BURGLAR & FIRE ALARM ASSOCIATION OF MICHIGAN

ESTABLISHED 1981

APPRENTICESHIP PROGRAM

BURGLAR & FIRE ALARM ASSOCIATION OF MICHIGAN ESTABLISHED 1981

APPRENTICESHIP PROGRAM

Period 4
Related Training Instruction (RTI)
Module 5 – NFPA 70 National Electrical Code

Reading material associated with this module:
Chapter 5
NFPA 70, National Electrical Code, 2023 Edition

BURGLAR & FIRE ALARM ASSOCIATION OF MICHIGAN ESTABLISHED 1981

APPRENTICESHIP PROGRAM

NFPA 70
National Electrical Code
2023 Edition
Chapter 5 – Special Occupancies

NFPA 70 National Electrical Code (NEC) 2023 Edition

Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- Combustible Dust: Solid particles that are 500µm (microns) or smaller that can form an explosible mixture when suspended in air at standard atmospheric pressure and temperature.
- Combustible Gas Detection System: A protection technique utilizing stationary gas detectors in industrial establishments.
- 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.
- 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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- Dusttight: Enclosures constructed so that dust will not enter under specified test conditions.
- Equipment: Materials, fittings, devices, appliances, and the like that are part of, or in connection with, an electrical installation. *Associated with electrical or electronic equipment.*
- 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.
- 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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
  - Explosionproof equipment examples:

NFPA 70 National Electrical Code (NEC) 2023 Edition

Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- Fibers/Flyings, Combustible: Fibers/flyings, where any dimension is >500µm (microns) in nominal size, which can form an explosible mixture when suspended in air at standard atmospheric pressure and temperature.
- Fibers/Flyings, Ignitible: Fibers/flyings, where any dimension is >500µm (microns) 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.
- 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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- 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.
- Intrinsically Safe Apparatus: Apparatus in which all the circuits are intrinsically safe.
- 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.
- Intrinsically Safe Circuits, Different: Intrinsically safe circuits in which the possible interconnections have not been evaluated and identified as intrinsically safe.
- Intrinsically Safe Systems: 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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- 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 *(also see Oil Immersion)*.
- 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.
- 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 a nonincendive component is not intended to exclude the flammable atmosphere or contain an explosion.

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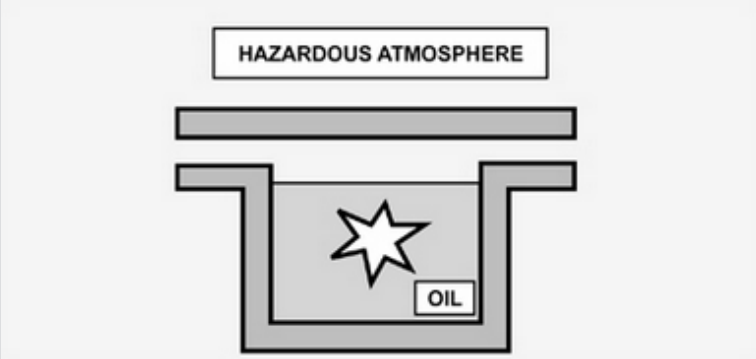
Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
  - Liquid Immersion “o” example:



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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- 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.
- 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.
- Nonincendive Field Wiring Apparatus: Apparatus intended to be connected to nonincendive field wiring.
- Nonsparking: Constructed to minimize the risk of arcs or sparks capable of creating an ignition hazard during conditions of normal operation.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- 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 1nm and 1000µm.
- Optical Radiation, Inherently Safe “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 in normal or specified fault conditions to ignite a specific explosive atmosphere.
- Optical Radiation, Protected “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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- 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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- 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 ignitable fibers/flyings.
- 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.
- 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.

NFPA 70 National Electrical Code (NEC) 2023 Edition

Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- 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 ignitable fiber.
- Restricted Industrial Establishment: Establishment with restricted public access, where conditions of maintenance and supervision ensure that only qualified persons service the installation.
- Sealed: Constructed such that equipment is sealed effectively against the entrance of an external atmosphere and is not opened during normal operation or for any maintenance activities.
- Sealed, Hermetically: 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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- Article 100 – Definitions:
- 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 can be demonstrated to provide the necessary equipment protection level.
- 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.
- Locations, Unclassified: 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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.1 Scope:
- (A) Covered: This article covers area classification and general requirements for electrical and electronic equipment and wiring rated at all voltages where fire and explosion hazards might exist due to flammable gases, flammable liquid-produced vapors, combustible liquid-produced vapors, combustible dusts, combustible fibers / flyings, or ignitable 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 II, Division 2 hazardous (classified) locations.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.1 Scope:
- (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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.5 Classification of Locations:
- (A) General:
  - (1) Hazardous (Classified) Locations: 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.
  - 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 to reduce the amount of special equipment required.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.5 Classification of Locations:
- (A) General:
  - (2) Refrigerant Machinery Rooms Using Ammonia: Refrigeration 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 150ppm shall be permitted to be classified as “unclassified” locations.
- (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 ignitable mixtures. Class I locations shall include those specified in 500.5(B)(1) and (B)(2).

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.5 Classification of Locations:
- (1) Class I, Division 1: A Class I, Division 1 location is a location:
  - (1) In which ignitable concentrations of flammable gases, flammable liquid–produced vapors, or combustible liquid–produced vapors can exist under normal operating conditions, or
  - (2) In which ignitable 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 ignitable 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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.5 Classification of Locations:
- (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 ignitable 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

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.5 Classification of Locations:
- (2) Class I, Division 2: A Class I, Division 2 location is a location:
  - (3) That is adjacent to a Class I, Division 1 location, and to which ignitable 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 Notes are contained in the NFPA 70 text that provide further information regarding example locations for Class I, Division 1 and Class I, Division 2 areas.*

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.5 Classification of Locations:
- (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).
- (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 ignitable mixtures, or
  - (2) Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable 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 *(combustible metal dusts including aluminum, magnesium)* may be present in quantities sufficient to be hazardous in normal or abnormal operating conditions.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.5 Classification of Locations:
- (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 ignitable 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 ignitable by abnormal operation or failure of electrical equipment.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.5 Classification of Locations:
- (C) Class III Locations: Class III locations shall be locations meeting the requirements of 500.5(D)(1) and 500.5(D)(2).
- (1) Class III, Division 1: Class III, Division 1 shall include those locations specified in 500.5(D)(1)(a) and 500.5(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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.5 Classification of Locations:
- (1) Class III, Division 1: Class III, Division 1 shall include those locations specified in 500.5(D)(1)(a) and 500.5(D)(1)(b):
  - (b) Ignitible Fibers/Flyings: Locations where ignitible fibers/flyings are handled, manufactured, or used shall be classified as Class III, Division 1.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.5 Classification of Locations:
- (2) Class III, Division 2: Class III, Division 2 locations shall include those locations specified in 500.5(D)(2)(a) and 500.5(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 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.
- *Informational Notes are contained in the NFPA 70 text that provide further information regarding example locations for Class II and Class III areas.*

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.6 Materials:
- (A) Class I Group Classifications: Class I groups shall be in accordance with 500.6(A)(1) through (A)(4):
  - (1) Group A: Acetylene
  - (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 0.45mm or a minimum igniting current ratio (MIC ratio) less than or equal to 0.40.
  - Informational Note: A typical Class I, Group B material is hydrogen.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.6 Materials:
- (A) Class I Group Classifications: Class I groups shall be in accordance with 500.6(A)(1) through (A)(4) (continued):
  - (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 0.45mm and less than or equal to 0.75mm, or a minimum igniting current ratio (MIC ratio) greater than 0.40 and less than or equal to 0.80.
  - Informational Note: A typical Class I, Group C material is ethylene.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.6 Materials:
- (A) Class I Group Classifications: Class I groups shall be in accordance with 500.6(A)(1) through (A)(4) (continued):
  - (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 0.75mm or a minimum igniting current ratio (MIC ratio) greater than 0.80.
  - Informational Note: A typical Class I, Group D material is propane.
- (B) Class II Combustible Dust Group Classifications: Combustible dust shall be grouped in accordance with 500.6(B)(1) through (B)(3):
  - (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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.6 Materials:
- (B) Class II Combustible Dust Group Classifications: Combustible dust shall be grouped in accordance with 500.6(B)(1) through (B)(3) (continued):
  - (2) Group F: Atmospheres containing combustible carbonaceous dusts that have more than 8 percent total entrapped volatiles or that have been sensitized by other materials so that they present an explosion hazard. Coal, carbon black, charcoal, and coke dusts are examples of carbonaceous dusts.
  - (3) Group G: Atmospheres containing combustible dusts not included in Group E or F, including flour, grain, wood, plastic, and chemicals.
- Class III Combustible Fibers/Flyings and Class III Ignitible Fibers/Flyings shall not be further grouped.
- *Informational Notes are contained in the NFPA 70 text that provide further information regarding Class III Group classifications.*

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 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.
  - (A) Explosionproof Equipment: This protection technique shall be permitted for equipment in Class I, Division 1 or 2 locations.
  - (B) Dust Ignitionproof: This protection technique shall be permitted for equipment in Class II, Division 1 or 2 locations.
  - (C) Dusttight: This protection technique shall be permitted for equipment in Class II, Division 2 or Class III, Division 1 or 2 locations.
  - (D) Purged and Pressurized: This protection technique shall be permitted for equipment in any hazardous (classified) location for which it is identified.
  - (E) Intrinsic Safety: This protection technique shall be permitted for equipment in Class I, Division 1 or 2; or Class II, Division 1 or 2; or Class III, Division 1 or 2 locations.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 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.
  - (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.
  - (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.
  - (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.
  - (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).
  - (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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 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.
  - (K) Detection System for Flammable Gases: A detection system for flammable gases shall be permitted as a means of protection in restricted industrial establishments.
    - Any gas detection system used as a protection technique shall meet all of the requirements of (1) General: 500.7(K)(1)(a) through (K)(1)(e), (2) Inadequate Ventilation, (3) Interior of a Building or Enclosed Space, and (4) Interior of a Control Panel.
  - (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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 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.
  - (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.
  - (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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 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.
  - (R) Enclosed-Break: This protection technique shall be permitted for equipment in Class I, Division 2 locations.
  - (S) Nonsparking: This protection technique shall be permitted for equipment in Class I, Division 2 locations.
  - (T) 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.
  - (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.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.8 Equipment:
- *Articles 500 through 506 require equipment construction and installation that ensure safe performance under conditions of proper use & maintenance.*
- (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 AHJ such as a manufacturer's self-evaluation or an owner's engineering judgement.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.8 Equipment:
- (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 in 500.8(C)(1) through (C)(5).
  - (1) Class: The marking shall specify the class(es) for which the equipment is suitable.
  - (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.
  - (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.
  - (4) Equipment Temperature.
  - (5) Ambient Temperature Range.
  - (6) Special Allowances.

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Article 500 – Hazardous (Classified) Locations, Classes I, II, III, Divisions 1 and 2:

- 500.8 Equipment:
- (E) Threading: Supply entry thread may be NPT or metric. Conduit and fittings shall be made wrench-tight to prevent sparking when fault current flows through the conduit system, and to ensure the explosionproof integrity of the conduit system, where applicable.
  - (1) NPT-threaded and metric-threaded entries into explosionproof equipment shall be made up with at least five threads fully engaged.
  - (3) All unused openings shall be closed with blanking elements or close-up plugs that are listed for the location and shall be made up with at least five threads fully engaged.
- (F) Optical Fiber Cables: An optical fiber cable, with or without current-carrying conductors 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.

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Article 501 – Class I Locations:

- 501.1 Scope: This article covers the requirements for electrical and electronic equipment and wiring for all voltages in Class I, Division 1 & 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 product explosive or ignitible mixtures.
- 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.

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Article 501 – Class I Locations:

- 501.150 Signaling, Alarm, Remote-Control, and Communications Systems:
- (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).
- (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).

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Article 501 – Class I Locations:

- 501.150 Signaling, Alarm, Remote-Control, and Communications Systems:
- (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.
- (2) Resistors and Similar Equipment: Resistors, resistance devices, thermionic tubes, rectifiers, and similar equipment shall comply with 501.105(B)(3).

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Article 501 – Class I Locations:

- 501.150 Signaling, Alarm, Remote-Control, and Communications Systems:
- (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.
- (4) Wiring and Sealing: All wiring shall comply with 501.10(B), 501.15(B), and 501.15(C).

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Article 502 – Class II Locations:

- 502.1 Scope: This article covers the requirement for electrical and electronic equipment and wiring for all voltages in Class II, Division 1 & 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.
- 502.6 Zone Equipment: Equipment listed and marked in accordance with 505.9(C)(2) for use for Zone 20 locations shall be permitted in Class II, Division 2 locations for the same dust 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 II, Division 1 locations for the same dust atmosphere and with a suitable temperature class.

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Article 502 – Class II Locations:

- 502.150 Signaling, Alarm, Remote-Control, and Communications Systems; and Meters, Instruments, and Relays:
- (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).
- (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 interruption of current occurs within a chamber sealed against the entrance of dust, enclosures shall be permitted to be of the general-purpose type.

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Article 502 – Class II Locations:

- 502.150 Signaling, Alarm, Remote-Control, and Communications Systems; and Meters, Instruments, and Relays:
- (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 where interruption of current occurs within a chamber sealed against the entrance of dust, enclosures shall be permitted to be of the general-purpose type.
- (3) Rotating Machinery: Motors, generators, and other rotating electrical machinery shall comply with 502.125(A).

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Article 502 – Class II Locations:

- 502.150 Signaling, Alarm, Remote-Control, and Communications Systems; and Meters, Instruments, and Relays:
- (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).
- (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 502.150(A)(1) or shall 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.
- (2) Transformers and Similar Equipment: The windings and terminal connections of transformers, choke coils, and similar equipment shall comply with 502.120(B)(2).

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Article 502 – Class II Locations:

- 502.150 Signaling, Alarm, Remote-Control, and Communications Systems; and Meters, Instruments, and Relays:
- (3) Resistors and Similar Equipment: Resistors, resistance devices, thermionic tubes, rectifiers, and similar equipment shall comply with 502.120(B)(3).
- (4) Rotating Machinery: Motors, generators, and other rotating electrical machinery shall comply with 502.125(B).

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Article 503 – Class III Locations:

- 503.1 Scope: This article covers the requirement for electrical and electronic equipment and wiring for all voltages in Class III, Division 1 & 2 locations where fire or explosion hazards might exist due to nonmetal combustible fibers/flyings or ignitible fibers/flyings.
- 503.5 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 2: Organic material that is carbonized or excessively dry is highly susceptible to spontaneous ignition.
- 503.6 Zone Equipment: Equipment listed and marked in accordance with 505.9(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 505.9(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.

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Article 503 – Class III Locations:

- 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.

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Additional 500 Series Articles:

- *Article 504 covers the installation of intrinsically safe apparatus, wiring, and systems for hazardous (classified) locations.*
- *Articles 505 and 506 cover the requirements for the zone classification system as an alternative to the division system for electrical and electronic equipment and wiring. The zone system for hazardous (classified) locations is used internationally and was developed by the International Electrotechnical Commission (IEC) which is a global organization that creates electrical and electronic standards. You may encounter the zone system in use among international manufacturers with locations in the US, or US based manufacturers with international facilities.*
- *Articles 511, 512, 513, 514, 515, and 516 cover requirements for specific hazardous locations, e.g., Commercial Garages, Aircraft Hangers, Bulk Storage Plants, Spray Application, etc.*
- *Articles 517 through 590 cover specific electrical design, construction or installation criteria for specific occupancy groups, e.g., healthcare, assembly, permanent amusement attractions, agricultural, etc.*

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Article 517 – Health Care Facilities:

- Part III Essential Electrical Systems (ESS):
- 517.33 Life Safety Branch: The life safety branch shall be limited to circuits essential to life safety. No function other than those listed in 517.33(A) through (H) shall be connected to the life safety branch. The life safety branch of the emergency system shall supply power as follows:
  - (C) Alarm and Alerting Systems: Alarm and alerting systems including the following:
    - (1) Fire Alarm Systems.
    - (2) Alarms or alerting systems other than fire alarm systems shall be connected to the life safety branch or critical branch.
    - (3) Alarms for systems used for the piping of nonflammable medical gases.
    - (4) Mechanical, control, and other accessories required for effective life safety systems operation shall be permitted to be connected to the life safety branch.
  - (D) Communications Systems: Hospital communications systems, where used for issuing instructions during emergency conditions.

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Article 517 – Health Care Facilities:

- Part VI Communications, Signaling Systems, Data Systems, Fire Alarm Systems, and Systems Less Than 120 Volts, Nominal:
- 517.80 Patient Care Areas: Equivalent insulation and isolation to that required for the electrical distribution systems in patient care areas shall be provided for communications, signaling systems, data system circuits, fire alarm systems, and systems less than 120 volts, nominal.
- Class 2 and Class 3 signaling and communications systems, Class 2 circuits that transmit power and data to a powered device, and power-limited fire alarm systems shall not be required to comply with the grounding requirements of 517.13, to comply with the mechanical protection requirements of 517.31(C)(3)(5), or to be enclosed in raceways, unless otherwise specified by Chapter 7 or 8.
- Secondary circuits of transformer powered communications or signaling systems shall not be required to be enclosed in raceways unless otherwise specified by Chapter 7 or 8.

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Additional Information:

- *Additional reading:*
  - *Information regarding conduit, wiring, and installation for Class I, Division 1 and 2 locations is contained in section 501.10, Class II, Division 1 and 2 locations in section 502.10, and Class III, Division 1 and 2 in section 503.10.*
  - *Information regarding sealing and drainage for Class I, Division 1 and 2 locations is contained in section 501.15, and sealing for Class II, Division 1 and 2 locations in section 502.15.*

END OF PERIOD 4 – MODULE 5