Other aspects of flood-resistant design and construction covered in Chapter 39 of *NFPA 5000* include determining the lowest floor elevation, designing foundations, selecting materials and systems, bringing existing buildings into compliance, and designing and building manufactured homes and temporary structures.

110.12 Mechanical Execution of Work. Electrical equipment shall be installed in a professional and skillful manner.

Informational Note: See ANSI/NECA 1-2015, *Standard for Good Workmanship in Electrical Construction*, and other ANSI-approved installation standards for information on accepted industry practices.

The requirement for installations to be done in a "professional and skillful manner" is representative of pride in one's work and is emphasized by persons involved in the training of apprentice electricians. A professional and skillful installation is also one that is easy to troubleshoot and is unlikely to have problems properly functioning.

Installations that do not qualify as "professional and skillful" include exposed runs of cables or raceways that are sagging between supports or supported by improper methods; cables that are kinked, flattened, or incorrectly sized; or cabinets, cutout boxes, and enclosures that are not plumb or not properly secured.

(A) Unused Openings. Unused openings, other than those intended for the operation of equipment, those intended for mounting purposes, or those permitted as part of the design for listed equipment, shall be closed to afford protection substantially equivalent to the wall of the equipment. Where metallic plugs or plates are used with nonmetallic enclosures, they shall be recessed at least 6 mm (¼ in.) from the outer surface of the enclosure.

(B) Integrity of Electrical Equipment and Connections. Internal parts of electrical equipment, including busbars, wiring terminals, insulators, and other surfaces, shall not be damaged or contaminated by foreign materials such as paint, plaster, cleaners, abrasives, or corrosive residues. There shall be no damaged parts that may adversely affect safe operation or mechanical strength of the equipment such as parts that are broken; bent; cut; or deteriorated by corrosion, chemical action, or overheating.

Δ **(C) Cables and Conductors.** Cables and conductors installed exposed on the surfaces of ceilings and sidewalls shall be supported by the building structure in such a manner that the cables and conductors will not be damaged by normal building use. Such cables and conductors shall be secured by hardware including straps, staples, cable ties, hangers, or similar fittings designed and installed so as not to damage the cable. The installation shall also conform with 300.4 and 300.11. Nonmetallic cable ties and other nonmetallic cable accessories used to secure and support cables in other spaces used for environmental air (plenums) shall be listed as having low smoke and heat release properties.

Informational Note No. 1: See NFPA 90A-2021, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 4.3.11.2.6.5 and 4.3.11.5.5.6, for discrete combustible components installed in accordance with 300.22(C).

Informational Note No. 2: Paint, plaster, cleaners, abrasives, corrosive residues, or other contaminants may result in an undetermined alteration of optical fiber cable properties.

110.13 Mounting and Cooling of Equipment.

(A) Mounting. Electrical equipment shall be firmly secured to the surface on which it is mounted. Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials shall not be used.

(B) Cooling. Electrical equipment that depends on the natural circulation of air and convection principles for cooling of exposed surfaces shall be installed so that room airflow over such surfaces is not prevented by walls or by adjacent installed equipment. For equipment designed for floor mounting, clearance between top surfaces and adjacent surfaces shall be provided to dissipate rising warm air.

Electrical equipment provided with ventilating openings shall be installed so that walls or other obstructions do not prevent the free circulation of air through the equipment.

The term *ventilated* is defined in Article 100. Ventilating openings in equipment are provided to allow the circulation of room air around internal equipment components. Blocking these openings can cause dangerous overheating. For example, a ventilated busway must be located where there are no walls or other obstructions that could interfere with the natural circulation of air and convection principles for cooling. The surfaces of some enclosures, such as panelboards and transformers, may also require normal room air circulation to prevent overheating. Proper placement of equipment requiring ventilation becomes enforceable using the requirements of 110.3(B).

See also

430.14(A) and **430.16** for ventilation requirements for motors

450.9 and **450.45** for ventilation requirements for transformers

Δ **110.14 Electrical Connections.** Because of different characteristics of dissimilar metals, devices such as pressure terminal or pressure splicing connectors and soldering lugs shall be identified for the material of the conductor and shall be properly installed and used. Conductors of dissimilar metals shall not be intermixed in a terminal or splicing connector where physical contact occurs between dissimilar conductors unless the device is identified for the purpose and conditions of use. Materials such as solder, fluxes, inhibitors, and compounds, where employed, shall be suitable for the use and shall be of a type that will not adversely affect the conductors, installation, or equipment.

Connectors and terminals for conductors more finely stranded than Class B and Class C stranding as shown in Chapter 9, Table 10, shall be identified for the specific conductor class or classes.