

sparkling distance is maintained between the workpiece or material being sprayed and electrodes, electrostatic atomizing heads, or charged conductors. Warnings defining this safe distance shall be posted. [33:11.4.1]

(b) The equipment shall provide an automatic means of rapidly de-energizing the high-voltage elements in the event the distance between the goods being painted and the electrodes or electrostatic atomizing heads falls below that specified in 516.10(A)(10)(a). [33:11.3.8]

(B) Hand-Spraying Electrostatic Equipment. This section shall apply to any equipment using electrostatically charged elements for the atomization, charging, or precipitation of flammable and combustible materials for coatings on articles, or for other similar purposes in which the charging or atomizing device is hand-held and manipulated during the spraying operation. Electrostatic hand-spraying equipment and devices used in connection with paint-spraying operations shall be of listed types and shall comply with 516.10(B)(1) through (B)(5).

(1) General. The high-voltage circuits shall be designed so as not to produce a spark of sufficient intensity to ignite the most readily ignitable of those vapor-air mixtures likely to be encountered or result in appreciable shock hazard upon coming in contact with a grounded object under all normal operating conditions. The electrostatically charged exposed elements of the handgun shall be capable of being energized only by an actuator that also controls the coating material supply.

(2) Power Equipment. Transformers, power packs, control apparatus, and all other electrical portions of the equipment shall be located outside of the Class I location or be identified for the location.

Exception: The handgun itself and its connections to the power supply shall be permitted within the Class I location.

(3) Handle. The handle of the spraying gun shall be electrically connected to ground by a conductive material and be constructed so that the operator in normal operating position is in electrical contact with the grounded handle with a resistance of not more than 1 megohm to prevent buildup of a static charge on the operator's body. Signs indicating the necessity for grounding other persons entering the spray area shall be conspicuously posted.

Δ (4) Electrostatic Equipment. All electrically conductive objects in the spraying area, except those objects required by the process to be at high voltage shall be electrically connected to ground with a resistance of not more than 1 megohm. This requirement shall apply to paint containers, wash cans, and any other electrical conductive objects or devices in the area. The equipment shall carry a prominent, permanently installed warning regarding the necessity for this grounding feature.

Informational Note: See NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials; NFPA 34, Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids; and NFPA 77, Recommended Practice on Static Electricity, for information on grounding and bonding for static electricity purposes.

(5) Support of Objects. Objects being painted shall be maintained in electrical contact with the conveyor or other grounded support. Hooks shall be regularly cleaned to ensure adequate grounding of 1 megohm or less. Areas of contact shall be sharp points or knife edges where possible. Points of support of the object shall be concealed from random spray where feasible, and, where the objects being sprayed are supported from a conveyor, the point of attachment to the conveyor shall be located so as to not collect spray material during normal operation.

(C) Powder Coating. This section shall apply to processes in which combustible dry powders are applied. The hazards associated with combustible dusts are present in such a process to a degree, depending on the chemical composition of the material, particle size, shape, and distribution.

Δ (1) Electrical Equipment and Sources of Ignition. Electrical equipment and other sources of ignition shall comply with the requirements of Part III of Article 502 or 506.20, as applicable. Portable electric luminaires and other utilization equipment shall not be used within a Class II location during operation of the finishing processes. Such luminaires or utilization equipment used during cleaning or repairing operations shall be of a type identified for Class II, Division 1 locations and all exposed metal parts shall be connected to an equipment grounding conductor.

Exception: Portable electric luminaires shall be of the type listed for Class II, Division 1 locations where required for operations in spaces not readily illuminated by fixed lighting within the spraying area and where readily ignitable residues might be present.

(2) Fixed Electrostatic Spraying Equipment. The provisions of 516.10(A) and 516.10(C)(1) shall apply to fixed electrostatic spraying equipment.

(3) Electrostatic Hand-Spraying Equipment. The provisions of 516.10(B) and 516.10(C)(1) shall apply to electrostatic hand-spraying equipment.

Δ (4) Electrostatic Fluidized Beds. Electrostatic fluidized beds and associated equipment shall be of identified types. The high-voltage circuits shall be designed such that any discharge produced when the charging electrodes of the bed are approached or contacted by a grounded object shall not be of sufficient intensity to ignite any powder-air mixture likely to be encountered or to result in an appreciable shock hazard.

(a) Transformers, power packs, control apparatus, and all other electrical portions of the equipment shall be located outside the powder-coating area or shall otherwise comply with the requirements of 516.10(C)(1).

Exception: The charging electrodes and their connections to the power supply shall be permitted within the powder-coating area.

(b) All electrically conductive objects within the powder-coating area shall be adequately grounded. The powder-coating

equipment shall carry a prominent, permanently installed warning regarding the necessity for grounding these objects.

Informational Note: See NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*; NFPA 34, *Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids*; and NFPA 77, *Recommended Practice on Static Electricity*, for information on grounding and bonding for static electricity purposes.

(c) Objects being coated shall be maintained in electrical contact (less than 1 megohm) with the conveyor or other support in order to ensure proper grounding. Hangers shall be regularly cleaned to ensure effective electrical contact. Areas of electrical contact shall be sharp points or knife edges where possible.

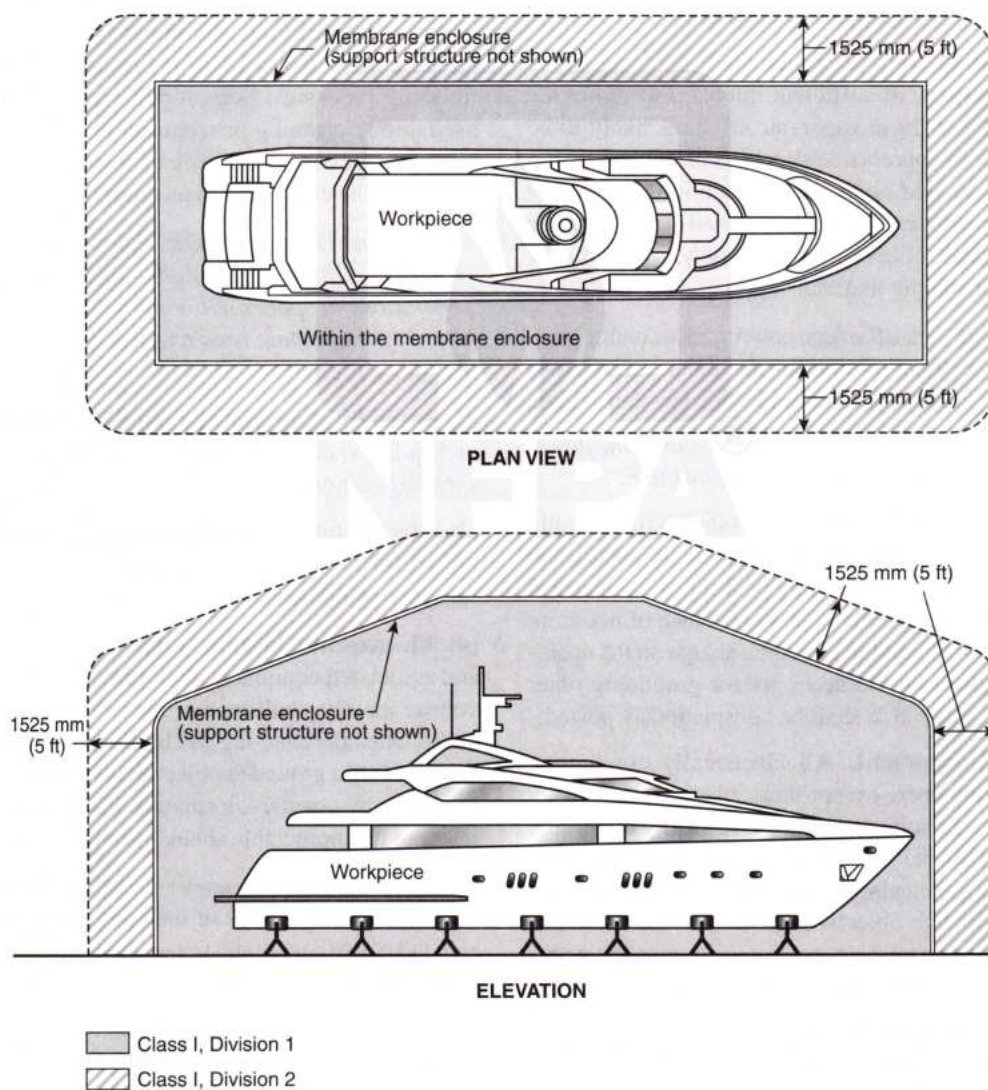
(d) The electrical equipment and compressed air supplies shall be interlocked with a ventilation system so that the equipment cannot be operated unless the ventilating fans are in operation. [33:Chapter 15]

516.16 Grounding. All metal raceways, the metal armors or metallic sheath on cables, and all non-current-carrying metal parts of fixed or portable electrical equipment, regardless of voltage, shall be grounded and bonded. Grounding and bonding shall comply with 501.30, 502.30, or 505.30, as applicable.

Part IV. Spray Application Operations in Membrane Enclosures

Δ 516.18 Area Classification for Temporary Membrane Enclosures. Electrical area classification shall be as follows:

- (1) The area within the membrane enclosure shall be considered a Class I, Division 1 area, as shown in Figure 516.18.
- (2) A 1.5 m (5 ft) zone outside of the membrane enclosure shall be considered Class I, Division 2, as shown in Figure 516.18.



Δ **FIGURE 516.18** Electrical Classifications for Outdoor Membrane Enclosures. [33:Figure 18.6.1.2]

Informational Note No. 1: See NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, for information on occupancy, ventilation, fire protection, and permitting for spray application operations in membrane enclosures. This document limits spray application operations within both outdoor and indoor temporary membrane enclosures, as well as use and time constraints. The risks to people and property are unique when spray painting within the confined spaces of temporary membrane enclosures.

Informational Note No. 2: See NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, Section 18.6, for the limits of material used in a vertical plane for membrane enclosures.

Informational Note No. 3: See NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, Test Method 2, for construction information.

Informational Note No. 4: See NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, 18.3.2.1.1, for membrane installation beneath sprinklers.

Informational Note No. 5: See NFPA 13, *Standard for the Installation of Sprinkler Systems*, 8.15.15, for information on the protection of membrane structures.

516.23 Electrical and Other Sources of Ignition. Electrical wiring and utilization equipment used within the classified areas inside and outside of membrane enclosures during spray painting shall be suitable for the location and shall comply with all of the following:

- (1) All power to the workpiece shall be removed during spray painting.
- (2) Workpieces shall be grounded.
- (3) Spray paint equipment shall be grounded.
- (4) Scaffolding shall be bonded to the workpiece and grounded by an approved method.

Part V. Printing, Dipping, and Coating Processes

Δ 516.29 Classification of Locations. Classification is based on quantities of flammable vapors, combustible mists, residues, dusts, or deposits that are present or might be present in quantities sufficient to produce ignitable or explosive mixtures with air. Electrical wiring and electrical utilization equipment located adjacent to open processes shall comply with the requirements as follows. Examples of these requirements are illustrated in Figure 516.29(1), Figure 516.29(2), Figure 516.29(3), and Figure 516.29(4).

Informational Note: See NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, Chapter 6, and NFPA 34, *Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids*, Chapter 6, for additional information.

- (1) Electrical wiring and electrical utilization equipment located in any sump, pit, or below grade channel that is within 7620 mm (25 ft) horizontally of a vapor source, as defined by this standard, shall be suitable for Class I, Division 1 or Class I, Zone 1 locations. If the sump, pit, or channel extends beyond 7620 mm (25 ft) of the vapor source, it shall be provided with a vapor stop, or it shall be classified as Class I, Division 1 or Class I, Zone 1 for its entire length. [34:6.4.1]
- (2) Electrical wiring and electrical utilization equipment located within 1525 mm (5 ft) of a vapor source shall be suitable for Class I, Division 1 or Class I, Zone 1 locations. The space inside a dip tank, ink fountain, ink reservoir, or ink tank shall be classified as Class I, Division 1 or Class I, Zone 0, whichever is applicable.

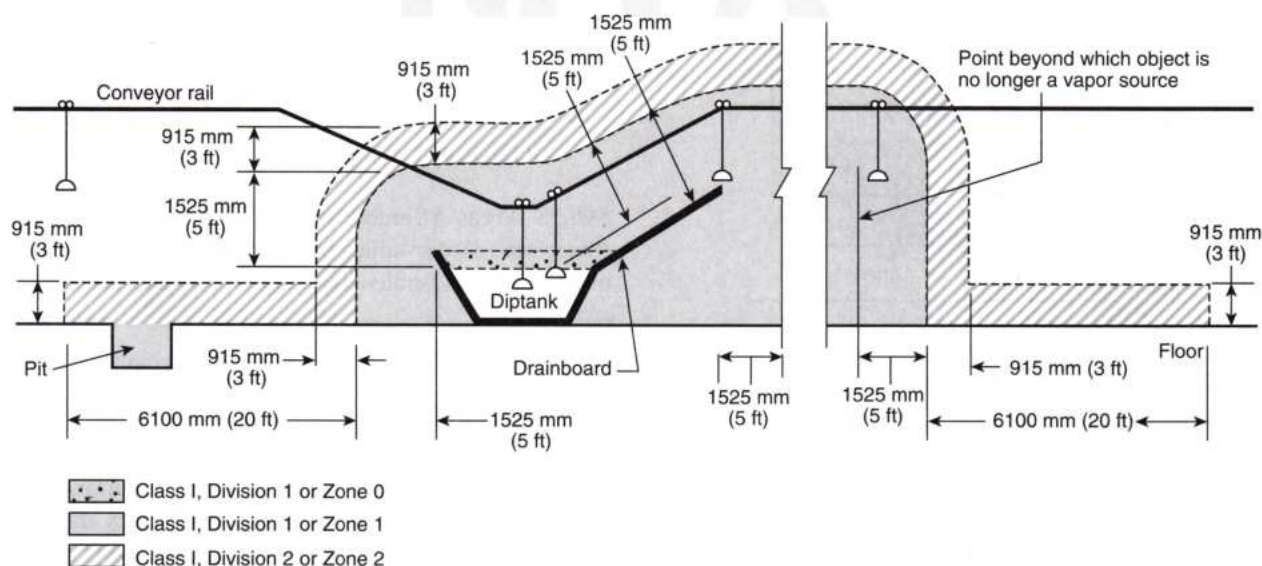
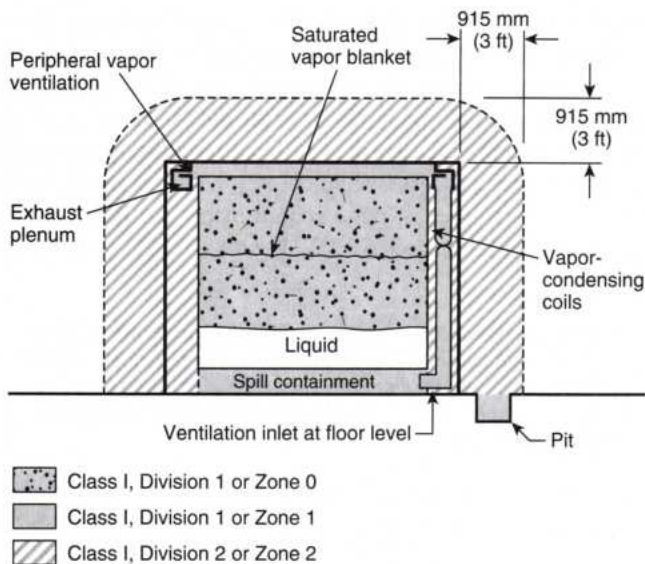


FIGURE 516.29(1) Electrical Area Classification for Open Dipping and Coating Processes Without Vapor Containment or Ventilation. [34:Figure 6.4(a)]



Definitions

Freeboard: The distance from the maximum solvent or coating material level to the top of the tank

Freeboard ratio: The freeboard height divided by the smaller of the interior length or interior width of the tank

FIGURE 516.29(2) Electrical Area Classification for Open Dipping and Coating Processes with Peripheral Vapor Containment and Ventilation — Vapors Confined to Process Equipment. [34:Figure 6.4(b)]

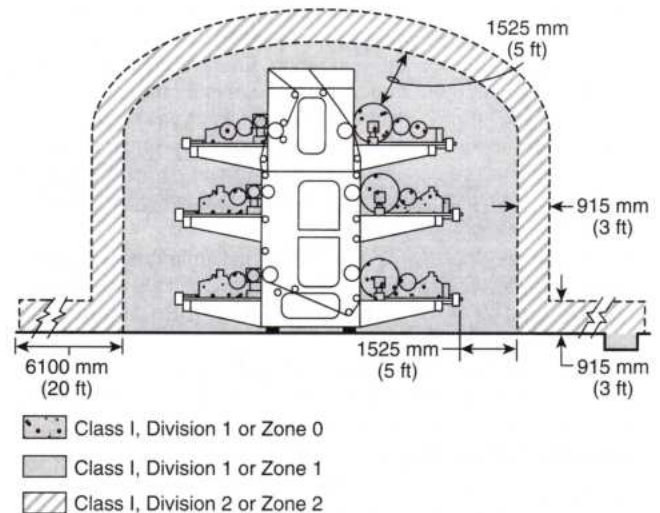


FIGURE 516.29(4) Electrical Area Classification for a Typical Printing Process. [34:Figure 6.4(d)]

- (3) Electrical wiring and electrical utilization equipment located within 915 mm (3 ft) of the Class I, Division 1 or Class I, Zone 1 location shall be suitable for Class I, Division 2 or Class I, Zone 2 locations, whichever is applicable.
- (4) The space 915 mm (3 ft) above the floor and extending 6100 mm (20 ft) horizontally in all directions from the Class I, Division 1 or Class I, Zone 1 location shall be classified as Class I, Division 2 or Class I, Zone 2, and electrical wiring and electrical utilization equipment located within this space shall be suitable for Class I, Division 2 or Class I, Zone 2 locations, whichever is applicable.
- (5) This space shall be permitted to be nonclassified for purposes of electrical installations if the surface area of the vapor source does not exceed 0.5 m² (5 ft²), the contents of the dip tank, ink fountain, ink reservoir, or ink tank do not exceed 19 L (5 gal), and the vapor concentration during operating and shutdown periods does not exceed 25 percent of the lower flammable limit.

516.35 Areas Adjacent to Enclosed Dipping and Coating Processes. Areas adjacent to enclosed dipping and coating processes are illustrated by Figure 516.35 and shall be classified as follows:

- (1) The interior of any enclosed dipping or coating process or apparatus shall be a Class I, Division 1 or Class I, Zone 1 location, and electrical wiring and electrical utilization equipment located within this space shall be suitable for Class I, Division 1 or Class I, Zone 1 locations, whichever is applicable. The area inside the dip tank shall be classified as Class I, Division 1 or Class I, Zone 0, whichever is applicable.
- (2) The space within 915 mm (3 ft) in all directions from any opening in the enclosure and extending to the floor

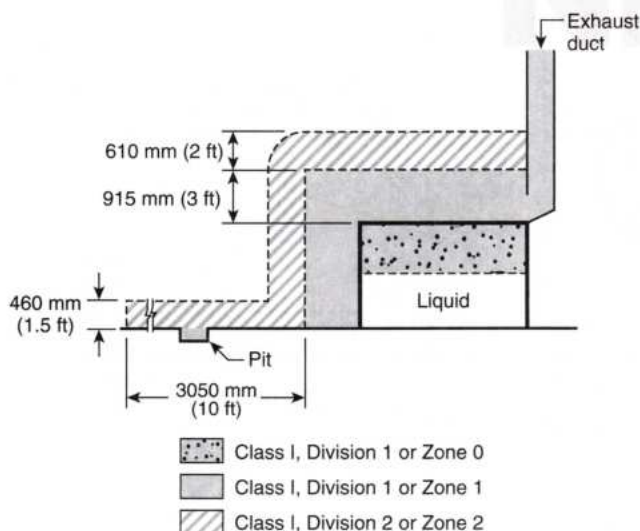


FIGURE 516.29(3) Electrical Area Classification for Open Dipping and Coating Processes with Partial Peripheral Vapor Containment and Ventilation — Vapors NOT Confined to Process Equipment. [34:Figure 6.4(c)]

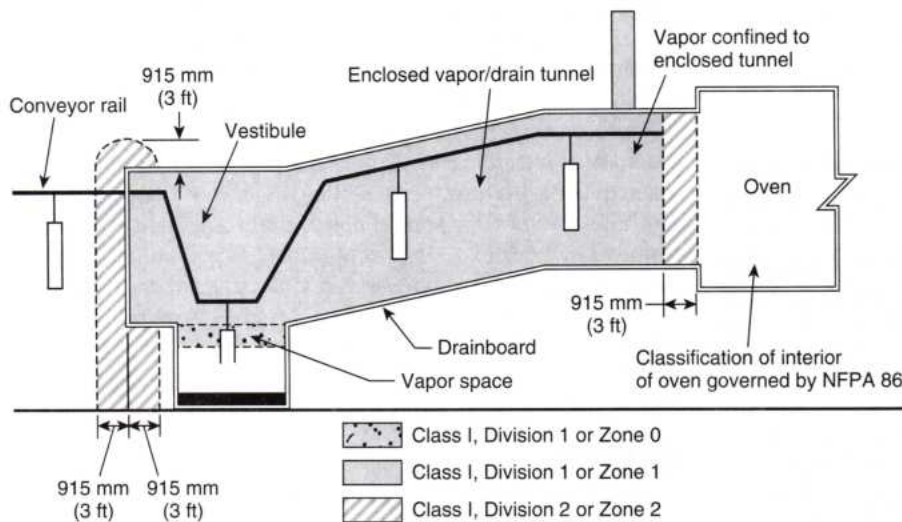


FIGURE 516.35 *Electrical Area Classification Around Enclosed Dipping and Coating Processes. [34:Figure 6.5]*

or grade level shall be classified as Class I, Division 2 or Class I, Zone 2, and electrical wiring and electrical utilization equipment located within this space shall be suitable for Class I, Division 2 locations or Class I, Zone 2 locations, whichever is applicable.

- (3) All other spaces adjacent to an enclosed dipping or coating process or apparatus shall be classified as nonhazardous for purposes of electrical installations.

516.36 Equipment and Containers in Ventilated Areas. Open containers, supply containers, waste containers, and solvent distillation units that contain Class I liquids shall be located in areas ventilated in accordance with 516.4.

516.37 Luminaires. For printing, coating, and dipping equipment where the process area is enclosed by glass panels that are sealed to confine vapors and mists to the inside of the enclosure, luminaires that are attached to the walls or ceilings of a process enclosure and that are located outside of any classified area shall be permitted to be of general purpose construction. Such luminaires shall be serviced from outside the enclosure.

Luminaires that are attached to the walls or ceilings of a process enclosure, are located within the Class I, Division 2 or Class I, Zone 2 location, and are separated from the process area by glass panels that are sealed to confine vapors and mists shall be suitable for use in that location. Such fixtures shall be serviced from outside the enclosure.

516.38 Wiring and Equipment Not Within Hazardous (Classified) Locations.

(A) Wiring. Fixed wiring above hazardous (classified) locations shall be permitted to be one or more of the following:

- (1) Rigid metal conduit (RMC) or intermediate metal conduit (IMC) with listed threaded or threadless fittings, or electrical metallic tubing (EMT) or electrical nonmetallic tubing (Type ENT) with listed fittings.
- (2) Rigid polyvinyl chloride conduit (PVC) or reinforced thermosetting resin conduit (RTRC).
- (3) Type MC cable or Type TC cable with listed fittings.
- (4) Type MI cable terminated with listed fittings and installed and supported to avoid tensile stress.
- (5) Cellular metal floor raceways only to supply ceiling outlets or as extensions to the area below the floor of a hazardous (classified) location. If cellular metal raceways are used, they shall not have connections leading into or passing through the hazardous (classified) location unless suitable seals are provided.

Δ (B) Equipment. Equipment that is capable of producing arcs, sparks, or particles of hot metal, such as lamps and lampholders for fixed lighting, cutouts, switches, receptacles, motors, or other equipment having make-and-break or sliding contacts, where installed above a classified location or above a location where freshly finished goods are handled, shall be of the totally enclosed type or be constructed to prevent the escape of sparks or hot metal particles.

Δ 516.40 Static Electric Discharges. All persons and all electrically conductive objects, including any metal parts of the process equipment or apparatus, containers of material, exhaust ducts, and piping systems that convey flammable or combustible liquids, shall be electrically grounded.

Provision shall be made to dissipate static electric charges from all nonconductive substrates in printing processes.

Informational Note: See NFPA 77, *Recommended Practice on Static Electricity*, for information on reducing the risk of ignition from electrostatic discharges.