots shall be deemed to comply with this section.

516.10(A)(3) High-Voltage Leads. High-voltage leads shall be properly insulated and protected from mechanical damage or exposure to destructive chemicals. Any exposed element at high voltage shall be effectively and permanently supported on suitable insulators and shall be effectively guarded against accidental contact or grounding.

516.10(A)(4) Support of Goods. Goods being coated using this process shall be supported on conveyors or hangers. The conveyors or hangers shall be arranged (1) to ensure that the parts being coated are electrically connected to ground with a resistance of 1 megohm or less and (2) to prevent parts from swinging.

516.10(A)(5) Automatic Controls. Electrostatic apparatus shall be equipped with automatic means that will rapidly de-energize the high-voltage elements under any of the following conditions:

(1) Stoppage of ventilating fans or failure of ventilating equipment from any cause

(2) Stoppage of the conveyor carrying goods through the highvoltage field unless stoppage is required by the spray process

(3) Occurrence of excessive current leakage at any point in the high-voltage system

(4) De-energizing the primary voltage input to the power supply

516.10(A)(6) Grounding. All electrically conductive objects in the spray area, except those objects required by the process to be at high voltage, shall be adequately grounded. This requirement shall apply to paint containers, wash cans, guards, hose connectors, brackets, and any other electrically conductive objects or devices in the area.

Informational Note: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials; NFPA 34, Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids; and NFPA 77, Recommended Practice on Static Electricity, for information on grounding and bonding for static electricity purposes.

516.10(A)(7) Isolation. Safeguards such as adequate booths, fencing, railings, interlocks, or other means shall be placed about the equipment or incorporated therein so that they, either by their location, character, or both, ensure that a safe separation of the process is maintained.

516.10(A)(8) Signs. Signs shall be conspicuously posted to convey the following:

(1) Designate the process zone as dangerous with regard to fire and accident

(2) Identify the grounding requirements for all electrically conductive objects in the spray area

(3) Restrict access to qualified personnel only

516.10(A)(9) Insulators. All insulators shall be kept clean and dry.

516.10(A)(10) Other Than Nonincendive Equipment. Spray equipment that cannot be classified as nonincendive shall comply with **516.10(A)(10)(a)** and **(A)(10)(b)**.

(a) Conveyors, hangers, and application equipment shall be arranged so that a minimum separation of at least twice the sparking distance is maintained between the workpiece or material being sprayed and electrodes, electrostatic atomizing heads, or charged conductors. Warnings defining this safe distance shall be posted. [**33**:11.4.1]

(b) The equipment shall provide an automatic means of rapidly de-energizing the high-voltage elements in the event the distance between the goods being painted and the electrodes or electrostatic atomizing heads falls below that specified in **516.10(A)(10)(a)**. [**33**:11.3.8]

516.10(B) Hand-Spraying Electrostatic Equipment. This section shall apply to any equipment using electrostatically charged elements for the atomization, charging, or precipitation of flammable and combustible materials for coatings on articles, or for other similar purposes in which the charging or atomizing device is hand-held and manipulated during the spraying operation. Electrostatic hand-spraying equipment and devices used in connection with paint-spraying operations shall be of listed types and shall comply with **516.10(B)(1)** through **(B)(5)**.

516.10(B)(1) General. The high-voltage circuits shall be designed so as not to produce a spark of sufficient intensity to ignite the most readily ignitible of those vapor–air mixtures likely to be encountered or result in appreciable shock hazard upon coming in contact with a grounded object under all normal operating conditions. The electrostatically charged exposed elements of the handgun shall be capable of being energized only by an actuator that also controls the coating material supply.

516.10(B)(2) Power Equipment. Transformers, power packs, control apparatus, and all other electrical portions of the equipment shall be located outside of the Class I location or be identified for the location.

Exception: The handgun itself and its connections to the power supply shall be permitted within the Class I location.

516.10(B)(3) Handle. The handle of the spraying gun shall be electrically connected to ground by a conductive material and be constructed so that the operator in normal operating position is in electrical contact with the grounded handle with a resistance of not more than 1 megohm to prevent buildup of a static charge on the operator's body. Signs indicating the necessity for grounding other persons entering the spray area shall be conspicuously posted.

516.10(B)(4) Electrostatic Equipment. All electrically conductive objects in the spraying area, except those objects required by the process to be at high voltage shall be electrically connected to ground with a resistance of not more than 1 megohm. This requirement shall apply to paint containers, wash cans, and any other electrical conductive objects or devices in the area. The equipment shall carry a prominent, permanently installed warning regarding the necessity for this grounding feature.

Informational Note: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials; NFPA 34, Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids; and NFPA 77, Recommended Practice on Static Electricity, for information on grounding and bonding for static electricity purposes.

516.10(B)(5) Support of Objects. Objects being painted shall be maintained in electrical contact with the conveyor or other grounded support. Hooks shall be regularly cleaned to ensure adequate grounding of 1 megohm or less. Areas of contact shall be sharp points or knife edges where possible. Points of support of the object shall be concealed from random spray where feasible, and, where the objects being sprayed are supported from a conveyor, the point of attachment to the conveyor shall be located so as to not collect spray material during normal operation.

516.10(C) Powder Coating. This section shall apply to processes in which combustible dry powders are applied. The hazards associated with combustible dusts are present in such a process to a degree, depending on the chemical composition of the material, particle size, shape, and distribution.

516.10(C)(1) Electrical Equipment and Sources of Ignition. Electrical equipment and other sources of ignition shall comply with the requirements of Part III of Article **502** or **506.20**, as applicable. Portable electric luminaires and other utilization equipment shall not be used within a Class II location during operation of the finishing processes. Such luminaires or utilization equipment used during cleaning or repairing operations shall be of a type identified for Class II, Division 1 locations and all exposed metal parts shall be connected to an equipment grounding conductor.

Exception: Portable electric luminaires shall be of the type listed for Class II, Division 1 locations where required for operations in spaces not readily illuminated by fixed lighting within the spraying area and where readily ignitible residues might be present.

516.10(C)(2) Fixed Electrostatic Spraying Equipment. The provisions of **516.10(A)** and **516.10(C)(1)** shall apply to fixed electrostatic spraying equipment.

516.10(C)(3) Electrostatic Hand-Spraying Equipment. The provisions of **516.10(B)** and **516.10(C)(1)** shall apply to electrostatic hand-spraying equipment.

516.10(C)(4) Electrostatic Fluidized Beds. Electrostatic fluidized beds and associated equipment shall be of identified types. The high-voltage circuits shall be designed such that any discharge produced when the charging electrodes of the bed are approached or contacted by a grounded object shall not be of sufficient intensity to ignite any powder–air mixture likely to be encountered or to result in an appreciable shock hazard.

(a) Transformers, power packs, control apparatus, and all other electrical portions of the equipment shall be located outside the powder-coating area or shall otherwise comply with the requirements of 516.10(C)(1).

Exception: The charging electrodes and their connections to the power supply shall be permitted within the powder-coating area.

(b) All electrically conductive objects within the powder-coating area shall be adequately grounded. The powder-coating equipment shall carry a prominent, permanently installed warning regarding the necessity for grounding these objects.

Informational Note: See NFPA 33, Standard for Spray Application Using Flammable or Combustible

Materials; NFPA 34, Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids; and NFPA 77, Recommended Practice on Static Electricity, for information on grounding and bonding for static electricity purposes.

(c) Objects being coated shall be maintained in electrical contact (less than 1 megohm) with the conveyor or other support in order to ensure proper grounding. Hangers shall be regularly cleaned to ensure effective electrical contact. Areas of electrical contact shall be sharp points or knife edges where possible.

(d) The electrical equipment and compressed air supplies shall be interlocked with a ventilation system so that the equipment cannot be operated unless the ventilating fans are in operation. [**33**:Chapter 15]

516.16 Grounding. All metal raceways, the metal armors or metallic sheath on cables, and all non–current-carrying metal parts of fixed or portable electrical equipment, regardless of voltage, shall be grounded and bonded. Grounding and bonding shall comply with **501.30**, **502.30**, or **505.25**, as applicable.

Part IV. Spray Application Operations in Membrane Enclosures

Part IV addresses temporary membrane enclosures, the spray application operations and control of ignition sources within the enclosures, as well as the hazardous location requirements.

516.18 Area Classification for Temporary Membrane Enclosures. Electrical area classification shall be as follows:

(1) The area within the membrane enclosure shall be considered a Class I, Division 1 area, as shown in **Figure 516.18**.

(2) A 1.5 m (5 ft) zone outside of the membrane enclosure shall be considered Class I, Division 2, as shown in **Figure 516.18**.

Informational Note No. 1: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials, for information on occupancy, ventilation, fire protection, and permitting for spray application operations in membrane enclosures. This document limits spray application operations within both outdoor and indoor temporary membrane enclosures, as well as use and time constraints. The risks to people and property are unique when spray painting within the confined spaces of temporary membrane enclosures.

Informational Note No. 2: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials, Section 18.6, for the limits of material used in a vertical plane for membrane enclosures.

Informational Note No. 3: See NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films, Test Method 2, for construction information.

Informational Note No. 4: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials, 18.3.2.1.1, for membrane installation beneath sprinklers.

Informational Note No. 5: See NFPA 13, Standard for the Installation of Sprinkler Systems, 8.15.15, for information on the protection of membrane structures.

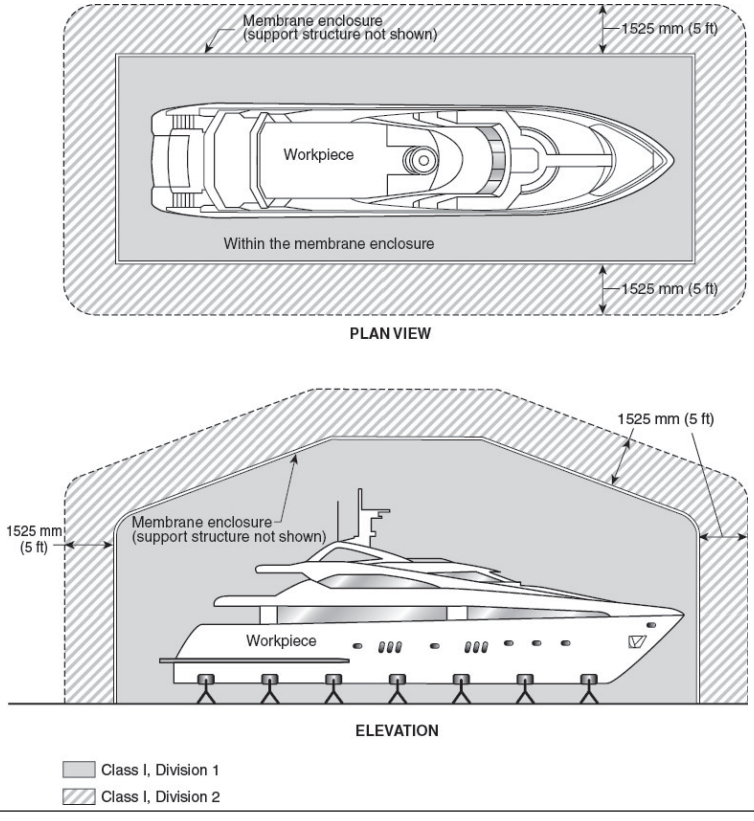
516.23 Electrical and Other Sources of Ignition. Electrical wiring and utilization equipment used within the classified areas inside and outside of membrane enclosures during spray painting shall be suitable for the location and shall comply with all of the following:

(1) All power to the workpiece shall be removed during spray painting.

(2) Workpieces shall be grounded.

(3) Spray paint equipment shall be grounded.

FIGURE 516.18 *Electrical Classifications for Temporary Outdoor Membrane Enclosures [33:Figure 18.7.1.1]*



(4) Scaffolding shall be bonded to the workpiece and grounded by an approved method.

Part V. Printing, Dipping, and Coating Processes

516.29 Classification of Locations. Classification is based on quantities of flammable vapors, combustible mists, residues, dusts, or deposits that are present or might be present in quantities sufficient to produce ignitable or explosive mixtures with air. Electrical wiring and electrical utilization equipment located adjacent to open processes shall comply with the requirements as follows. Examples of these requirements are illustrated in **Figure 516.29(a)**, **Figure 516.29(b)**, **Figure 516.29(c)**, and F**igure 516.29(d)**.

Informational Note: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials, Chapter 6, and NFPA 34, Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids, Chapter 6, for additional information.

(1) Electrical wiring and electrical utilization equipment located in any sump, pit, or below grade channel that is within 7620 mm (25 ft) horizontally of a vapor source, as defined by this standard, shall be suitable for Class I, Division 1 or Class I, Zone 1 locations. If the sump, pit, or channel extends beyond 7620 mm (25 ft) of the vapor source, it shall be provided with a vapor stop, or it shall be classified as Class I, Division 1 or Class I, Zone 1 for its entire length. [**34**:6.4.1]

(2) Electrical wiring and electrical utilization equipment located within 1525 mm (5 ft) of a vapor source shall be suitable for Class I, Division 1 or Class I, Zone 1 locations. The space inside a dip tank, ink fountain, ink reservoir, or ink tank shall be classified as Class I, Division 1 or Class I, Zone 0, whichever is applicable.

(3) Electrical wiring and electrical utilization equipment located within 915 mm (3 ft) of the Class I, Division 1 or Class I, Zone 1 location shall be suitable for Class I, Division 2 or Class I, Zone 2 locations, whichever is applicable.

(4) The space 915 mm (3 ft) above the floor and extending 6100 mm (20 ft) horizontally in all directions from the Class I, Division 1 or Class I, Zone 1 location shall be classified as Class I, Division 2 or Class I, Zone 2, and electrical wiring and electrical utilization equipment located within this space shall be suitable for Class I, Division 2 or Class I, Zone 2 locations, whichever is applicable.

(5) This space shall be permitted to be nonclassified for purposes of electrical installations if the surface area of the vapor source does not exceed 0.5 m^2 (5 ft^2), the contents of the dip tank, ink fountain, ink reservoir, or ink tank do not exceed 19 L (5 gal), and the vapor concentration during operating and shutdown periods does not exceed 25 percent of the lower flammable limit.

When spraying adjacent to enclosed coating and dipping operations, where the operation is enclosed, the location is non-hazardous. The Exception describes as Class I, Division 2 the space "within 3 feet in all directions from any opening in the enclosure."

516.35 Areas Adjacent to Enclosed Dipping and Coating Processes. Areas adjacent to enclosed dipping and coating processes are illustrated by **Figure 516.35** and shall be classified as follows:

(1) The interior of any enclosed dipping or coating process or apparatus shall be a Class I, Division 1 or Class I, Zone 1 location, and electrical wiring and electrical utilization equipment located within this space shall be suitable for Class I, Division 1 or Class I, Zone 1 locations, whichever is applicable. The area inside the dip tank shall be classified as Class I, Division 1 or Class I, Zone 0, whichever is applicable.

(2) The space within 915 mm (3 ft) in all directions from any opening in the enclosure and extending to the floor or grade level shall be classified as Class I, Division 2 or Class I, Zone 2, and electrical wiring and electrical utilization equipment located within this space shall be suitable for Class I, Division 2 locations or Class I, Zone 2 locations, whichever is applicable.

(3) All other spaces adjacent to an enclosed dipping or coating process or apparatus shall be classified as nonhazardous for purposes of electrical installations.

FIGURE 516.29(a) *Electrical Area Classification for Open Dipping and Coating Processes Without Vapor Containment or Ventilation. [**34**:Figure 6.4(a)]*

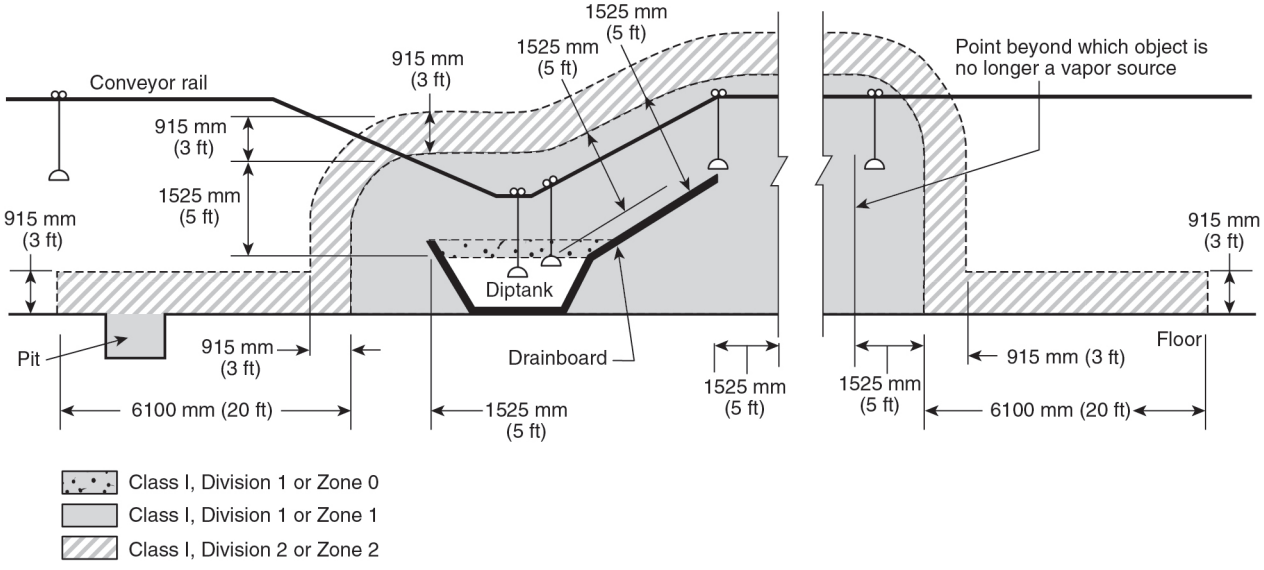


FIGURE 516.29(b) *Electrical Area Classification for Open Dipping and Coating Processes with Peripheral Vapor Containment and Ventilation — Vapors Confined to Process Equipment. [**34**:Figure 6.4(b)]*

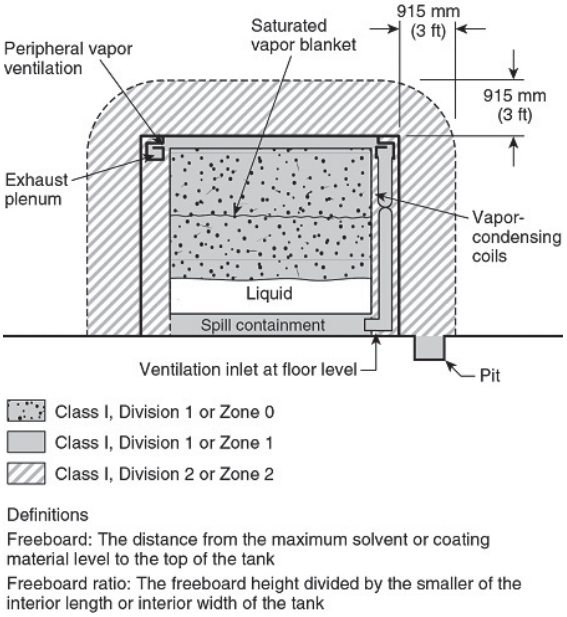


FIGURE 516.29(c) *Electrical Area Classification for Open Dipping and Coating Processes with Partial Peripheral Vapor Containment and Ventilation — Vapors NOT Confined to Process Equipment. [**34**:Figure 6.4(c)]*

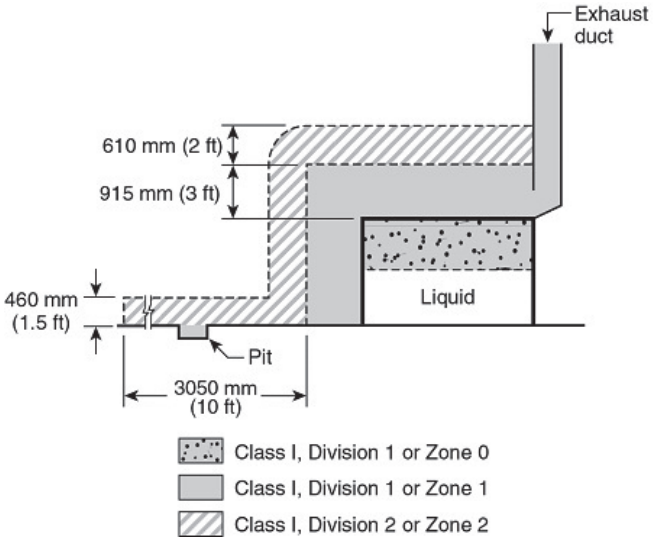
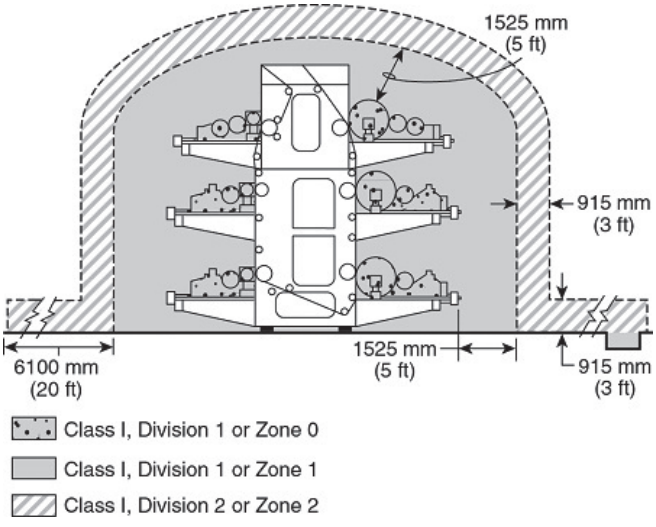


FIGURE 516.29(d) *Electrical Area Classification for a Typical Printing Process. [**34**:Figure 6.4(d)]*



516.36 Equipment and Containers in Ventilated Areas. Open containers, supply containers, waste containers, and solvent distillation units that contain Class I liquids shall be located in areas ventilated in accordance with **516.4**.

516.37 Luminaires. For printing, coating, and dipping equipment where the process area is enclosed by glass panels that are sealed to confine vapors and mists to the inside of the enclosure, luminaires that are attached to the walls or ceilings of a process enclosure and that are located outside of any classified area shall be permitted to be of general purpose construction. Such luminaires shall be serviced from outside the enclosure.

Luminaires that are attached to the walls or ceilings of a process enclosure, are located within the Class I, Division 2 or Class I, Zone 2 location, and are separated from the process area by glass panels that are sealed to confine vapors and mists shall be suitable for use in that location. Such fixtures shall be serviced from outside the enclosure.

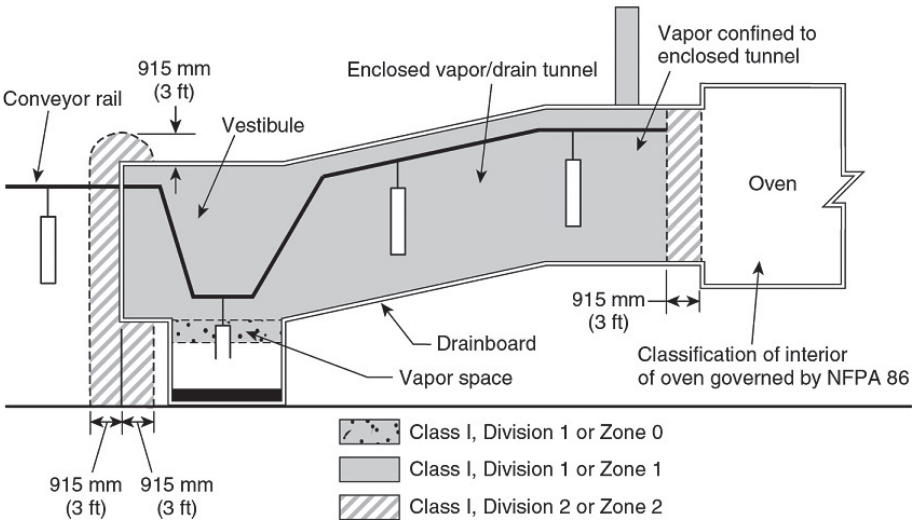
516.38 Wiring and Equipment Not Within Hazardous (Classified) Locations.

516.38(A) Wiring. Fixed wiring above hazardous (classified) locations shall be permitted to be one or more of the following:

(1) Rigid metal conduit (RMC) or intermediate metal conduit (IMC) with listed threaded or threadless fittings, or electrical metallic tubing (EMT) or electrical nonmetallic tubing (Type ENT) with listed fittings.

(2) Rigid polyvinyl chloride conduit (PVC) or reinforced thermosetting resin conduit (RTRC).

FIGURE 516.35 *Electrical Classification Around Enclosed Dipping and Coating Processes. [**34**:Figure 6.5]*



The requirement for RTRC to include the suffix -XW was deleted as it was redundant. The application of RTRC is covered by Article 355, the need for RTRC with the suffix -XW is based on whether it is subject to physical damage as covered by 355.12(C).

(3) Type MC cable or Type TC cable with listed fittings.

(4) Type MI cable terminated with listed fittings and installed and supported to avoid tensile stress.

(5) Cellular metal floor raceways only to supply ceiling outlets or as extensions to the area below the floor of a hazardous (classified) location. If cellular metal raceways are used, they shall not have connections leading into or passing through the hazardous (classified) location unless suitable seals are provided.

This section permits Type PVC Conduit and Type RTRC Conduit. This better defines the types of rigid nonmetallic conduit that is suitable for the application.

516.38(B) Equipment. Equipment that is capable of producing arcs, sparks, or particles of hot metal, such as lamps and lampholders for fixed lighting, cutouts, switches, receptacles, motors, or other equipment having make-and-break or sliding contacts, where installed above a classified location or above a location where freshly finished goods are handled, shall be of the totally enclosed type or be constructed so as to prevent the escape of sparks or hot metal particles.

516.40 Static Electric Discharges. All persons and all electrically conductive objects, including any metal parts of the process equipment or apparatus, containers of material, exhaust ducts, and piping systems that convey flammable or combustible liquids, shall be electrically grounded.

Provision shall be made to dissipate static electric charges from all nonconductive substrates in printing processes.

Informational Note: See NFPA 77,Recommended Practice on Static Electricity, for information on reducing the risk of ignition from electrostatic discharges.

PAINT BUBBLES, DRIPS AND OTHER SURFACE IRREGULARITIES ARE VIRTUALLY ELIMINATED SINCE POWDER, RATHER THAN A LIQUID PAINT, IS APPLIED ELECTROSTATICALLY.

APPENDIX A-1: CLASS I FLAMMABLE GASES AND VAPORS

- Definitions not included in Article 100:
- Autoignition Temperature (AIT). The minimum temperature required to initiate or cause self-sustained combustion of a solid, liquid, or gas independently of the heating or heated element.
- Minimum Ignition Energy (MIE). The minimum energy required from a capacitive spark discharge to ignite the most easily ignitable mixture of a gas or vapor.
- Minimum Igniting Current (MIC) Ratio. The ratio of the minimum current required from an inductive spark discharge to ignite the most easily ignitible mixture of a gas or vapor, divided by the minimum current required from an inductive spark discharge to ignite methane under the same test conditions.
- Maximum Experimental Safe Gap (MESG). The maximum clearance between two parallel metal surfaces that has been found, under specified test conditions, to prevent an explosion in a test chamber from being propagated to a secondary chamber containing the same gas or vapor at the same concentration.
- Ignitible Mixture. A combustible material that is within its flammable range.
- Lower Flammable Limit (LFL). The minimum concentration at which a flammable mixtures in the air can be ignited (causing an explosion). Also called Lower Explosive Limit (LEL).
- Upper Flammable Limit (UFL). The maximum concentration at which a flammable mixtures in the air can be ignited (causing an explosion). Also called Upper Explosive Limit (UEL).

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
Acetaldehyde	75–07–0	C[d]	I	–38	175	4.0	60.0	1.5	874.9	IIA	0.37	0.98	0.92
Acetic Acid	64–19–7	D[d]	II	39	426		19.9	2.1	15.6	IIA		2.67	1.76
Acetic Acidtert-Butyl Ester	540–88–5	D	II			1.7	9.8	4.0	40.6				
Acetic Anhydride	108–24–7	D	II	49	316	2.7	10.3	3.5	4.9	IIA			1.23
Acetone	67–64–1	D[d]	I	–20	465	2.5	12.8	2.0	230.7	IIA	1.15	1.00	1.02
Acetone Cyanohydrin	75–86–5	D	IIIA	74	688	2.2	12.0	2.9	0.3				
Acetonitrile	75–05–8	D	I	6	524	3.0	16.0	1.4	91.1	IIA			1.50
Acetylene	74–86–2	Ad	GAS		305	2.5	100	0.9	36600	IIC	0.017	0.28	0.25
Acrolein (Inhibited)	107–02–8	B(C)[e]	I		235	2.8	31.0	1.9	274.1	IIB	0.13		
Acrylic Acid	79–10–7	D	II	54	438	2.4	8.0	2.5	4.3	IIB			0.86
Acrylonitrile	107–13–1	D[d]	I	0	481	3	17	1.8	108.5	IIB	0.16	0.78	0.87
Adiponitrile	111–69–3	D	IIIA	93	550			1.0	0.002				
Allyl Alcohol	107–18–6	Cd	I	22	378	2.5	18.0	2.0	25.4	IIB			0.84
Allyl Chloride	107–05–1	D	I	–32	485	2.9	11.1	2.6	366	IIA		1.33	1.17
Allyl Glycidyl Ether	106–92–3	B(C)[e]	II		57			3.9					
Alpha-Methyl Styrene	98–83–9	D	II		574	0.8	11.0	4.1	2.7				
n-Amyl Acetate	628–63–7	D	I	25	360	1.1	7.5	4.5	4.2	IIA			1.02
sec-Amyl Acetate	626–38–0	D	I	23		1.1	7.5	4.5		IIA			
Ammonia	7664–41–7	D[d,f]	GAS		651	15	28	0.6	7498.0	IIA	680	6.85	3.17
Aniline	62–53–3	D	IIIA	70	615	1.2	8.3	3.2	0.7	IIA			
Benzene	71–43–2	D[d]	I	–11	498	1.2	7.8	2.8	94.8	IIA	0.20	1.00	0.99
Benzyl Chloride	98–87–3	D	IIIA		585	1.1		4.4	0.5				
Bromopropyne	106–96–7	D	I	10	324	3.0							
n-Butane	106–97–8	Dd,g	GAS		288	1.9	8.5	2.0		IIA	0.25	0.94	1.07
1,3-Butadiene	106–99–0	B(D)[d,e]	GAS		420	2.0	11.5	1.9		IIB	0.13	0.76	0.79
1-Butanol	71–36–3	Dd	I	36	343	1.4	11.2	2.6	7.0	IIA			0.91
Butyl alcohol(s)(butanol-2)	78–92–2	Dd	I	23.8	405	1.7	9.8	2.6		IIA			
Butylamine	109–73–9	D	GAS	–12	312	1.7	9.8	2.5	92.9	IIA		1.13	
Butylene	25167–67–3	D	I		385	1.6	10.0	1.9	2214.6	IIA			0.94
n-Butyraldehyde	123–72–8	Cd	I	–12	218	1.9	12.5	2.5	112.2	IIA			0.92
n-Butyl Acetate	123–86–4	Dd	I	22	421	1.7	7.6	4.0	11.5	IIA		1.08	1.04
sec-Butyl Acetate	105–46–4	D	II	–8		1.7	9.8	4.0	22.2				
tert-Butyl Acetate	540–88–5	D	II			1.7	9.8	4.0	40.6				
n-Butyl Acrylate (Inhibited)	141–32–2	D	II	49	293	1.7	9.9	4.4	5.5	IIB			0.88
n-Butyl Glycidyl Ether	2426–08–6	B(C)[e]	II										
n-Butyl Formal	110–62–3	C	IIIA						34.3				
Butyl Mercaptan	109–79–5	C	I	2				3.1	46.4				
Butyl-2-Propenoate	141–32–2	D	II	49		1.7	9.9	4.4	5.5				
para tert-Butyl Toluene	98–51–1	D	IIIA										

[a] Type is used to designate if the material is a gas, flammable liquid, or combustible liquid. (See *4.2.6* and *4.2.7.*)
[b] Vapor pressure reflected in units of mm Hg at 77°F (25°C) unless stated otherwise.
[c] Class I, Zone Groups are based on IEC 60079-20-1, 1996, Explosive atmospheres — *Part 20-1:Material characteristics for gas and vapor classification — Test methods and data*, which contains additional data on MESG and group classifications.
[d] Material has been classified by test.
[e] Where all conduit runs into explosionproof equipment, the conduit is provided with explosionproof seals installed within 18 in. (450 mm) of the enclosure, equipment for the group classification shown in parentheses is permitted.
[f] For classification of areas involving ammonia, see ASHRAE 15, Safety Standard for Refrigeration Systems, and CGA G2.1, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia.*
[g] Commercial grades of aliphatic hydrocarbon solvents are mixtures of several isomers of the same chemical formula (or molecular weight). The autoignition temperatures (AIT) of the individual isomers are significantly different. The electrical equipment should be suitable for the AIT of the solvent mixture. (See *A.4.4.2.*)
[h] Certain chemicals have characteristics that need safeguards beyond those necessary for any of the above groups. Carbon disulfide is one of these chemicals because of its low autoignition temperature and the small joint clearance necessary to arrest its flame propagation.
[i] Petroleum naphtha is a saturated hydrocarbon mixture whose boiling range is 68°F to 275°F (20°C to 135°C). It is also known as benzine, ligroin, petroleum ether, and naphtha.
[j] Fuel and process gas mixtures found by test not to present hazards similar to those of hydrogen can be grouped based on the test results.
[k] Liquid type and flash point vary due to regional blending differences.

Data is from NFPA 497-2017, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.

APPENDIX A-1: CLASS I FLAMMABLE GASES AND VAPORS

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
n-Butyric Acid	107–92–6	D[d]	IIIA	72	443	2.0	10.0	3.0	0.8				
Carbon Disulfide	75–15–0	[d,h]	I	–30	90	1.3	50.0	2.6	358.8	IIC	0.009	0.39	0.20
Carbon Monoxide	630–08–0	C[d]	GAS		609	12.5	74	0.97		IIB			0.54
Chloroacetaldehyde	107–20–0	C	IIIA	88					63.1				
Chlorobenzene	108–90–7	D	I	29	593	1.3	9.6	3.9	11.9				
1-Chloro-1-Nitropropane	2425–66–3	C	IIIA										
Chloroprene	126–99–8	D	GAS	–20		4.0	20.0	3.0					
Cresol	1319–77–3	D	IIIA	81	559	1.1		3.7					
Crotonaldehyde	4170–30–3	C[d]	I	13	232	2.1	15.5	2.4	33.1	IIB			0.81
Cumene	98–82–8	D	I	36	424	0.9	6.5	4.1	4.6	IIA			1.05
Cyclohexane	110–82–7	D	I	–17	245	1.3	8.0	2.9	98.8	IIA	0.22	1.0	0.94
Cyclohexanol	108–93–0	D	IIIA	68	300			3.5	0.7	IIA			
Cyclohexanone	108–94–1	D	II	44	420	1.1	9.4	3.4	4.3	IIA			0.98
Cyclohexene	110–83–8	D	I	–6	244	1.2		2.8	89.4	IIA		0.97	
Cyclopropane	75–19–4	D[d]	I		503	2.4	10.4	1.5	5430	IIA	0.17	0.84	0.91
p-Cymene	99–87–6	D	II	47	436	0.7	5.6	4.6	1.5	IIA			
Decene	872–05–9	D	II		235			4.8	1.7				
n-Decaldehyde	112–31–2	C	IIIA						0.09				
n-Decanol	112–30–1	D	IIIA	82	288			5.3	0.008				
Decyl Alcohol	112–30–1	D	IIIA	82	288			5.3	0.008				
Diacetone Alcohol	123–42–2	D	IIIA	64	603	1.8	6.9	4.0	1.4				
Di-Isobutylene	25167–70–8	D[d]	I	2	391	0.8	4.8	3.8			0.96		
Di-Isobutyl Ketone	108–83–8	D	II	60	396	0.8	7.1	4.9	1.7				
o-Dichlorobenzene	955–50–1	D	IIIA	66	647	2.2	9.2	5.1		IIA			
1,4-Dichloro-2,3 Epoxybutane	3583–47–9	D[d]	I			1.9	8.5	2.0		IIA	0.25	0.98	1.07
1,1-Dichloroethane	1300–21–6	D	I		438	6.2	16.0	3.4	227	IIA			1.82
1,2-Dichloroethylene	156–59–2	D	I	97	460	5.6	12.8	3.4	204	IIA			3.91
1,1-Dichloro-1-Nitroethane	594–72–9	C	IIIA	76				5.0					
1,3-Dichloropropene	10061–02–6	D	I	35		5.3	14.5	3.8					
Dicyclopentadiene	77–73–6	C	I	32	503				2.8	IIA			0.91
Diethylamine	109–87–9	C[d]	I	–28	312	1.8	10.1	2.5		IIA			1.15
Diethylaminoethanol	100–37–8	C	IIIA	60	320			4.0	1.6	IIA			
Diethyl Benzene	25340–17–4	D	II	57	395			4.6					
Diethyl Ether (Ethyl Ether)	60–29–7	C[d]	I	–45	160	1.9	36	2.6	538	IIB	0.19	0.88	0.83
Diethylene Glycol Monobutyl Ether	112–34–5	C	IIIA	78	228	0.9	24.6	5.6	0.02				
Diethylene Glycol Monomethyl Ether	111–77–3	C	IIIA	93	241				0.2				
n-n-Dimethyl Aniline	121–69–7	C	IIIA	63	371	1.0		4.2	0.7				
Dimethyl Formamide	68–12–2	D	II	58	455	2.2	15.2	2.5	4.1	IIA			1.08
Dimethyl Sulfate	77–78–1	D	IIIA	83	188			4.4	0.7				
Dimethylamine	124–40–3	C	GAS		400	2.8	14.4	1.6		IIA			
2,2-Dimethylbutane	75–83–2	D[g]	I	–48	405				319.3				
2,3-Dimethylbutane	78–29–8	D[g]	I		396								
3,3-Dimethylheptane	1071–26–7	D[g]	I		325				10.8				
2,3-Dimethylhexane	31394–54–4	D[g]	I		438								
2,3-Dimethylpentane	107–83–5	D[g]	I		335				211.7				
Di-N-Propylamine	142–84–7	C	I	17	299				27.1	IIA			0.95
1,4-Dioxane	123–91–1	C[d]	I	12	180	2.0	22.0	3.0	38.2	IIB	0.19		0.70
Dipentene	138–86–3	D	II	45	237	0.7	6.1	4.7		IIA			1.18
Dipropylene Glycol Methyl Ether	34590–94–8	C	IIIA	85		1.1	3.0	5.1	0.5				
Diisopropylamine	108–18–9	C	GAS	–6	316	1.1	7.1	3.5		IIA			1.02

[a] Type is used to designate if the material is a gas, flammable liquid, or combustible liquid. (See *4.2.6* and *4.2.7*.)
[b] Vapor pressure reflected in units of mm Hg at 77°F (25°C) unless stated otherwise.
[c] Class I, Zone Groups are based on IEC 60079-20-1, 1996, Explosive atmospheres — *Part 20-1:Material characteristics for gas and vapor classification — Test methods and data*, which contains additional data on MESG and group classifications.
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[g] Commercial grades of aliphatic hydrocarbon solvents are mixtures of several isomers of the same chemical formula (or molecular weight). The autoignition temperatures (AIT) of the individual isomers are significantly different. The electrical equipment should be suitable for the AIT of the solvent mixture. (See *A.4.4.2*.)
[h] Certain chemicals have characteristics that need safeguards beyond those necessary for any of the above groups. Carbon disulfide is one of these chemicals because of its low autoignition temperature and the small joint clearance necessary to arrest its flame propagation.
[i] Petroleum naphtha is a saturated hydrocarbon mixture whose boiling range is 68°F to 275°F (20°C to 135°C). It is also known as benzine, ligroin, petroleum ether, and naphtha.
[j] Fuel and process gas mixtures found by test not to present hazards similar to those of hydrogen can be grouped based on the test results.
[k] Liquid type and flash point vary due to regional blending differences.

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Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
Dodecene	6842-15-5	D	IIIA	100	255								
Epichlorohydrin	3132-64-7	C[d]	I	33	411	3.8	21.0	3.2	13.0				
Ethane	74-84-0	D[d]	GAS	−135	472	3.0	12.5	1.0		IIA	0.24	0.82	0.91
Ethanol	64-17-5	D[d]	I	13	363	3.3	19.0	1.6	59.5	IIA		0.88	0.89
Ethylamine	75-04-7	D[d]	I	−18	385	3.5	14.0	1.6	1048		2.4		
Ethylene	74-85-1	C[d]	GAS		490	2.7	36.0	1.0		IIB	0.070	0.53	0.65
Ethylenediamine	107-15-3	D[d]	I	33	385	2.5	12.0	2.1	12.5				
Ethylenimine	151-56-4	C[d]	I	−11	320	3.3	54.8	1.5	211		0.48		
Ethylene Chlorohydrin	107-07-3	D	IIIA	59	425	4.9	15.9	2.8	7.2				
Ethylene Dichloride	107-06-2	D[d]	I	13	413	6.2	16.0	3.4	79.7				
Ethylene Glycol Monoethyl Ether Acetate	111-15-9	C	II	47	379	1.7		4.7	2.3	IIA		0.53	0.97
Ethylene Glycol Monobutyl Ether Acetate	112-07-2	C	IIIA		340	0.9	8.5		0.9				
Ethylene Glycol Monobutyl Ether	111-76-2	C	IIIA		238	1.1	12.7	4.1	1.0				
Ethylene Glycol Monoethyl Ether	110-80-5	C	II		235	1.7	15.6	3.0	5.4				0.84
Ethylene Glycol Monomethyl Ether	109-86-4	D	II		285	1.8	14.0	2.6	9.2				0.85
Ethylene Oxide	75-21-8	B(C)[d,e]	I	−20	429	3	100	1.5	1314	IIB	0.065	0.47	0.59
2-Ethylhexaldehyde	123-05-7	C	II	52	191	0.8	7.2	4.4	1.9				
2-Ethylhexanol	104-76-7	D	IIIA	81		0.9	9.7	4.5	0.2				
2-Ethylhexyl Acrylate	103-09-3	D	IIIA	88	252				0.3				
Ethyl Acetate	141-78-6	D[d]	I	−4	427	2.0	11.5	3.0	93.2	IIA	0.46		0.99
Ethyl Acrylate (Inhibited)	140-88-5	D[d]	I	9	372	1.4	14.0	3.5	37.5	IIA			0.86
Ethyl Alcohol	64-17-5	D[d]	I	13	363	3.3	19.0	1.6	59.5	IIA		0.88	0.89
Ethyl Sec-Amyl Ketone	541-85-5	D	II	59									
Ethyl Benzene	100-41-4	D	I	15	432	0.8	6.7	3.7	9.6				
Ethyl Butanol	97-95-0	D	II	57		1.2	7.7	3.5	1.5				
Ethyl Butyl Ketone	106-35-4	D	II	46				4.0	3.6				
Ethyl Chloride	75-00-3	D	GAS	−50	519	3.8	15.4	2.2					
Ethyl Formate	109-94-4	D	GAS	−20	455	2.8	16.0	2.6		IIA			0.94
Ethyl Mercaptan	75-08-1	C[d]	I	−18	300	2.8	18.0	2.1	527.4	IIB		0.90	0.90
n-Ethyl Morpholine	100-74-3	C	I	32				4.0					
2-Ethyl-3-Propyl Acrolein	645-62-5	C	IIIA	68				4.4					
Ethyl Silicate	78-10-4	D	II					7.2					
Formaldehyde (Gas)	50-00-0	B	GAS		430	7	73	1.0		IIB			0.57
Formic Acid	64-18-6	D	II	50	434	18.0	57.0	1.6	42.7	IIA			1.86
Fuel Oil 1	8008-20-6	D	II or IIIAk	38–72k	210	0.7	5.0						
Fuel Oil 2			II or IIIAk	52–96k	257								
Fuel Oil 6			IIIA or IIIBk	66–132k									
Furfural	98-01-1	C	IIIA	60	316	2.1	19.3	3.3	2.3				0.94
Furfuryl Alcohol	98-00-0	C	IIIA	75	490	1.8	16.3	3.4	0.6				
Gasoline	8006-61-9	D[d]	I	−46	280	1.4	7.6	3.0					
n-Heptane	142-82-5	D[d]	I	−4	204	1.0	6.7	3.5	45.5	IIA	0.24	0.88	0.91
n-Heptene	81624-04-6	D[g]	I	−1	204			3.4					0.97
n-Hexane	110-54-3	D[d,g]	I	−23	225	1.1	7.5	3.0	152	IIA	0.24	0.88	0.93
Hexanol	111-27-3	D	IIIA	63				3.5	0.8	IIA			0.98
2-Hexanone	591-78-6	D	I	35	424	1.2	8.0	3.5	10.6				
Hexene	592-41-6	D	I	−26	245	1.2	6.9		186				
sec-Hexyl Acetate	108-84-9	D	II	45				5.0					
Hydrazine	302-01-2	C	II	38	23		98.0	1.1	14.4				
Hydrogen	1333-74-0	B[d]	GAS		500	4	75	0.1		IIC	0.019	0.25	0.28
Hydrogen Cyanide	74-90-8	C[d]	GAS	−18	538	5.6	40.0	0.9		IIB			0.80

[a] Type is used to designate if the material is a gas, flammable liquid, or combustible liquid. (See *4.2.6* and *4.2.7.*)
[b] Vapor pressure reflected in units of mm Hg at 77°F (25°C) unless stated otherwise.
[c] Class I, Zone Groups are based on IEC 60079-20-1, 1996, Explosive atmospheres — *Part 20-1:Material characteristics for gas and vapor classification — Test methods and data*, which contains additional data on MESG and group classifications.
[d] Material has been classified by test.
[e] Where all conduit runs into explosionproof equipment, the conduit is provided with explosionproof seals installed within 18 in. (450 mm) of the enclosure, equipment for the group classification shown in parentheses is permitted.
[f] For classification of areas involving ammonia, see ASHRAE 15, Safety Standard for Refrigeration Systems, and CGA G2.1, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia.*
[g] Commercial grades of aliphatic hydrocarbon solvents are mixtures of several isomers of the same chemical formula (or molecular weight). The autoignition temperatures (AIT) of the individual isomers are significantly different. The electrical equipment should be suitable for the AIT of the solvent mixture. (See *A.4.4.2.*)
[h] Certain chemicals have characteristics that need safeguards beyond those necessary for any of the above groups. Carbon disulfide is one of these chemicals because of its low autoignition temperature and the small joint clearance necessary to arrest its flame propagation.
[i] Petroleum naphtha is a saturated hydrocarbon mixture whose boiling range is 68°F to 275°F (20°C to 135°C). It is also known as benzine, ligroin, petroleum ether, and naphtha.
[j] Fuel and process gas mixtures found by test not to present hazards similar to those of hydrogen can be grouped based on the test results.
[k] Liquid type and flash point vary due to regional blending differences.

Data is from NFPA 497-2017, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.

APPENDIX A-1: CLASS I FLAMMABLE GASES AND VAPORS

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
Hydrogen Selenide	7783-07-5	C	I						7793				
Hydrogen Sulfide	7783-06-4	C[d]	GAS		260	4.0	44.0	1.2		IIB	0.068		0.90
Isoamyl Acetate	123-92-2	D	I	25	360	1.0	7.5	4.5	6.1				
Isoamyl Alcohol	123-51-3	D	II	43	350	1.2	9.0	3.0	3.2	IIA			1.02
Isobutane	75-28-5	D[g]	GAS		460	1.8	8.4	2.0		IIA			0.95
Isobutyl Acetate	110-19-0	D[d]	I	18	421	2.4	10.5	4.0	17.8				
Isobutyl Acrylate	106-63-8	D	I		427			4.4	7.1				
Isobutyl Alcohol	78-83-1	D[d]	I	-40	416	1.2	10.9	2.5	10.5	IIA		0.92	0.98
Isobutyraldehyde	78-84-2	C	GAS	-40	196	1.6	10.6	2.5		IIA			0.92
Isodecaldehyde	112-31-2	C	IIIA					5.4	0.09				
Isohexane	107-83-5	D[g]			264				211.7	IIA		1.00	
Isopentane	78-78-4	D[g]			420				688.6				
Isooctyl Aldehyde	123-05-7	C	II		197				1.9				
Isophorone	78-59-1	D		84	460	0.8	3.8	4.8	0.4				
Isoprene	78-79-5	D[d]	I	-54	220	1.5	8.9	2.4	550.6				
Isopropyl Acetate	108-21-4	D	I		460	1.8	8.0	3.5	60.4				
Isopropyl Ether	108-20-3	D[d]	I	-28	443	1.4	7.9	3.5	148.7	IIA	1.14		0.94
Isopropyl Glycidyl Ether	4016-14-2	C	I										
Isopropylamine	75-31-0	D	GAS	-26	402	2.3	10.4	2.0			2.0		
Kerosene	8008-20-6	D	II	72	210	0.7	5.0			IIA			
Liquefied Petroleum Gas	68476-8-7	D	I		405								
Mesityl Oxide	141-97-9	D[d]	I	31	344	1.4	7.2	3.4	47.6				
Methane	74-82-8	D[d]	GAS		600	5	15	0.6		IIA	0.28	1.00	1.12
Methanol	67-56-1	D[d]	I	12	385	6.0	36.0	1.1	126.3	IIA	0.14	0.82	0.92
Methyl Acetate	79-20-9	D	GAS	-10	454	3.1	16.0	2.6		IIA		1.08	0.99
Methyl Acrylate	96-33-3	D	GAS	-3	468	2.8	25.0	3.0		IIB		0.98	0.85
Methyl Alcohol	67-56-1	D[d]	I		385	6.0	36	1.1	126.3	IIA			0.91
Methyl Amyl Alcohol	108-11-2	D	II	41		1.0	5.5	3.5	5.3	IIA			1.01
Methyl Chloride	74-87-3	D	GAS	-46	632	8.1	17.4	1.7		IIA			1.00
Methyl Ether	115-10-6	C[d]	GAS	-41	350	3.4	27.0	1.6		IIB		0.85	0.84
Methyl Ethyl Ketone	78-93-3	D[d]	I	-6	404	1.4	11.4	2.5	92.4	IIB	0.53	0.92	0.84
Methyl Formal	534-15-6	C[d]	I	1	238			3.1					
Methyl Formate	107-31-3	D	GAS	-19	449	4.5	23.0	2.1		IIA			0.94
2-Methylhexane	31394-54-4	D[g]	I		280								
Methyl Isobutyl Ketone	108-10-1	D[d]	I	13	440	1.2	8.0	3.5	11				
Methyl Isocyanate	624-83-9	D	GAS	-15	534	5.3	26.0	2.0		IIA			1.21
Methyl Mercaptan	74-93-1	C	GAS	-18		3.9	21.8	1.7					
Methyl Methacrylate	80-62-6	D	I	10	422	1.7	8.2	3.6	37.2	IIA			0.95
Methyl N-Amyl Ketone	110-43-0	D	II	49	393	1.1	7.9	3.9	3.8				
Methyl Tertiary Butyl Ether	1634-04-4	D	I	-80	435	1.6	8.4	0.2	250.1				
2-Methyloctane	3221-61-2				220				6.3				
2-Methylpropane	75-28-5	D[g]	I		460				2639				
Methyl-1-Propanol	78-83-1	D[d]	I	-40	416	1.2	10.9	2.5	10.1	IIA			0.98
Methyl-2-Propanol	75-65-0	D[d]	I	10	360	2.4	8.0	2.6	42.2				
2-Methyl-5-Ethyl Pyridine	104-90-5	D		74		1.1	6.6	4.2					
Methylacetylene	74-99-7	C[d]	I			1.7		1.4	4306		0.11		
Methylacetylene- Propadiene	27846-30-6	C	I							IIB			0.74
Methylal	109-87-5	C	I	-18	237	1.6	17.6	2.6	398				
Methylamine	74-89-5	D	GAS		430	4.9	20.7	1.0		IIA			1.10
2-Methylbutane	78-78-4	D[g]		-56	420	1.4	8.3	2.6	688.6				

[a] Type is used to designate if the material is a gas, flammable liquid, or combustible liquid. (See 4.2.6 and 4.2.7.)
[b] Vapor pressure reflected in units of mm Hg at 77°F (25°C) unless stated otherwise.
[c] Class I, Zone Groups are based on IEC 60079-20-1, 1996, Explosive atmospheres — *Part 20-1:Material characteristics for gas and vapor classification — Test methods and data*, which contains additional data on MESG and group classifications.
[d] Material has been classified by test.
[e] Where all conduit runs into explosionproof equipment, the conduit is provided with explosionproof seals installed within 18 in. (450 mm) of the enclosure, equipment for the group classification shown in parentheses is permitted.
[f] For classification of areas involving ammonia, see ASHRAE 15, Safety Standard for Refrigeration Systems, and CGA G2.1, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*.
[g] Commercial grades of aliphatic hydrocarbon solvents are mixtures of several isomers of the same chemical formula (or molecular weight). The autoignition temperatures (AIT) of the individual isomers are significantly different. The electrical equipment should be suitable for the AIT of the solvent mixture. (See *A.4.4.2.*)
[h] Certain chemicals have characteristics that need safeguards beyond those necessary for any of the above groups. Carbon disulfide is one of these chemicals because of its low autoignition temperature and the small joint clearance necessary to arrest its flame propagation.
[i] Petroleum naphtha is a saturated hydrocarbon mixture whose boiling range is 68°F to 275°F (20°C to 135°C). It is also known as benzine, ligroin, petroleum ether, and naphtha.
[j] Fuel and process gas mixtures found by test not to present hazards similar to those of hydrogen can be grouped based on the test results.
[k] Liquid type and flash point vary due to regional blending differences.

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APPENDIX A-1: CLASS I FLAMMABLE GASES AND VAPORS

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
Methylcyclohexane	208-87-2	D	I	−4	250	1.2	6.7	3.4			0.27		
Methylcyclohexanol	25630-42-3	D		68	296			3.9					
2-Methycyclohexanone	583-60-8	D	II					3.9					
2-Methylheptane		D[g]			420								
3-Methylhexane	589-34-4	D[g]			280				61.5				
3-Methylpentane	94-14-0	D[g]			278								
2-Methylpropane	75-28-5	D[g]	I		460				2639				
2-Methyl-1-Propanol	78-83-1	D[d]	I	−40	223	1.2	10.9	2.5	10.5				
2-Methyl-2-Propanol	75-65-0	D[d]	I		478	2.4	8.0	2.6	42.2				
2-Methyloctane	2216-32-2	D[g]			220								
3-Methyloctane	2216-33-3	D[g]			220				6.3				
4-Methyloctane	2216-34-4	D[g]			225				6.8				
Monoethanolamine	141-43-5	D		85	410			2.1	0.4	IIA			
Monoisopropanolamine	78-96-6	D		77	374			2.6	1.1				
Monomethyl Aniline	100-61-8	C			482				0.5				
Monomethyl Hydrazine	60-34-4	C	I	23	194	2.5	92.0	1.6					
Morpholine	110-91-8	C[d]	II	35	310	1.4	11.2	3.0	10.1	IIA			0.95
Naphtha (Coal Tar)	8030-30-6	D	II	42	277					IIA			
Naphtha (Petroleum)	8030-30-6	D[d,i]	I	42	288	1.1	5.9	2.5		IIA			
Neopentane	463-82-1	D[g]		−65	450	1.4	8.3	2.6	1286				
Nitrobenzene	98-95-3	D		88	482	1.8		4.3	0.3	IIA			0.94
Nitroethane	79-24-3	C	I	28	414	3.4		2.6	20.7	IIB			0.87
Nitromethane	75-52-5	C	I	35	418	7.3		2.1	36.1	IIA		0.92	1.17
1-Nitropropane	108-03-2	C	I	34	421	2.2		3.1	10.1	IIB			0.84
2-Nitropropane	79-46-9	C[d]	I	28	428	2.6	11.0	3.1	17.1				
n-Nonane	111-84-2	D[g]	I	31	205	0.8	2.9	4.4	4.4	IIA			
Nonene	27214-95-8	D	I			0.8		4.4					
Nonyl Alcohol	143-08-8	D				0.8	6.1	5.0	0.02	IIA			
n-Octane	111-65-9	D[d,g]	I	13	206	1.0	6.5	3.9	14.0	IIA			0.94
Octene	25377-83-7	D	I	8	230	0.9		3.9					
n-Octyl Alcohol	111-87-5	D						4.5	0.08	IIA			1.05
n-Pentane	109-66-0	D[d,g]	I	−40	243	1.5	7.8	2.5	513	IIA	0.28	0.97	0.93
1-Pentanol	71-41-0	D[d]	I	33	300	1.2	10.0	3.0	2.5	IIA			1.30
2-Pentanone	107-87-9	D	I	7	452	1.5	8.2	3.0	35.6	IIA			0.99
1-Pentene	109-67-1	D	I	−18	275	1.5	8.7	2.4	639.7				
2-Pentene	109-68-2	D	I	−18				2.4					
2-Pentyl Acetate	626-38-0	D	I	23		1.1	7.5	4.5					
Phenylhydrazine	100-63-0	D		89				3.7	0.03				
Process Gas > 30% H_2		B[j]	GAS		520	4.0	75.0	0.1			0.019	0.45	
Propane	74-98-6	D[d]	GAS		450	2.1	9.5	1.6		IIA	0.25	0.82	0.97
1-Propanol	71-23-8	D[d]	I	15	413	2.2	13.7	2.1	20.7	IIA			0.89
2-Propanol	67-63-0	D[d]	I	12	399	2.0	12.7	2.1	45.4	IIA	0.65		1.00
Propiolactone	57-57-8	D				2.9		2.5	2.2				
Propionaldehyde	123-38-6	C	I	−9	207	2.6	17.0	2.0	318.5	IIB			0.86
Propionic Acid	79-09-4	D	II	54	466	2.9	12.1	2.5	3.7	IIA			1.10
Propionic Anhydride	123-62-6	D		74	285	1.3	9.5	4.5	1.4				
n-Propyl Acetate	109-60-4	D	I	14	450	1.7	8.0	3.5	33.4	IIA			1.05
n-Propyl Ether	111-43-3	C[d]	I	21	215	1.3	7.0	3.5	62.3				
Propyl Nitrate	627-13-4	B[d]	I	20	175	2.0	100.0						
Propylene	115-07-1	D[d]	GAS		460	2.4	10.3	1.5		IIA	0.28		0.91

[a] Type is used to designate if the material is a gas, flammable liquid, or combustible liquid. (See *4.2.6* and *4.2.7.*)
[b] Vapor pressure reflected in units of mm Hg at 77°F (25°C) unless stated otherwise.
[c] Class I, Zone Groups are based on IEC 60079-20-1, 1996, Explosive atmospheres — *Part 20-1:Material characteristics for gas and vapor classification — Test methods and data*, which contains additional data on MESG and group classifications.
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[g] Commercial grades of aliphatic hydrocarbon solvents are mixtures of several isomers of the same chemical formula (or molecular weight). The autoignition temperatures (AIT) of the individual isomers are significantly different. The electrical equipment should be suitable for the AIT of the solvent mixture. (See *A.4.4.2.*)
[h] Certain chemicals have characteristics that need safeguards beyond those necessary for any of the above groups. Carbon disulfide is one of these chemicals because of its low autoignition temperature and the small joint clearance necessary to arrest its flame propagation.
[i] Petroleum naphtha is a saturated hydrocarbon mixture whose boiling range is 68°F to 275°F (20°C to 135°C). It is also known as benzine, ligroin, petroleum ether, and naphtha.
[j] Fuel and process gas mixtures found by test not to present hazards similar to those of hydrogen can be grouped based on the test results.
[k] Liquid type and flash point vary due to regional blending differences.

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APPENDIX A-1: CLASS I FLAMMABLE GASES AND VAPORS

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
Propylene Dichloride	78-87-5	D	I	16	557	3.4	14.5	3.9	51.7	IIA			1.32
Propylene Oxide	75-56-9	B[(C)d,e]	I	-37	449	2.3	36.0	2.0	534.4	IIB	0.13		0.70
Pyridine	110-86-1	D[d]	I	20	482	1.8	12.4	2.7	20.8	IIA			
Styrene	100-42-5	D[d]	I	31	490	0.9	6.8	3.6	6.1	IIA		1.21	
Tetrahydrofuran	109-99-9	C[d]	I	-14	321	2.0	11.8	2.5	161.6	IIB	0.54		0.87
Tetrahydronaphthalene	119-64-2	D	IIIA		385	0.8	5.0	4.6	0.4				
Tetramethyl Lead	75-74-1	C	II	38				9.2					
Toluene	108-88-3	D[d]	I	4	480	1.1	7.1	3.1	28.53	IIA	0.24		
n-Tridecene	2437-56-1	D	IIIA			0.6		6.4	593.4				
Triethylamine	121-44-8	C[d]	I	-9	249	1.2	8.0	3.5	68.5	IIA	0.75		1.05
Triethylbenzene	25340-18-5	D		83			56.0	5.6					
2,2,3-Trimethylbutane		D[g]			442								
2,2,4-Trimethylbutane		D[g]			407								
2,2,3-Trimethylpentane		D[g]			396								
2,2,4-Trimethylpentane		D[g]			415					IIA			1.04
2,3,3-Trimethylpentane		D[g]			425								
Tripropylamine	102-69-2	D	II	41				4.9	1.5	IIA			1.13
Turpentine	8006-64-2	D	I	35	253	0.8			4.8				
n-Undecene	28761-27-5	D	IIIA			0.7		5.5					
Unsymmetrical Dimethyl Hydrazine	57-14-7	C[d]	I	-15	249	2.0	95.0	1.9		IIB			0.85
Valeraldehyde	110-62-3	C	I	280	222			3.0	34.3				
Vinyl Acetate	108-05-4	D[d]	I	-6	402	2.6	13.4	3.0	113.4	IIA	0.70		0.94
Vinyl Chloride	75-01-4	D[d]	GAS	-78	472	3.6	33.0	2.2		IIA			0.96
Vinyl Toluene	25013-15-4	D		52	494	0.8	11.0	4.1					
Vinylidene Chloride	75-35-4	D	I		570	6.5	15.5	3.4	599.4	IIA			3.91
Xylene	1330-20-7	D[d]	I	25	464	0.9	7.0	3.7		IIA	0.2		1.09
Xylidine	121-69-7	C	IIIA	63	371	1.0		4.2	0.7				

[a] Type is used to designate if the material is a gas, flammable liquid, or combustible liquid. (See 4.2.6 and 4.2.7.)
[b] Vapor pressure reflected in units of mm Hg at 77°F (25°C) unless stated otherwise.
[c] Class I, Zone Groups are based on IEC 60079-20-1, 1996, Explosive atmospheres — *Part 20-1:Material characteristics for gas and vapor classification — Test methods and data*, which contains additional data on MESG and group classifications.
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[g] Commercial grades of aliphatic hydrocarbon solvents are mixtures of several isomers of the same chemical formula (or molecular weight). The autoignition temperatures (AIT) of the individual isomers are significantly different. The electrical equipment should be suitable for the AIT of the solvent mixture. (See *A.4.4.2.*)
[h] Certain chemicals have characteristics that need safeguards beyond those necessary for any of the above groups. Carbon disulfide is one of these chemicals because of its low autoignition temperature and the small joint clearance necessary to arrest its flame propagation.
[i] Petroleum naphtha is a saturated hydrocarbon mixture whose boiling range is 68°F to 275°F (20°C to 135°C). It is also known as benzine, ligroin, petroleum ether, and naphtha.
[j] Fuel and process gas mixtures found by test not to present hazards similar to those of hydrogen can be grouped based on the test results.
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Data is from NFPA 497-2017, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.

APPENDIX A-2: CLASS II COMBUSTIBLE DUSTS

Notes: *(General) NFPA 499-2017 has classified 25 Group E, 10 Group F and 185 Group G combustible dusts. The tables shown below, does not include all dusts that may be encountered in business and industry. Some dusts were not classified because they have explosive characteristics that require safeguards that go beyond those required for combustible dusts classified by NEC®. On the other hand, other dusts were not classified because they do not represent a significant hazard, that is, they are not combustible. However, any combustible dust not included in these tables (such as thorium hydride and uranium) should be investigated by a qualified testing laboratory (see NFPA "Fire Protection Handbook," for additional dusts not classified by NEC®. Even such pesticide combustible dusts as Ferbam, Manganese Vancide and Sevin classified above, which have ignition temperatures below that which would be safe within the operating temperature ranges presented in Section 500.8(C) and Table 500.8(C)(2), may present serious problems. Also, caution is advised with combustible dusts that melt or sublime below the operating temperature of the electrical equipment (see footnotes 3 and 4 above).*

(1) Normally, the minimum ignition temperature of a layer of a specific dust is lower than the minimum ignition temperature of a cloud of that dust. Because this is not universally true, the lower of the two minimum ignition temperatures is listed. If no symbol appears in the "Code" column, then the layer ignition temperature is shown. "CL" means the cloud ignition temperature is shown. "NL" means that no layer ignition temperature is available, and the cloud ignition temperature is shown. "M" signifies that the dust layer melts before it ignites; the cloud ignition temperature is shown. "S" signifies that the dust layer sublimes before it ignites; the cloud ignition temperature is shown.

(2) Certain metal dusts might have characteristics that necessitate safeguards beyond those needed for atmospheres containing the dusts of aluminum, magnesium, and their commercial alloys. For example, zirconium and thorium dusts can ignite spontaneously in air, especially at elevated temperatures.

(3) Combustible metal fibers/flyings, as defined in 3.3.4.1, are Group E/IIIC materials.

(4) Due to the impurities found in coal, its ignition temperatures vary regionally, and ignition temperatures are not available for all regions in which coal is mined.

Chemical Name	CAS No.	Division Group/ Zone Group	Code	Layer or Cloud Ignition Temperature °C
Acetal, linear		G/IIIB	NL	440
Acetoacet-p-phenetidide	122-82-7	G//IIIB	NL	560
Acetoacetanilide	102-01-2	G//IIIB	M	440
Acetylamino-t-nitrothiazole		G//IIIB	450	
Acrylamide polymer		G/IIIB	240	
Acrylonitrile polymer		G//IIIB	460	
Acrylonitrile-vinyl chloride-vinylidenechloride copolymer (70-20-10)		G//IIIB	210	
Acrylonitrile-vinyl pyridine copolymer		G//IIIB	240	
Adipic acid	124-04-9	G//IIIB	M	550
Alfalfa meal		G//IIIB	200	
Alkyl ketone dimer sizing compound		G//IIIB	160	
Allyl alcohol derivative (CR-39)		G//IIIB	NL	500
Almond shell		G//IIIB	200	
Aluminum, A422 flake	7429-90-5	E/IIIC	320	
Aluminum, atomized collector fines		E/IIIC	CL	550
Aluminum—cobalt alloy (60-40)		E/IIIC	570	
Aluminum—copper alloy (50-50)		E/IIIC	830	
Aluminum—lithium alloy (15% Li)		E/IIIC	400	
Aluminum—magnesium alloy (dowmetal)		E/IIIC	CL	430
Aluminum—nickel alloy (58-42)		E/IIIC	540	
Aluminum—silicon alloy (12% Si)		E/IIIC	NL	670
Amino-5-nitrothiazole 121-66-4		G/IIIB	460	
Anthranilic acid	118-92-3	G/IIIB	M	580
Apricot pit		G/IIIB	230	
Aryl-nitrosomethylamide		G/IIIB	NL	490
Asphalt	8052-42-4	F/IIIB	510	
Aspirin [acetol (2)]	50-78-2	G/IIIB	M	660
Azelaic acid	109-31-9	G/IIIB	M	610
Azo-bis-butyronitrile	78-67-1	G/IIIB	350	
Benzethonium chloride		G/IIIB	CL	380
Benzoic acid	65-85-0	G/IIIB	M	620
Benzotriazole	95-14-7	G/IIIB	M	440
Beta-naphthalene-axo-dimethylaniline		G/IIIB	175	
Bis (2-hydroxy-5-chlorophenyl) methane	97-23-4	G/IIIB	NL	570
Bisphenol-A	80-05-7	G/IIIB	M	570
Boron, commercial amorphous (85% B)	7440-42-8	E/IIIC	400	
Calcium silicide		E/IIIC	540	
Carbon black (more than 8% total entrapped volatiles)		F/IIIB		
Carboxymethyl cellulose	9000-11-7	G/IIIB	290	
Carboxypolymethylene		G/IIIB	NL	520
Cashew oil, phenolic, hard		G/IIIB	180	
Cellulose		G/IIIB	260	
Cellulose acetate		G/IIIB	340	
Cellulose acetate butyrate		G/IIIB	NL	370
Cellulose triacetate		G/IIIB	NL	430
Charcoal (activated)	64365-11-3	F/IIIB	180	
Charcoal (more than 8% total entrapped volatiles)		F/IIIB		
Cherry pit		G/IIIB	220	
Chlorinated phenol		G/IIIB	NL	570
Chlorinated polyether alcohol		G/IIIB	460	
Chloroacetoacetanilide	101-92-8	G/IIIB	M	640

APPENDIX A-2: CLASS II COMBUSTIBLE DUSTS

Chemical Name	CAS No.	Division Group/ Zone Group	Code	Layer or Cloud Ignition Temperature °C
Chromium (97%) electrolytic, milled	7440-47-3	E/IIIC	400	
Cinnamon		G/IIIB	230	
Citrus peel		G/IIIB	270	
Coal, Kentucky bituminous		F/IIIB	180	
Coal, Pittsburgh experimental		F/IIIB	170	
Coal, Wyoming		F/IIIB	180	
Cocoa bean shell		G/IIIB	370	
Cocoa, natural, 19% fat		G/IIIB	240	
Coconut shell		G/IIIB	220	
Coke (more than 8% total entrapped volatiles)		F/IIIB		
Cork		G/IIIB	210	
Corn		G/IIIB	250	
Corn dextrine		G/IIIB	370	
Corncob grit		G/IIIB	240	
Cornstarch, commercial		G/IIIB	330	
Cornstarch, modified		G/IIIB	200	
Cottonseed meal		G/IIIB	200	
Coumarone-indene, hard		G/IIIB	NL	520
Crag No. 974	533-74-4	G/IIIB	CL	310
Cube root, South America	83-79-4	G/IIIB	230	
Di-alphacumyl peroxide, 40-60 on CA	80-43-3	G/IIIB	180	
Diallyl phthalate	131-17-9	G/IIIB	M	480
Dicyclopentadiene dioxide		G/IIIB	NL	420
Dieldrin (20%)	60-57-1	G/IIIB	NL	550
Dihydroacetic acid		G/IIIB	NL	430
Dimethyl isophthalate	1459-93-4	G/IIIB	M	580
Dimethyl terephthalate	120-61-6	G/IIIB	M	570
Dinitro-o-toluamide	148-01-6	G/IIIB	NL	500
Dinitrobenzoic	acid	G/IIIB	NL	460
Diphenyl	92-52-4	G/IIIB	M	630
Ditertiary-butyl-paracresol	128-37-0	G/IIIB	NL	420
Dithane m-45	8018-01-7	G/IIIB	180	
Epoxy		G/IIIB	NL	540
Epoxy-bisphenol A		G/IIIB	NL	510
Ethyl cellulose		G/IIIB	CL	320
Ethyl hydroxyethyl cellulose		G/IIIB	NL	390
Ethylene oxide polymer		G/IIIB	NL	350
Ethylene-maleic anhydride copolymer		G/IIIB	NL	540
Ferbam™	14484-64-1	G/IIIB	150	
Ferromanganese, medium carbon	12604-53-4	E/IIIC	290	
Ferrosilicon (88% Si, 9% Fe)	8049-17-0	E/IIIC	800	
Ferrotitanium (19% Ti, 74.1% Fe, 0.06% C)		E/IIIC	CL	380
Flax shive		G/IIIB	230	
Fumaric acid	110-17-8	G/IIIB	M	520
Garlic, dehydrated		G/IIIB	NL	360
Gilsonite	12002-43-6	F/IIIB	500	
Green base harmon dye		G/IIIB	175	
Guar seed		G/IIIB	NL	500
Gulasonic acid, diacetone		G/IIIB	NL	420
Gum, arabic		G/IIIB	260	
Gum, karaya		G/IIIB	240	
Gum, manila		G/IIIB	CL	360
Gum, tragacanth	9000-65-1	G/IIIB	260	
Hemp hurd		G/IIIB	220	
Hexamethylene tetramine	100-97-0	G/IIIB	S	410
Hydroxyethyl cellulose		G/IIIB	NL	410
Iron, 98% H_2 reduced		E/IIIC	290	
Iron, 99% carbonyl	13463-40-6	E/IIIC	310	
Isotoic anhydride		G/IIIB	NL	700
L-sorbose		G/IIIB	M	370
Lignin, hydrolized, wood-type, fine		G/IIIB	NL	450
Lignite, California		F/IIIB	180	
Lycopodium		G/IIIB	190	
Malt barley		G/IIIB	250	

APPENDIX A-2: CLASS II COMBUSTIBLE DUSTS

Chemical Name	CAS No.	Division Group/ Zone Group	Code	Layer or Cloud Ignition Temperature °C
Manganese	7439-96-5	E/IIIC	240	
Magnesium, grade B, milled		E/IIIC	430	
Manganese vancide		G/IIIB	120	
Mannitol	69-65-8	G/IIIB	M	460
Methacrylic acid polymer		G/IIIB	290	
Methionine (l-methionine)	63-68-3	G/IIIB	360	
Methyl cellulose		G/IIIB	340	
Methyl methacrylate polymer	9011-14-7	G/IIIB	NL	440
Methyl methacrylate-ethyl acrylate		G/IIIB	NL	440
Methyl methacrylate-styrene-butadiene		G/IIIB	NL	480
Milk, skimmed		G/IIIB	200	
N,N-dimethylthio-formamide		G/IIIB	230	
Nitropyridone	100703-82-0	G/IIIB	M	430
Nitrosamine		G/IIIB	NL	270
Nylon polymer	63428-84-2	G/IIIB	430	
Para-oxy-benzaldehyde	123-08-0	G/IIIB	CL	380
Paraphenylene diamine	106-50-3	G/IIIB	M	620
Paratertiary butyl benzoic acid	98-73-7	G/IIIB	M	560
Pea flour		G/IIIB	260	
Peach pit shell		G/IIIB	210	
Peanut hull		G/IIIB	210	
Peat, sphagnum	94114-14-4	G/IIIB	240	
Pecan nut shell	8002-03-7	G/IIIB	210	
Pectin	5328-37-0	G/IIIB	200	
Pentaerythritol	115-77-5	G/IIIB	M	400
Petrin acrylate monomer	7659-34-9	G/IIIB	NL	220
Petroleum coke (more than 8% total entrapped volatiles)		F/IIIB		
Petroleum resin	64742-16-1	G/IIIB	500	
Phenol formaldehyde	9003-35-4	G/IIIB	NL	580
Phenol formaldehyde, polyalkylene-p	9003-35-4	G/IIIB	290	
Phenol furfural	26338-61-4	G/IIIB	310	
Phenylbetanaphthylamine	135-88-6	G/IIIB	NL	680
Phthalic anydride	85-44-9	G/IIIB	M	650
Phthalimide	85-41-6	G/IIIB	M	630
Pitch, coal tar	65996-93-2	F/IIIB	NL	710
Pitch, petroleum	68187-58-6	F/IIIB	NL	630
Polycarbonate		G/IIIB	NL	710
Polyethylene, high pressure process	9002-88-4	G/IIIB	380	
Polyethylene, low pressure process	9002-88-4	G/IIIB	NL	420
Polyethylene terephthalate	25038-59-9	G/IIIB	NL	500
Polyethylene wax	68441-04-8	G/IIIB	NL	400
Polypropylene (no antioxidant)	9003-07-0	G/IIIB	NL	420
Polystyrene latex	9003-53-6	G/IIIB	500	
Polystyrene molding compound	9003-53-6	G/IIIB	NL	560
Polyurethane foam, fire retardant	9009-54-5	G/IIIB	390	
Polyurethane foam, no fire retardant	9009-54-5	G/IIIB	440	
Polyvinyl acetate	9003-20-7	G/IIIB	NL	550
Polyvinyl acetate/alcohol	9002-89-5	G/IIIB	440	
Polyvinyl butyral	63148-65-2	G/IIIB	390	
Polyvinyl chloride-dioctyl phthalate		G/IIIB	NL	320
Potato starch, dextrinated	9005-25-8	G/IIIB	NL	440
Pyrethrum	8003-34-7	G/IIIB	210	
Rayon (viscose) flock	61788-77-0	G/IIIB	250	
Red dye intermediate		G/IIIB	175	
Rice		G/IIIB	220	
Rice bran		G/IIIB	NL	490
Rice hull		G/IIIB	220	
Rosin, DK	8050-09-7	G/IIIB	NL	390
Rubber, crude, hard	9006-04-6	G/IIIB	NL	350
Rubber, synthetic, hard (33% S)	64706-29-2	G/IIIB	NL	320
Safflower meal		G/IIIB	210	
Salicylanilide	87-17-2	G/IIIB	M	610
Sevin	63-25-2	G/IIIB	140	
Shale, oil	68308-34-9	F/IIIB		

APPENDIX A-2: CLASS II COMBUSTIBLE DUSTS

Chemical Name	CAS No.	Division Group/ Zone Group	Code	Layer or Cloud Ignition Temperature °C
Shellac	9000-59-3	G/IIIB	NL	400
Sodium resinate	61790-51-0	G/IIIB	220	
Sorbic acid (copper sorbate or potash)	110-44-1	G/IIIB	460	
Soy flour	68513-95-1	G/IIIB	190	
Soy protein	9010-10-0	G/IIIB	260	
Stearic acid, aluminum salt	637-12-7	G/IIIB	300	
Stearic acid, zinc salt	557-05-1	G/IIIB	M	510
Styrene modified polyester-glass fiber	100-42-5	G/IIIB	360	
Styrene-acrylonitrile (70-30)	9003-54-7	G/IIIB	NL	500
Styrene-butadiene latex (>75% styrene)	903-55-8	G/IIIB	NL	440
Styrene-maleic anhydride copolymer	9011-13-6	G/IIIB	CL	470
Sucrose	57-50-1	G/IIIB	CL	350
Sugar, powdered	57-50-1	G/IIIB	CL	370
Sulfur	7704-34-9	G/IIIB	220	
Tantalum	7440-25-7	E/IIIC	300	
Terephthalic acid	100-21-0	G/IIIB	NL	680
Thorium (contains 1.2% O)	7440-29-1	E/IIIC	CL	270
Tin, 96%, atomized (2% Pb)	7440-31-5	E/IIIC	430	
Titanium, 99% Ti 7440-32-6		E/IIIC	CL	330
Titanium hydride (95% Ti, 3.8% H)	7704-98-5	E/IIIC	CL	480
Trithiobisdimethylthio-formamide		G/IIIB	230	
Tung, kernels, oil-free	8001-20-5	G/IIIB	240	
Urea formaldehyde molding compound	9011-05-6	G/IIIB	NL	460
Urea formaldehyde-phenol formaldehyde	25104-55-6	G/IIIB	240	
Vanadium, 86.4%	7440-62-2	E/IIIC	490	
Vinyl chloride-acrylonitrile copolymer	9003-00-3	G/IIIB	470	
Vinyl toluene-acrylonitrile butadiene	76404-69-8	G/IIIB	NL	530
Violet 200 dye		G/IIIB	175	
Vitamin B1, mononitrate	59-43-8	G/IIIB	NL	360
Vitamin C	50-81-7	G/IIIB	280	
Walnut shell, black		G/IIIB	220	
Wheat		G/IIIB	220	
Wheat flour	130498-22-5	G/IIIB	360	
Wheat gluten, gum	100684-25-1	G/IIIB	NL	520
Wheat starch		G/IIIB	NL	380
Wheat straw		G/IIIB	220	
Wood flour		G/IIIB	260	
Woodbark, ground		G/IIIB	250	
Yeast, torula	68602-94-8	G/IIIB	260	
Zirconium hydride	7704-99-6	E/IIIC	270	
Zirconium (contains 0.3% O)	7440-67-7	E/IIIC	CL	330

APPENDIX B-1: REFERENCED PRODUCT AND INSTALLATION STANDARDS

API STANDARDS: American Petroleum Institute

- ANSI/API RP 14F, *Recommended Practice for Design and Installation of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Division 1 and Division 2 Locaations*
- ANSI/API RP 14FZ, *Recommended Practice for Design and Installation of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations*
- ANSI/API RP 500, *Recommended Practice for Classification of Locations of Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2*
- ANSI/API RP 505, *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2*
- API RP 2003, *Protection Against Ignitions Arising Out of Static Lightning and Stray Currents*

ASME STANDARDS: The American Society of Mechanical Engineers

- ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*

ASTM STANDARDS: ASTM International

- ASTM E 11-09, *Standard Specification for Wire Cloth and Sieves for Testing Purposes*
- ASTM E 1226-12a, *Standard Test Methods Method for Explosibility of Dust Clouds*
- ASTM D3175, *Standard Test Method for Volatile Matter in the Analysis Sample of Coal and Coke*

IEC STANDARDS: International Electrotechnical Commission

- ISO/IEC 80079-20-1, *Explosive atmospheres — Part 20-1: Material characteristics for gas and vapour classification — Test methods and data*

IEEE STANDARDS: Institute of Electrical and Electronics Engineers, Inc.

- ANSI/IEEE C2, *National Electrical Safety Code*
- ANSI/IEEE 60079-30-2, *IEEE/IEC International Standard for Explosive atmospheres — Part 30-2: Electrical resistance trace heating — Application guide for design, installation, and maintenance*
- IEEE 844.1/CSA C22.2 No. 293.1-17, *IEEE/CSA Standard for Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — General, Testing, Marking, and Documentation Requirements*
- IEEE 844.2/CSA C293.2-17, IEEE/CSA *Standard for Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures — Application Guide for Design, Installation, Testing, Commissioning, and Maintenance*
- IEEE 1349, *IEEE Guide for the Application of Electric Motors in Class I, Division 2 and Class I, Zone 2 Hazardous (Classified) Locations*

ISA STANDARDS: International Society of Automation

- ANSI/ISA-RP 12.06.01, *Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation — Part 1: Intrinsic Safety*
- ANSI/ISA-12.01.01, *Definitions and Information Pertaining to Electrical Equipment in Hazardous (Classified) Locations*
- ANSI/ISA-60079-0 (12.00.01), *Explosive Atmospheres — Part 0: Equipment — General Requirements*
- ANSI/ISA 60079-10-1, *Explosive Atmospheres — Part 10-1: Classification of Areas — explosive gas atmospheres*
- ANSI/ISA 60079-10-2 (12.10.05), *Explosive Atmospheres — Part 10-2: Classification of Areas — Combustible Dust Atmospheres*
- ANSI/ISA-60079-29-1 (12.13.01), *Explosive Atmospheres — Part 29-1: Gas detectors — Performance requirements of detectors for flammable gases*
- ANSI/ISA-60079-29-2 (12.13.02), *Explosive Atmospheres — Part 29-2: Gas detectors — Selection, installation, use and maintenance of detectors for flammable gases and oxygen*
- ISA-12.10, *Area Classification in Hazardous (Classified) Dust Locations*
- ISA-TR12.13.03, *Guide for Combustible Gas Detection as a Method of Protection*

ISO STANDARDS: International Organization of Standardization

- ISO 965-1, *ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data*
- ISO 965-3, *ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads*

NFPA STANDARDS: National Fire Protection Association

- NFPA 2, *Hydrogen Technologies Code*
- NFPA 13, *Standard for the Installation of Sprinkler Systems, for protection of membrane structures*
- NFPA 30, *Flammable and Combustible Liquids Code*
- NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*
- NFPA 32, *Standard for Drycleaning Facilities*
- NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*
- NFPA 34, *Standard for Dipping, Coating and Printing Processes Using Flammable or Combustible Liquids*
- NFPA 35, *Standard for the Manufacture of Organic Coatings*
- NFPA 36, *Standard for Solvent Extraction Plants*
- NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*
- NFPA 52, *Vehicular Natural Gas Fuel Systems Code*
- NFPA 55, *Compressed Gases and Cryogenic Fluids Code*
- NFPA 58, *Liquefied Petroleum Gas Code*
- NFPA 59, *Utility LP-Gas Plant Code*
- NFPA 77, *Recommended Practice on Static Electricity*
- NFPA 88A, *Standard for Parking Structures*
- NFPA 303, *Fire Protection Standard for Marinas and Boatyards, and NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages*
- NFPA 409, *Standard on Aircraft Hangars*
- NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*
- NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*
- NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installation in Chemical Process Areas*
- NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*
- NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*
- NFPA 780, *Standard for the Installation of Lightning Protection Systems*
- NFPA 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities*

UL STANDARDS: Underwriters Laboratories Inc.

- ANSI/UL 514B, *Conduit, Tubing, and Cable Fittings*
- ANSI/UL 1203, *Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations*
- ANSI/UL 1309, *Marine Shipboard Cable*
- ANSI/UL 2225, *Cables and Cable-Fittings for Use in Hazardous (Classified) Locations*
- ANSI/UL 60079-0, *Electrical Apparatus for Explosive Gas Atmospheres — Part 0: General Requirements*
- ANSI/UL 60079-1, *Explosive Atmospheres — Part 1: Equipment Protection by Flameproof Enclosures "d"*
- ANSI/UL 60079-11, *Explosive Atmospheres — Part 11: Equipment Protection by Intrinsic Safety "i"*

- ANSI/UL-60079-26, *Explosive Atmospheres — Part 26: Equipment with Equipment Protection Level (EPL) Ga*
- ANSI/UL 60079-28, *Explosive Atmospheres — Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation*
- ANSI/UL 60079-30-1, *Explosive Atmospheres — Electrical Resistance Trace Heating — General and Testing Requirements*
- ANSI/UL 120002, *Certificate Standard for AEx Equipment for Hazardous (Classified) Locations*
- ANSI/UL 122001, *General Requirements for Electrical Ignition Systems for Internal Combustion Engines in Class I, Division 2 or Zone 2, Hazardous (Classified) Locations*
- ANSI/UL 121203, *Standard for Portable Electronic Products Suitable for Use in Class I and II, Division 2, Class I Zone 2 and Class III, Division 1 and 2 Hazardous (Classified) Locations*
- ANSI/UL 122701, *Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids*
- UL 1836, *Outline of Investigation for Electric Motors and Generators for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2 and Zone 22 Hazardous (Classified) Locations*

OTHER STANDARDS

- ANSI/ASHRAE 15, *Safety Standard for Refrigeration Systems*
- ANSI/CGA G2.1, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*
- ANSI/IIAR 2, *Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems*
- ANSI/NEMA 250, *Enclosures for Electrical Equipment*

APPENDIX B-2: NEMA ENCLOSURE DEFINITIONS

NON-CLASSIFIED LOCATION ENCLOSURES.

- NEMA enclosures 2, 5, 12, 12K and 13 are not intended to provide protection against conditions such as internal condensation. NEMA enclosures 3, 3X, 3R, 3RX, 3S, 3SX, 4, 4X, 6 and 6P are not intended to provide protection against conditions such as internal condensation or internal icing.
- Type 1 Enclosures. Type 1 enclosures are intended for indoor use primarily to provide a degree of protection against limited amounts of falling dirt in locations where unusual service conditions do not exist.
- Type 2 Enclosures. Type 2 enclosures are intended for indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt.
- Type 3 Enclosures. Type 3 enclosures are intended for outdoor use primarily to provide a degree of protection against rain, sleet, and wind-blown dust; and to be undamaged by the formation of ice on the enclosure.
- Type 3X Enclosures. Type 3X enclosures are intended for outdoor use primarily to provide a degree of protection against rain, sleet, and wind blown dust; and to be undamaged by the formation of ice on the enclosure. These enclosures also provide an additional level of protection against corrosion.
- Type 3R Enclosures. Type 3R enclosures are intended for outdoor use primarily to provide a degree of protection against rain and sleet; and to be undamaged by the formation of ice on the enclosure. They must have a provision for a drain hole.
- Type 3RX Enclosures. Type 3RX enclosures are intended for outdoor use primarily to provide a degree of protection against rain and sleet: and to be undamaged by the formation of ice on the enclosure. They must have a provision for a drain hole. These enclosures also provide an additional level of protection against corrosion.
- Type 3S Enclosures. Type 3S enclosures are intended for outdoor use primarily to provide a degree of protection against rain, sleet, and windblown dust, and to provide for operation of external mechanisms when ice laden.
- Type 3SX Enclosures. Type 3SX enclosures are intended for outdoor use primarily to provide a degree of protection against rain, sleet, and windblown dust, and to provide for the operation of external mechanisms when ice laden. These enclosures also provide an additional level of protection against corrosion.
- Type 4 Enclosures. Type 4 enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water; and to be undamaged by the formation of ice on the enclosure.
- Type 4X Enclosures. Type 4X enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, and hose-directed water; and to be undamaged by the formation of ice on the enclosure.
- Type 5 Enclosures. Type 5 enclosures are intended for indoor use primarily to provide a degree of protection against settling airborne dust, falling dirt, and dripping noncorrosive liquids.
- Type 6 Enclosures. Type 6 enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against hose-directed water and the entry or water during temporary submersion at a limited depth; and to be undamaged by the formation of ice on the enclosure.
- Type 6P Enclosures. Type 6P enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against hose-directed water and the entry of water during prolonged submersion at a limited depth; and to be undamaged by the formation of ice on the enclosure.
- Type 12 Enclosures. Type 12 enclosures are intended for indoor use primarily to provide a degree of protection against circulating dust, falling dirt, and dripping noncorrosive liquids.
- Type 12K Enclosures. Type 12K enclosures are intended for indoor use primarily to provide a degree of protection against circulating dust, falling dirt, and dripping noncorrosive liquids. The knockouts shall be provided only in the top or bottom walls, or both.
- Type 13 Enclosures. Type 13 enclosures are intended for indoor use primarily to provide a degree of protection against lint, dust, spraying of water, oil, and noncorrosive coolant.

CLASSIFIED LOCATION ENCLOSURES.

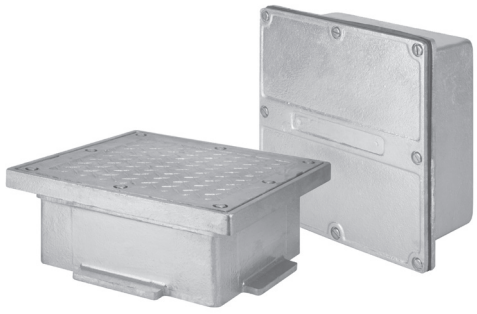
- Type 7 Enclosures. Type 7 enclosures are for indoor use in hazardous (classified) locations as Class I, Division 1, Groups A, B, C, or D, as defined in the National Electrical Code. Type 7 enclosures provide Explosionproof hazardous location protection.
- Type 8 Enclosures. Type 8 enclosures are for indoor or outdoor use in hazardous (classified) locations as Class I, Division 1, Groups A, B, C, or D, as defined in the National Electrical Code. Type 8 enclosures provide hazardous location protection by oil-immersion.
- Type 9 Enclosures. Type 9 enclosures are intended for indoor use in hazardous (classified) locations as Class II, Division 1, Groups E, F, and G, as defined in the National Electrical Code. Type 9 enclosures provide dust-ignitionproof hazardous location protection.
- Type 10 Enclosures (MSHA). Type 10 enclosures shall be capable of meeting the requirements of the Mine Safety and Health Administration, 30 C.F.R., Part 18. Type 10 enclosures provide hazardous location protection for mines.

ANCILLARY RATINGS

- In addition to Type designations, the following ancillary conditions can be evaluated and marked. The ancillary ratings are optional add-ons to the basic Type ratings.

PRESSURE WASH

- PW. Enclosures constructed for exterior cleaning with high-pressure power washers. The PW ancillary rating may be appended only to the following ratings: 3, 3X, 3S, 3SX, 4, 4X, 6, 6P, 12, 12X, 13
- XH: Corrosive- and Hosedown- Capable Indoor Enclosures.
- Enclosure evaluated for indoor locations that are subject to hosedown by the means of hose directed water. The “-XH” ancillary rating may be appended only to Type 12, 12K, or 13 enclosure ratings.



APPENDIX B-3: THE RELATIONSHIP BETWEEN NEMA 250 – "ENCLOSURES FOR ELECTRICAL EQUIPMENT (1000 VOLTS MAXIMUM)" AND IEC 60529 – "DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP CODE)"

This Publication provides a brief explanation of the differences between NEMA Standard 250, Enclosures for Electrical Equipment (1000 Volts Maximum) and IEC Standard 60529, Degrees of Protection Provided by Enclosures (IP Code). For a detailed comparison of the differences between the NEMA 250 and IEC 60529 performance specifications, please refer to the respective documents.

What is IEC 60529?

- IEC 60529 is an enclosure classification standard that was developed through the International Electrotechnical Commission (IEC), an international standards group.

What does IEC 60529 cover?

- The scope of IEC 60529 states, "This standard applies to the classification of degrees of protection provided by enclosures for electrical equipment with a rated voltage not exceeding 72.5 kV." IEC 60529 provides definitions, designations and requirements for the "degree of protection" provided by the enclosure, and designated by an "IP Code."

What is not covered by IEC 60529?

- IEC 60529 is NOT a "product standard" and does not cover enclosure requirements other than the "degree of protection" provided. For instance IEC 60529 does not specify the corrosion protection and other environmental operating requirements and tests defined in NEMA 250.

What does "degree of protection" mean in IEC 60529?

- "Degree of protection" is a term used in the standard to describe:
  1. the protection of persons against access to hazardous parts inside the enclosure;
  2. the protection of the equipment inside the enclosure against ingress of solid foreign objects;
  3. the protection of the equipment inside the enclosure against harmful effects due to the ingress of water.

What is an "IP Code"?

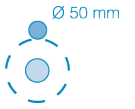
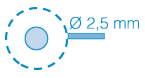
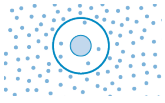
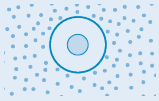
- The IP Code is a designation that indicates the level, or amount, of the protection. The IP Code designation consists of the letters IP (International Protection) followed by two numerals.

What does the first numeral of an IP Code indicate?

- The first characteristic numeral indicates the degree of protection provided by the enclosure with respect to persons having access to hazardous parts and with respect to solid foreign objects entering the enclosure. To understand what the first number specifies see Table 1 IEC 60529 below.

TABLE 1. IEC 60529

Degrees of Access to Hazardous Parts, First Characteristic Numeral 2nd Figure: protection against liquids

First Characteristic Numeral		With Respect to Persons	With Respect to Solid Foreign Objects
0		Non-protected.	Non-protected.
1		Protected against access to hazardous parts with the back of a hand.	Protected against solid foreign objects > 50 mm diameter.
2		Protected against access to hazardous parts with a finger.	Protected against solid foreign objects > 12.5 mm diameter.
3		Protected against access to hazardous parts with a tool.	Protected against solid foreign objects > 2.5 mm diameter.
4		Protected against access to hazardous parts with a wire.	Protected against solid foreign objects > 1.0 mm diameter.
5		Protected against access to hazardous parts with a wire.	Dust-protected (Dust shall not penetrate in quantity to interfere with satisfactory operation of the apparatus or to impair safety).
6		Protected against access to hazardous parts with a wire.	Dust-tight (No ingress of dust).

APPENDIX B-3: THE RELATIONSHIP BETWEEN NEMA 250 – "ENCLOSURES FOR ELECTRICAL EQUIPMENT (1000 VOLTS MAXIMUM)" AND IEC 60529 – "DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP CODE)"

What does the second numeral of an IP Code indicate?

- The second characteristic numeral indicates the degree of protection provided by the enclosure with respect to the harmful ingress of water. To understand what the second number specifies see Table 2 IEC 60529 below.

If a requirement for an enclosure Type is specified, can an equivalent IP rated enclosure be substituted?

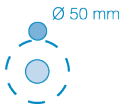
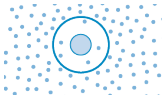
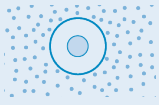
- NO! The IP Code only addresses requirements for protection of people, ingress of solid objects, and ingress of water. There are numerous other requirements covered by the Type designations that are not addressed by the IEC 60529/IP Codes. IEC 60529 does not specify:
  - — Construction requirements
  - — Door and cover securement
  - — Corrosion resistance
  - — Effects of icing
  - — Gasket aging and oil resistance
  - — Coolant effects
- The Type designation specifies requirements for these additional performance protections. For this reason, the IEC enclosure IP Code designations cannot be converted to enclosure Type numbers.

Can a specification for an IP Code be met by using a Type enclosure?

- Possibly! Table 1 shows a matrix of the NEMA Type and IP Code designations for enclosures. This table provides a summary of the NEMA Type Enclosure Ratings that exceed the specification requirements for the respective IEC IP Code designations. This Table was created after a detailed review of each test requirement specified for a particular NEMA Type number, versus the test requirements specified for each IP Code. As previously stated, Table 1 cannot be used to convert from IEC IP Codes to enclosure Type numbers.

TABLE 2. IEC 60529

Degrees of Protection Against Water Ingress, Second Characteristic Numeral

Second Characteristic Numeral		With Respect to the Harmful Ingress of Water
0		Non-protected.
1		Protected against vertically falling water drops.
2		Protected against vertically falling water drops when enclosure tilted up to 150.
3		Protected against spraying water.
4		Protected against splashing water.
5		Protected against water jets.
6		Protected against powerful water jets.
7		Protected against the effects of temporary immersion in water.
8		Protected against the effects of continuous immersion in water.

APPENDIX B-3: THE RELATIONSHIP BETWEEN NEMA 250 – "ENCLOSURES FOR ELECTRICAL EQUIPMENT (1000 VOLTS MAXIMUM)" AND IEC 60529 – "DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP CODE)"

What valid usage exists for IP Codes in North America?

- NEMA 250 is a product standard that addresses many aspects of enclosure design and performance requirements; IEC 60529 addresses only the degree of enclosure protection provided. As such an IP Code can only be used to supplement the NEMA Type designation; it cannot be used instead of a NEMA Type designation. To understand the conversion see Table 3 below.
- Two examples illustrate this point:
  - — Example #1: An enclosure meets all the requirements for a NEMA Type 4X rating and can be marked by an appropriate label. If the enclosure additionally meets the requirements for IP 56, it is appropriate to claim IP 56 compliance for the enclosure.
  - — Example #2: If a compartment within a NEMA Type 1 rating has been evaluated for compliance with the "finger protection" requirements of IEC 60529, it would be appropriate to claim IP 20 compliance for that compartment in addition to the NEMA Type 1 designation for the overall enclosure.

Example of Table 3 Use: An IEC IP 45 Enclosure Rating is specified. What NEMA Type Enclosures meet and exceed the IP 45 rating?

Referencing the first character, 4, in the IP rating and the row designated "IP4_" in the leftmost column in the table; the blocks in Column "A" for NEMA Types 3, 3S, 4, 4X, 5, 6, 6P, 12, 12K and 13 are shaded. These NEMA ratings meet and exceed the IEC protection requirements against access to hazardous parts and solid foreign objects. Referencing the second character, 5, in the IP rating and the row designated "IP_5" in the rightmost column in the table; the blocks in Column "B" for NEMA Types 3, 3S, 4, 4X, 6 and 6P are shaded. These NEMA ratings meet and exceed the IEC requirements for protection against the ingress of water. The absence of shading in Column "B" beneath the "NEMA Enclosure Type 5" indicates that Type 5 does not meet the IP 45 protection requirements against the ingress of water. Likewise the absence of shading in Column "B" for NEMA Type 12, 12K and 13 enclosures indicates that these enclosures do not meet the IP 45 requirements for protection against the ingress of water. Only Types 3, 3S, 4, 4X, 6 and 6P have both Column "A" in the "IP4_" row and Column "B" in the "IP_5" row shaded and could be used in an IP45 application.

- The NEMA Enclosure Type 3 not only meets the IP 45 Enclosure Rating, but also exceeds the IEC requirements because the NEMA Type requires an outdoor corrosion test; a gasket aging test; a dust test; an external icing test; and no water penetration in the rain test. Slight differences exist between the IEC and NEMA test methods, but the IEC rating permits the penetration of water if "it does not deposit on insulation parts, or reach live parts." The IEC rating does not require a corrosion test; gasket aging test; dust test or external icing test. Because the NEMA ratings include additional test requirements, this table cannot be used to select IP Designations for NEMA rated enclosure specifications.
- IEC 60529 specifies that an enclosure shall only be designated with a stated degree of protection indicated by the first characteristic numeral if it also complies with all lower degrees of protection. Furthermore IEC 60529 states that an enclosure shall only be designated with a degree of protection indicated by the second characteristic numeral if it also complies with all lower degrees of protection up to and including the second characteristic numeral 6. An enclosure designated with a second characteristic numeral 7 or 8 only is considered unsuitable for exposure to water jets (designated by second characteristic numeral 5 or 6) and need not comply with requirements for numeral 5 or 6 unless it is dual coded. Since the IEC protection requirements become more stringent with increasing IP character value up through 6, once a NEMA Type rating meets the requirements for an IP designation up through 6, it will also meet the requirements for all lower IP designations. This is apparent from the shaded areas shown in the table.

TABLE 3.
Conversion of NEMA 250 Enclosure Type Ratings to IEC 60529 Enclosure Classification Designations (IP)
(Cannot be Used to Convert IEC 60529 Classification Designations to NEMA 250 Type Ratings)

IP First Character	NEMA Enclosure Type																		NEMA Ancillary Rating				IP Second Character
	1		2		3, 3X, 3S, 3SX		3R, 3RX		4, 4X		5		6		6P		12, 12K, 13		_PW		_XH		
IP0_																							IP_0
IP1_																							IP_1
IP2_																							IP_2
IP3_																							IP_3
IP4_																							IP_4
IP5_																							IP_5
IP6_																							IP_6
																							IP_7
																							IP_8
																							IP_9
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	

A = A shaded block in "A" column indicates that the NEMA 250 Enclosure Type exceeds the requirements for the respective IEC 60529 IP First Character Designation for the protection against access to hazardous parts and solid foreign objects.

B = A shaded block in "B" column indicates that the NEMA 250 Enclosure Type exceeds the requirements for the respective IEC 60529 IP Second Character Designation for the protection against the ingress of water.

Ancillary Ratings Notes: PW rating may only be appended to Type 3, 3X, 3S, 3SX, 4, 4X, 6, 6P, 12, 12K, or 13 enclosure ratings.

American National Standards Institute (ANSI).

- The Institute oversees the creation, promulgation and use of thousands of norms and guidelines that directly impact businesses in nearly every sector: from acoustical devices to construction equipment, from dairy and livestock production to energy distribution, and many more. ANSI is also actively engaged in accrediting programs that assess conformance to standards – including globally-recognized cross-sector programs such as the ISO 9000 (quality) and ISO 14000 (environmental) management systems.

Institute of Electrical and Electronics Engineers (IEEE).

- IEEE's core purpose is to foster technological innovation and excellence for the benefit of humanity.

International Society of Automation. (ISA®)

- ISA® develops standards; certifies industry professionals; provides education and training; publishes books and technical articles; and hosts conferences and exhibitions for automation professionals. ISA® is the founding sponsor of the Automation Federation.

INTERTEK TESTING SERVICES (ITS).

- ITS is an OSHA Certified Nationally Recognized Testing Laboratory (NRTL). The ITS mark for electrical safety is the ETL mark.

AMERICAN PETROLEUM INSTITUTE (API®).

- This organization publishes Recommended Practice for Classification of Locations for Electrical Installations in Petroleum Facilities (API RP 500).

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA).

- NEMA issues standards on electrical equipment on all major categories of electrical equipment. Generally, where construction and performance relate to safety, reference is made to standards of others, such as Underwriters Laboratories Incorporated. The widely recognized NEMA enclosure types are described in NEMA's Standard Publication/No. 250.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC®).

- This organization is comprised of approximately forty member countries, including the United States. The purpose of the IEC® is to establish standards for a wide variety of electrical products to encourage international trade. IEC® publication series 79, entitled Electrical Apparatus for Explosive Gas Atmospheres, consists of several parts covering area classification, test apparatus and several techniques used for protection of apparatus, intended for use in hazardous locations.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA).

- OSHA mandates the use of electrical equipment that has been verified by Nationally Recognized Test Labs (NRTLs) as being suitable for the application. Some units of a system installation are not necessarily NRTL certified if such certification is judged not applicable. All products involved must meet NEC® requirements, as interpreted by OSHA.

OTHER ASSOCIATIONS.

- Professional and technical organizations develop and/or sponsor standards as product guidelines, application recommendations, safety rules or test methods. Typical associations include the American Iron and Steel Institute (AISI), the Aluminum Association (AA), the Illuminating Engineering Society (IES) and the Edison Electric Institute (EEI).

UNDERWRITERS LABORATORIES, INC. (UL®).

- UL® is an OSHA Certified Nationally Recognized Testing Laboratory (NRTL). In addition to specific UL Standards, UL publishes a "Green" book, an "Orange" book and a "Red" book. These three books contain the names of companies who have qualified to use the Listing or Classification Marking of Underwriters Laboratories on products which have been found to be in compliance with applicable UL requirements. The "Green" book, entitled Electrical Construction Materials Directory, contains detailed information on listed electrical devices generally considered as construction materials, and for use by electricians or others in the electrical industry. The "Orange" book, entitled Electrical Appliance and Utilization Equipment Directory, contains detailed information on listed appliances or other similar equipment generally considered for use by the general public. The "Red" book, entitled Hazardous Location Equipment Directory, contains detailed information on listed equipment intended for use in hazardous locations as defined by Article 500 of the National Electrical Code. These three publications can be used to obtain the names of companies who have a Listing in a specific product category, and to obtain information regarding the scope, limitations, or special conditions of a particular product category.

LOCAL BUILDING CODES.

- These codes influence and determine ultimate decisions on product suitability. NEC® Article 100 provides this definition: "APPROVED: Acceptable to authority having jurisdiction."

MANUFACTURERS DATA.

- Manufacturers such as Emerson, working with recognized organizations, develop and improve products for third party certification and thus set additional product suitability standards.
- Standards set by such organizations as Underwriters Laboratories (UL) and Canadian Standards Association (CSA) identify the criteria used by Appleton in the design and company testing of its products. These Third Party standards evolved over the years as manufacturing and processing became more complex and more hazardous.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA®).

- One of the pioneering organizations to set standards for the wiring and control of electricity was the National Fire Protection Association. Formed in 1896, the NFPA is composed of national and regional groups, plus individuals, firms and institutions interested in protecting life and property. This organization sets minimum standards to form a National Electrical Code (NEC®), which is used as a criteria for insurance, state and civic inspectors when making inspections or recommendations for electrical installations. Typical member organizations of the NFPA are the National Electrical Manufacturers Association, American Petroleum Institute, Institute of Electrical and Electronic Engineers, American Institute of Architects, Underwriters Laboratories, Inc., Factory Mutual, American Insurance Association, and many fire underwriting groups.
- Emerson designs and tests its Appleton brand products to meet or exceed the standards established by Third Party Certifiers.

CANADIAN STANDARDS ASSOCIATION (CSA®).

- CSA® is an OSHA Certified Nationally Recognized Testing Laboratory (NRTL). CSA® has established standards similar to UL for the testing of electrical products. Thousands of Appleton products marketed in the USA are both UL Listed and CSA® Certified. All products manufactured by Emerson at their Appleton Group Canada, Ltd facility meets or exceeds CSA® standards and most are CSA certified.

FACTORY MUTUAL (FM).

- FM is an OSHA Certified Nationally Recognized Testing Laboratory (NRTL). FM is a non-profit third party testing and certification organization, providing many of the same services as UL®. FM uses three broad standards: 3611, 3615 and 3616. In addition, FM tests and approves products not covered by these standards.

OUR CERTIFICATION POLICY.

- In each section of the Appleton™ Catalog under "Compliances," the appropriate published UL Standard is shown. This number signifies that the products in that section meet or exceed the requirements of that UL Standard. The term "Compliances" does not necessarily mean that the products are UL® Listed. UL® approval is a matter of independent record, signified by product nameplate or carton marking and can be ascertained by referring to approved sources. Although the majority of Appleton products are UL® Listed, there are instances where this is impractical. For example, a product may not be UL Listed because it is a subassembly, such as a mounting box. Often a product is not UL® Listed because it is in the process of being approved by UL. Due to technical problems in presentation, most of the Appleton UL Listed products are not so indicated in the Appleton Catalog, but information regarding UL® approvals on any specific product is obtainable upon request. Emerson has thousands of UL Listed Appleton™ products. In addition, all other NRTL and/or IEC® standards and compliances are also listed.

NORTH AMERICAN CERTIFICATION.

- The United States and Canada are both members of the IECEx Conformity Assessment System. As a result, for Hazardous Location Certification UL and CSA accepts each other's data for purpose of providing their National Certification Marks. This applies when the Essential Requirements of both countries are the same.

APPENDIX C-2: NATIONALLY RECOGNIZED TESTING LABORATORIES

The majority of Appleton products are listed or certified by one or more Nationally Recognized Testing Laboratories (NRTL) such as UL Solutions (formerly Underwriters Laboratories)(UL), CSA Group Testing & Certification Inc. (formerly Canadian Standards Association)(CSA), or ETL-Intertek (ETL). UL, CSA, and ETL are NRTLs involved in product safety testing and certification services. These NRTL's are on an approved list published by the U.S. Department of Labor – OSHA and widely accepted by code enforcement officials throughout the United States, Canada and various countries around the world.

Most end-user customers, as well as design engineers and electrical inspectors, accept UL, CSA, or ETL as an assurance of compliance to industry safety standards, as well as confirmation of a level of quality and safety in the electrical products they specify, purchase, and install.

Access to product listing certifications can easily be found in the website links below. These links are publicly available resources free to anyone with internet access, and may be searched by file number, product catalog number, keyword, manufacturer's name, etc.

UL Solutions https://iq.ulprospector.com/en

CSA GROUP https://www.csagroup.org/testing-certification/product-listing/

Intertek https://ramuk.intertekconnect.com/webclients/its/dlp/products.nsf/$$search?openform

Below are examples of listing marks from NRTLs relative to Appleton's 3rd party product approvals. These marks can be found on product labels, cast-in or stamped-on products, as well as displayed on packaging.

UL Listed to USA Standards

UL Listed to Canadian Standards

UL Listed to USA and Canadian Standards

UL Classified to USA Standards

UL Classified to Canadian Standards

UL Classified to USA and Canadian Standards

UL Recognized: product components meet USA and Canadian safety and quality standards

CSA Certified to USA Standards

CSA Certified to Canadian Standards

CSA Certified to USA and Canadian Standards

ETL Listed to USA Standards

ETL Listed to Canadian Standards

ETL Listed to USA and Canadian Standards

APPENDIX D: QUICK SELECTION GUIDE – EQUIPMENT FOR HAZARDOUS LOCATIONS

Product Category	Description	Class I, Division 1; Class I, Zone 1	Class I, Division 2; Class I, Zone 2	Class II, Division 1 ; Class II, Zone 21	Class II, Division 2; Class II, Zone 22 ; Class III, Division 1 & 2
Conduit Outlet Boxes and Conduit Bodies ① *Suitable if installed in compliance with NEC© 501.10(B)(4)*					
CPU	Universal Conduit Outlet Boxes	CD	CD	EFG	FG
ELBD - Aluminum	90° Pulling Elbows, LB Style	CD	CD	EFG	FG
ELBD - Iron	90° Pulling Elbows, LB Style	D	D	EFG	FG
ELBY - Malleable Iron	Corner Pulling Fittings	BCD	BCD	EFG	FG
ELBY - Aluminum	Corner Pulling Fittings	CD	CD	EFG	FG
ER	Conduit Outlet Boxes (conduit body type)	CD	CD	EFG	FG
FM7™	Conduit Bodies		ABCD ①		FG
FM8™	Conduit Bodies		ABCD ①		FG
FM9™	Conduit Bodies		ABCD ①		FG
Form 35™	Conduit Bodies		ABCD ①		FG
Form 85™	Conduit Bodies		ABCD ①		FG
GR	Conduit Outlet Boxes	BCD	BCD	EFG	FG
GRF	Conduit Outlet Boxes, Flanged	BCD	BCD	EFG	FG
GRH	Conduit Outlet Boxes	ABCD	ABCD	EFG	FG
GRJ	Conduit Outlet Boxes	CD	CD	EFG	FG
GRJS	Universal Conduit Outlet Boxes	CD	CD	EFG	FG
GRSS/GRSSA	Conduit Outlet Boxes, Multi-hub	BCD	BCD	EFG	FG
GRU/GRUE	Universal Conduit Outlet Boxes	CD	CD	EFG	FG
GRUJ	Conduit Outlet Boxes, Multi-hub	CD	CD	EFG	FG
GRUO	Conduit Outlet Boxes	CD	CD	EFG	FG
GSU	Conduit Outlet Boxes		ABCD ①		FG
GU	Conduit Outlet Boxes	BCD	BCD	EFG	FG
GUEB	Conduit Outlet Boxes, Multi-hub	BCD	BCD	EFG	FG
JB/JBD/JBLX	Conduit Outlet Boxes		ABCD ①		FG
LBD/LBDN	Conduit Bodies		ABCD ①		FG
Mogul	Conduit Bodies		ABCD ①		FG
PTB/PTC	Pull Boxes		ABCD ①		FG
SEH	Conduit Outlet Boxes		ABCD ①		FG
Junction Boxes ① Suitable if installed in compliance with NEC© 501.10(B)(4)					
AGUB	Cast Instrument Enclosures	BCD	BCD	EFG	FG
AJBEW	Cast Junction Boxes	BCD	BCD	EFG	FG
DER/GUB	Cast Junction Boxes	ABCD	ABCD	EFG	FG
DTX	Cast Junction Boxes			EFG	FG
EXB	Cast Junction Boxes	D	D	EFG	FG
GUBB	Cast Junction Boxes	BCD	BCD	EFG	FG
GUBBM	Cast Instrument Enclosures	D	D	EFG	FG
GUBM	Cast Instrument Enclosures	ABCD	ABCD	EFG	FG
RS	Hub Plate Boxes		ABCD ①		FG
WY	Cast Junction Boxes		ABCD ①		FG
PJB	FRP Non-metallic Junction Boxes	Zone 1, IIC	Zone 2, IIC		
SJB	Stainless Steel Junction Boxes	Zone 1, IIC	ABCD / IIC	FG	FG

APPENDIX D: QUICK SELECTION GUIDE – EQUIPMENT FOR HAZARDOUS LOCATIONS

Product Category	Description	Class I, Division 1; Class I, Zone 1	Class I, Division 2; Class I, Zone 2	Class II, Division 1 ; Class II, Zone 21	Class II, Division 2; Class II, Zone 22 ; Class III, Division 1 & 2
	Panelboards				
AGPN	Ground Fault Panel, Non-factory Sealed	BCD	BCD	EFG	FG
ALPF	Lighting Panel, Factory Sealed	BCD	BCD	EFG	FG
ALPN	Lighting Panel, Non-factory Sealed	BCD	BCD	EFG	FG
APPF	Power Panel, Factory Sealed	BCD	BCD	EFG	FG
APPFT	25kAIC Power Panel, Factory Sealed	CD	CD	EFG	FG
APPN	Power Panel, Non-factory Sealed	BCD	BCD	EFG	FG
D2P	Lighting Panel, Factory Sealed	BCD	BCD	EFG	FG
EWP	Lighting Panel, Factory Sealed	BCD	BCD	EFG	FG
Plexpower™ RC	Fiber Patch Panel, Factory Sealed		BCD	FG	FG
Plexpower™ RF	Power Panel, Factory Sealed		BCD	FG	FG
PlexPower™ RQ	Lighting Panel, Factory Sealed		BCD	FG	FG
XP	Lighting/Power Panel, Non-factory Sealed	BCD	BCD	EFG	FG
XP	Lighting/Power Panel, Factory Sealed		BCD	EFG	FG
	Plugs and Receptacles				
ACP	Powertite™ Plugs		Group Ratings Coincide with Receptacle Ratings		
CPH	CPH Plugs		Group Ratings Coincide with Receptacle Ratings		
CES/CESD/CPH	30A Plugs & Receptacles, Factory Sealed	CD	CD		
CES/CPH	60A Plugs & Receptacles, Factory Sealed	CD	CD		
CESD/CPH	60A Plugs & Receptacles, Factory Sealed	D	D		
CPS/CPP	20A Plugs & Receptacles, Factory Sealed	BCD	BCD	FG	FG
CPS/CPP Contender™	20A Plugs & Receptacles, Factory Sealed	CD	CD		
DBR/ACP/CPH	Receptacles w/ Disc. Switch or Circuit Bkr.			FG	FG
EBR/ACP/CPH	Receptacles w/ Circuit Breaker	BCD	BCD	FG	FG
EBRH/ACP/CPH	Receptacles w/ Disconnect Switch	BCD	BCD	FG	FG
ECC	20A Portable Cord Connector, Factory Sealed	CD	CD	G	G
ECCL/ECC U-Line™	20A Cable Connector for ECP Plugs, Factory Sealed	BCD	BCD	FG	FG
ECH/ECHT U-Line™	20A Panel Mount Receptacles	BCD	BCD	FG	FG
ECP/NCP	U-Line™ 20A Interchanger Plugs	BCD	BCD	FG	FG
EFS U-Line™	U-Line™ 20A Plugs & Receptacles, Factory Sealed	BCD	BCD	FG	FG
EFSR-GFI	U-Line™ 20A GFI, Factory Sealed	BCD	BCD	FG	FG
ENR Contender™	U-Line™ 20A Plugs & Receptacles, Factory Sealed	CD	BCD	FG	FG
ENR Contender™	U-Line™ 20A GFI & Receptacles, Factory Sealed	CD	CD	FG	FG
FSQC/ACP	30/60/100A Switched Receptacles	BCD	BCD	FG	FG
JBR/ACP/CPH	30/60A Switched Receptacles	BCD	BCD	FG	FG
MD2SR/ACP/CPH	30/60/100A Switched Receptacles, Factory Sealed		BCD	FG	FG
N1 U-Line™	20A Non-metallic Intraground™ Receptacles	CD	BCD		
N2 U-Line™	20A Non-metallic Intraground™ Receptacles		BCD	FG	FG
U2023	20A Portable Receptacles with GFCI	CD	CD	FG	FG

APPENDIX D: QUICK SELECTION GUIDE – EQUIPMENT FOR HAZARDOUS LOCATIONS

Product Category	Description	Class I, Division 1; Class I, Zone 1	Class I, Division 2; Class I, Zone 2	Class II, Division 1 ; Class II, Zone 21	Class II, Division 2; Class II, Zone 22 ; Class III, Division 1 & 2
	Control Stations and Pilot Lights				
ACSEW	Cast Control Centers and Operators	BCD	BCD	EFG	FG
EDS	Contender™ Div. 1 Control Stations, Factory Sealed	CD	BCD	EFG	FG
ED2S	Contender™ Div. 2 Control Stations, Factory Sealed		BCD	EFG	FG
EFD/EFDB and EDS	Control Stations, Factory Sealed	BCD	BCD	EFG	FG
EFDL	3-Device Control Stations, Factory Sealed	CD	BCD	EFG	FG
EFDT	2-Gang Tandem Control Stations, Non-Sealed	CD	BCD	EFG	FG
EFS	Tumbler Switches, Non-Sealed	CD	CD	EFG	FG
UCS Unicode™	Nonmetallic Control Stations, Factory Sealed	BCD	BCD	EFG	FG
U6 Unicode™ 2	Stainless Steel Control Stations, Factory Sealed		ABCD	EFG	FG
U2 Unicode™ 2	F.R.P. Control Stations, Factory Sealed		ABCD	EFG	FG
	Switches				
AE	Molded Case Switches, Bolted Enclosure	BCD	BCD	EFG	FG
AE - DS	Disconnect Switch, Bolted Enclosure, Non-fused	BCD	BCD	EFG	FG
AE - FDS	Disconnect Switch, Bolted Enclosure, Fused	BCD	BCD	EFG	FG
AFAX	Conveyor Belt Alignment Switches	CD	CD	EFG	FG
AFSX	Speed Responsive Switch	CD	CD	EFG	FG
AFUX	Conveyor Control Switch	CD	CD	EFG	FG
AEPGI	Ground Indicator	BCD	BCD	EFG	FG
EGC	Ground Indicator	CD	CD	EFG	FG
EDS	Contender™ Tumbler Switches, Factory Sealed	BCD	BCD	EFG	FG
EDS & EFS	Tumbler Switches, Factory Sealed	BCD	BCD	EFG	FG
EDS	Heavy Duty Disconnect Switches	BCD	BCD	EFG	FG
GUSC	Heavy Duty Tumbler Switches	D	D	EFG	FG
MD2DS	Disconnect Switches, Factory Sealed		BCD	FG	FG
TBSM	Vibration Switches	CD	CD	EFG	FG
TBSM-B	Vibration Switches	BCD	BCD	EFG	FG
4AS	Inertia Switches	BCD	BCD	EFG	FG
WD2S	Disconnect Switches, Factory Sealed, Non-fused		BCD	EFG	FG
WD2S-F	Disconnect Switches, Factory Sealed, Fused		BCD	EFG	FG

APPENDIX D: QUICK SELECTION GUIDE – EQUIPMENT FOR HAZARDOUS LOCATIONS

Product Category	Description	Class I, Division 1; Class I, Zone 1	Class I, Division 2; Class I, Zone 2	Class II, Division 1 ; Class II, Zone 21	Class II, Division 2; Class II, Zone 22 ; Class III, Division 1 & 2
Motor Starters, Circuit Breakers and Manual Contractors					
ACSE	Manual Motor Starters, Across the Line	CD	CD	EFG	FG
AE	Enclosed Circuit Breakers	BCD	BCD	EFG	FG
AEB	Motor Starters & Contactors	BCD	BCD	EFG	FG
AELB	Motor Starters & Contactors, 65kAIC	CD	CD	EFG	FG
AELB	Molded Case Circuit Breakers, 65kAIC	CD	CD	EFG	FG
AETB	Molded Case Circuit Breakers, 25kAIC	CD	CD	EFG	FG
AEXMS	Manual Motor Starters, Across the Line	CD	CD	EFG	FG
Plexpower™	Enclosed Circuit Breakers, Factory Sealed		BCD	FG	FG
Plexpower™	Motor Starters & Contactors, Factory Sealed		BCD		FG
EB	Enclosed Circuit Breakers	BCD	BCD	EFG	FG
EDS	Manual Motor Starters, Factory Sealed	BCD	BCD	EFG	FG
EFD	Motor Rated Switches, Non-Sealed	CD	CD	EFG	FG
EDS Contender™	Manual Motor Starters, Factory Sealed	CD	CD	EFG	FG
EDS Contender™	Motor Rated Switches, Factory Sealed	CD	CD	EFG	FG

APPENDIX D: QUICK SELECTION GUIDE – EQUIPMENT FOR HAZARDOUS LOCATIONS

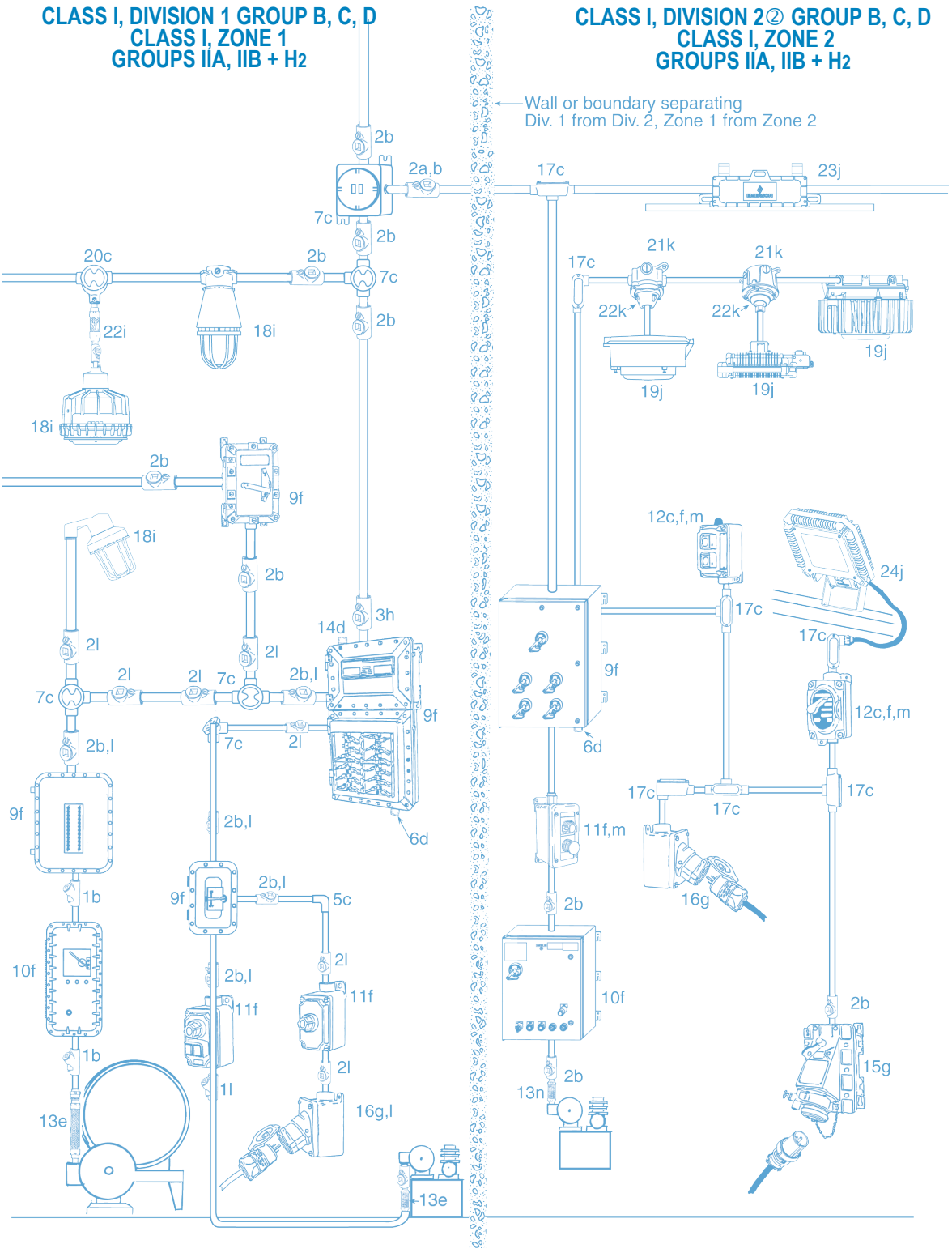
Product Category	Description	Class I, Division 1; Class I, Zone 1	Class I, Division 2; Class I, Zone 2	Class II, Division 1 ; Class II, Zone 21	Class II, Division 2; Class II, Zone 22 ; Class III, Division 1 & 2
	LED Luminaires *Note: Please refer to Appleton™ Product Catalogs and NEC 500.8(D) for Temperature Class (T-Code)*				
AAL	A-51™ LED Factory Sealed	ABCD	ABCD	FG	FG
AL	A-51™ LED Factory Sealed	CD	CD	FG	FG
AERL	Explosionproof Reelites	D	D	EFG	FG
BLZ	Baymaster™ High Bay LED Zone 1	IIC	IIC	IIIC	IIIC
BHZ	Baymaster™ High Bay High Lumen LED Zone 1	IIC	IIC	IIIC	IIIC
BLL	Baymaster™ High Bay LED		ABCD / IIC	EFG / IIIC	FG
BHL	Baymaster™ High Bay High Lumen LED		ABCD / IIC	EFG / IIIC	FG
CMLED	Code•Master™ LED Factory Sealed	BCD	BCD	EFG	FG
CJL	Code•Master™ Jr. LED Factory Sealed	BCD	BCD	EFG	FG
EHLED	LED Handlamp Factory Sealed	CD	CD		
AMLG	Areamaster™ Generation 2 LED		ABCD / IIC	EFG / IIIC	FG
AMLH	Areamaster™ Generation 2 LED HL		ABCD / IIC	EFG / IIIC	FG
AMLZ	Areamaster™ Generation 2 LED Zone 1	IIC	IIC	IIIC	IIIC
AMHZ	Areamaster™ Generation 2 LED High Lumen Zone 1	IIC	IIC	IIIC	IIIC
ERM	Rigmaster™ Linear LED Explosionproof	CD	CD	EFG	FG
ERM	Rigmaster™ Linear LED Explosionproof Emergency	CD	CD	EFG	FG
RM	Rigmaster™ Linear LED		ABCD / IIC	EFG / IIIC	FG / IIIB
RM	Rigmaster™ Linear LED Emergency		ABCD / IIC	EFG / IIIC	FG / IIIB
MLGL	Mercmaster™ LED Generation 3		ABCD / IIC	EFG / IIIC	FG / IIIB
MLGL	Mercmaster™ LED Generation 3 Emergency		ABCD / IIC	EFG / IIIC	FG / IIIB
MLGH/MLGX	Mercmaster™ LED Generation 3 High Lumen		ABCD	EFG	FG
MGZ	Mercmaster™ LED Generation 3 Zone 1	IIC	IIC	IIIC	IIIB
MLLED	Mercmaster™ LED Low Profile		ABCD / IIC	EFG / IIIC	FG
VMV	Contender™ LED Fixture Unit		ABCD / IIC	EFG / IIIC	FG / IIIB
HEX	HEX LED Series Exit Sign		ABCD / IIA, IIB, IIC		
	Fixture Hangers *① Suitable if installed in compliance with NEC© 501.10(B)(4)*				
CPU	Fixture Hangers, Non-flexible	CD	CD	EFG	FG
EFHC	Fixture Hanger Outlet Boxes	BCD	BCD	EFG	FG
EFHCA	Fixture Hanger Outlet Boxes	ABCD	ABCD	EFG	FG
EFHU	Fixture Hangers, Flexible Cushion	CD	CD	EFG	FG
ESD/ESS	Swivel Hangers	CD	CD	EFG	FG
EXJF	Fixture Hangers, Flexible Coupling	ABCD	ABCD	EFG	FG
GRF	Conduit Outlet Boxes, Flanged	CD	CD	EFG	FG
GRK	Fixture Hanger Covers/Canopies for GRF Outlet Boxes	CD	CD	EFG	FG
EFHM/F	Fixture Support Hooks		ABCD ①		
FHS	Fixture Support - Dummy Side		ABCD ①		
AHG	Fixture Hangers, Flexible Cushion, Gasketed		ABCD ①		
UNJ	Fixture Hangers, Flexible Ball Type		ABCD ①		
GSU/GSK	Conduit Outlet Boxes/Hanger Covers		ABCD ①		
JB & GS	Conduit Outlet Boxes/Hanger Covers		ABCD ①		
AL	Ball & Cushion Flexible Fixture Hangers		ABCD ①		
G-P	Poles and Brackets		ABCD ①		

APPENDIX D: QUICK SELECTION GUIDE – EQUIPMENT FOR HAZARDOUS LOCATIONS

Product Category	Description	Class I, Division 1; Class I, Zone 1	Class I, Division 2; Class I, Zone 2	Class II, Division 1 ; Class II, Zone 21	Class II, Division 2; Class II, Zone 22 ; Class III, Division 1 & 2
Sealing Fittings, Unions, Flexible Couplings, Drains & Breathers, Reducing Bushings, Bell Reducers ① *Suitable if installed in compliance with NEC© 501.10(B)(4)*					
BR	Bell Reducing Couplings	See Catalog for Group Info		EFG	FG
BRTB4X	NEMA 4X Breather	BCD	BCD	EFG	FG
ECD50B4X	NEMA 4X Drain	BCD	BCD	EFG	FG
ECDB38	Universal Drain Breather	CD	CD	EFG	FG
ECDB-B	NEMA 3R Universal Drain Breather	BCD	BCD	EFG	FG
ECDB-HP	NEMA 3R Universal Drain Breather, High Performance	CD	CD	EFG	FG
CRN	Drain Breather (Non-Explosionproof)		ABCD ①		
EL	45° and 90° Elbows	See Catalog for Group Info		EFG	FG
ES	25% Fill Sealing Hubs	See Catalog for Group Info		EFG	FG
ESUF/ESUM	25% Sealing Fittings, Horizontal/Vertical, Bolted Cover	CD	CD	EFG	FG
EXGJH	Flexible Couplings, Two Male Nipples	See Catalog for Group Info		EFG	FG
EXLK	Flexible Couplings, One Male Nipple, One Union	See Catalog for Group Info		EFG	FG
EYD-1	25% Fill Drain Seal Fittings Vertical Only	CD	CD	EFG	FG
EYDEF	40% Fill Drain Seal Fittings Vertical Only	See Catalog for Group Info		EFG	FG
EYDM	25% Fill Drain Seal Fittings Vertical Only	See Catalog for Group Info		EFG	FG
EYF/EYM	25% Fill Sealing Fittings, Horizontal/Vertical	See Catalog for Group Info		EFG	FG
EYS-1	25% Fill Sealing Fittings, Vertical Only	ABCD	ABCD	EFG	FG
EYS-11	25% Fill Sealing Fittings, Horizontal/Vertical	See Catalog for Group Info		EFG	FG
EYSEF	40% Fill Sealing Fittings, Horizontal/Vertical	See Catalog for Group Info		EFG	FG
EYSF/EYSM	25% Fill Sealing Fittings, Vertical Only	See Catalog for Group Info		EFG	FG
AC and F	Kwiko™ A Sealing Cement and Fiber Filler	Group Ratings Coincide with Sealing Fitting Ratings			
PLG	Close-Up Plugs	See Catalog for Group Info		EFG	FG
RB	Reducing Bushings	See Catalog for Group Info		EFG	FG
UNAF	360° Swivel Unions	CD	CD	EFG	FG
UNL	90° Elbow Unions	ABCD	ABCD	EFG	FG
UNY/UNF	Conduit Unions	See Catalog for Group Info		EFG	FG
UNY/UNF	Expansion Unions	CD	CD	EFG	FG

APPENDIX D: QUICK SELECTION GUIDE – EQUIPMENT FOR HAZARDOUS LOCATIONS

Product Category	Description	Class I, Division 1; Class I, Zone 1	Class I, Division 2; Class I, Zone 2	Class II, Division 1 ; Class II, Zone 21	Class II, Division 2; Class II, Zone 22 ; Class III, Division 1 & 2
Conduit Hubs, Straps & Hangers, Liquidtight Connectors, Cord Grips, Cable Glands, Cable Tray Clamps ① *Suitable if installed in compliance with NEC© 501.10(B)(4)*					
CG	Strain Relief Cord Grips		ABCD ①		FG
CG	Strain Relief Cord Grips w/ Wire Mesh		ABCD ①		FG
CH/HUB	Threaded Conduit Hubs		ABCD ①		FG
ST™/ STB	Liquidtight Flex Metal Conduit Connectors		ABCD ①		FG
ST-F	Liquidtight Flex to RMC/IMC Connectors		ABCD ①		FG
STB-SR	Liquidtight Flex Connectors w/ Wire Mesh		ABCD ①		FG
ST-L	Liquidtight Flex Connectors w/ External Ground Lug		ABCD ①		FG
TMC2	Metal Clad Cable Connectors		ABCD ① / IIC	EFG	FG
TMC2X	Metal Clad Cable Connectors w/ Barrier Seal	ABCD / IIC	ABCD / IIC	EFG	FG
TMCX	Metal Clad Cable Connectors w/ Barrier Seal	ABCD / IIC	ABCD / IIC	EFG	FG
XJ & BJ	Expansion Fittings & Bonding Jumpers		ABCD ①		FG
SCC	Split Couplings, Threaded		ABCD ①		
EC	Three Piece Couplings, Threaded		ABCD ①		
NTC/SNTC	Threadless Conduit Connectors		ABCD ①		
NTCC/SNTCC	Threadless Conduit Couplings		ABCD ①		
TC	Tray Cable Connector		ABCD ①		FG
GIB	Grounding Insulated Bushings		ABCD ①		
GL	Bonding Locknuts		ABCD ①		
A2	Industrial Cable Gland		ABCD ①		FG
T3	Jacketed Braided Armor Cable Gland		ABCD ①		FG
PXSS2K-REX	Non-armored Cable Gland w/ Barrier Seal	CD / IIC	ABCD / IIC	EFG / IIIC	FG / IIIB
PX2K-REX	Braid, Tape, Wire Armor Cable Gland w/ Barrier Seal	ABCD / IIC	ABCD / IIC	EFG / IIIC	FG / IIIB
PX2KX-REX	Jacketed Wire Braid Cable Gland w/ Barrier Seal	ABCD / IIC	ABCD / IIC	EFG / IIIC	FG / IIIB



For Class I, Division 2, locations seals are required when using 2" trade size or larger where splices or taps are contained.
① Refer to Section 505.9(C)(1).
② All items shown in Division 1 are also suitable for Division 2.

APPENDIX E-1: LIGHTING AND POWER DIAGRAMS: CLASS I, DIVISION 1 AND 2, GROUP B; CLASS 1, ZONES 1 AND 2, GROUPS IIA, IIB+ H_2 ①

Key to Product ③

1 — Sealing Fittings. EYSF/M, EYS — used with vertical conduits.

2 — Sealing Fittings. EYF/M, EYS series — used for sealing vertical or horizontal conduits.

3 — Sealing Fittings, expanded fill. EYSEF, EYDEF.

4 — Unions, UNY-NR, UNF-NR, UNL.

5 — Elbows. ELF, ELMF, ELMFL.

6 — Drains. DRNB4X, ECDB50B.

7 — Explosionproof Junction Boxes. GR, GU, GRH, GRF, ELBY, GRSS, GUBB, with threaded covers. See "l" in the reference column.

8 — Explosionproof Junction Boxes, AJBEW, with ground surface covers.

9 — Panelboards, Circuit Breaker, PlexPower, ALPN, APPN, AGPN, APPF, D2P, EWP. Manual Starter, Disconnect Switch, EB, EDS, MD2DS.

10 — Combination Circuit Breaker and Line Starters. AEB Series, bolted cover.

11 — Push Button/Pilot Lights, factory sealed. Division 1 — EDS, EFDB, Division 2 only — EFS Division 2 Contender, Unicode, N2.

12 — Switch/Motor Starters, factory sealed. Division 1 — EDS, EFDB. Factory sealed switch Division 2 — FDK2.

13 — Flexible Couplings. EXGJH, EXLK, liquidtight connector.

14 — Breathers. BRTB4X, ECDB50B.

15 — Receptacles, non-factory sealed, interlocked. FSQC, JBR, EBRH.

16 — Receptacles, EFSB, EFS requires seal for Group B, Division 1. See "l" in the reference column.

17 — Conduit Boxes, Bodies, Fittings. Form 35, Form 85, FM7, FM8, FM9, Mogul, JB, GSU, LBD.

18 — Luminaires, Division 1, LED — Code•Master, Code•Master Jr., A-51.

19 — Luminaires, Division 2, LED — Mercmaster Connect, Mercmaster Generation 3, Mercmaster Low Profile, Baymaster, Areamaster Connect, Areamaster Generation 2.

20 — Fixture Hangers, Division 1 — EFHC, EFHCA.

21 — Fixture Hangers, Division 2 — JB, GSU.

22 — Flexible Fixture Supports, Division 1 — EXJF; Division 2 — JB Cushion, AHG Cushion, GS Cushion.

23 — Luminaires. Division 2 — LED, Rigmaster Series.

24 — Luminaires. Division 2 — LED, Areamaster Connect, Aremaster Generation 2 Series.

National Electrical Code® Reference

a — Sec. 501.15(A)(4) Seal required (within 10 feet) on either side of boundary entering or leaving hazardous area

b — Sec. 501.15(A)(1) Seals required within 18 inches of all arcing devices.

c — Sec. 501.10(A) and (B) and 500.8(D) In Division 1, boxes and fittings must be explosionproof and have 5 full threads (4-1/2 when factory threaded) engaged. Permitted wiring methods include Threaded RMC, Threaded IMC, listed MI cable/fittings, and listed MC-HL cable with listed cable connectors. In Division 2, boxes and fittings are not required to be explosionproof unless the enclosure contains arcing (contacts), sparking or heat producing devices. Permitted wiring methods include all those for Division 1 such as Threaded RMC, Threaded IMC, and listed MC-HL cable with listed cable connectors. Also a variety of additional cable and raceway systems are permitted including MC cable with approved MC cable connectors.

d — Sec. 501.15(F)(1) Drain/breathers must be installed to prevent accumulation of liquids or condensed vapors.

e — Sec. 501.10(A)(2) Flexible connections as at motor terminals must be explosionproof and listed for Class I, Division 1 locations.

f — Sec. 501.115 Panelboards, circuit breakers, push buttons, switches, motor controllers — shall be explosionproof and approved for Class I, Division 1 locations.

g — Sec. 501.145 Receptacles and plugs must be explosionproof, Group B approved and provide grounding conductor for portable equipment.

h — Sec. 501.15(C)(6) Approved expanded fill seals permit up to 40% fill of cross sectional area of conduit.

i — Sec. 501.130(A)(1) and (3) Lighting fixtures in Division 1 must be identified for the Class I, Division 1 location and if stem exceeds 12 inches it must be braced or have a flexible connector.

j — Sec. 501.130(B)(1) In Division 2, fixtures must be tested and marked as to operating temperature or temperature range.

k — Sec. 501.130(B)(3) In Division 2, hangers must be effectively braced or provide flexibility in the form of an identified fitting or flexible connector.

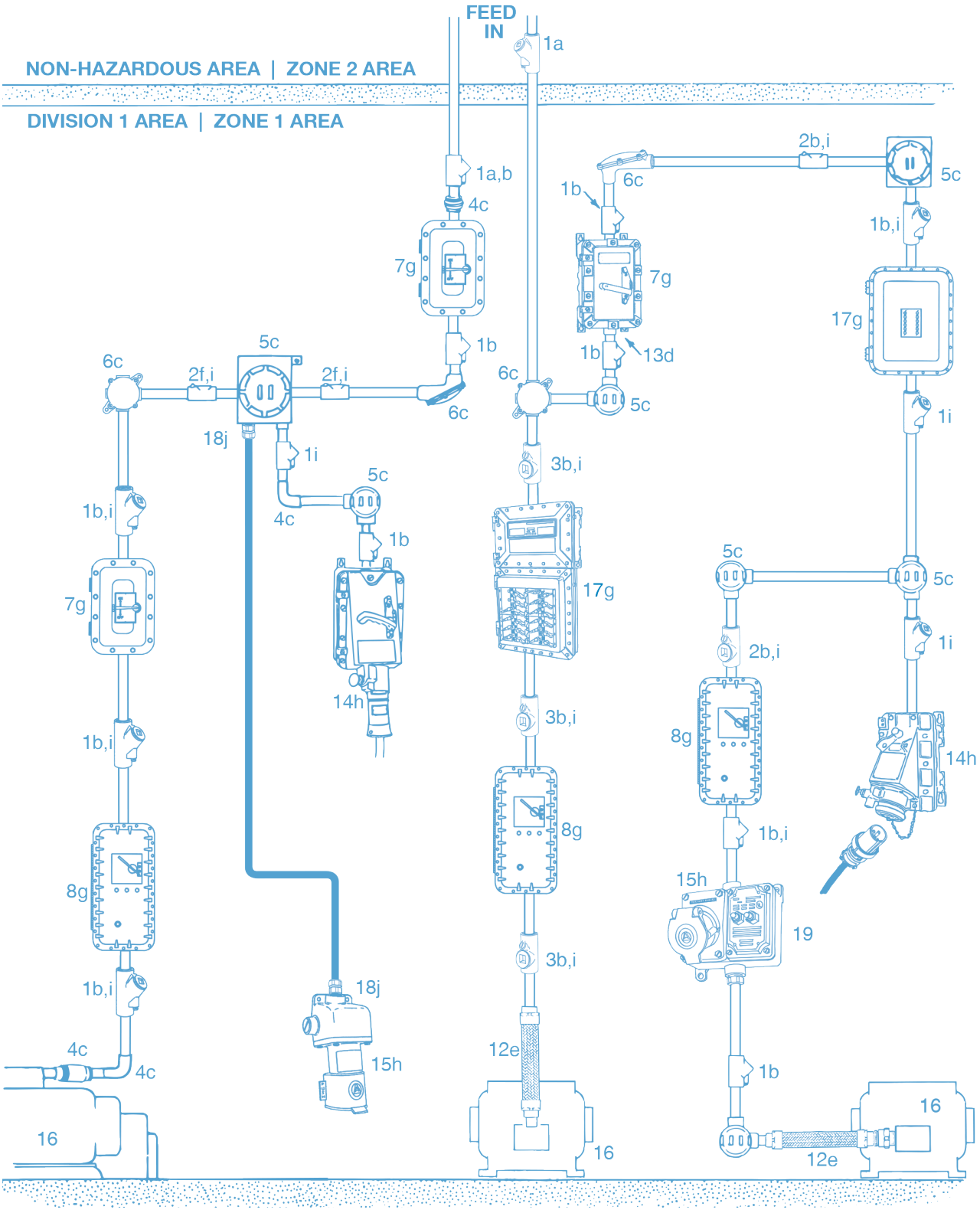
l — For Division 1 listings, some products require seals installed immediately adjacent. See catalog for exact distance (can vary by product).

m — Sec. 501.15(A)(1) Seals shall not be required in Class I, Division 1 and 2 locations if switches (contacts) are enclosed within a factory sealed explosionproof chamber.

n — Sec. 501.10(B)(2) Class I, Division 2 flexible connections as at motor terminals can be flexible metal conduit (indoors), liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit with listed fittings.

① Refer to Section 505.9(C)(1).
③ Not every size and style of mentioned series is suitable for Group B. See Appleton™ product catalogs for specific listings.

APPENDIX E-2: POWER DIAGRAM:
CLASS I, DIVISION 1, GROUPS C, D; CLASS I, ZONE 1, GROUPS IIA, IIB ①



① *Refer to Section 505.9(C)(1).*

APPENDIX E-2: POWER DIAGRAM:
CLASS I, DIVISION 1, GROUPS C, D; CLASS I, ZONE 1, GROUPS IIA, IIB ①

Key to Product

1 — Sealing Fittings. EYSF/M, EYS 1, 2, 3, 16, 26, 36—used with vertical conduits.

2 — Sealing Fittings. EYF/M, EYS, EYD, EYDM, ESUF/M—used with vertical or horizontal conduits.

3 — Sealing Fittings, expanded fill. EYSEF, EYDEF.

4 — Unions/Elbows. UNY-NR, UNF-NR, UNY/F UNL, UNYL/UNFL; ELF, ELMF, UNA.

5 — Explosionproof Junction Boxes. GRTS, GR, GRSS, GRF, GUBB, GRU, GRUE, GU, ELBY, with threaded covers.

6 — Explosionproof Junction Boxes. ELBD②, CPU, ER, AJBEW, with ground surface covers.

7 — Circuit Breaker/Disconnect Switch/Manual Starters. AEXMS, EDS, EFS, N1.

8 — Combination Circuit Breaker and Line Starter. AEB bolted cover.

9—Threaded Circuit Breaker. AE threaded cover.

10 — Push Button/Pilot Lights, factory sealed. EDS, EFDB, EFD, EFS/D Contender.

11 — Push Buttons, non-factory sealed. N1, EFD, OFC.

12 — Switch/Motor Starters, factory sealed. EFD, EDS, EFDB.

13 — Flexible Connectors. EXGJH, EXLK.

14 — Drain/Breather, combination. ECDB5OHP.

15 — Receptacles, non-factory sealed. FSQC, JBR, EBR.

16 — Receptacles factory sealed. U-Line, EFS, CPS, CES③, CESD③.

17 — Motor for Explosionproof Location.

18 — Panelboards. EWP, ALPN, APPN, AGPN, APPF.

19 — Type MC-HL Cable with TMCX Connectors, listed for Class I, Division 1.

20 — Ground Fault Interrupter (GFI) EFSRGFI, GFS1.

National Electrical Code® Reference

a — *Sec. 501.15(A)(4)* Seal required on either side of boundary (within 10 feet) entering or leaving hazardous area.

b — *Sec. 501.15(A)(1)* Seals required within 18 inches of all arcing devices.

c — *Sec. 501.10(A) and 500.8(D)* Boxes and fittings must be explosionproof and have 5 full threads (4-1/2 when factory threaded) engaged. Permitted wiring methods include Threaded RMC, Threaded IMC, listed MI cable/fittings and listed MC-HL cable with listed cable connectors.

d — *Sec. 501.15(F)(1)* Drain/breathers must be installed to prevent accumulation of liquids or condensed vapors.

e — *Sec. 501.10(A)(2)* Flexible connections as at motor terminals must be explosionproof.

f — *Sec. 501.10(A)(3)* All boxes, fittings and joints shall be approved for Class I, Division 1.

g — *Sec. 501.115* Panelboards, circuit breakers, push buttons, switches, motor controllers—shall be explosionproof and approved for Class I, Division 1 locations.

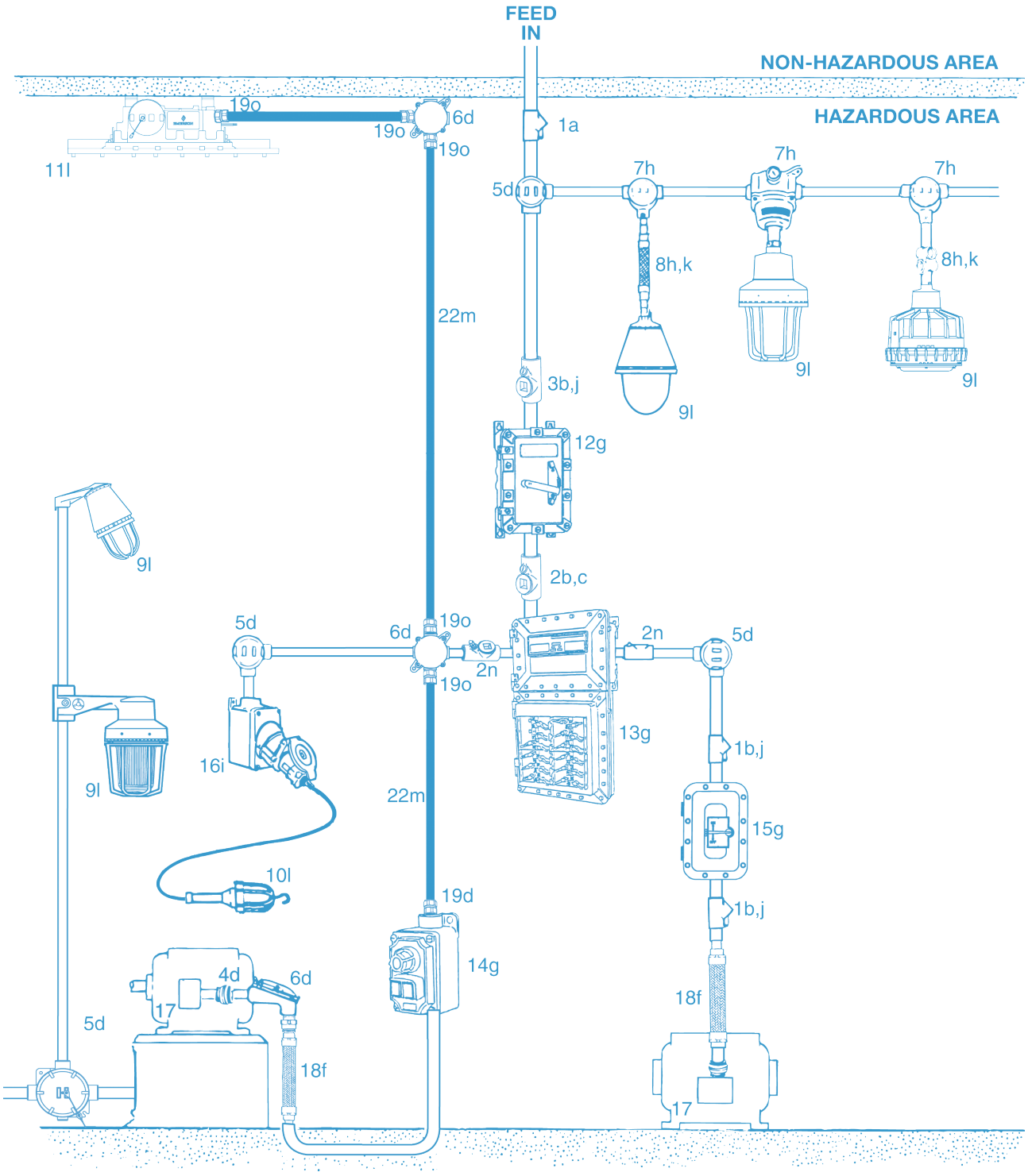
h — *Sec. 501.115* Receptacles and plugs must be explosionproof and provide grounding conductor for portable equipment.

i — *Sec. 501.15(A)(1)(2)* Seals required if entries are trade size 2" or larger.

j — *Sec. 501.15(D)(1)* Cable seals, Class I, Division 1.

① Refer to Section 505.9(C)(1).
② ELBD is suitable for Group D only.
③ 60 Amp CES/CESD Suitable for Group D only.

APPENDIX E-3: LIGHTING DIAGRAM: CLASS I, DIVISION 1, GROUPS C, D; CLASS I, ZONE 1, GROUPS IIA, IIB ①



① *Refer to Section 505.9(C)(1).*

APPENDIX E-3: LIGHTING DIAGRAM: CLASS I, DIVISION 1, GROUPS C, D; CLASS I, ZONE 1, GROUPS IIA, IIB ①

Key to Product

1 — Sealing Fittings. EYSF/M, EYS 1, 2, 3, 16, 26, 36—used with vertical conduits.

2 — Sealing Fittings. EYF/M, EYS, EYD, EYDM, ESUF/M—used with vertical or horizontal conduits.

3 — Sealing Fittings, expanded fill. EYSEF, EYDEF.

4 — Unions/Elbows. UNY-NR, UNF-NR, UNY/F, UNL, UNYL/UNFL; ELF, ELMF.

5 — Explosionproof Junction Boxes. GRTS, GR, GRSS, GRF, GUBB, GRU, GRUE, GU, with threaded covers.

6 — Explosionproof Junction boxes. ELBD, CPU, AJBEW, with ground surface covers.

7 — Fixture Hangers. CPU, EFHU, EFHC, GRF, FHS.

8 — Flexible and Swivel Fixture Supports. EXJF, ESD, ESS.

9—Luminaires, Task/Area, Division 1, LED — Code•Master, Code•Master Jr., A-51.

10 — Luminaires, Handlamp, Division 1, LED — EHLED.

11 — Luminaires, Linear, Division 1, LED — Explosionproof Rigmaster.

12 — Circuit Breaker. EB.

13 — Panelboard, factory sealed. EWP.

14 — Push Button/ Pilot Lights, factory sealed. EDS, EFDB.

15 — Switch/Manual Motor Starter. AEXMS, EDS Disconnect.

16 — Receptacles, factory sealed, U-Line, EFS.

17 — Motor for Hazardous Location.

18 — Flexible Connector. EXGJH, EXLK.

19 — TMCX Cable/Connectors, listed for Class I, Division 1.

22 — MC-HL armored/PVC jacketed cable.

National Electrical Code® Reference

a — *Sec. 501.15(A)(4)* Seal required on either side of boundary (within 10 feet) entering or leaving hazardous area.

b — *Sec. 501.15(A)(1)* Seals required within 18 inches of all arcing devices.

c — *Sec. 501.15(A)(1)* Seals required if conduit is Trade Size 2 or larger.

d — *Sec. 501.10(A) and 500.8(D)* Boxes and fittings must be explosionproof and have 5 full threads (4-1/2 when factory threaded) engaged. Permitted wiring methods include Threaded RMC, Threaded IMC, listed MI cable/fittings and listed MC-HL cable with listed cable connectors.

e — *Sec. 501.15(F)(1)* Drain/breathers must be installed to prevent accumulation of liquids or condensed vapors.

f — *Sec. 501.10(A)(2)* Flexible connections as at motor terminals must be explosionproof.

g — *Sec. 501.115* Panelboards, circuit breakers, push buttons, switches, motor controllers—shall be explosionproof and approved for Class I, Division 1 locations.

h — *Sec. 501.130(A)(4)* Boxes and fittings used for support of lighting fixtures shall be approved for Class I, Division 1 locations.

i — *Sec. 501.145* Receptacles and plugs must be explosionproof and provide grounding conductor for portable equipment.

j — *Sec. 501.15(C)(6)* Approved expanded fill seals permit up to 40% fill of cross sectional area of conduit.

k — *Sec. 501.130(A)(3)* Pendant fixture stems must be threaded rigid or IMC conduit. Stems over 12 inches must be braced or have approved flexible connector.

l — *Sec. 501.130(A)(1)* All lighting fixtures, both fixed and portable, must be approved for Class I, Division 1.

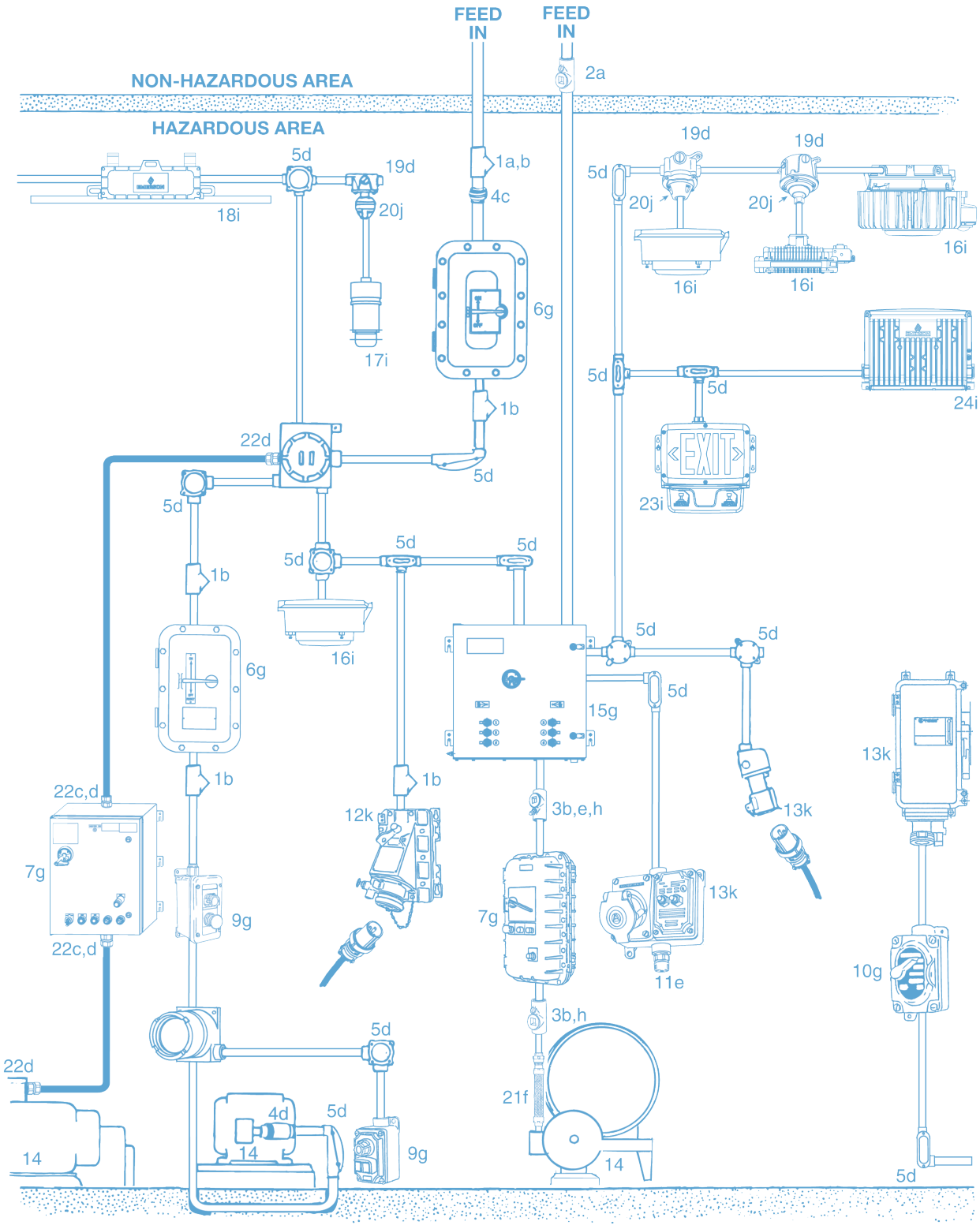
m — *Sec. 501.10(A)(1)(c)* Where wiring methods allow MC-HL cable in industrial establishments with limited public access.

n — For some applications products may require seals installed immediately adjacent. Refer to Appleton product catalogs.

o — *Sec. 501.15(D)(1)* Cable seals, Class I, Division 1.

① *Refer to Section 505.9(C)(1).*

APPENDIX E-4: LIGHTING AND POWER DIAGRAM: CLASS I, DIVISION 2, GROUPS C, D; CLASS I, ZONE 2, GROUPS IIA, IIB ①



① *All items this page also suitable for Class I, Zone 2.*

Key to Product

1 — Sealing Fittings. EYSF/M, EYS 1, 2, 3, 16, 26, 36—used with vertical conduits.

2 — Sealing Fittings. EYF/M, EYS, EYD, EYDM, ESUF/M—used with vertical or horizontal conduits.

3 — Sealing Fittings, expanded fill. EYSEF, EYDEF.

4 — Unions/Elbows. UNY-NR, UNF-NR, UNY/F, UNL, UNYL/ UNFL; ELF, ELMF.

5 — Conduit Boxes, Bodies, Fittings. Form 35, Form 85, FM7, FM8, FM9, Mogul, JB, GSU, LBD, RS.

6 — Circuit Breaker or Disconnect Switches. EB, AE, AEXMS, EDS, MD2DS.

7 — Combination Circuit Breaker and Line Starter. AEB, bolted cover.

8 — Threaded Circuit Breaker, AE, threaded cover.

9 — Push Button/Pilot Lights, factory sealed. EDS, EFDB, Unicode.

10 — Switch/Motor Starters, factory sealed. EFD, EFDB, EDS.

11 — Drain/Breather, combination. ECDB5OHP.

12 — Receptacles, non-factory sealed, interlocked, EBR, JBR.

13 — Receptacles, factory sealed, U-Line. EFS with GFI, CES, CESD, MD2SR.

14 — Motor for Division 2 Hazardous Location.

15 — Lighting Panelboard, factory sealed. D2P.

16 — Luminaires, Task/Area, Division 2, LED — Mercmaster Connect, Mercmaster Generation 3, Mercmaster Low Profile, Baymaster.

17 — Luminaires, Task/Area, Division 2, LED — Retromaster, Glomaster.

18 — Luminaires, Linear, Division 2, LED — Rigmaster.

19 — Outlet Boxes for Pendant Mount Fixtures. JB, GSU.

20 — Flexible Fixture Supports. AHG, EXJF, JB Cushion, AHG Cushion.

21 — Flexible Connectors. EXGJH, EXLK; Liquidtight flexible metal conduit and fittings. ST, STB, STN.

22 — Cable/Connectors. MC-HL—listed for Division 2. TMCX.

23 — Luminaires, Emergency Lighting System, Division 2, LED — HEX, Mercmaster Low Profile Emergency Battery Backup, Mercmaster Generation 3 Emergency Battery Backup Series.

24 — Luminaires, Task/Area, Division 2, LED - Wallmaster

National Electrical Code® Reference

a — *Sec. 501.15(B)(2)* Seals required on either side of the boundary (within 10 feet) entering or leaving the hazardous (classified) areas.

b — *Sec. 501.15(B)(1)* Seals required in all conduits connected to enclosures that are required to be explosionproof.

c — *Sec. 501.15(B)(1) and 501.15(E)(1)* Class I, Division 1 wiring methods such as threaded rigid metal conduit, IMC and explosionproof fittings are required between the seal and the explosionproof enclosure. MC-HL or MC cable is allowed however fittings must be Class I, Division 1 listed (cable connector with integral sealing method).

d — *Sec. 501.10(B)* Boxes and fittings are not required to be explosionproof unless the enclosure contains arcing (contacts), sparking or heat producing devices. Permitted wiring methods include all those for Division 1 such as threaded RMC, threaded IMC and listed MC-HL cable with listed cable connectors. Also a variety of additional cable and raceway systems are permitted including MC cable with listed MC cable connectors.

e — *Sec. 501.15(F)(1)* Drains/Breathers must be installed to prevent accumulation of liquids or condensed vapors.

f — *Sec. 501.10(B)(2)* Flexible connections such as flexible fittings and liquidtight flexible metal conduit with listed fittings are permitted. listed liquidtight flexible metal conduit fittings are fittings listed for use with liquidtight flexible metal conduit. They are not fittings listed for Class I, Division 2 hazardous (classified) locations. (There is no such thing as a liquidtight flexible metal conduit fitting listed for Class I, Division 2.)

g — *Sec. 501.115(B)(1)* Circuit breakers, pushbuttons, switches, motor controllers shall be identified for the location - explosionproof or contacts are within a factory sealed explosionproof chamber.

h — *Sec. 501.15(C)(6)* Approved expanded fill seals permit up to 40% fill of cross sectional area of conduit.

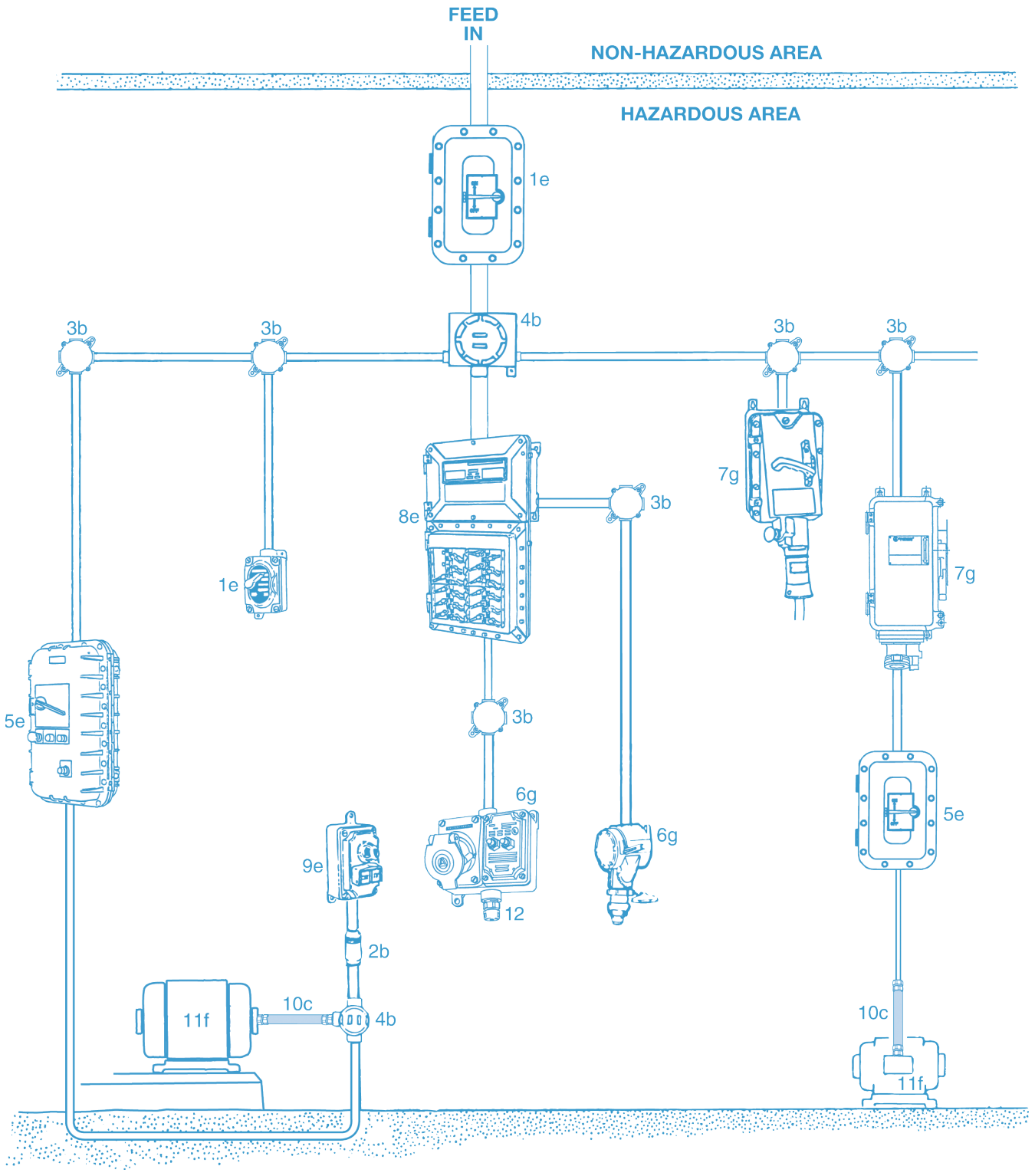
i — *Sec. 501.130(B)(1)* Luminaires shall be tested and marked with the operating temperature/T-Code (Class I, Division 2) or luminaires shall be identified Class I, Division 1 - explosionproof.

j — *Sec. 501.130(B)(3)* Pendant fixture stems must be threaded rigid metal or IMC conduit. Stems over 12 inches must be braced or have an approved flexible fitting/connector.

k — *Sec. 501.145* Receptacles and plugs must be identified for the location (explosionproof or Class I, Division 2) and have a grounding conductor for portable equipment.

① All items on this page also suitable for Class I, Zone 2.

APPENDIX E-5: POWER DIAGRAM:
CLASS II, DIVISIONS 1 AND 2, GROUPS E ①, F AND G; CLASS II, ZONES 21 AND 22 ②



① *Where Class II, Group E dusts are present in hazardous quantities, there are only Division 1 locations.*
② *Products listed for use in Class II, Division 1 and 2 are permitted to be installed in Class II, Zones 21 and 22 locations in accordance with the wiring methods in NEC® Article 506.*

APPENDIX E-5: POWER DIAGRAM:
CLASS II, DIVISIONS 1 AND 2, GROUPS E ①, F AND G; CLASS II, ZONES 21 AND 22 ②

Key to Product

1 — Circuit Breaker or Disconnect Switches. AEB, EDS series.

2 — Unions/Elbows. UNY-NR, UNF-NR, UNY/F, UNL, UNYL/UNFL; ELF, ELMF.

3 — Junction Box. CPU, with ground surface cover.

4 — Junction Box. GUBB, with screw cover.

5 — Combination/Motor Starters. AEB, AEXMS.

6 — Receptacles. EFS U-Line with GFI, CPS, FSQC.

7 — Receptacles, Interlocked. DBR, EBR, JBR, MD2SR.

8 — Panelboards. PlexPower, EWP, D2P, ALPN, APPN, AGPN, APPF.

9 — Push Button Stations. EFDB, N2, EFS, EFD, Unicode.

10 — Flexible Connectors. Liquidtight, ST Fittings.

11 — Motor for Location.

12—Combination Drain/Breather ECDB50HP.

National Electrical Code® Reference

a — *Sec. 502.10(A) and (B)* Wiring methods in Class, II Division 1 include threaded RMC, threaded IMC and MC-HL cable with cable connectors listed for Division 1. In addition to all the Division I wiring methods, permitted methods for Class II, Division 2 include unthreaded RMC & IMC as well as EMT. Also a variety of additional cable and raceway systems are permitted including MC cable with listed MC cable connectors.

b — *Sec. 502.10(A)(1)(4) and (B(4)* Boxes and fittings in Class II, Division 1 have threaded bosses and are dust Ignitionproof (NEMA 9) for Group E and when enclosures contain taps, splices or cable terminations. All other boxes and fittings in Class I, Division 1 and all boxes and fittings in Class II, Division 2 locations are dusttight. Where not available dusttight, use boxes and fittings approved for Class II, Division 1.

c — *Sec. 502.10(A)(2) and (B)(2)* Flexible connections for Division 1 and Division 2 include dusttight flexible connectors, liquidtight flexible conduit (both metal and nonmetallic) with listed fittings, jacketed interlock armor MC cable with Class II, Division 1 listed connectors and flexible cord for extra hard usage with bushed fittings.

d — *Sec. 502.15* Sealing is required to keep dust from entering a dust-ignitionproof enclosure through the raceway and is the same for Division 1 and Division 2. It can be accomplished via distance or a “permanent and effective seal.” Sealing fittings must be accessible but not explosionproof.

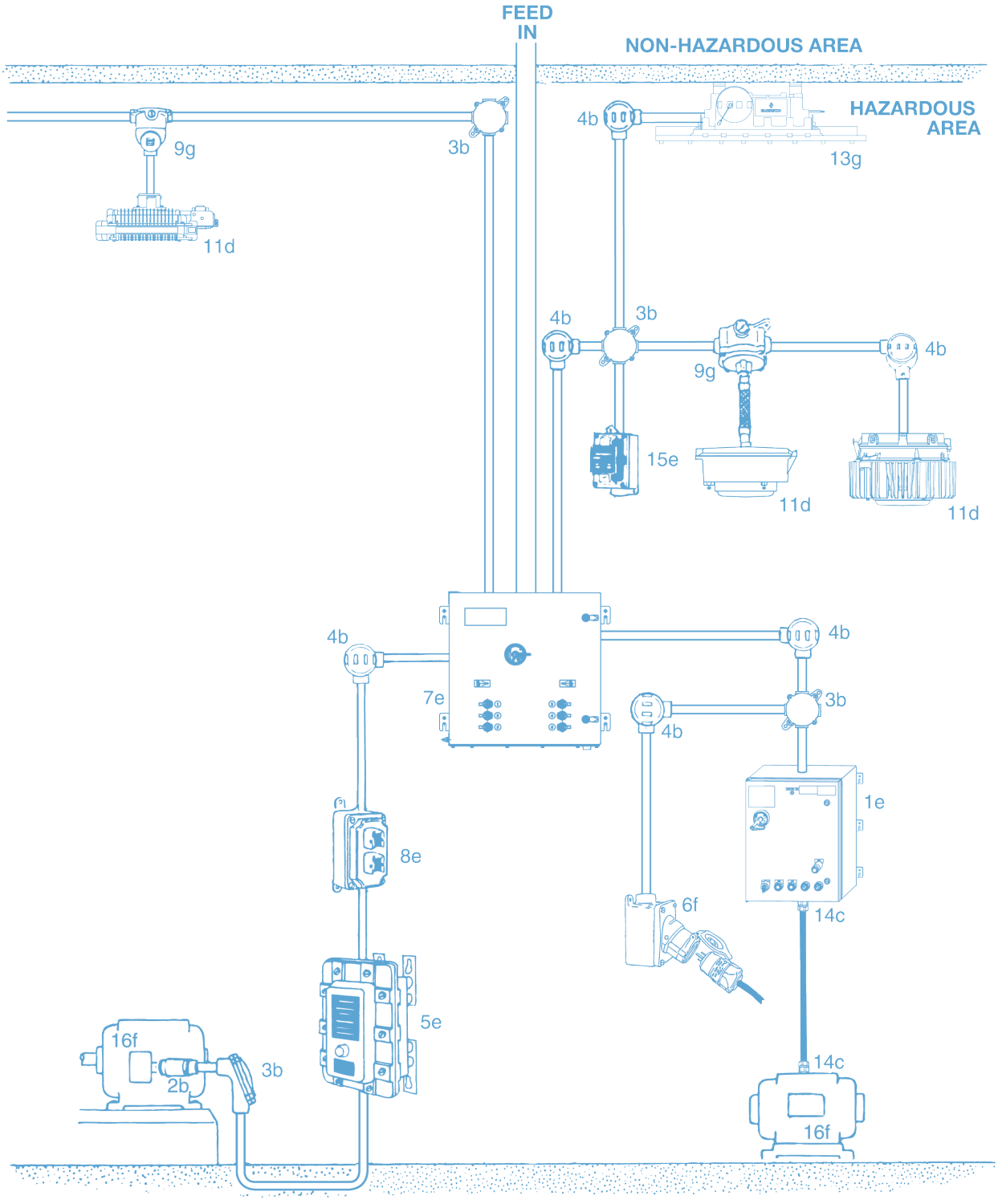
e — *Sec. 502.115(A) and (B)* Circuit breakers, pushbuttons, switches, motor controllers in Group E and Division 1 shall be dust-ignitionproof. Dusttight enclosures are suitable for Division 2.

f — *Sec. 502.125* Motors and generators in Class II, Division 1 are identified for Class II, Division 1. For Division 2 see Table 500.8(D)(2).

g — *Sec. 502.145(A) and (B)* In Division 1 receptacles and attachment plugs shall be identified for Class II. In Division 2 connection to the supply circuit cannot be made or broken while live parts are exposed. Identified Class II receptacles and attachment plugs will also meet this requirement.
Note: Due to the conductive and abrasive nature of metal dusts, there are no plugs and receptacles made for use in a Group E location.

① Where Class II, Group E dusts are present in hazardous quantities, there are only Division 1 locations.
② Products listed for use in Class II, Division 1 and 2 are permitted to be installed in Class II, Zones 21 and 22 locations in accordance with the wiring methods in NEC® Article 506.

APPENDIX E-6: LIGHTING DIAGRAM:
CLASS II, DIVISIONS 1, AND 2, GROUPS E ①, F, AND G; CLASS II, ZONES 21 AND 22 ②



① *Where Class II, Group E dusts are present in hazardous quantities, there are only Division 1 locations.*
② *Products listed for use in Class II, Division 1 and 2 are permitted to be installed in Class II, Zones 21 and 22 locations in accordance with the wiring methods in NEC® Article 506.*

APPENDIX E-6: LIGHTING DIAGRAM:
CLASS II, DIVISIONS 1, AND 2, GROUPS E ①, F, AND G; CLASS II, ZONES 21 AND 22 ②

Key to Product

1 — Circuit Breaker, Disconnect Switch, Manual Starters. EB,EDS, EXMS.

2 — Unions/Elbows, UNY-NR, UNF-NR, UNY/F UNL, UNYL/UNFL, ELF, ELMF.

3 — Junction Box. CPU, ELBD, with ground surface cover.

4 — Junction Box. GR, with screw cover.

5 — Manual Motor Starter. EXMS.

6 — Receptacle. EFS U-Line.

7 — Panelboards. PlexPower, EWP, D2P, ALPN, AGPN, APPN, APPF.

8 — Push Button/Pilot Lights. EFDB, N2, EFS, EFD, Unicode.

9 — Fixture Hangers. Division 1—CPU, GRF, EFHC, EFHU, EXJF.

11 — Luminaires, Task/Area, Division 2, LED — Mercmaster Connect, Mercmaster Generation 3, Mercmaster Low Profile, Baymaster.

13—Luminaires, Linear, Division 1, LED — Explosionproof Rigmaster.

14 — Flexible Connectors. Liquidtight, ST Fittings.

15 — Switches. EFS, EDS, Contender.

16 — Motors for Location.

National Electrical Code® Reference

a — *Sec. 502.145(A) and (B)* In Division 1 receptacles and attachment plugs shall be identified for Class II. In Division 2 connection to the supply circuit cannot be made or broken while live parts are exposed. Identified Class II receptacles and attachment plugs will also meet this requirement.
Note: Due to the conductive and abrasive nature of metal dusts, there are no plugs and receptacles made for use in a Group E location.

b — *Sec. 502.10(A)(1)(4) and (B(4)* Boxes and fittings in Class II Division 1 have threaded bosses and are dust Ignitionproof (NEMA 9) for Group E and when enclosures contain taps, splices or cable terminations. All other boxes and fittings in Class I, Division 1 and all boxes and fittings in Class II Division 2 locations are dusttight. Where not available dusttight, use boxes and fittings approved for Class II, Division 1.

c — *Sec. 502.10(A)(2) and (B)(2)* Flexible connections for Division 1 and Division 2 include dusttight flexible connectors, liquidtight flexible conduit (both metal and nonmetallic) with listed fittings, jacketed interlock armor MC cable with Class II, Division 1 listed connectors and flexible cord for extra hard usage with bushed fittings.

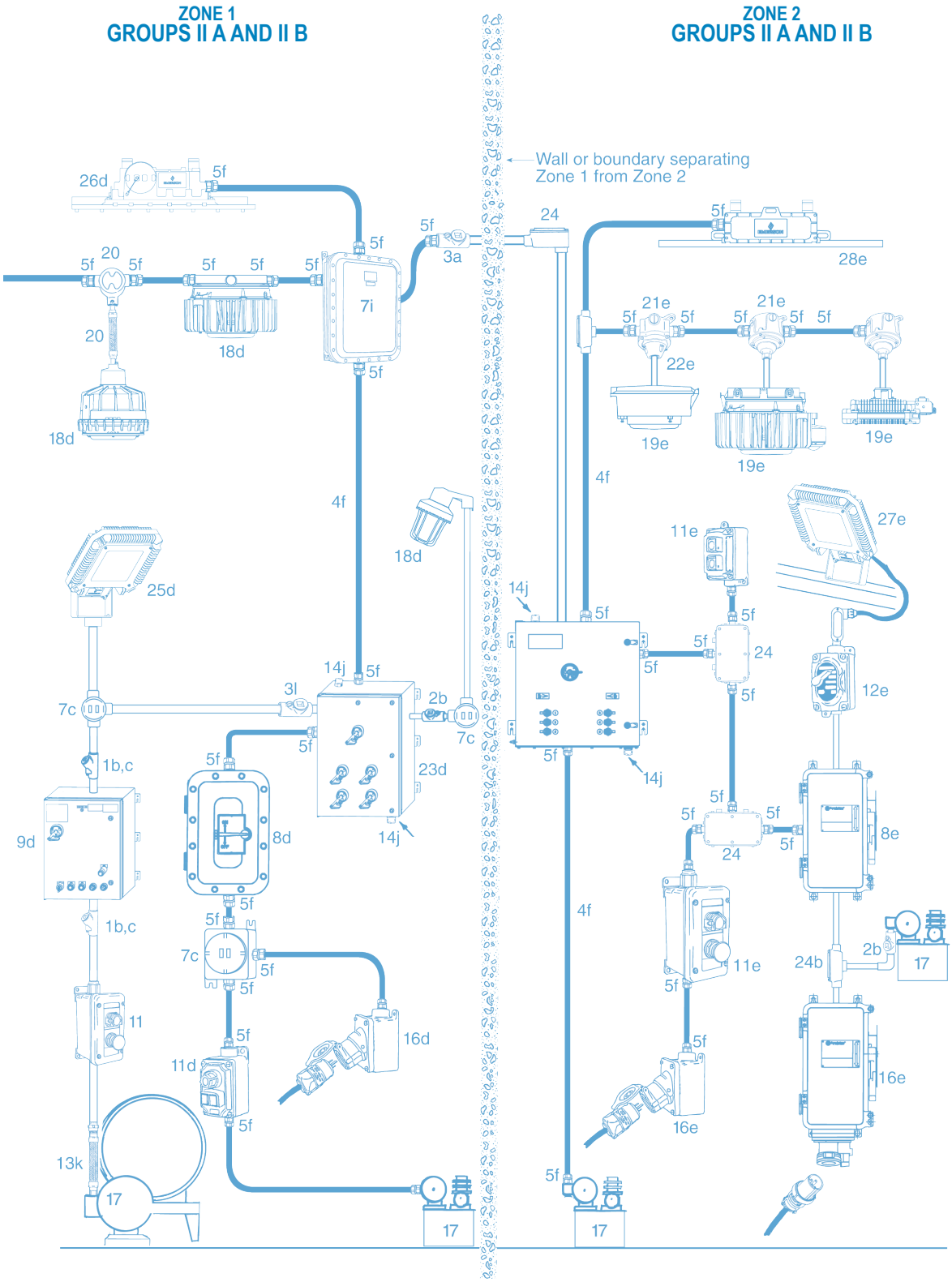
d — *Sec. 502.130(B)* In Division 2, luminaires must be suitable for Division 1 or be dusttight, temperature tested and marked with maximum lamp wattage not to exceed Table 500.8(D)(2).

e — *Sec. 502.115(A) and (B)* Circuit breakers, pushbuttons, switches, motor controllers in Group E and Division 1 shall be dust-ignitionproof. Dusttight enclosures are suitable for Division 2.

f — *Sec. 502.125* Motors and generators in Class II, Division 1 are identified for Class II, Division 1. For Division 2 see Table 500.8(D)(2)

g — *Sec. 502.130(A)* In Division 1, luminaires shall be identified for Class II (dust-ignitionproof) and marked with maximum lamp wattage. Pendant luminaires are permitted to be suspended by threaded RMC or threaded IMC stems, or chain. Stems longer than 12 inches must be braced or have a Class II listed flexible fitting or connector. For wiring not enclosed in conduit, flexible cord for hard usage with seals shall be used.

① Where Class II, Group E dusts are present in hazardous quantities, there are only Division 1 locations.
② Products listed for use in Class II, Division 1 and 2 are permitted to be installed in Class II, Zones 21 and 22 locations in accordance with the wiring methods in NEC® Article 506.


ZONE 1
GROUPS II A AND II B
ZONE 2
GROUPS II A AND II B
Wall or boundary separating
Zone 1 from Zone 2
26d
5f
20
18d
7i
3a
4f
25d
14j
3l
2b
7c
1b,c
23d
9d
8d
11
11d
16d
13k
17
24
28e
21e
22e
19e
27e
11e
12e
8e
24b
16e

Key to Product

1 — Sealing Fittings. EYSF/M, EYS 1, 2, 3, 16, 26, 36—used with vertical conduits.

2 — Sealing Fittings. EYF/M, EYS, EYD, EYDM, ESUF/M—used with vertical or horizontal conduits.

3 — Sealing Fittings, expanded fill. EYSEF, EYDEF.

4 — Cable, MC-HL, TMCX.

5 — Cable connector, TMCX.

6 — Unions. UNY-NR, UNF-NR, UNY/F UNL, UNYL/UNFL

7 — Explosionproof Junction Boxes. GRTS, GR, GRSS, GRF, GUBB, GRU, GRUE, AJBEW.

8 — Circuit Breaker or Disconnect Switch. EB, AEXMS, EDS, MD2DS.

9 — Combination Circuit Breaker and Line Starter. AEB, with bolted cover.

10 — Push Button/Pilot Light, factory sealed. EDS, EFDB.

11 — Push Button/Pilot Light, factory sealed, approved for Zone 1 and Zone 2. Unicode, EDS, EFD, Division 2 Contender.

12 — Switch/Motor Starter, factory sealed. EFD, EFDB.

13 — Flexible Coupling. EXGJH, EXLK.

14 — Drain/Breather, combination. ECDB.

15 — Receptacle, non-factory sealed, interlocked. EBR, JBR.

16 — Receptacle, factory sealed. U-Line, EFS, MD2SR.

17 — Motor for explosionproof location.

18 — Luminaires, Task/Area, Zone 1, LED — Code•Master, Code•Master Jr., Mercmaster Generation 3 Zone 1.

19 — Luminaires, Task/Area, Zone 2, LED — Mercmaster Connect, Mercmaster Generation 3, Mercmaster Low Profile, Baymaster.

20 — Fixture Hangers, Zone 1. EXJF, EFHC, EFHU.

21 — Fixture Hangers, Zone 2. JB, GSU.

22 — Flexible Fixture Supports, Zone 2. JB Cushion, AHG Cushion.

23 — Panelboard, Zone 1. EWP, ALPN, AGPN, APPN, APPF; Zone 2–D2P.

24 — Conduit Boxes, Bodies, Fittings, Zone 2. Form 35, Form 85, FM7, FM8, Mogul, JB, GSU, LBD, RS.

25 — Luminaires, Flood, Zone 1, LED — Areamaster Generation 2 Zone 1.

26 — Luminaires, Linear, Zone 1, LED — Explosionproof Rigmaster.

27 — Luminaires, Flood, Zone 2, LED — Areamaster Connect, Areamaster Generation 2.

28 — Luminaires, Linear, Zone 2, LED — Rigmaster.

National Electrical Code® Reference

a — *Sec. 505.16(B)(4)* Seals required within 3.05 m (10 ft.) of either side of boundary entering or leaving hazardous area.

b — *Sec. 505.15(B)* Wiring methods for Zone 1 sealing and drainage per Sec. 505.16. In Zone 2 [505.15(C)] wiring methods are same as for Division 2. Sealing and drainage per Sec. 505.16.

c — *Sec. 505.15(B)* Listed explosionproof fittings and boxes used with rigid, steel IMC or MI cable required.

d — *Sec. 505.20(B)* In Zone 1, equipment must be specifically listed and marked. Equipment listed for Class 1, Division 1 of the same gas group and with similar temperature marking (if any) is permitted.

e — *Sec. 505.20(C)* In Zone 2, equipment suitable for Class 1, Division 1 or Division 2 of the same gas group and similar temperature is permitted.

f — *Sec. 505.15(B)(C)* Approved MC-HL cable and listed fittings are suitable for use in Zone 1 and Zone 2.

g — *Sec. 505.16(B)(2)* Seals required within 18 inches of all arcing devices.

i — *Sec. 505.9(E), 505.15(B) and 505.20(B)* Boxes must be explosionproof and have 5 full NPT threads engaged when used with rigid or IMC conduit. Approved MI cable and fittings allowed. Approved MC-HL cable allowed with approved cable connectors.

j — *Sec. 505.16(E)* Drain/breathers must be installed to prevent accumulation of liquids or condensed vapors.

k — *Sec. 505.15(B)(2)* Flexible connections as at motor terminals must be listed for Class I, Zone 1 or Division 1 location or can be flexible cord meeting 505.17.

l — *Sec. 505.16(D)(5)* Approved expanded fill seals permit up to 40% fill of cross sectional area of conduit.

Ensure Safety and Reliability in Corrosive Environments and Hazardous Atmospheres.

Appleton electrical products by Emerson are designed to protect people, equipment, and facilities by providing exceptional safety and reliability in the harshest environments.

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