

**(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.

Where a grounding electrode is necessary for associated apparatus, the electrodes specified in 250.52(A)(1) through (A)(4) (metal underground water pipes, metal in-ground support structures, concrete-encased electrodes, and ground rings) are required to be used if present. These electrodes usually provide lower resistance grounds than ground rods and plate electrodes, which are covered in 250.52(A)(5) and (A)(7).

#### See also

**504.50(B)**, Informational Note, for where this connection might be required

### 504.60 Bonding.

**(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.

**(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.

**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.*

The use of an IS system does not remove the need to seal interconnecting cables. Any cable capable of transmitting material to another location must be sealed. These seals are not required to be explosionproof or flameproof, but they must be identified to minimize the passage of gases or dust and must be accessible.

**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.

**(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.

**(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.

**(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.

#### ARTICLE

## 505

### Zone 0, 1, and 2 Locations

#### Δ 505.1 Scope.

**(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]*.

The requirements in this article parallel those in Articles 500 and 501. The zone classification concept, based on the standards developed by the International Electrotechnical Commission (IEC), offers an alternative method of classifying Class I hazardous locations. The IEC classification scheme includes underground mines, whereas in the United States, underground mines are under the jurisdiction of the Mine Safety and Health Administration (MSHA) and are outside the scope of the NEC®.

**(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.

**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/ISA 60079-10-1 (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/ISA 60079-10-1 (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.

### 505.5 Classifications of Locations.

#### Δ (A) General.

**N (1) Hazardous (Classified) Locations.** 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.

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 a reduced level of classification or in an unclassified location to reduce the amount of special equipment required.

**N (2) Refrigerant Machinery Rooms Using Ammonia.** 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: See ANSI/IIAR 2, *Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems*, for information on the classification and ventilation of areas involving closed-circuit ammonia refrigeration systems.

**(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 ignitable mixtures. Zone 0, 1, and 2 locations shall include those specified in 505.5(B)(1), (B)(2), and (B)(3).

**Δ (1) Zone 0.** A Zone 0 location is a location in which one of the following conditions exists:

- (1) Ignitable concentrations of flammable gases or vapors are present continuously
- (2) Ignitable 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 ignitable 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

**(2) Zone 1.** A Zone 1 location is a location

- (1) In which ignitable concentrations of flammable gases or vapors are likely to exist under normal operating conditions; or
- (2) In which ignitable 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 ignitable 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 ignitable 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 ignitable concentrations of flammable vapors or gases are likely to occur in the course of normal operation but are not classified Zone 0

**(3) Zone 2.** A Zone 2 location is a location

- (1) In which ignitable 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 ignitable 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 ignitable 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 vapor 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:

**▲ (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.

**(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<sub>2</sub>.

**(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.

The zone classification system for gases is different from the division system used in Articles 500 and 501. Commentary Table 505.1 contrasts the classification of the two systems. Note that Group I is used for the classification of gases normally

**COMMENTARY TABLE 505.1** Comparison of Groups Defined Under the Zone and Division Classification Systems

Zone Classification	Division Classification
Group IIC	Groups A and B
Group IIB	Group C
Group IIA	Group D
Group I	Group D



encountered in mining applications. The group consists primarily of methane, which is known in some countries as firedamp.

- A 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 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.

**(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.

**(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.

An installation is permitted to be designed using either the classification scheme of Article 500 or the classification scheme of Article 505. Both schemes cannot be used for classifying the same area.

**(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.

**(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 <sup>37</sup> / <sub>64</sub>
IIB	30	1 <sup>3</sup> / <sub>16</sub>
IIA	10	2 <sup>5</sup> / <sub>64</sub>

**(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.

**(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.

The limit on available short-circuit current is due to the rating of terminals and terminal blocks of equipment evaluated under UL 508A, *Standard for Industrial Control Panels*, using the Type “e” protection technique.

**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.

Where the area is classified in accordance with the zone method, 505.8(A) through (N) identify the methods for protecting electrical and electronic equipment. Many of the protection methods are different from those in Article 501, and only those specified are suitable for zone installations. Of the many protection techniques, intrinsic safety, flameproof, and increased safety are the most common for Zone 1 locations.

#### See also

**505.9(C)** for marking requirements

**(A) Flameproof Enclosure “d”.** This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations.

Equipment identified as flameproof is similar to explosionproof equipment. Flameproof protection is commonly combined with increased safety protection. For example, motor control and other switching contacts are commonly protected by flameproof enclosures, with the field wiring terminals protected in a separate but attached enclosure by increased safety. The conductors between the enclosures are protected by flameproof feed-through insulators. The equipment shown in Exhibit 505.1 employs this combination of protection techniques.





**EXHIBIT 505.1** Typical control stations with the combination of flameproof and increased safety types of protection suitable for use in Zone 1 areas. (Courtesy of Eaton, Crouse-Hinds Division)

**(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.

**(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.

The identifying letter for intrinsic safety is “i” followed by either “a,” “b,” or “c,” indicating whether the equipment is suitable for Zone 0 (ia), Zone 1 (ib), or Zone 2 (ic). The associated apparatus is identified by the same letters in brackets, that is, [ia], [ib], or [ic].

The “ic” classification extends the intrinsic safety concept to Zone 2 locations. The concept is similar to the nonincendive technique in that faults to the circuit or system are not applied.

**(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.

**(E) Liquid Immersion “o”.** This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations.

**(F) Increased Safety “e”.** This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations.

The increased safety protection technique is commonly used for terminal boxes, fluorescent luminaires, motors, and generators (see 505.22).

**(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.

**(H) Powder Filling “q”.** This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations.

**Δ (I) Detection Systems for Flammable Gases.** A detection system for flammable gases shall be permitted as a means of protection in restricted industrial establishments.

**Δ (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 gas detectors are used as a protection technique.

(e) The applications for the use of 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.

**Δ (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 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).

Section 17.11 of NFPA 30, *Flammable and Combustible Liquids Code*, and 3.3.1 of 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*, provide information on what is considered adequate ventilation.



**Δ (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 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 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.

**(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.

The gas detection system must be suitable for the original zone classification of the area even though the remainder of installed equipment is permitted to be suitable for one zone lower.

**(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.

**(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.

**(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.

**(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.

**(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 locations for which it is listed.

**N (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.

**N (P) Pressurized Room “p”.** This protection technique shall be permitted for equipment in Zone 1 or Zone 2 locations for which it is identified.

**N (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.

### 505.9 Equipment.

**(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.

**(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. + H2.”

**(C) Marking.** Equipment shall be marked in accordance with 505.9(C)(1) or (C)(2).

**Δ (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: