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CHAPTER 3. WIRING METHODS AND MATERIALS

Article 300 - Wiring Methods - General Requirements

300-1. Scope.

(a) The provisions of Chapter 3 apply to the electrical and mechanical requirements for the various methods of installing fixed electrical conductors for electric light, heat, power, and certain signal systems.

(b) The provisions of this Article shall apply to all wiring installations, except for remote-control, including low voltage relay switching, low-energy power and signal systems as provided in Article 725, and communication systems as provided in Article 800.

(c) On premises where a continuous underground metallic water-piping network system is not available as a grounding electrode, and where it is not practicable otherwise to secure a ground of permanently low resistance, the use of a wiring method which does not employ metal enclosures for the wires is recommended, unless the character or occupancy of the building is such as to require the use of a metal-enclosed wiring system.

(d) The provisions of this Article are not intended to apply to the conductors which form an integral part of equipment such as motors, motor controllers and the like.

300-2. Voltage Limitations. Wiring methods specified in Chapter 3 may be used for voltages not exceeding 600, unless specifically limited in some Article of Chapter 3. They may be used for voltages over 600 where specifically permitted elsewhere in this code.

300-3. Conductors of Different Systems.

(a) Conductors of light and power systems of 600 volts or less may occupy the same enclosure, without regard to whether the individual circuits are alternating-current or direct-current, only where all conductors are insulated for the maximum voltage of

any conductor within the enclosure.

(b) Conductors of light and power systems of over 600 volts shall not occupy the same enclosure with conductors of light and power systems of 600 volts or less.

(c) Secondary wiring to electric discharge lamps of 1,000 volts or less, insulated for the secondary voltage involved, may occupy the same fixture enclosure as the branch circuit conductors.

(d) Primary leads of electric discharge lamp ballasts, insulated for the primary voltage of the ballast, when contained within the individual wiring enclosure may occupy the same fixture enclosure as the branch circuit conductors.

(e) Excitation, control, relay and ammeter conductors used in connection with any individual motor or starter may occupy the same enclosure as the motor circuit conductors.

(f) Conductors of signal or radio systems shall not occupy the same enclosure with conductors of light or power systems except as permitted for elevators in Section 620-36; for sound recording in Section 640-6; for remote-control, low-energy power and signal circuits in Sections 725-16 and 725-42; and communication system in Sections 800-3 and 800-21.

300-4. Protection Against Physical Damage. Where subject to physical damage, conductors shall be adequately protected.

300-5. Protection Against Corrosion. Metal raceways, cable armor, boxes, cable sheathing, cabinets, metallic elbows, couplings, fittings, supports and support hardware shall be of materials suitable for the environment in which they are to be installed.

(a) Ferrous raceways, cable armor, boxes, cable sheathing, cabinets, metallic elbows, couplings, fittings, supports and support hardware shall be suitably protected against corrosion inside and outside (except threads at joints) by a coating of approved corrosion resistant material such as zinc, cadmium, or enamel. Where protected from corrosion solely by enamel, they shall not be used out of doors or in wet locations as described in (c) below. When boxes or cabinets have an approved system of organic coatings and are marked "Raintight" or "Outdoor Type" they may be used out of doors.

(b) Unless made of materials judged suitable for the condition, or unless corrosion protection approved for the condition is provided, ferrous or non-ferrous metallic raceways, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, fittings, supports and support hardware shall not be installed in concrete or in direct contact with the earth, or in areas subject

to severe corrosive influences.

(c) In portions of dairies, laundries, canneries, and other indoor wet locations, and in locations where walls are frequently washed or where there are surfaces of absorbent materials, such as damp paper or wood, the entire wiring system, including all boxes, fittings, conduits and cable used therewith, shall be mounted so that there is at least one-quarter inch air space between it and the wall or supporting surface.

Meat-packing plants, tanneries, hide cellars, casing rooms, glue houses, fertilizer rooms, salt storage, some chemical works, metal refineries, pulp mills, sugar mills, round houses, some stables, and similar locations are judged to be occupancies where severe corrosive conditions are likely to be present.

300-6. Raceways Exposed to Different Temperatures.

(a) **Sealing.** Where portions of an interior raceway system are exposed to widely different temperatures, as in refrigerating or cold-storage plants, provision shall be made to prevent circulation of air from a warmer to a colder section through the raceway.

(b) **Expansion Joints.** Expansion joints for runs of raceway shall be provided where required to compensate for thermal expansion and contraction.

300-7. Underground Runs. Conductors run underground shall comply with the provisions of Section 230-32 as far as mechanical protection is concerned.

Underground cable run under a building shall be in a raceway that is extended beyond the outside wall of the building.

300-8. Through Studs, Joists and Rafters.

(a) Where exposed or concealed wiring conductors in insulating tubes or cables are installed through bored holes in studs, joists or similar wood members, holes shall be bored at the approximate centers of wood members, or at least two inches from the nearest edge where practical.

(b) Where there is no objection because of weakening the building structure, metal-clad or nonmetallic sheathed cable, aluminum sheathed cable and Type MI cable may be laid in notches in the studding or joists when the cable at those points is protected against the driving of nails into it by having the notch covered with a steel plate at least 1/16 inch in thickness before building finish is applied.

300-9. Grounding Metal Enclosures. Metal raceways, boxes, cabinets, cable armor and fittings shall be grounded if and as prescribed in Article 250.

300-10. Electrical Continuity of Metal Raceways and Enclosures. Metal raceways, cable armor, and other metal enclosures for conductors, shall be metallically joined together into a continuous electrical conductor, and shall be so connected to all boxes, fittings and cabinets as to provide effective electrical continuity. Raceways and cable assemblies shall be mechanically secured to boxes, fittings, cabinets and other enclosures, except as provided for nonmetallic boxes in Section 370-7.

300-11. Secured in Place. Raceways, cable assemblies, boxes, cabinets and fittings shall be securely fastened in place, unless otherwise provided for specific purposes elsewhere in this Code.

See Article 318 for Continuous Rigid Cable Supports.

300-12. Mechanical Continuity - Raceways and Cables. Raceways and cable assemblies shall be continuous from outlet to outlet and from fitting to fitting.

300-13. Mechanical Continuity - Conductors. Conductors shall be continuous between outlets, devices, etc., and, except as permitted for auxiliary gutters in Section 374-8, and for wireways in Section 362-6, there shall be no splice or tap within a raceway itself.

300-14. Free Length of Conductors at Outlets and Switch Points. At least six inches of free conductor shall be left at each outlet and switch point for the making up of joints or the connection of fixtures or devices, except where conductors are intended to loop without joints through lampholders, receptacles and similar devices.

300-15. Boxes or Fittings. Except as permitted in Sections 336-11 and 410-60 a box or fitting shall be installed at each outlet, switch point, junction point or conductor splice connection joining sections of conduit, electrical metallic tubing or surface raceway. A box shall be installed at each outlet, switch point, or conductor splice connection joining sections of metal-clad cable, aluminum sheathed cable, non-metallic sheathed cable or Type MI cable, and at each outlet and switch point of concealed knob-and-tube work.

Exception: Straight through splice joints for MI cable are permitted without a box provided the splice is accessible and a fitting approved for the purpose is used.

300-16. Raceway or Cable to Open or Concealed Wiring.

(a) A box or terminal fitting having a separately bushed hole for each conductor shall be used wherever a change is made from conduit, electrical metallic tubing, nonmetallic sheathed cable, metal-clad cable, aluminum sheathed cable, or Type MI cable and surface raceway wiring to open wiring or to concealed knob-

and-tube work. A fitting used for this purpose shall contain no taps or splices and shall not be used at fixture outlets.

(b) A bushing may be used in lieu of a box or terminal fitting at ends of conduit or electrical metallic tubing where conductors leave the conduit or tubing behind a switchboard, or where more than 4 conductors leave the conduit or tubing at control apparatus or in similar locations, in which case the conductors shall be bunched, taped and painted with insulating paint. Such a bushing shall be of the insulating type except for lead-covered conductors.

300-17. Number of Conductors in Raceway. In general the percentage of the total interior cross-sectional area of a raceway occupied by conductors shall not be more than will permit a ready installation or withdrawal of the conductors and dissipation of the heat generated without injury to the insulation of the conductors. See the following Sections of this Code: conduit, Section 346-6; electrical metallic tubing, 348-6; flexible metal conduit, 350-3; surface raceways, 352-4 and 352-25; underfloor raceways, 354-5; cellular metal floor raceways, 356-5; structural raceways, 357-6; cellular concrete floor raceways, 358-9; wireways, 362-5; auxiliary gutters, 374-5; theatres, 520-5; signs, 600-21(d); elevators, 620-33; and sound recording, 640-3 and 640-4; and Remote-Control, Low-Energy Power, Low-Voltage Power and Signal Circuits, Article 725.

300-18. Inserting Conductors in Raceways.

(a) Raceways shall first be installed as a complete raceway system without conductors, except those raceways exposed and having a removable cover or capping.

(b) As far as possible, conductors shall not be inserted until the interior of the building has been physically protected from the weather, and all mechanical work on the building which is likely to injure the conductors has been completed.

(c) Pull wires, if to be used, shall not be installed until the raceway system is in place.

(d) Cleaning agents or materials used as lubricants that might have a deleterious effect on conductor coverings shall not be used.

300-19. Supporting Conductors in Vertical Raceways.

(a) Conductors in vertical raceways shall be supported at intervals not greater than those specified in the following Table:

Table 300-19(a). Spacings for Conductor Supports

		Conductors	
		Aluminum	Copper
No. 18	to No. 8.....	Not Greater than...100 feet	100 feet
No. 6	to No. 0.....	Not Greater than...200 feet	100 feet
No. 00	to No. 0000....	Not Greater than...180 feet	80 feet
211,601 CM	to 350,000 CM..	Not Greater than...135 feet	60 feet
350,001 CM	to 500,000 CM..	Not Greater than...120 feet	50 feet
500,001 CM	to 750,000 CM..	Not Greater than... 95 feet	40 feet
	Above 750,000 CM..	Not Greater than... 85 feet	35 feet

(b) One of the following methods of support, or a method of equal effectiveness is recommended:

(1) By clamping devices constructed of or employing insulating wedges inserted in the ends of the conduits. With cables having varnished cambric or thermoplastic insulation it may also be necessary to clamp the conductor.

(2) By inserting boxes at the required intervals in which insulating supports are installed and secured in a satisfactory manner to withstand the weight of the conductors attached thereto, the boxes being provided with covers.

(3) In junction boxes, by deflecting the cables not less than 90 degrees and carrying them horizontally to a distance not less than twice the diameter of the cable, the cables being carried on two or more insulating supports, and additionally secured thereto by tie wires if desired. When this method is used cables shall be supported at intervals not greater than 20 per cent of those mentioned in the preceding tabulation.

300-20. Induced Currents in Metal Enclosures. When conductors carrying alternating current are installed in metal enclosures they shall be so arranged as to avoid heating the surrounding metal by induction. To accomplish this all phase conductors and the neutral, where one is used, shall be grouped together.

When a single conductor of a circuit passes through metal with magnetic properties the inductive effect shall be minimized by:

(1) Cutting slots in the metal between the individual holes through which the individual conductors pass, or

(2) Passing all the conductors in the circuit through an insulating wall sufficiently large for all of the conductors of the circuit.

Exception: In the case of circuits supplying vacuum or electric discharge lighting systems or signs, or X-ray apparatus, the currents carried by the conductors are so small that the inductive heating effect may be ignored where these conductors are placed in metal enclosures or pass through metal.

Aluminum being a nonmagnetic metal, there will be no heating due to eddy currents, however, induced currents will be present. These are not considered of sufficient magnitude to require grouping of conductors or special treatment in passing conductors through aluminum wall sections.

300-21. Prevention of Spread of Fire. Electrical installations shall be so made that the possible spread of fire through fire-stopped partitions, hollow spaces, fire walls or fire partitions, vertical shafts, ventilating or air-handling ducts is reduced to a minimum.

300-22. Wiring in Ducts, Plenums, and Other Air Handling Spaces.

(a) No wiring systems of any type shall be installed in ducts used to transport dust, loose stock, flammable vapors, nor shall any wiring system of any type be installed in any duct, or shaft containing only such ducts, used for vapor removal or ventilation of commercial type cooking equipment.

(b) Wiring systems of MI cable, ALS cable, electrical metallic tubing, or rigid metal conduit may be installed in ducts or plenum chambers used to transport higher velocity environmental air. Flexible metal conduit may be used, in lengths not to exceed 4 feet, to connect physically adjustable equipment and devices permitted to be in these ducts and plenum chambers. The connectors used with flexible metal conduit shall effectively close any openings in the connection. Equipment and devices may only be installed within such ducts or plenum chambers if necessary for their direct action upon, or sensing of, the contained air. Where equipment or devices are installed and illumination is necessary to facilitate maintenance and repair, enclosed gasketed type fixtures may be installed.

(c) Hollow spaces which are used as ducts or plenum chambers for lower velocity environmental air, other than those described in Paragraph (b) above, may contain MI cable, ALS cable, electrical metallic tubing, rigid metal conduit, flexible metal conduit, and other electrical equipment that is permitted within the concealed spaces of such structures, provided:

(1) The wiring materials, including fixtures, are suitable for the expected ambient temperature to which they will be subjected.

(2) The wiring system, including fixtures, in no way reduces the fire protective rating of the construction in which

they are installed.

(3) Flexible metal conduit shall be limited to the connection of devices, equipment, and fixtures in lengths not exceeding six feet. The connectors used with flexible metal conduit shall effectively close any openings in the connection.

Exception No. 1. The above provisions shall not apply to integral fan systems specifically approved for the purpose.

Exception No. 2. This section does not include habitable rooms or areas of buildings, the prime purpose of which is not air handling.

NFPA Standard for the Installation of Air Conditioning and Ventilating Systems, No. 90A, sets forth requirements of building used for ducts and plenums.

(d) The wiring systems used for data processing systems and located within air handling areas created by raised floors shall conform to Article 645.

300-23. Temporary Wiring.

(a) Suitable disconnecting switches or plug connectors shall be installed to permit the disconnection of all conductors of the temporary circuit by a single operation.

(b) Not bare conductors nor earth returns shall be used for the wiring of any temporary circuit.