

ARTICLE

503

Class III Locations

Part I. General

503.1 Scope. This article covers the requirements for electrical and electronic equipment and wiring for all voltages in Class III, Division 1 and Division 2 locations where fire or explosion hazards might exist due to nonmetal combustible fibers/flyings or ignitable fibers/flyings.

Class III locations usually include textile mills that process cotton, rayon, and other fabrics, where easily ignitable fibers/flyings are present in the manufacturing process. Sawmills and other woodworking plants, where sawdust, wood shavings, and combustible fibers/flyings are present, also can become hazardous locations. However, if wood flour (dust) is present, the location is a Class II, Group G location and not a Class III location.

Fibers/flyings are hazardous not only because they are easily ignited, but also because flames quickly spread through them. Such fires travel with a rapidity approaching an explosion and are commonly called flash fires.

Class III, Division 1 applies to locations where material is handled, manufactured, or used. Division 2 applies to locations where material is stored or handled but where no manufacturing processes are performed. Unlike Class I and Class II locations, Class III locations do not have material group designations.

- Δ **503.5 General.** Equipment installed in Class III locations shall be able to function at full rating without developing surface temperatures high enough to cause excessive dehydration or gradual carbonization of accumulated fibers/flyings.

Informational Note No. 1: See NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*, for information on electric trucks.

Informational Note No. 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 506.9(C)(2) for Zone 20 locations and with a temperature marking in accordance with 500.8(D)(3) shall be permitted in Class III, Division 1 locations.

Equipment listed and marked in accordance with 506.9(C)(2) for Zone 20, Zone 21, or Zone 22 locations and with a temperature marking in accordance with 500.8(D)(3) shall be permitted in Class III, Division 2 locations.

Part II. Wiring

503.10 Wiring Methods. Wiring methods shall comply with 503.10(A) or (B).

Informational Note: See Article 100 for the definition of *restricted industrial establishment [as applied to hazardous (classified) locations]*.

(A) Class III, Division 1.

- Δ **(1) General.** In Class III, Division 1 locations, the following wiring methods shall be permitted:

- (1) Rigid metal conduit (RMC), PVC conduit, RTRC conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT), dusttight wireways, or Type MC or Type MI cable with listed termination fittings.
- (2) Type PLTC cable or Type PLTC-ER cable used in Class 2 and Class 3 circuits, including installation in cable tray systems. The cable shall be terminated with listed fittings. Type PLTC-ER cable shall include an equipment grounding conductor in addition to a drain wire that might be present.
- (3) Type ITC cable or Type ITC-ER cable as permitted in 335.4 and terminated with listed fittings. Type ITC-ER cable shall include an equipment grounding conductor in addition to a drain wire.
- (4) Type MV, Type TC, or Type TC-ER cable, including installation in cable tray systems. Type TC-ER cable shall include an equipment grounding conductor in addition to a drain wire that might be present. The cable shall be terminated with listed fittings.
- (5) Cablebus.
- (6) In restricted industrial establishments, listed Type P cable with metal braid armor, with an overall jacket, that is terminated with fittings listed for the location, and installed in accordance with Part II of Article 337. If installed in ladder, ventilated trough, or ventilated channel cable trays, cables shall be installed in a single layer, with a space not less than the larger cable diameter between the two adjacent cables unless otherwise protected against dust buildup resulting in increased heat.

Informational Note No. 1: See UL 1309A, *Outline of Investigation for Cable for Use in Mobile Installations*, for information on construction, testing, and marking of Type P cable.

Informational Note No. 2: See ANSI/UL 2225, *Cables and Cable-Fittings for Use in Hazardous (Classified) Locations*, for information on construction, testing, and marking of cable fittings.

- (2) Boxes and Fittings.** All boxes and fittings shall be dusttight.

- Δ **(3) Flexible Connections.** Where flexible connections are necessary, one or more of the following shall be permitted:

- (1) Dusttight flexible connectors
- (2) Liquidtight flexible metal conduit (LFMC) with listed fittings
- (3) Liquidtight flexible nonmetallic conduit (LFNC) with listed fittings and bonded in accordance with 503.30(B)
- (4) Interlocked armor Type MC cable having an overall jacket of suitable polymeric material and installed with listed dusttight termination fittings
- (5) Flexible cord in accordance with 503.140
- (6) For elevator use, an identified elevator cable of Type EO, Type ETP, or Type ETT, shown under the “use” column

in Table 400.4 for “hazardous (classified) locations” and terminated with listed dusttight fittings

- (7) In restricted industrial establishments, listed Type P cable with metal braid armor, with an overall jacket, that is terminated with fittings listed for the location and installed in accordance with Part II of Article 337

Informational Note: See UL 1309A, *Outline of Investigation for Cable for Use in Mobile Installations*, for information on construction, testing, and marking of Type P cable.

(4) Nonincendive Field Wiring. Nonincendive field wiring shall be permitted using any of the wiring methods permitted for unclassified locations. Nonincendive field wiring systems shall be installed in accordance with the control drawing(s). Simple apparatus, not shown on the control drawing, shall be permitted in a nonincendive field wiring circuit if the simple apparatus does not interconnect the nonincendive field wiring circuit to any other circuit.

Informational Note: See Article 100 for the definition of *simple apparatus*.

Separate nonincendive field wiring circuits shall be installed in accordance with one of the following:

- (1) In separate cables
- (2) In multiconductor cables where the conductors of each circuit are within a grounded metal shield
- (3) In multiconductor cables where the conductors of each circuit have insulation with a minimum thickness of 0.25 mm (0.01 in.)

Δ (B) Class III, Division 2. Wiring methods in Class III, Division 2 locations shall be in accordance with the following:

- (1) The wiring shall comply with 503.10(A).
- (2) In sections, compartments, or areas that do not contain machinery and are used solely for storage, open wiring on insulators shall be permitted where installed in accordance with Part II of Article 398, including the condition required by 398.15(C) that protection be provided where conductors are not run in roof spaces and are well out of reach of sources of physical damage.

503.25 Uninsulated Exposed Parts, Class III, Divisions 1 and 2. There shall be no uninsulated exposed parts, such as electrical conductors, buses, terminals, or components, that operate at more than 30 volts (15 volts in wet locations). These parts shall additionally be protected by a protection technique according to 500.7(E), (F), or (G) that is suitable for the location.

Exception: As provided in 503.155.

Exposed live parts are permitted in Class III, Division 1 and 2 locations provided the voltage does not exceed 30 volts in dry locations or 15 volts in wet locations. Protection techniques permitted for these parts are intrinsically safe or nonincendive. These techniques limit the circuit's energy to a level incapable of causing ignition of the hazardous area.

Δ 503.30 Grounding and Bonding. Regardless of the voltage of the electrical system, wiring systems and equipment shall comply with 503.30(A) and (B).

N (A) Grounding. Wiring systems and equipment shall be grounded in accordance with Part I and Part VI of Article 250, as applicable.

Δ (B) Bonding. Bonding shall comply with Part I and Part V of Article 250, as applicable, and 503.30(B)(1) and (B)(2).

N (1) Specific Bonding Means. Bonding shall comply with 503.30(B)(1)(a) and (B)(2)(b).

(a) The locknut-bushing and double-locknut types of contacts shall not be depended on for bonding purposes, but bonding jumpers with identified fittings or other approved means of bonding shall be used. These bonding means shall apply to all metal raceways, fittings, boxes, cable trays, and enclosures, and other parts of raceway systems between hazardous (classified) locations and the point of grounding for service equipment or point of grounding for a separately derived system. Metal struts, angles, or channels provided for support and mechanical or physical protection as permitted in 335.4(5), 336.10(7)(c), or 722.135(C) shall be bonded in accordance with 250.102.

(b) Where the branch-circuit overcurrent protection is located on the load side of the disconnecting means, the specific bonding means shall be permitted to end at the nearest point where the grounded circuit conductor and the grounding electrode conductor are connected together on the line side of the building or structure disconnecting means as specified in 250.32(B).

The requirements for enhanced bonding in Class III locations are the same as those for Class I and Class II locations.

See also

501.30(B)(1) and its commentary for more information on grounding and bonding requirements

250.100 for additional requirements applying to bonding in hazardous locations

N (2) Liquidtight Flexible Metal Conduit. Liquidtight flexible metal conduit shall comply with 503.30(B)(2)(a) and (B)(2)(b).

(a) Liquidtight flexible metal conduit shall include an equipment bonding jumper of the wire type in accordance with 250.102.

(b) In Class III locations, the bonding jumper shall not be required where all of the following conditions are met:

- (1) Listed liquidtight flexible metal conduit 1.8 m (6 ft) or less in length, with fittings listed for grounding, is used.
- (2) Overcurrent protection in the circuit is limited to 10 amperes or less.
- (3) The load is part of a meter, instrument, or relay circuit.

Part III. Equipment

503.100 Transformers and Capacitors — Class III, Divisions 1 and 2. Transformers and capacitors shall comply with 502.100(B).

503.115 Switches, Circuit Breakers, Motor Controllers, and Fuses — Class III, Divisions 1 and 2. Switches, circuit breakers, motor controllers, and fuses, including pushbuttons, relays, and similar devices, shall be provided with dusttight enclosures.

503.120 Control Transformers and Resistors — Class III, Divisions 1 and 2. Transformers, impedance coils, and resistors used as, or in conjunction with, control equipment for motors, generators, and appliances shall be provided with dusttight enclosures complying with the temperature limitations in 503.5.

503.125 Motors and Generators — Class III, Division 1 and Division 2. In Class III, Division 1 and Division 2 locations, motors, generators, and other rotating machinery shall be totally enclosed nonventilated, totally enclosed pipe ventilated, or totally enclosed fan cooled.

Exception: In locations where, in the judgment of the authority having jurisdiction, only moderate accumulations of ignitable fibers/flyings are likely to collect on, in, or in the vicinity of a rotating electrical machine and where such machine is readily accessible for routine cleaning and maintenance, one of the following shall be permitted:

- (1) Self-cleaning textile motors of the squirrel-cage type
- (2) Standard open-type machines without sliding contacts or centrifugal or other types of switching mechanisms, including motor overload devices
- (3) Standard open-type machines having such contacts, switching mechanisms, or resistance devices enclosed within tight housings without ventilating or other openings

503.128 Ventilating Piping — Class III, Divisions 1 and 2. Ventilating pipes for motors, generators, or other rotating electrical machinery, or for enclosures for electric equipment, shall be of metal not less than 0.53 mm (0.021 in.) in thickness, or of equally substantial noncombustible material, and shall comply with the following:

- (1) Lead directly to a source of clean air outside of buildings
- (2) Be screened at the outer ends to prevent the entrance of small animals or birds
- (3) Be protected against physical damage and against rusting or other corrosive influences

Ventilating pipes shall be sufficiently tight, including their connections, to prevent the entrance of appreciable quantities of fibers/flyings into the ventilated equipment or enclosure and to prevent the escape of sparks, flame, or burning material that might ignite accumulations of fibers/flyings or combustible material in the vicinity. For metal pipes, lock seams and riveted or welded joints shall be permitted; and tight-fitting slip joints shall be permitted where some flexibility is necessary, as at connections to motors.

503.130 Luminaires — Class III, Divisions 1 and 2.

(A) Fixed Lighting. Luminaires for fixed lighting shall provide enclosures for lamps and lampholders that are designed to minimize entrance of fibers/flyings and to prevent the escape of sparks, burning material, or hot metal. Each luminaire shall be clearly marked to show the maximum wattage of the lamps that shall be permitted without exceeding an exposed surface temperature of 165°C (329°F) under normal conditions of use.

(B) Physical Damage. A luminaire that may be exposed to physical damage shall be protected by a suitable guard.

(C) Pendant Luminaires. Pendant luminaires shall be suspended by stems of threaded rigid metal conduit, threaded intermediate metal conduit, threaded metal tubing of equivalent thickness, or by chains with approved fittings. For stems longer than 300 mm (12 in.), permanent and effective bracing against lateral displacement shall be provided at a level not more than 300 mm (12 in.) above the lower end of the stem, or flexibility in the form of an identified fitting or a flexible connector shall be provided not more than 300 mm (12 in.) from the point of attachment to the supporting box or fitting.

(D) Portable Lighting Equipment. Portable lighting equipment shall be equipped with handles and protected with substantial guards. Lampholders shall be of the unswitched type with no provision for receiving attachment plugs. There shall be no exposed current-carrying metal parts, and all exposed non-current-carrying metal parts shall be grounded. In all other respects, portable lighting equipment shall comply with 503.130(A).

503.135 Utilization Equipment — Class III, Divisions 1 and 2.

(A) Heaters. Electrically heated utilization equipment shall be identified for Class III locations.

(B) Motors. Motors of motor-driven utilization equipment shall comply with 503.125.

(C) Switches, Circuit Breakers, Motor Controllers, and Fuses. Switches, circuit breakers, motor controllers, and fuses shall comply with 503.115.

503.140 Flexible Cords — Class III, Divisions 1 and 2. Flexible cords shall comply with the following:

- (1) Be of a type listed for extra-hard usage
- (2) Contain, in addition to the conductors of the circuit, an equipment grounding conductor complying with 400.23
- (3) Be supported by clamps or other suitable means in such a manner that there will be no tension on the terminal connections
- (4) Be terminated with a listed dusttight cord connector

503.145 Receptacles and Attachment Plugs — Class III, Division 1 and Division 2. Receptacles and attachment plugs

shall be of the grounding type, shall be designed to minimize the accumulation or the entry of fibers/flyings, and shall prevent the escape of sparks or molten particles.

Exception: In locations where, in the judgment of the authority having jurisdiction, only moderate accumulations of ignitable fibers/flyings are likely to collect in the vicinity of a receptacle, and where such receptacle is readily accessible for routine cleaning and mounted to minimize the entry of fibers/flyings, general-purpose grounding-type receptacles shall be permitted.

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.

503.155 Electric Cranes, Hoists, and Similar Equipment — Class III, Divisions 1 and 2. Where installed for operation over combustible fibers or accumulations of flyings, traveling cranes and hoists for material handling, traveling cleaners for textile machinery, and similar equipment shall comply with 503.155(A) through (D).

In Class III locations, two hazards can be introduced by cranes, equipped with rolling or sliding collectors that contact with bare conductors, that are installed over accumulations of fibers/flyings.

The first hazard results from arcing between a conductor and a collector rail igniting combustible fibers or lint that has accumulated on or near the bare conductor. This hazard can be prevented by maintaining the proper alignment of the bare conductor, by using a collector designed so that proper contact is always maintained, and by using guards or shields to confine hot metal particles that result from arcing.

The second hazard occurs if enough moisture is present and fibers/flyings accumulating on the insulating supports of the bare conductors form a conductive path between the conductors or from one conductor to ground, permitting enough current to flow to ignite the fibers. If the system is ungrounded, a current flow to ground is unlikely to start a fire.

A suitable recording ground detector sounds an alarm and automatically de-energizes contact conductors when the insulation resistance is lowered by an accumulation of fibers on the insulators or in case of a fault to ground. A ground-fault indicator that maintains an alarm until the system is de-energized or the ground fault is cleared is permitted.

(A) Power Supply. The power supply to contact conductors shall be electrically isolated from all other systems, ungrounded, and shall be equipped with an acceptable ground detector that gives an alarm and automatically de-energizes the contact conductors in case of a fault to ground or gives a visual and audible alarm as long as power is supplied to the contact conductors and the ground fault remains.

(B) Contact Conductors. Contact conductors shall be located or guarded so as to be inaccessible to other than authorized persons and shall be protected against accidental contact with foreign objects.

(C) Current Collectors. Current collectors shall be arranged or guarded so as to confine normal sparking and prevent escape of sparks or hot particles. To reduce sparking, two or more separate surfaces of contact shall be provided for each contact conductor. Reliable means shall be provided to keep contact conductors and current collectors free of accumulations of lint or flyings.

(D) Control Equipment. Control equipment shall comply with 503.115 and 503.120.

503.160 Storage Battery Charging Equipment — Class III, Divisions 1 and 2. Storage battery charging equipment shall be located in separate rooms built or lined with substantial noncombustible materials. The rooms shall be constructed to prevent the entrance of ignitable amounts of flyings or lint and shall be well ventilated.

ARTICLE

504

Intrinsically Safe Systems

Δ 504.1 Scope. This article covers the installation of intrinsically safe (I.S.) apparatus, wiring, and systems for hazardous (classified) locations.

Informational Note: See ANSI/ISA RP 12.06.01, *Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation — Part 1: Intrinsic Safety*, for additional information.

There are two standards used in the United States for construction and performance requirements for intrinsically safe (IS) systems: ANSI/UL 913, *Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations*, and ANSI/UL 60079-11, *Electrical Apparatus for Explosive Gas Atmospheres — Part 11: Intrinsic Safety “I,”* which is based on the IEC 60079-11 standard. The NEC® offers the choice of designating hazardous locations as two divisions (1 and 2) or three zones (0, 1, and 2). Equipment certified by a testing laboratory for Zone 1 would not necessarily meet UL 913 requirements for Division 1.

Due to its physical and electrical characteristics, an IS circuit does not develop sufficient electrical energy (millijoules) in an arc or spark to cause ignition or sufficient thermal energy resulting from an overload condition to cause the temperature of the installed circuit to exceed the ignition temperature of a specified gas or vapor under normal or abnormal operating conditions.

An abnormal condition may occur due to damage, failure of electrical components, excessive voltage, or improper adjustment or maintenance of the equipment. Abnormal conditions are mitigated by associated apparatus such as the IS barrier shown in Exhibit 504.1.