Part VIII — Electrical

CHAPTER 33

GENERAL REQUIREMENTS

SECTION E3301
GENERAL

E3301.1 Applicability. The provisions of Chapters 33 through 42 shall establish the general scope of the electrical system and equipment requirements of this code. Chapters 33 through 42 cover those wiring methods and materials most commonly encountered in the construction of one- and two-family dwellings and structures regulated by this code. Other wiring methods, materials and subject matter covered in the NFPA 70 are also allowed by this code.

E3301.2 Scope. Chapters 33 through 42 shall cover the installation of electrical systems, equipment and components indoors and outdoors that are within the scope of this code, including services, power distribution systems, fixtures, appliances, devices and appurtenances. Services within the scope of this code shall be limited to 120/240-volt, 0- to 400-ampere, single-phase systems. These chapters specifically cover the equipment, fixtures, appliances, wiring methods and materials that are most commonly used in the construction or alteration of one- and two-family dwellings and accessory structures regulated by this code. The omission from these chapters of any material or method of construction provided for in the referenced standard NFPA 70 shall not be construed as prohibiting the use of such material or method of construction. Electrical systems, equipment or components not specifically covered in these chapters shall comply with the applicable provisions of the NFPA 70.

E3301.3 Not covered. Chapters 33 through 42 do not cover the following:

1. Installations, including associated lighting, under the exclusive control of communications utilities and electric utilities.
2. Services over 400 amperes.

E3301.4 Additions and alterations. Any addition or alteration to an existing electrical system shall be made in conformity with the provisions of Chapters 33 through 42. Where additions subject portions of existing systems to loads exceeding those permitted herein, such portions shall be made to comply with Chapters 33 through 42.

SECTION E3302
BUILDING STRUCTURE PROTECTION

E3302.1 Drilling and notching. Wood-framed structural members shall not be drilled, notched or altered in any manner except as provided for in this code.

E3302.2 Penetrations of fire-resistance-rated assemblies. Electrical installations in hollow spaces, vertical shafts, and ventilation or air-handling ducts shall be made so that the possible spread of fire or products of combustion will not be substantially increased. Electrical penetrations through fire-resistance-rated walls, partitions, floors or ceilings shall be protected by approved methods to maintain the fire-resistance rating of the element penetrated. Penetrations of fire-resistance-rated walls shall be limited as specified in Section R317.3.

E3302.3 Penetrations of firestops and draftstops. Penetrations through fire blocking and draftstopping shall be protected in an approved manner to maintain the integrity of the element penetrated.

SECTION E3303
INSPECTION AND APPROVAL

E3303.1 Approval. Electrical materials, components and equipment shall be approved.

E3303.2 Inspection required. New electrical work and parts of existing systems affected by new work or alterations shall be inspected by the building official to ensure compliance with the requirements of Chapters 33 through 42.

E3303.3 Listing and labeling. Electrical materials, components, devices, fixtures and equipment shall be listed for the application, shall bear the label of an approved agency and shall be installed, and used, or both, in accordance with the manufacturer's installation instructions.

SECTION E3304
GENERAL EQUIPMENT REQUIREMENTS

E3304.1 Voltages. Throughout Chapters 33 through 42, the voltage considered shall be that at which the circuit operates.

E3304.2 Interrupting rating. Equipment intended to interrupt current at fault levels shall have a minimum interrupting rating of 10,000 amperes. Equipment intended to interrupt current at levels other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted.

E3304.3 Circuit characteristics. The overcurrent protective devices, total impedance, component short-circuit current ratings and other characteristics of the circuit to be protected shall be so selected and coordinated as to permit the circuit protective devices that are used to clear a fault to do so without extensive damage to the electrical components of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors or between any circuit conductor and the grounding conductor or enclosing metal raceway. Listed products applied in accordance with their listing shall be considered to meet the requirements of this section.

E3304.4 Protection of equipment. Equipment identified only as "dry locations," "Type 1," or "indoor use only" shall be protected against permanent damage from the weather during building construction.

E3304.5 Unused openings. Unused cable or raceway openings in boxes, cabinets, meter socket enclosures, equipment cases or housings shall be effectively 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 $^1/_4$ inch (6 mm) from the outer surface of the enclosure.

E3304.6 Integrity of electrical equipment. 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 or abrasives, and corrosive residues. There shall not be any damaged parts that might adversely affect safe operation or mechanical strength of the equipment, such as parts that are broken; bent; cut; deteriorated by corrosion, chemical action, or overheating. Foreign debris shall be removed from equipment.

E3304.7 Mounting. Electric equipment shall be firmly secured to the surface on which it is mounted. Wooden plugs driven into masonry, concrete, plaster, or similar materials shall not be used.

E3304.8 Energized parts guarded against accidental contact. Approved enclosures shall guard energized parts that are operating at 50 volts or more against accidental contact.

E3304.9 Prevent physical damage. In locations where electrical equipment is likely to be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent such damage.

E3304.10 Equipment identification. The manufacturer's name, trademark or other descriptive marking by which the organization responsible for the product can be identified shall be placed on all electric equipment. Other markings shall be provided that indicate voltage, current, wattage or other ratings as specified elsewhere in Chapters 33 through 42. The marking shall have the durability to withstand the environment involved.

E3304.11 Identification of disconnecting means. Each disconnecting means shall be legibly marked to indicate its purpose, except where located and arranged so that the purpose is evident. The marking shall have the durability to withstand the environment involved.

SECTION E3305
EQUIPMENT LOCATION AND CLEARANCES

E3305.1 Working space and clearances. Sufficient access and working space shall be provided and maintained around all electrical equipment to permit ready and safe operation and maintenance of such equipment in accordance with this section and Figure E3305.1.

E3305.2 Working clearances for energized equipment and panelboards. Except as otherwise specified in Chapters 33 through 42, the dimension of the working space in the direction of access to panelboards and live parts likely to require examination, adjustment, servicing or maintenance while energized shall be not less than 36 inches (914 mm) in depth. Distances shall be measured from the energized parts where such parts are exposed or from the enclosure front or opening where such parts are enclosed. In addition to the 36-inch dimension (914 mm), the work space shall not be less than 30 inches (762 mm) wide in front of the electrical equipment and not less than the width of such equipment. The work space shall be clear and shall extend from the floor or platform to a height of 6.5 feet (1981 mm). In all cases, the work space shall allow at least a 90-degree opening of equipment doors or hinged panels. Equipment associated with the electrical installation located above or below the electrical equipment shall be permitted to extend not more than 6 inches (152 mm) beyond the front of the electrical equipment.

E3305.3 Clearances over panelboards. A dedicated space directly over a panelboard that extends from the panelboard to the structural ceiling or to a height of 6 feet (1829 mm) above the panelboard, whichever is lower, and has a width and depth equal to the equipment shall be dedicated and kept clear of equipment unrelated to the electrical equipment. Piping, ducts or equipment unrelated to the electrical equipment shall not be installed in such dedicated space.

E3305.4 Location of clear spaces. Required working space shall not be designated for storage. Panelboards and overcurrent protection devices shall not be located in clothes closets or bathrooms.

E3305.5 Access and entrance to working space. Access shall be provided to the required working space.

E3305.6 Illumination. Artificial illumination shall be provided for all working spaces for service equipment and panelboards installed indoors.

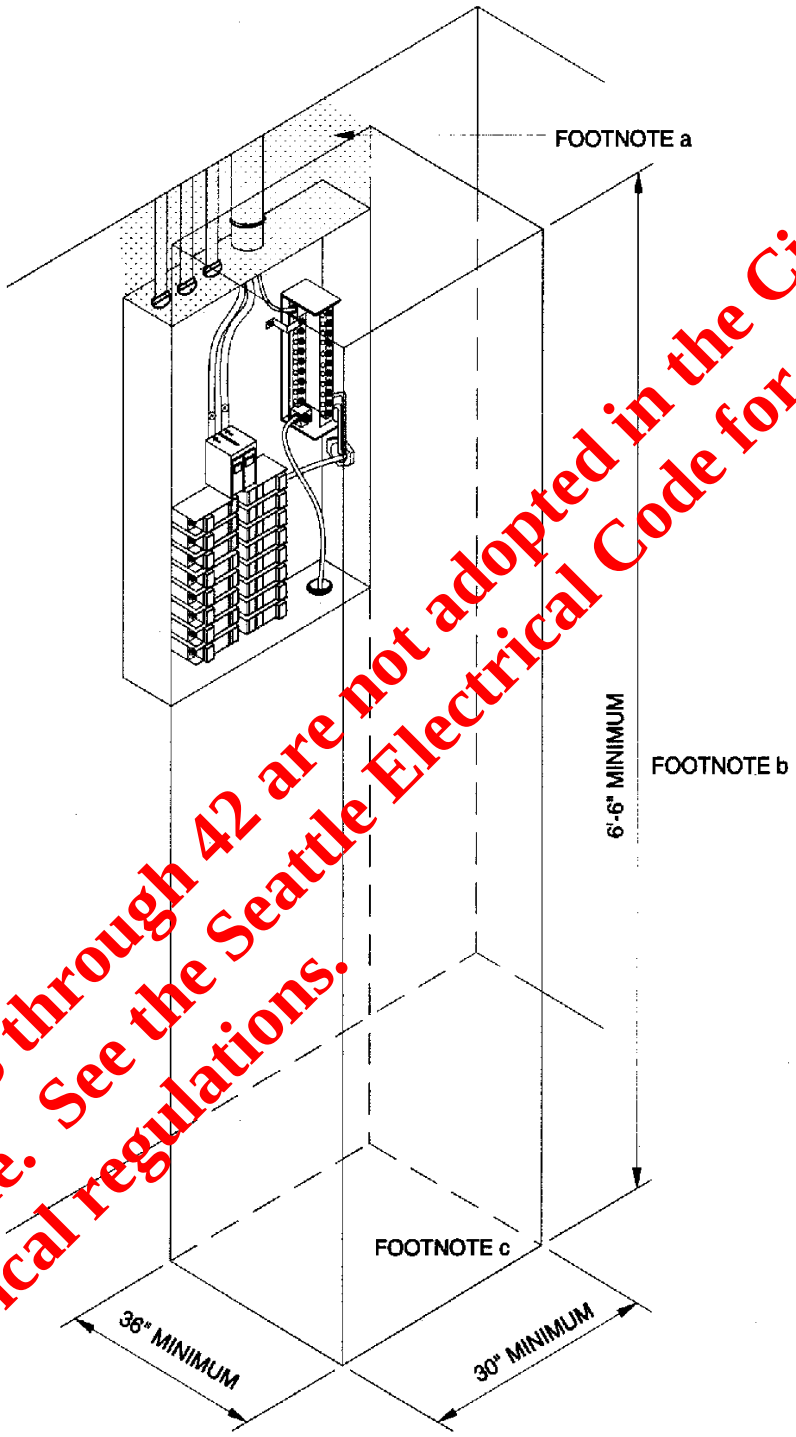

FIGURE E3305.1[a,b,c,d,e]
WORKING SPACE AND CLEARANCES

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. Equipment, piping and ducts shall not be placed in the shaded area extending directly above the top of the panelboard from the panelboard to the ceiling above.

b. The working space shall be clear and unobstructed from the floor to a height of 6.5 feet.

c. The working space shall not be designated for storage.

d. Panelboards, service equipment and similar enclosures shall not be located in bathrooms, toilet rooms and clothes closets.

e. Such work spaces shall be provided with artificial lighting where located indoors.

E3305.7 Headroom. The minimum headroom for working spaces for service equipment and panelboards shall be 6.5 feet (1981mm).

SECTION E3306
ELECTRICAL CONDUCTORS AND CONNECTIONS

E3306.1 General. This section provides general requirements for conductors, connections and splices. These requirements do not apply to conductors that form an integral part of equipment, such as motors, appliances and similar equipment, or to conductors specifically provided for elsewhere in Chapters 33 through 42.

E3306.2 Conductor material. Conductors used to conduct current shall be of copper except as otherwise provided in Chapters 33 through 42. Where the conductor material is not specified, the material and the sizes given in these chapters shall apply to copper conductors. Where other materials are used, the conductor sizes shall be changed accordingly.

E3306.3 Minimum size of conductors. The minimum size of conductors for feeders and branch circuits shall be No. 14 copper and No. 12 aluminum. The minimum size of service conductors shall be as specified in Chapter 35. The minimum size of class 2 remote control, signaling and power-limited circuits conductors shall be as specified in Chapter 42.

E3306.4 Stranded conductors. Where installed in raceways, conductors of size No. 8 and larger shall be stranded. A solid No. 8 conductor shall be permitted to be installed in a raceway only to meet the requirements of Section E4103.

E3306.5 Individual conductor insulation. Except where otherwise permitted in Sections E3505.5 and E3808.9, and E4203, current-carrying conductors shall be insulated. Insulated conductors shall have insulation types identified as RH, RHW, RHW-2, THHN, THWN, THW, THW-2, THWN-2, THWN, THWN-2, TW, UF, USE, USE-2, XHHW or XHHW-2. Insulation types shall be approved for the application.

E3306.6 Conductors in parallel. Circuit conductors that are electrically joined at each end to form a single conductor shall be limited to sizes No. 1/0 and larger. Conductors in parallel shall be of the same length, same conductor material, same circular mil area and same insulation type. Conductors in parallel shall be terminated in the same manner. Where run in separate raceways or cables, the raceway or cables shall have the same physical characteristics.

E3306.7 Conductors of the same circuit. All conductors of the same circuit and, where used, the grounded conductor and all equipment grounding conductors shall be contained within the same raceway, cable or cord.

E3306.8 Aluminum and copper connections. Terminals and splicing connectors shall be approved for the material of the conductors joined. Conductors of dissimilar metals shall not be joined in a terminal or splicing connector where physical contact occurs between dissimilar conductors such as copper and aluminum, copper and copper-clad aluminum, or aluminum and copper-clad aluminum, except where the device is listed for the purpose and conditions of application. Materials such as inhibitors and compounds shall be suitable for the application and shall be of a type that will not adversely affect the conductors, installation or equipment.

E3306.9 Terminals. Connection of conductors to terminal parts shall be made without damaging the conductors and shall be made by means of pressure connectors, including set-screw type, by means of splices to flexible leads, or for conductor sizes of No. 10 and smaller, by means of wire binding screws or studs and nuts having upturned lugs or the equivalent. Terminals for more than one conductor and terminals for connecting aluminum conductors shall be identified for the application.

E3306.10 Splices. Conductors shall be spliced or joined with splicing devices listed for the purpose. Splices and joints and the free ends of conductors shall be covered with an insulation equivalent to that of the conductors or with an insulating device listed for the purpose. Wire connectors or splicing means installed on conductors for direct burial shall be listed for such use.

E3306.10.1 Continuity. Conductors in raceways shall be continuous between outlets, devices and junctions and shall be without splices or taps in the raceway.

Exception: Splices shall be permitted within surface-mounted raceways that have a removable cover.

E3306.10.2 Device connections. The continuity of a grounded conductor in multiwire branch circuits shall not be dependent on connection to devices such as receptacles and lampholders. The continuity of equipment grounding conductors shall not be dependent on such connections in any type of branch circuit.

E3306.10.3 Length of conductor for splice or termination. Where conductors are to be spliced, terminated or connected to fixtures or devices, a minimum length of 6 inches (150 mm) of free conductor, shall be provided at each outlet, junction or switch point. The required length shall be measured from the point in the box where the conductor emerges from its raceway or cable sheath. Where the opening to an outlet, junction, or switch point is less than 8 inches (200 mm) in any dimension, each conductor shall be long enough to extend at least 3 inches (75 mm) outside of such opening.

SECTION E3307
CONDUCTOR AND TERMINAL IDENTIFICATION

E3307.1 Grounded conductors. Insulated grounded conductors of sizes No. 6 and smaller shall be identified by a continuous white or natural gray outer finish or by three continuous white stripes on other than green insulation along the entire length of the conductors. Conductors of sizes larger than No. 6 shall be identified by a continuous white or natural gray outer finish or by three continuous white stripes on other than green insulation along the entire length of the conductor, or shall be identified by a distinctive white marking that is applied at the time of installation and that encircles the conductor at all terminations.

E3307.2 Equipment grounding conductors. Equipment grounding conductors shall be identified by a continuous green

color or a continuous green color with one or more yellow stripes on the insulation or covering, except where bare.

E3307.3 Ungrounded conductors. Insulation on the ungrounded conductors shall be a continuous color other than white, gray or green.

Exception: An insulated conductor that is part of a cable or flexible cord assembly and that has a white or gray finish or a finish marking with three continuous white stripes shall be permitted to be used as an ungrounded conductor where it is permanently reidentified to indicate its use as an ungrounded conductor at all terminations and at each location where the conductor is visible and accessible.

E3307.4 Identification of terminals. Terminals for attachment to conductors shall be identified in accordance with Sections E3307.4.1 and E3307.4.2.

E3307.4.1 Device terminals. All devices, excluding lighting and appliance branch-circuit panelboards, provided with terminals for the attachment of conductors and intended for connection to more than one side of the circuit shall have terminals properly marked for identification, except where the terminal intended to be connected to the grounded conductor is clearly evident.

Exception: Terminal identification shall not be required for devices that have a normal current rating of over 30 amperes, other than polarized attachment caps and polarized receptacles for attachment caps as required in Section E3307.4.2.

E3307.4.2 Receptacles, plugs, and connectors. Receptacles, polarized attachment plugs and cord connectors for plugs and polarized plugs shall have the terminal intended for connection to the grounded (white) conductor identified. Identification shall be by a metal or metal coating substantially white in color or by the word "white" or the letter "W" located adjacent to the identified terminal. Where the terminal is not visible, the conductor entrance hole for the connection shall be colored white or marked with the word "white or the letter "W."

E3307.5 Tag marking. All cable shall be marked by means of a printed tag attached to the coil, reel or carton.

Chapter 33 through 42 are not adopted in the City of Seattle. See the Seattle Electrical Code for electrical regulations.