for Class I, Division 2 or Zone 2 locations, electrical equipment shall be permitted.

N **(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.

N **(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.

N **(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.

N **(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.

N **(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.

N **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.

N **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.

N **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.

N **(A) Division Equipment.** Equipment for Class I, Division 1 or Class I, Division 2 shall be marked in accordance with 500.8(C).

N **(B) Zone Equipment.** Equipment for Zone 1 or Zone 2 shall be marked in accordance with 500.8(C)(2).

ARTICLE
513 Aircraft Hangars

Δ **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 does not apply to areas in which the only fuel contained in the aircraft is a Class II combustible liquid, unless the fuel will be used or stored above its flash point within the hangar. A Class II liquid has a closed-cup flash point at or above 100°F. Some aviation fuel, such as Jet-A, is a Class II combustible liquid. An aircraft manufacturing plant in which the aircraft under construction have never contained fuel is an example of a facility not covered by the requirements of Article 513.

Many steps are required to properly classify a hazardous location. Although the *NEC*® provides general area classifications in Articles 501, 502, 503, 505, and 506, it does not classify specific locations. The *NEC* classifications for specific occupancies or processes have been extracted from other NFPA documents. The classifications from those documents are based on the premise that all applicable requirements of the document have been met. Deviations in on-site conditions, such as process conditions, area ventilation, and room construction, from those assumed by the document may alter the general classification. Those responsible for the specific area classification must consider the basis for the general classifications to determine the applicability to a specific location.

N **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.

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.

N *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

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.

(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.

(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.

(C) Vicinity of Aircraft.

Δ **(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 engine enclosures.

Information on aircraft parking patterns, the types of aircraft, and the operations to be performed in the hangar are needed to properly classify hangar areas. Much of the hangar area classification is dependent on the dimensional outline of the aircraft; therefore, consideration of future aircraft and parking patterns is appropriate to avoid costs associated with changes in the area classification. Exhibit 513.1 illustrates area classifications in aircraft hangars. In aircraft painting hangars, the classified areas expand to include the entire surface area of the aircraft per 513.3(C)(2), not only the engines and fuel tanks.

Δ **(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, *Standard for Spray Application Using Flammable or Combustible Materials*, for information on ventilation and grounding for static protection in spray painting areas.

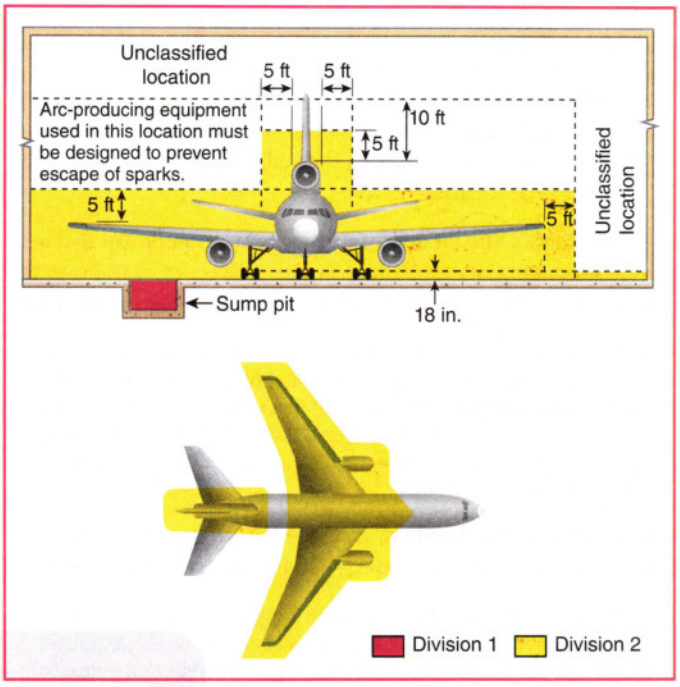

EXHIBIT 513.1 Area classification in aircraft hangars.

Δ **(D) Areas Suitably Separated 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, designed with positive air pressure, or effectively separated from the hangar itself by walls or partitions.

513.4 Wiring and Equipment in Class I Locations.

Δ **(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 shall be identified for the location or shall be designed so they cannot be energized while the connections are being made or broken.

Δ **(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.

(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.

(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.

(C) Arcing Equipment. In locations above those described in 513.3, equipment that is less than 3.0 m (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.

(D) Lampholders. Lampholders of metal-shell, fiber-lined types shall not be used for fixed incandescent lighting.

(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.

Δ **(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 FT CLEAR OF AIRCRAFT
ENGINES AND FUEL TANK AREAS

513.8 Underground Wiring.

(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.

(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.

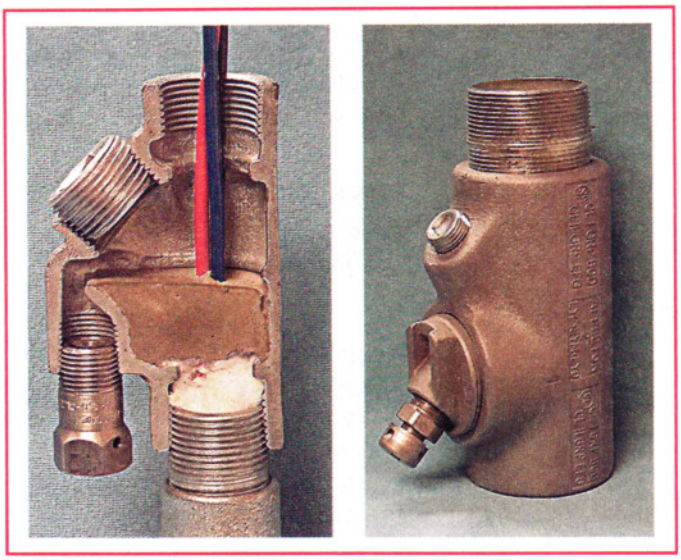

EXHIBIT 513.2 Explosionproof conduit seal fittings that can be used to meet the requirements for boundary seals in runs of conduit that transition from classified to unclassified locations. *(Courtesy of Appleton™, Emerson Electric Co.)*

Wiring and equipment embedded in or buried below the hangar floor is considered to be in a Class I, Division 1 location, whereas uninterrupted raceways that are embedded in or buried below the hangar floor are considered to be in the same hazardous location that exists above the floor. Raceways that rise out of the floor in unclassified locations must be provided with boundary seals in accordance with 501.15. Exhibit 513.2 shows two examples of seal fittings that can be used to comply with the requirements to provide boundary seals for raceways installed in or under hangar floors.

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.

513.10 Special Equipment.

(A) Aircraft Electrical Systems.

(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.

(2) Aircraft Batteries. Aircraft batteries shall not be charged where installed in an aircraft located inside or partially inside a hangar.

Δ **(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 be located in a separate building or in an area 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

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.

(C) External Power Sources for Energizing Aircraft.

(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).

Δ **(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

(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.

(D) Mobile Servicing Equipment with Electrical Components.

Δ **(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

(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.

(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.

(E) Portable Equipment.

(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.

(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).

513.16 Grounding and Bonding Requirements.

(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 505.30 for Zone 0, 1, and 2 locations.

(B) Supplying Circuits with Grounded and Equipment Grounding Conductors in Class I Locations.

(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,