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ARTICLE 110 - GENERAL

110-1. Scope. This Article provides the general requirements for electrical installations.

110-2. Approval. The conductors and equipment required or permitted by this Code shall be acceptable only when approved. See definition of "Approved" in Article 100.

110-3. Mandatory and Advisory Rules. Mandatory rules of this Code are characterized by the use of the word, "shall." Advisory rules are characterized by the use of the word, "should," or are stated as recommendations of that which is advised but not required.

110-4. Examination of Equipment. Materials, devices, fittings, apparatus and appliances designed for use under this Code shall be judged chiefly with reference to the following considerations which also determine the classification by types, size, voltages, current capacities, and specific use.

(a) Suitability for installation and use in conformity with the provisions of this Code.

(b) Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided.

(c) Electrical insulation.

(d) Heating effects under normal conditions of use and also under abnormal conditions likely to arise in service.

(e) Arcing effects.

110-5. Voltages. Throughout this Code the voltage considered shall be that at which the circuit operates, whether the current is supplied by a battery, generator, transformer, rectifier, or a thermopile.

110-6. Conductor Gages. Conductor sizes are given in American Wire Gage (AWG).

110-7. Conductors. Conductors normally used to carry current shall be of copper unless otherwise provided in this Code. Where the conductor material is not specified, the sizes given in this Code shall apply to copper conductors. Where other materials are used, the size shall be changed accordingly.

For aluminum conductors, see Tables 310-14 and 310-15.

110-8. Wiring Methods. Only wiring methods recognized as suitable are included in this Code. The recognized methods of wiring maybe installed in any type of building or occupancy except as otherwise provided in this Code.

110-9. Interrupting Capacity. Devices intended to break current shall have an interrupting capacity sufficient for the voltage employed and for the current which must be interrupted.

110-10. Circuit Impedance and Other Characteristics. The overcurrent protective devices, the total impedance and other characteristics of the circuit to be protected shall be so selected and coordinated as to permit the circuit protective devices used to clear a fault without the occurrence of extensive damage to the electrical components of the circuit. This fault may be assumed to be between two or more of the circuit conductors; or between any circuit conductor and the grounding conductor or enclosing metal raceway.

110-11. Deteriorating Agencies. Unless approved for the purpose, no conductors or equipment shall be located in damp or wet locations; where exposed to gases, fumes, vapors, liquids or other agents having a deteriorating effect on the conductors or equipment; nor where exposed to excessive temperatures.

Control equipment, utilization equipment and busways approved for use in dry locations only, should be protected against permanent damage from weather during building construction.

110-12. Mechanical Execution of Work. Electrical equipment shall be installed in a neat and workmanlike manner.

110-13. Mounting of Equipment. 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 depended on for security.

110-14. Connections to Terminals. Connection of conductors to terminal parts shall insure a thoroughly good connection without damaging the conductors and shall be made by means of pressure connectors (including set screw type), solder lugs or splices to flexible leads except that No. 8 or smaller solid conductors and

No. 10 or smaller stranded conductors may be connected by means of clamps or screws with terminal plates having upturned lugs. Terminals for more than one conductor shall be of a type approved for the purpose.

Because of different characteristics of copper and aluminum, devices such as pressure connectors and soldering lugs shall be suitable for the material of the conductor and shall be properly installed and used. Materials such as solder, fluxes, inhibitors, and compounds, where employed, shall be suitable for the use and shall be of a type which will not adversely affect the conductors, installation, or equipment.

110-15. Splices. Conductors shall be spliced or joined with splicing devices approved for the use or by brazing, welding or soldering with a fusible metal or alloy. Soldered splices shall first be so spliced or joined as to be mechanically and electrically secure without solder and then soldered. All splices and joints and the free ends of conductors shall be covered with an insulation equivalent to that of the conductors.

110-16. Working Space about Electrical Equipment (600 Volts or Less). Sufficient access and working space shall be provided and maintained about all electrical equipment to permit ready and safe operating and maintenance of such equipment.

(a) Working Clearances. Except as elsewhere required or permitted in this Code, the dimension of the working space in the direction of access to live parts, operating at not more than 600 volts, which are likely to require examination, adjustment, servicing or maintenance while alive, shall not be less than indicated in Table 110-16(a). Distances are to be measured from the live parts if such are exposed or from the enclosure front or opening when such are enclosed.

Table 110-16(a). Working Clearances

Voltage to Ground	**Minimum Clear Distance**		
Condition:	**1**	**2**	**3**
0-150	2-1/2 ft.	2-1/2 ft.	3 ft.
151-600	2-1/2	3-1/2	4

Where the "Conditions" are as follows:

1. Exposed live part on one side and no live or grounded part on the other side of the working space or exposed live parts on both sides effectively guarded by suitable wood or other insulating materials. Insulated wire or insulated bus bars operating at not more than 300 volts shall not be considered live parts.

2. Exposed live parts on one side and grounded parts on the other side. Concrete, brick or tile walls shall be considered as grounded.

3. Exposed live parts on both sides of the work space (not guarded as provided in Condition 1) with the operator between.

Exception No. 1. Working space is not required in back of assemblies such as dead-front switchboards or control centers when there are no renewable or adjustable parts such as fuses or switches on the back and when all connections are accessible from other locations than the back.

Exception No. 2. Smaller spaces may be permitted by the authority having jurisdiction where it is judged that the particular arrangement of the installation will provide adequate accessibility.

(b) Clear Spaces. Working space required by this Section shall not be used for storage. When normally enclosed live parts are exposed for inspection or servicing, the working space, if in a passageway or general open space, shall be suitably guarded.

(c) Access and Entrance to Working Space. At least one entrance of sufficient area shall be provided to give access to the working space about electrical equipment.

(d) Front Working Space. In all cases where there are live parts normally exposed on the front of switchboards or control centers, the working space in front of such boards or panels shall be not less than 3 feet.

(e) Illumination. Adequate illumination shall be provided for all working spaces about switchboards and control centers.

(f) Headroom. The minimum headroom of working spaces about switchboards or control centers where there are live parts exposed at any time, shall be 6% feet.

For higher voltages, see Article 710.

110-17. Guarding of Live Parts. (Not more than 600 Volts)

(a) Except as elsewhere required or permitted by this Code, live parts of electrical equipment operating at 50 volts or more shall be guarded against accidental contact by approved cabinets or other forms of approved enclosures, or any of the following means:

(1) By location in a room, vault, or similar enclosure which is accessible only to qualified persons.

(2) By suitable permanent, substantial partitions or screens so arranged that only qualified persons will have access to the space within reach of the live parts. Any openings in such partitions or screens shall be so sized and located that persons are not likely to come into accidental contact with the live parts or to bring conducting objects into contact with them.

(3) By a guard rail, provided the live parts operate at 600 volts or less and provided the location is such as to make contact with live parts unlikely.

(4) By location on a suitable balcony, gallery, or platform so elevated and arranged as to exclude unqualified persons.

(5) By elevation at least 8 feet above the floor or other working surface.

(b) In locations where electrical equipment would be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent such damage.

(c) Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

For motors see Sections 430-132 and 430-133. For additional requirements at voltages over 600 see Article 710.

110-18. Arcing Parts. Parts of electrical equipment which in ordinary operation produce arcs, sparks, flames or molten metal, shall be enclosed unless separated and isolated from all combustible material. For hazardous locations see Articles 500-517 inclusive. For motors see Section 430-14.

110-19. Light and Power from Railway Conductors. Circuits for lighting and power shall not be connected to any system containing trolley wires with a ground return, except in electric railway cars, car houses, power houses, or passenger and freight stations operated in connection with electric railways.

110-20. Insulation Resistance. All wiring shall be so installed that when completed the system will be free from short-circuits and from grounds other than as provided in Article 250.

110-21. Marking. The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified, shall be placed on all electrical equipment. Other markings shall be provided giving voltage, current, wattage, or other ratings as are prescribed elsewhere in this Code.

110-22. Identification. Each disconnecting means required by this Code for motors and appliances, and each service, feeder or branch circuit at the point where it originates, shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident. The marking shall be of sufficient durability to withstand the environment involved.