



2008 SEATTLE ELECTRICAL CODE

(Contains replacement pages to be inserted in the
2008 National Electrical Code.)

ORDINANCE 122970

Effective June 5, 2009

City of Seattle

DEPARTMENT OF PLANNING AND DEVELOPMENT

Permits and Information

Applicant Services Center	Key Tower, 20 th floor 700 Fifth Avenue (206) 684-8850
Electrical Counter	Key Tower, 20 th floor 700 Fifth Avenue (206) 684-8464
Electrical Code Tech. Support Line	(206) 684-5383
Inspection Requests	(206) 684-8900 (24-hour recording)
Inspectors' Office Hours:	7:30-9:00 a.m.
Inspectors' Office Location:	Key Tower, 21 st & 22 nd floors (206) 684-8950
DPD Mailing Address:	700 Fifth Avenue, Suite 2000 P.O. Box 34019 Seattle, WA 98124-4019

CITY OF SEATTLE
ELECTRICAL CODE

ORDINANCE 122970
Effective June 5, 2009

**SEATTLE AMENDMENTS TO THE 2008 EDITION
OF THE NATIONAL ELECTRICAL CODE**

Department of Planning and Development

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Richard G. Alford, *Chief Electrical Inspector*

Development of the 2008 Seattle Electrical Code is the result of cooperative effort of the volunteers of the Construction Codes Advisory Board (CCAB), the CCAB Electrical Code Review Committee, the Washington State Department of Labor and Industries, the Seattle Fire Department and the Department of Planning and Development. The City is deeply indebted to these volunteers and staff members for their hard work and expertise during the months leading to the adoption of this Code. The staff of DPD wishes to extend its appreciation to them.

Electrical Code Review Committee

Chris Porter, Chair
Joe Andre
Greg Batie
Pat Elwood
Ebby Ghojiei
Jeri Hall
Keith Lane
Steven Leighton
Warren Shill
Richard White

May 2008

Dear Electrical Code Purchaser:

This packet contains the Seattle amendments to the 2008 National Electrical Code (NEC). You will not have a complete Seattle Electrical Code unless you also obtain a current copy of the Washington State Electrical Regulations, and the 2008 NEC.

If you would like to receive occasional email messages notifying you of future amendments and errata to the Seattle Electrical Code, send an email to maureen.traxler@seattle.gov with “Electrical Code notification” in the subject line.

ARTICLE 80
Administration

Note: Article 80 is entirely Seattle amendments to the National Electrical Code (NEC), and is not underlined.

I. Title, Purpose and Scope

80.1 Title. This *Code* shall be known as the "Seattle Electrical Code" and may be so cited. It is referred to herein as the "Electrical Code" or "this *Code*."

(A) Referenced Codes. The code provisions and standards referenced in this *Code* are considered part of this *Code* to the extent prescribed by each such reference. Where differences occur between provisions of this *Code* and referenced codes and standards, the provisions of this *Code* govern.

(B) Metric Units. Whenever in this *Code* there is a conflict between metric units of measurement and U.S. customary units, the U.S. customary units govern.

80.2 Purpose.

(A) Protection from Hazards. The purpose of this code is to promote public safety in a practical manner from hazards arising from the use of electricity. This *Code* is intended to provide for and promote the health, safety and welfare of the general public, and not to create or otherwise establish or designate any particular class or group of persons who will or should be especially protected or benefited by the terms of this *Code*. This *Code* is not intended as a design specification nor an instruction manual for untrained persons.

(B) Chapter 296-46B Washington Administrative Code. An additional purpose of this *Code* is to provide equal, higher or better standards of construction and equal, higher or better standards of materials, devices, appliances and equipment than that required by the State of Washington under the provisions of Chapter 19.28 RCW (Revised Code of Washington). Only those sections of the Washington State Electrical Code amending the *National Electric Code*, as set forth at Chapter 296-46B of the Washington Administrative Code (WAC), specifically referenced in this *Code* by a fine print note, hereafter designated as FPN are adopted. The City incorporates by reference these adopted WAC provisions in each individual FPN.

80.3 Scope. The Electrical Code shall apply to all electrical wiring and equipment, including communications systems, installed or used within the City.

Exception No. 1: Installations in ships and watercraft not connected to public utilities, railway rolling stock, aircraft or automotive vehicles.

Exception No. 2: Installations of railways or generation, transformation, transmission or distribution of power used exclusively for operation of rolling stock or installations used exclusively for signaling and communication purposes.

Exception No. 3: Installations of communication equipment under exclusive control of communication utilities, located outdoors or in building spaces used exclusively for such installations.

Exception No. 4: Installations under the exclusive control of electric utilities for the purpose of communication, metering or for the generation, control, transformation, transmission and distribution of electric energy located in buildings used for such purposes or leased by the utility or on public highways, streets, roads or other public ways, or outdoors on established rights on private property up to the service point as defined in this code. The installation and maintenance of all utility owned conductors up to the service point, as defined by this Code, shall be the responsibility of the serving utility.

80.4 Application to Existing Buildings.

(A) Additions, Alterations and Repairs. Additions, alterations and repairs may be made to the electrical system of existing buildings or structures without making the entire electrical system comply with all of the requirements of this code for new buildings or structures, provided the additions, alterations or repairs made comply with the requirements of this *Code*. This section does not limit the effect of applicable retroactive ordinances.

Exception: Subject to the approval of the authority having jurisdiction, repairs may be made with the same materials of which the building or structure is constructed, other than for the replacement of receptacles as provided in NEC Section 406.3(D), provided the repair complies with the electrical code in effect at the time of original installation and provided further that no change shall be permitted which increases its hazard.

(B) Existing Electrical Systems. Electrical systems in existence at the time of the passage of this *Code* may continue to be used provided such use was legal at the time of the passage of this *Code* and provided continued use is not detrimental to public safety.

(C) Maintenance. All buildings or structures, both existing and new, and all parts thereof shall be maintained in a safe condition. All devices or safeguards required by this *Code* or by a code in effect when the building or structure was erected, altered or repaired shall be maintained in good working order. The owner or the owner's agent shall be responsible for the maintenance of buildings and structures.

It shall be the duty of the owner or the owner's agent to maintain in a safe and usable condition all parts of buildings or equipment that are intended to assist in the extinguishing of fire, or to prevent the origin or spread of fire, or to safeguard life or property. It shall be unlawful to fail to comply with any notice or order of the fire chief or the authority having jurisdiction.

Exception: The authority having jurisdiction may modify the requirements of this subsection where all or a portion of a building is unoccupied.

(D) Historic Buildings and Structures. The authority having jurisdiction may modify the specific requirements of

this code as it applies to buildings and structures designated as landmarks and require in lieu thereof alternate requirements that, in the opinion of the authority having jurisdiction, will result in a reasonable degree of safety to the public and the occupants of those buildings.

For purposes of this *Code*, a landmark building is a building or structure:

- (1) that is subject to a requirement to obtain a certificate of approval from the City Landmarks Preservation Board before altering or making changes to specific features or characteristics,
- (2) that has been nominated for designation or has been designated for preservation by the City Landmarks Preservation Board,
- (3) that has been designated for preservation by the State of Washington,
- (4) has been listed or determined eligible to be listed in the National Register of Historic Places, or
- (5) that is located in a landmark or special review district subject to a requirement to obtain a certificate of approval before making a change to the external appearance of the structure.

(E) Moved Buildings. Electrical permits for electrical work performed on a building or structure moved into or within the City shall be obtained from the authority having jurisdiction. The authority having jurisdiction will inspect the electrical system for deficiencies and issue corrections. Deficiencies shall be corrected before a certificate of occupancy will be issued.

The service to a moved building or structure shall comply with this *Code*. Other than the service, a building or structure moved into or within the City is not required to comply with this *Code* if the original occupancy classification of the building or structure is not changed. A building or structure that undergoes a substantial alteration as defined in Chapter 34 of the *Seattle Building Code* and a building or structure wired by standards other than those recognized by this *Code* and the *National Electrical Code* shall comply with this *Code*.

Any moved building that is not in compliance within one year from the date of permit issuance and is found to be a public nuisance may be abated.

FPN: For the definition of *Occupancy Classification*, see Chapter 3 of the *Seattle Building Code*.

80.5 Tests. Whenever there is insufficient evidence of compliance with the provisions of this *Code* or evidence that any equipment or construction does not conform to the requirements of this *Code*, the authority having jurisdiction may require tests to be made, at no expense to the City, as proof of compliance.

Test methods shall be specified by this *Code* or by other recognized test standards. If there are no recognized and accepted test methods for the proposed alternate, the authority having jurisdiction shall determine the test procedures.

All tests shall be made by an agency that has been approved by the authority having jurisdiction. The agency shall provide a report of the test results to the authority having jurisdiction which will retain the report.

80.6 Utilization Equipment and Alternate Materials and Methods of Wiring. This *Code* does not prevent the use of any utilization equipment, material, method or design of wiring not specifically allowed or prohibited by this *Code*, provided the same has been approved and its use authorized by the authority having jurisdiction.

The authority having jurisdiction may approve an alternate, provided the proposed alternate complies with the provisions of this *Code* and the alternate, when considered together with other safety features or relevant circumstances, will provide at least an equivalent level of strength, effectiveness, fire resistance, durability, safety and sanitation.

The authority having jurisdiction may require that sufficient evidence or proof be submitted to substantiate any claims regarding the use or suitability of utilization equipment, material, method or design of wiring. The authority having jurisdiction may, but is not required to, record the approval of alternate materials and methods, and any relevant information in the files of the authority having jurisdiction or on the approved permit plans.

80.7 Modifications. The authority having jurisdiction may grant modifications for individual cases whenever there are practical difficulties involved in carrying out the provisions of this *Code*. Prior to granting any modifications, the authority having jurisdiction must first find that:

- (1) the strict application of this code is impractical under the circumstances;
- (2) the modification is in conformity with the intent and purpose of this *Code*;
- (3) the modification does not lessen any fire protection requirements;
- (4) the modification does not lessen any degree of structural integrity.

The authority having jurisdiction may, but is not required to, record the approval of modifications and any relevant information in the files of the authority having jurisdiction or on the approved permit plans.

II. Organization and Enforcement

80.10 Authority. Whenever the term or title "Authority Having Jurisdiction," "Administrative Authority," "Responsible Official," "Chief Inspector" or "Code Enforcement Officer" is used in this *Code*, it is construed to mean the Director of the Department of Planning and Development, who is the code official.

80.11 Powers and Duties of the Authority Having Jurisdiction.

(A) General. The authority having jurisdiction is authorized and directed to interpret and enforce the provisions and intent of this *Code*.

Compliance with the requirements of this *Code* shall be the obligation of the owner of the building, structure or

premises, the duly authorized agent of the owner, or other person responsible for the condition or work, and not of the City or any of its officers or employees.

(B) Designees. The authority having jurisdiction may appoint such officers, inspectors, assistants and other employees as shall be authorized from time to time. The authority having jurisdiction may designate such employees as may be necessary to carry out the functions of the Department of Planning and Development.

(C) Right of Entry. With the consent of the owner or occupier of a building or premises, or pursuant to a lawfully issued warrant, the authority having jurisdiction may enter a building or premises at any reasonable time to perform the duties imposed by this *Code*.

(D) Stop Work Orders. Whenever any installation, alteration, repair or removal of electrical work is being done contrary to the provisions of this *Code*, or in the event of dangerous or unsafe conditions related to electrical work, the authority having jurisdiction may issue a stop work order describing the violation.

(1) Service of Stop Work Order. The authority having jurisdiction may serve the stop work order by posting it in a conspicuous place at the site, if posting is physically possible. If posting is not physically possible, then the stop work order may be served in the manner set forth in Revised Code of Washington (RCW) 4.28.080 for service of a summons or by sending it by first class mail to the last known address of the property owner, the person doing or causing the work to be done, and the holder of a permit if work is being stopped on a permit. For the purpose of this section, service is complete at the time of posting or of personal service, or if mailed, 3 days after the date of mailing. When the last day of the period so computed is a Saturday, Sunday or City holiday, the period runs until 5:00 p.m. on the next business day.

(2) Effective Date of Stop Work Order. Stop work orders are effective when posted, or if posting is not physically possible, when one of the persons identified in Section 80.11(D)(1) is served.

(3) Review by the Authority Having Jurisdiction for Stop Work Orders.

(a) Any person aggrieved by a stop work order may obtain a review of the order by delivering to the authority having jurisdiction a request in writing within 2 business days of the date of service of the stop work order.

The review shall occur within 2 business days after receipt by the authority having jurisdiction of the request for review unless the requestor agrees to a longer time.

Any person aggrieved by or interested in the stop work order may submit additional information to the authority having jurisdiction for consideration as part of the review at any time prior to the review.

(b) The review will be made by a representative of the authority having jurisdiction who will review all additional information received and may also request a

site visit. After the review, the authority having jurisdiction may:

- (1) Sustain the stop work order;
- (2) Withdraw the stop work order;
- (3) Modify the stop work order; or
- (4) Continue the review to a date certain for receipt of additional information.

(c) The authority having jurisdiction shall issue an order of the authority having jurisdiction containing the decision within 2 business days after the review and shall cause the order to be sent by first class mail to the person or persons requesting the review, any person on whom the stop work order was served, and any other person who requested a copy before issuance of the order. The City and appellant shall be bound by the order.

(E) Authority to Disconnect Utilities in an Emergency.

The authority having jurisdiction has the authority to disconnect or order discontinuance of any utility service or energy supply to buildings, structures or equipment regulated by this *Code* in cases of emergency where necessary to eliminate an imminent hazard to life or property. The authority having jurisdiction may enter any building or premises to disconnect utility service or energy supply. The authority having jurisdiction shall notify the serving utility, the owner and occupant of the building, structure or premises of the decision to disconnect prior to taking such action, and shall notify the serving utility, owner and occupant of the building, structure or premises in writing of such disconnection immediately thereafter.

Utility service shall be discontinued until the equipment, appliances, devices or wiring found to be defective or defectively installed are removed or restored to a safe condition.

It shall be unlawful for any person to reconnect any electrical equipment disconnected by the authority having jurisdiction until the equipment is placed in a safe condition and is approved by the authority having jurisdiction.

(F) Liability. Nothing contained in this *Code* is intended to be nor shall be construed to create or form the basis for any liability on the part of the City or its officers, employees or agents, for any injury or damage resulting from the failure of a building to conform to the provisions of this code, or by reason or as a consequence of any inspection, notice, order, certificate, permission or approval authorized or issued or done in connection with the implementation or enforcement of this code, or by reason of any action or inaction on the part of the City related in any manner to the enforcement of this code by its officers, employees or agents.

This *Code* shall not be construed to relieve or lessen the responsibility of any person owning, operating or controlling any building or structure for any damages to persons or property caused by defects, nor shall the Department of Planning and Development or the City of Seattle be held to have assumed any such liability by reason

of the inspections authorized by this *Code* or any permits or certificates issued under this *Code*.

Neither the authority having jurisdiction nor any employee charged with the enforcement of this *Code* shall be personally liable for any damage that accrues to persons or property as a result of any act or omission committed in the discharge of their duties, provided that the authority having jurisdiction or employee acted in good faith and without malice.

(G) Code Interpretation or Explanation. Electrical inspectors may give information as to the meaning or application of the *National Electrical Code* and the *Seattle Electrical Code*, but shall not lay out work or act as consultants for contractors, owners or users.

(H) Cooperation of Other Officials and Officers. The authority having jurisdiction may request, and shall receive so far as may be necessary in the discharge of duties, the assistance and cooperation of other officials of the City of Seattle and officers of public and private utilities.

80.12 Unsafe Conditions or Code Violations.

(A) Unsafe Conditions or Code Violations. The authority having jurisdiction may inspect any new or existing electrical installation or equipment, and if the installation or equipment is found to be maintained or used in an unsafe condition or found to be in violation of this *Code*, the authority having jurisdiction is authorized to serve upon the owner or user a notice or order requiring correction. Any person served such notice who fails to comply with the order therein shall be in violation of this ordinance and subject to the penalties provided in this *Code*.

(B) Emergency Orders. Whenever the authority having jurisdiction finds that any building or structure, or portion thereof, is in such a dangerous and unsafe condition as to constitute an imminent hazard to life or limb, the authority having jurisdiction may issue an emergency order directing that the building or structure, or portion thereof, be restored to a safe condition. The order shall specify the time for compliance. The order may also require that the building or structure, or portion thereof, be vacated within a reasonable time, to be specified in the order. In the case of extreme danger, the order may specify immediate vacation of the building or structure, or may authorize disconnection of the utilities or energy source pursuant to Section 80.11(E). No person shall occupy the building or structure, or portion thereof, after the date on which it is required to be vacated until it is restored to a safe condition as required by the order and this code. It shall be unlawful for any person to fail to comply with an emergency order issued by the authority having jurisdiction and subject to the penalties provided in this *Code*.

80.13 Violations and Penalties.

(A) Violations. It shall be a violation of this *Code* for any person, firm or corporation to:

- (1) erect, construct, enlarge, repair, move, improve, remove, convert or demolish, equip, occupy, or maintain any building or structure in the City, contrary to or in violation of any of the provisions of this *Code*;
- (2) knowingly aid, abet, counsel, encourage, hire, commend, induce or otherwise procure another to violate or fail to comply with any of the provisions of this *Code*;
- (3) use any materials or to install any device, appliance or equipment which does not comply with applicable standards of this *Code* or which has not been approved by the authority having jurisdiction;
- (4) violate or fail to comply with any final order issued by the building official pursuant to the provisions of this code or with any requirements of this *Code*; or
- (5) remove, mutilate, destroy or conceal any notice or order issued or posted by the building official pursuant to the provisions of this *Code*, or any notice or order issued or posted by the building official in response to a natural disaster or other emergency.

(B) Notice of Violation. If, after investigation, the authority having jurisdiction determines that standards or requirements of this *Code* have been violated or that orders or requirements have not been complied with, the authority having jurisdiction may serve a notice of violation upon the owner, agent or other person responsible for the action or condition.

(1) Serving the Notice of Violation. The notice of violation shall state the standards or requirements violated, shall state what corrective action, if any, is necessary to comply with the standards or requirements, and shall set a reasonable time for compliance. The notice shall be served upon the owner, agent or other responsible person by personal service or first class mail addressed to the last known address of such person. If no address is available after reasonable inquiry, the notice may be posted at a conspicuous place on the property. The notice may also be posted even if served by personal service or first class mail. The notice of violation shall be considered a final order of the authority having jurisdiction if no request for review before the authority having jurisdiction is made pursuant to Section 80.13(B)(2). Nothing in this section limits or precludes any action or proceeding to enforce this Article, and nothing obligates or requires the authority having jurisdiction to issue a notice of violation prior to the imposition of civil or criminal penalties.

(2) Review of Notice of Violation by the Authority Having Jurisdiction.

(a) Any person affected by a notice of violation issued pursuant to Section 80.13(B) may obtain a review of the notice by making a request in writing within 10 days after service of the notice. When the last day of the period computed is a Saturday, Sunday or City holiday, the period runs until 5:00 p.m. of the next business day.

The review shall occur not less than 10 nor more than 20 days after the request is received by the authority having

jurisdiction unless otherwise agreed by the person requesting the review.

Any person aggrieved by or interested in the notice of violation may submit additional information to the authority having jurisdiction within ten days after the request for review if filed, unless the authority having jurisdiction and the person requesting review agree to a different time period for documents to be submitted.

(b) The review shall be made by a representative of the authority having jurisdiction who will review any additional information that is submitted and the basis for issuance of the notice of violation. The reviewer may request clarification of the information received and a site visit.

After the review, the authority having jurisdiction shall:

1. Sustain the notice; or
2. Withdraw the notice; or
3. Continue the review to a date certain; or
4. Amend the notice.

(c) The authority having jurisdiction shall issue an order containing the decision within 15 days of the date that the review is completed and shall mail or cause the order to be mailed by regular first class mail to the persons requesting the review and the persons named on the notice of violation, addressed to their last known addresses.

(C) Judicial Review. Because civil actions to enforce Title 22 Seattle Municipal Code are brought in Seattle Municipal Court pursuant to Section 80.13(D), orders of the authority having jurisdiction issued under this chapter are not subject to judicial review pursuant to Chapter 36.70C *Revised Code of Washington* (RCW).

(D) Civil Penalties.

(1) Any person violating or failing to comply with the provisions of this *Code* shall be subject to a cumulative civil penalty in an amount not to exceed \$500 per day for each violation from the date the violation occurs or begins until compliance is achieved. In cases where the authority having jurisdiction has issued a notice of violation, the violation will be deemed to begin, for purposes of determining the number of days of violation, on the date compliance is required by the notice of violation.

(2) Civil actions to enforce this chapter shall be brought exclusively in Seattle Municipal Court, except as otherwise required by law or court rule. In any civil action for a penalty, the City has the burden of proving by a preponderance of the evidence that a violation exists or existed; the issuance of a notice of violation or of an order following a review by the authority having jurisdiction is not itself evidence that a violation exists.

(E) Criminal Penalties. Anyone violating or failing to comply with any notice of violation or order issued by the authority having jurisdiction pursuant to this *Code* or who

removes, mutilates, destroys or conceals a notice issued or posted by the authority having jurisdiction shall, upon conviction thereof, be punished by a fine of not more than \$5,000 or by imprisonment for not more than 365 days, or by both such fine and imprisonment for each separate violation. Each day's violation shall constitute a separate offense.

(F) Additional Relief. The authority having jurisdiction may seek legal or equitable relief to enjoin any acts or practices and abate any condition when necessary to achieve compliance.

80.14 Recording of Notices. The authority having jurisdiction may record a copy of any order or notice with the Department of Records and Elections of King County.

The authority having jurisdiction may record with the Department of Records and Elections of King County a notice that a permit has expired without a final inspection after reasonable efforts have been made to obtain a final inspection.

80.15 Rules of the Authority Having Jurisdiction.

(A) Authority. The authority having jurisdiction has authority to issue interpretations of this code and to adopt and enforce rules and regulations supplemental to this code as may be deemed necessary in order to clarify the application of the provisions of this *Code*. Such interpretations, rules and regulations shall be in conformity with the intent and purpose of this *Code*.

(B) Procedure for Adoption of Rules. The authority having jurisdiction shall promulgate, adopt and issue rules according to the procedures as specified in the *Administrative Code*, Chapter 3.02 of the *Seattle Municipal Code*.

80.16 Construction Codes Advisory Board. An Electrical Code Committee of the Construction Codes Advisory Board, as established in Section 105 of the *Seattle Building Code*, may examine proposed new editions of, and amendments to this *Code* and any proposed administrative rules promulgated to enforce this *Code*. The Electrical Code Committee may make recommendations to the authority having jurisdiction and to the City Council relating to this *Code* and administrative rules. The committee may be called on an as-needed basis for the Construction Codes Advisory Board.

80.17 Appeals. Except for stop work orders, notices of violation and revocation of permits, appeals from decisions or actions pertaining to the administration and enforcement of this *Code* shall be addressed in writing to the authority having jurisdiction. The appellant may request a review by a panel of the Construction Codes Advisory Board, convened by the Board Chair. The chair shall select a panel of at least three members from the Electrical Code Committee. The results of the review panel's review shall be advisory only. The final decision on any appealable matter is made by the authority having jurisdiction.

III. Permits and Inspections

80.50 Permits.

(A) Permit Required. It shall be unlawful to install, alter, extend or connect any electrical equipment in a building or premises, or allow the same to be done, without first obtaining a permit for the work from the authority having jurisdiction.

(B) Exempted Work. An electrical permit shall not be required for the following work:

- (1) Replacing flush or snap switches, fuses, lamp sockets, receptacles, or ballasts.
- (2) Reconnecting or replacing a range within an individual dwelling unit, hot plate, water heater, electric baseboard, and wall-heating unit to a circuit that has been lawfully installed and approved, when no alteration of the circuit is necessary.
- (3) The setting of meters by Seattle City Light or anyone else engaged in the business of supplying electricity to the public, provided that meter loops have been installed under permit and that such meters are not connected to any electrical installation regulated by this *Code* until approval for such connection has been given by the authority having jurisdiction.
- (4) Wiring for communication systems, as set forth in *NEC* Chapter 8 and Article 770, as follows:
 - (a) in one- and two-family dwellings, or
 - (b) installations of 1000 feet or less.
- (5) The installation or repair of electrical equipment installed in connection with an elevator, dumbwaiter, or similar conveyance provided such work is covered under the issuance of an elevator permit.

Exemption from the permit requirements of this *Code* shall not be deemed to grant authorization for work done in any manner that violates the provisions of this *Code* or any other laws or ordinances of the City.

(C) Flood Hazard Areas. In addition to the permit required by this section, all work to be performed in areas of special flood hazard, as identified in the report entitled "Flood Insurance Study for King County, Washington and Incorporated Areas" and the accompanying Flood Insurance Rate Maps filed in C.F. 296948, is subject to additional standards and requirements, including floodplain development approval or a Floodplain Development License, as set forth in Chapter 25.06, the Seattle Floodplain Development Ordinance.

80.51 Application and Plans.

(A) Application. Application for an electrical permit shall be made on a form provided by the authority having jurisdiction. Each application shall:

- (1) state the name and address of the owner or occupant in possession of the building or premises where the work is to be done;
- (2) state the name, address and phone number of the person responsible for the installation together with state license number of the licensed contractor, if any;

(3) provide details about the electrical installation, including drawings as required by the authority having jurisdiction and this *Code*; and

(4) include documentation of compliance with the Seattle Energy Code.

The authority having jurisdiction may refuse to issue or may revoke a permit if any statement in the permit application is found to be untrue.

(B) Plans and Specifications.

(1) General. In addition to the requirements of Section 80.51(A), two sets of plans and specifications shall be submitted with each application for an electrical permit for installation of the following:

- (a) services or feeders of 400 amperes or over;
- (b) all switches, circuit breakers and equipment rated 400 amperes or over;
- (c) any equipment operating at voltages exceeding 600;
- (d) services, feeders and power supplies for emergency, legally required standby or fire pump systems;
- (e) any proposed alteration or installation the scope of which covers more than 2,500 square feet;
- (f) any proposed alteration or installation which cannot be adequately described on the application form;
- (g) new or altered electrical installations in educational, institutional, and health or personal care occupancies as required in WAC 296-46B-900(1); (3)(a), (b), (c), (e) & (g); and WAC269-46B-900 Tables 900-1 and 900-2.

Exception to (a) through (g): Plan review applications will not be accepted for installations in one- and two-family dwelling structures that can be adequately described on the over-the-counter application form.

(h) solar systems or other renewable energy systems

Exception to (h): Renewable energy systems rated 26 kW or less shall submit one set of line drawings showing all system components.

(2) Fire Department Review. Three sets of plans and specifications for fire alarm systems shall be submitted. See *Seattle Fire Code* Section 907 for required submittal information.

(3) Clarity of Plans. Plans shall be drawn to a clearly indicated and commonly accepted scale upon substantial paper such as blueprint quality or standard drafting paper. The plans shall be of microfilm quality and limited to a minimum size of 11 inches by 17 inches (279 mm by 432 mm) and maximum size of 41 inches by 54 inches (1041 mm by 1372 mm). Plans shall indicate the nature and extent of the work proposed and shall show in detail that it will conform to the provisions of this *Code*. All electrical work shall be readily distinguishable from other mechanical work. If plans are incomplete, unintelligible or indefinite, the authority having jurisdiction may require that the plans

be prepared by a licensed electrical engineer, or may reject or refuse to examine such plans, even though a plan examination fee has been paid.

FPN: At such time as the authority having jurisdiction accepts electronically submitted plans, such plans shall be in a format acceptable to the authority having jurisdiction.

(4) Information on Plans and Specifications. Information on plans and specifications shall include the following:

- (a) The type of occupancy and a complete scope of work.
- (b) A complete riser and one line diagram to include all service and feeder connections.
- (c) Clear identification of all circuitry, to include but not limited to: circuit numbers, wire sizes, insulation types, conduit sizes and types.
- (d) A complete set of switchboard and panel schedules. These shall include all load calculations and demand factors used for computation.
- (e) A complete project load summary to include existing loads as computed in accordance with *NEC* Article 220 and all added loads. Electrical calculations, heat loss calculations and lighting summaries may be submitted on separate computation sheets.
- (f) Fault current calculations and the listed interrupting rating of all feeder and service equipment.
- (g) Voltage characteristics of all electrical systems and equipment.
- (h) A key to all symbols used.
- (i) A schedule showing all pertinent luminaire information.
- (j) Any other information as may be required by the plans examiner.
- (k) Selective coordination as required per 620.62, 700.27, 701.18 and 708.54 of this *Code*.

(C) Advance Plan Examination. An architect or engineer registered in the State of Washington may apply for an electrical permit and may request an advance plan examination of electrical plans where the electrical contractor has not yet been selected. Upon submission of an application including required plans, and payment of fifty percent of the estimated permit fee, the authority having jurisdiction will review the application. If the application and plans are found to be in compliance with the *Seattle Electrical Code*, the authority having jurisdiction will approve the application and plans as ready for issuance. Neither the permit nor the plans can be issued until the remainder of the fee required by the Fee Subtitle is paid and the electrical contractor's name and license number is placed on the permit.

80.52 Permits.

(A) Issuance.

(1) General. The application and plans filed by an applicant for a permit shall be checked by the authority

having jurisdiction. Such plans may be reviewed by other departments of the City to check compliance with the laws and ordinances under their jurisdiction. If the authority having jurisdiction finds that the work as described in an application for permit and the plans filed therewith conforms to the requirements of this code and other pertinent laws and ordinances and that the fees specified in the Fee Subtitle have been paid, the authority having jurisdiction shall issue a permit to the applicant who becomes the permit holder. The authority having jurisdiction may refuse to issue an electrical permit to any person who refuses or fails to complete the work permitted by an existing permit(s) on the same building or premises.

Exception No. 1: The authority having jurisdiction may issue a permit for the installation of part of the electrical system of a building or structure before complete plans for the whole building or structure have been submitted or approved, provided adequate information and detailed statements have been filed complying with all pertinent requirements of this Code. Holders of such permits may proceed at their own risk without assurance that the permit for the entire building or structure will be granted.

Exception No. 2: A permit may be issued for work to commence prior to the approval of plans, if such approval is delayed beyond 10 working days after the plans have been submitted for examination. The holders of such permits may proceed at their own risk, with the understanding that any work undertaken prior to approval of plans shall be done in accordance with the provisions of this Code and in accordance with the plans as subsequently approved.

(2) Compliance with Approved Plans and Permit. When issuing a permit, the authority having jurisdiction shall endorse the permit in writing and endorse in writing or stamp the plans APPROVED. Approved plans and permits shall not be changed, modified or altered without authorization from the authority having jurisdiction, and all work shall be done in accordance with the approved plans, except as the authority having jurisdiction may require during field inspection to correct errors or omissions.

(3) Amendments to the Permit. When modifications, substitutions and changes to the approved work are made during construction, approval of the authority having jurisdiction shall be obtained prior to execution. The electrical inspector may approve minor modifications, substitutions and changes to the plans for work not reducing the fire and life safety of the structure. Substitutions, changes and clarifications shall be as shown on two sets of plans that shall be submitted to the authority having jurisdiction, accompanied by fees specified in the Fee Subtitle prior to occupancy. All substitutions and changes shall conform to the requirements of this *Code* and other pertinent laws and ordinances.

(4) Requirement for License. No electrical permit shall be issued to an applicant who is engaging in, conducting or carrying on the business of installing wires or equipment to

convey electric current or of installing apparatus to be operated by electric current unless the applicant possesses a valid State of Washington license as required by RCW 19.28. The licensed installer responsible for the work shall be identified on the electrical permit.

Exception: Persons not possessing a license may obtain an electrical permit in order to do electrical work at a residence, farm, place of business or other property that they own as described in RCW 19.28.261.

(5) Cancellation of Permit Application. Applications may be cancelled if no permit is issued by the earlier of the following:

- (1) 12 months following the date of application; or
- (2) 60 days from the date of written notice that the permit is ready to issue.

After cancellation, plans and other data submitted for review may be returned to the applicant or destroyed by the authority having jurisdiction.

The authority having jurisdiction will notify the applicant in writing at least 30 days before the application is cancelled. The notice shall specify a date by which a request for extension must be submitted in order to avoid cancellation. The date shall be at least two weeks prior to the date on which the application will be cancelled.

At the discretion of the authority having jurisdiction, applications for projects that require more than 12 months to review and approve may be extended for a period that provides reasonable time to complete the review and approval, but in no case longer than 24 months from the date of the original application. No application may be extended more than once. After cancellation, the applicant shall submit a new application and pay a new fee to restart the permit process.

Exception: Notwithstanding other provisions of this Code, applications may be extended where issuance of the permit is delayed by litigation, preparation of environmental impact statements, appeals, strikes or other causes related to the application that are beyond the applicant's control, or while the applicant is making progress toward issuance of a master use permit.

(B) Retention of Plans and Permits. One set of approved plans, which may be on microfilm, shall be retained by the authority having jurisdiction. One set of approved plans shall be returned to the applicant and shall be kept at the site or the building or work for use by inspection personnel at all times during which the work authorized is in progress. The permit issued by the authority having jurisdiction shall be kept posted on the premises at all times during the course of the installation or work.

(C) Validity. The issuance or granting of a permit or approval of plans shall:

- (1) not be construed to be a permit for, or an approval of, any violation of any of the provisions of this *Code* or other pertinent laws or ordinances.

- (2) not prevent the authority having jurisdiction from later requiring the correction of errors in the plans or from preventing building operations being carried on thereunder when in violation of this *Code* or of other pertinent laws and ordinances of the City.
- (3) not prevent the authority having jurisdiction from requiring correction of conditions found to be in violation of this *Code* or any other ordinance of the City.
- (4) not be construed to extend or otherwise affect any period of time for compliance specified in any notice or order issued by the authority having jurisdiction or other administrative authority requiring the correction of any such conditions.

(D) Expiration and Renewal of Issued Permits.

(1) Expiration. Permits and renewed permits shall expire one year from the date of issuance.

Exception No.1: Initial permits for major construction projects that require more than one year to complete, according to a construction schedule submitted by the applicant, may be issued for a period that provides reasonable time to complete the work but in no case longer than three years.

Exception No.2: Permits that expire in less than one year may be issued where the authority having jurisdiction determines a shorter period is appropriate.

(2) Renewal. Permits may be renewed and renewed permits may be further renewed by the authority having jurisdiction provided the following conditions are met:

- (1) Application for renewal shall be made within the thirty-day period immediately preceding the date of expiration of the permit;
- (2) The work authorized by the permit has been started and is progressing at a rate approved by the authority having jurisdiction;
- (3) If an application for renewal is made either more than one year after the effective date of a new or revised edition of the Electrical Code, the permit shall not be renewed unless:
 - a. The authority having jurisdiction determines that the permit complies, or is modified to comply, with the code or codes in effect on the date of application renewal; or
 - b. The work authorized by the permit is substantially underway and progressing at a rate approved by the authority having jurisdiction. For the purpose of this Article "substantially underway" means work that is being completed and inspected on a continuing basis.

Permits may also be renewed where commencement or completion of the work authorized by the permit is delayed by litigation, appeals, strikes or other causes related to the work authorized by the permit, beyond the permit holder's control.

(3) Re-establishment. A new permit shall be required to complete work where a permit expired and was not renewed.

Exception: A permit which has been expired for less than one year may be reestablished upon approval of the authority having jurisdiction provided it complies with Items (1) and (2) of Section 80.52(D)(2) above.

(E) Revocation. The authority having jurisdiction may, by written order, revoke a permit issued under the provisions of this *Code* whenever the permit is issued in error or on the basis of false or misleading information, or in violation of any ordinance or regulation or any provision of this *Code*.

(1) Standards for Revocation. A permit may be revoked if:

- (a) This *Code* or the permit has been or is being violated and issuance of a notice of violation or stop work order has been or would be ineffective to secure compliance because of circumstances related to the violation, or
- (b) The permit was issued in error or obtained with false or misleading information.

(2) Notice of Revocation. Whenever the authority having jurisdiction determines there are grounds for revoking a permit, a notice of revocation may be issued. The notice of revocation shall identify the reason for the proposed revocation, including the violations, the conditions violated, and any alleged false or misleading information provided.

- (a) *Serving Notice of Revocation.* The notice of revocation shall be served on the owner of the property on which the work is occurring, the holder of a permit if different than the owner, and the person doing or causing the work to be done. The notice of revocation shall be served in the manner set forth in RCW 4.28.080 for service of a summons or sent by first class mail to the last known address of the responsible party. For purposes of this Section, service is complete at the time of personal service, or if mailed, three days after the date of mailing. When the last day of the period so computed is a Saturday, Sunday or City holiday, the period runs until five p.m. on the next business day.
- (b) *Effective Date of Revocation.* The authority having jurisdiction shall identify in the notice of revocation a date certain on which the revocation will take effect unless review before the authority having jurisdiction is requested and pursued pursuant to Section 80.52(E)(3).

(3) Review by the Authority Having jurisdiction.

- (a) *Requesting a Review.* Any person aggrieved by a notice of revocation may obtain a review by making a request in writing to the authority having jurisdiction within 3 business days of the date of service of the notice of revocation.

The review shall occur within 5 business days after receipt by the authority having jurisdiction of the request for review.

- (b) *Information Reviewed.* Any person aggrieved by or interested in the notice of revocation may submit additional information to the authority having jurisdiction for consideration as part of the review at any time prior to the review. The review will be made by a representative of the authority having jurisdiction who will review all additional information received and may also request a site visit.
- (c) *After the Review.* After the review, the authority having jurisdiction may:
 - (1) Sustain the notice of revocation and set or modify the date the revocation will take effect;
 - (2) Withdraw the notice of revocation;
 - (3) Modify the notice of revocation and set or modify the date the revocation will take effect; or
 - (4) Continue the review to a date certain.
- (d) *Decision of the Authority Having Jurisdiction.* The authority having jurisdiction shall issue an order containing the decision within 10 days after the review and shall cause the same to be sent by first class mail to the person or persons requesting the review, any other person on whom the notice of revocation was served, and any other person who requested a copy before issuance of the order. The order of the authority having jurisdiction is the final order of the City and the City and all appellants shall be bound by the order.

(F) Permit for Temporary Installations. The authority having jurisdiction may issue a nonrenewable permit for temporary electrical installations for use during the construction of buildings or for carnivals, conventions, festivals, fairs, the holding of religious services, temporary lighting of streets and the like if it is found that life or property will not be jeopardized.

Permission to use a temporary installation shall be granted for no longer than six months, except that a permit for a temporary installation to be used for the construction of a building may be issued for the necessary period of construction. Should temporary lighting be over the street area, proper authority for use of the street shall first be obtained from the Seattle Department of Transportation. All temporary installations shall comply with all other requirements of this *Code*.

80.53 Permit Fees. A fee for each electrical permit and for other activities related to the enforcement of this *Code* shall be paid as set forth in the Fee Subtitle.

80.54 Inspections.

(A) General. It shall be unlawful to connect or to allow the connection of any electrical installations, extensions thereof, or electrical equipment to the electric current until the work is inspected and approved by the authority having jurisdiction.

(B) Inspection Requests. The owner of the property, the owner's authorized agent, or the person designated by the owner or agent to do the work authorized by a permit shall notify the authority having jurisdiction that work as specified in this section is ready for inspection. Where a permit has been issued to a licensed contractor, it shall be the duty of the contractor to notify the authority having jurisdiction that work requiring inspection is ready for inspection.

It shall be the duty of the permit holder and of the person requesting any inspections required by this *Code* to provide access to and means for proper inspection of the work. It shall be the duty of the permit holder to cause the work to be accessible and exposed for inspection purposes. Neither the authority having jurisdiction nor the City is liable for any expense incurred in the required removal or replacement of any material to allow inspection.

(C) Inspection Record. Work requiring a permit shall not be commenced until the permit holder or the permit holder's agent has posted an inspection record in a conspicuous place on the premises and in a position which allows the authority having jurisdiction to conveniently make the required entries thereon regarding inspection of the work. This record shall be maintained in such position by the permit holder or the permit holder's agent until final approval has been granted by the authority having jurisdiction and the serving utility has made the connection to the electric current.

(D) Approvals Required. No work shall be done on any part of the building or structure beyond the point indicated in each successive inspection without first obtaining the written approval of the authority having jurisdiction. Written approval shall be given only after an inspection has been made of each successive step in the construction as indicated by each of the inspections required in Section 80.54(E) below.

Approval as a result of an inspection is not an approval of any violation of the provisions of this *Code* or of other pertinent laws and ordinances of the City. Inspection presuming to give authority to violate or cancel the provisions of this *Code* or of other pertinent laws and ordinances of the City are not valid.

(E) Required Inspections.

(1) Cover Inspection. The authority having jurisdiction is authorized to conduct cover inspections when all of the following work has been completed:

- (a) All piping, ducts, plumbing and like installations of other trades which are liable to interfere or run in close proximity to the electrical installation are permanently in place and inspected, but prior to any work to cover or conceal any installation of electrical equipment, and;
- (b) Electrical equipment grounding (boxes, equipment, conductors and provisions for grounding receptacles, etc.) for all systems shall be completely made-up.
- (c) For conduit systems, after all conduit has been installed and properly secured to the structure.

(2) Final Inspection. The authority having jurisdiction is authorized to conduct a final inspection after all wiring has been completed and all permanent fixtures such as switches, outlet receptacles, plates, electric hot-water tanks, lighting fixtures and all other equipment has been properly installed. The permit holder shall call for a final inspection when the work described on the permit has been completed.

(F) Other Inspections. In addition to the called inspections specified in Section 80.54(E), the authority having jurisdiction is authorized to conduct or require any other inspections of any construction work to ascertain compliance with the provisions of this *Code* and other laws enforced by the authority having jurisdiction.

Where work, for which any permit or approval is required, is commenced or performed prior to making formal application and receiving the authority having jurisdiction's permission to proceed, the authority having jurisdiction may make a special investigation inspection before a permit may be issued for the work. Where a special investigation is made, a special investigation fee may be assessed in accordance with the Fee Subtitle.

(G) Reinspections. The authority having jurisdiction is authorized to conduct a reinspection when work is not complete, corrections not made, the approved plans are not readily available to the inspector, for failure to provide access on the date for which inspection is requested, or when deviations from plans that require the approval of the authority having jurisdiction have been made without proper approval.

For the purpose of determining compliance with Section 80.4(C) Maintenance, the authority having jurisdiction or the fire chief may cause any structure to be reinspected.

The authority having jurisdiction may assess a reinspection fee as set forth in the Fee Subtitle for any action listed above for which reinspection may be required. In instances where reinspection fees have been assessed, no additional inspection of the work shall be performed until the required fees have been paid.

NFPA 70
National Electrical Code®
2008 Edition

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ARTICLE 90
Introduction

90.1 ((Purpose.)) Reserved.

~~((A) Practical Safeguarding.~~ The purpose of this Code is the practical safeguarding of persons and property from hazards arising from the use of electricity.

~~(B) Adequacy.~~ This Code contains provisions that are considered necessary for safety. Compliance therewith and proper maintenance results in an installation that is essentially free from hazard but not necessarily efficient, convenient, or adequate for good service or future expansion of electrical use.

FPN: Hazards often occur because of overloading of wiring systems by methods or usage not in conformity with this Code. This occurs because initial wiring did not provide for increases in the use of electricity. An initial adequate installation and reasonable provisions for system changes provide for future increases in the use of electricity.

~~(C) Intention.~~ This Code is not intended as a design specification or an instruction manual for untrained persons.

~~(D) Relation to Other International Standards.~~ The requirements in this Code address the fundamental principles of protection for safety contained in Section 131 of International Electrotechnical Commission Standard 60364-1, *Electrical Installations of Buildings*.

FPN: IEC 60364-1, Section 131, contains fundamental principles of protection for safety that encompass protection against electric shock, protection against thermal effects, protection against overcurrent, protection against fault currents, and protection against overvoltage. All of these potential hazards are addressed by the requirements in this Code.)

90.2 ((Scope.)) Reserved.

~~((A) Covered.~~ This Code covers the installation of electrical conductors, equipment, and raceways; signaling and communications conductors, equipment, and raceways; and optical fiber cables and raceways for the following:

- ~~(1) Public and private premises, including buildings, structures, mobile homes, recreational vehicles, and floating buildings~~
- ~~(2) Yards, lots, parking lots, carnivals, and industrial substations~~
- ~~(3) Installations of conductors and equipment that connect to the supply of electricity~~
- ~~(4) Installations used by the electric utility, such as office buildings, warehouses, garages, machine shops, and recreational buildings, that are not an integral part of a generating plant, substation, or control center.~~

~~(B) Not Covered.~~ This Code does not cover the following:

- ~~(1) Installations in ships, watercraft other than floating buildings, railway rolling stock, aircraft, or automotive vehicles other than mobile homes and recreational vehicles~~

FPN: Although the scope of this Code indicates that the Code does not cover installations in ships, portions of this Code are incorporated by reference into Title 46, *Code of Federal Regulations*, Parts 110–113.

- ~~(2) Installations underground in mines and self-propelled mobile surface mining machinery and its attendant electrical trailing cable~~
- ~~(3) Installations of railways for generation, transformation, transmission, or distribution of power used exclusively for operation of rolling stock or installations used exclusively for signaling and communications purposes~~
- ~~(4) Installations of communications equipment under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations~~
- ~~(5) Installations under the exclusive control of an electric utility where such installations~~
 - ~~a. Consist of service drops or service laterals, and associated metering, or~~
 - ~~b. Are located in legally established easements or rights-of-way designated by or recognized by public service commissions, utility commissions, or other regulatory agencies having jurisdiction for such installations, or~~
 - ~~c. Are on property owned or leased by the electric utility for the purpose of communications, metering, generation, control, transformation, transmission, or distribution of electric energy.~~

FPN to (4) and (5): Examples of utilities may include those entities that are typically designated or recognized by governmental law or regulation by public service/utility commissions and that install, operate, and maintain electric supply (such as generation, transmission, or distribution systems) or communication systems (such as telephone, CATV,

~~Internet, satellite, or data services). Utilities may be subject to compliance with codes and standards covering their regulated activities as adopted under governmental law or regulation. Additional information can be found through consultation with the appropriate governmental bodies, such as state regulatory commissions, the Federal Energy Regulatory Commission, and the Federal Communications Commission.~~

~~(C) **Special Permission.** The authority having jurisdiction for enforcing this Code may grant exception for the installation of conductors and equipment that are not under the exclusive control of the electric utilities and are used to connect the electric utility supply system to the service-entrance conductors of the premises served, provided such installations are outside a building or terminate immediately inside a building wall.)~~

90.3 Code Arrangement. This Code is divided into the introduction and nine chapters, as shown in Figure 90.3. Chapters 1, 2, 3, and 4 apply generally; Chapters 5, 6, and 7 apply to special occupancies, special equipment, or other special conditions. These latter chapters supplement or modify the general rules. Chapters 1 through 4 apply except as amended by Chapters 5, 6, and 7 for the particular conditions.

Chapter 8 covers communications systems and is not subject to the requirements of Chapters 1 through 7 except where the requirements are specifically referenced in Chapter 8.

Chapter 9 consists of tables that are applicable as referenced.

Annexes are not part of the requirements of this Code but are included for informational purposes only.

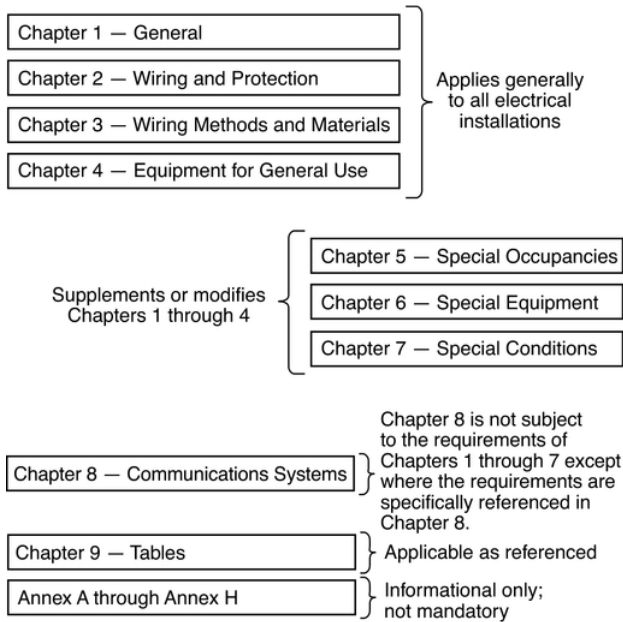


Figure 90.3 Code Arrangement.

90.4 Enforcement. This Code is intended to be suitable for mandatory application by governmental bodies that exercise legal jurisdiction over electrical installations, including signaling and communications systems, and for use by insurance inspectors. The authority having jurisdiction for enforcement of the Code has the responsibility for making interpretations of the rules, for deciding on the approval of equipment and materials, and for granting the special permission contemplated in a number of the rules.

By special permission, the authority having jurisdiction may waive specific requirements in this Code or permit alternative methods where it is assured that equivalent objectives can be achieved by establishing and maintaining effective safety.

This Code may require new products, constructions, or materials that may not yet be available at the time the Code is adopted. In such event, the authority having jurisdiction may permit the use of the products, constructions, or materials that comply with the most recent previous edition of this Code adopted by the jurisdiction.

90.5 Mandatory Rules, Permissive Rules, and Explanatory Material.

(A) Mandatory Rules. Mandatory rules of this Code are those that identify actions that are specifically required or prohibited and are characterized by the use of the terms *shall* or *shall not*.

(B) Permissive Rules. Permissive rules of this Code are those that identify actions that are allowed but not required, are normally used to describe options or alternative methods, and are characterized by the use of the terms *shall be permitted* or *shall not be required*.

(C) Explanatory Material. Explanatory material, such as references to other standards, references to related sections of this Code, or information related to a Code rule, is included in this Code in the form of fine print notes (FPNs). Fine print notes are informational only and are not enforceable as requirements of this Code.

Brackets containing section references to another NFPA document are for informational purposes only and are provided as a guide to indicate the source of the extracted text. These bracketed references immediately follow the extracted text.

FPN: The format and language used in this Code follows guidelines established by NFPA and published in the *NEC Style Manual*. Copies of this manual can be obtained from NFPA.

90.6 Formal Interpretations. To promote uniformity of interpretation and application of the provisions of this Code, formal interpretation procedures have been established and are found in the NFPA Regulations Governing Committee Projects.

90.7 Examination of Equipment for Safety. For specific items of equipment and materials referred to in this *Code*, examinations for safety made under standard conditions provide a basis for approval where the record is made generally available through promulgation by organizations properly equipped and qualified for experimental testing, inspections of the run of goods at factories, and service-value determination through field inspections. This avoids the necessity for repetition of examinations by different examiners, frequently with inadequate facilities for such work, and the confusion that would result from conflicting reports on the suitability of devices and materials examined for a given purpose.

It is the intent of this *Code* that factory-installed internal wiring or the construction of equipment need not be inspected at the time of installation of the equipment, except to detect alterations or damage, if the equipment has been listed by a qualified electrical testing laboratory that is recognized as having the facilities described in the preceding paragraph and that requires suitability for installation in accordance with this *Code*.

FPN No. 1: See requirements in 110.3.

FPN No. 2: *Listed* is defined in Article 100.

FPN No. 3: Annex A contains an informative list of product safety standards for electrical equipment.

90.8 Wiring Planning.

(A) Future Expansion and Convenience. Plans and specifications that provide ample space in raceways, spare raceways, and additional spaces allow for future increases in electric power and communication circuits. Distribution centers located in readily accessible locations provide convenience and safety of operation.

(B) Number of Circuits in Enclosures. It is elsewhere provided in this *Code* that the number of wires and circuits confined in a single enclosure be varyingly restricted. Limiting the number of circuits in a single enclosure minimizes the effects from a short circuit or ground fault in one circuit.

90.9 Units of Measurement.

(A) Measurement System of Preference. For the purpose of this *Code*, metric units of measurement are in accordance with the modernized metric system known as the International System of Units (SI).

(B) Dual System of Units. SI units shall appear first, and inch-pound units shall immediately follow in parentheses. Conversion from inch-pound units to SI units shall be based on hard conversion except as provided in 90.9(C).

(C) Permitted Uses of Soft Conversion. The cases given in 90.9(C)(1) through (C)(4) shall not be required to use hard conversion and shall be permitted to use soft conversion.

(1) Trade Sizes. Where the actual measured size of a product is not the same as the nominal size, trade size designators shall be used rather than dimensions. Trade practices shall be followed in all cases.

(2) Extracted Material. Where material is extracted from another standard, the context of the original material shall not be compromised or violated. Any editing of the extracted text shall be confined to making the style consistent with that of the *NEC*.

(3) Industry Practice. Where industry practice is to express units in inch-pound units, the inclusion of SI units shall not be required.

(4) Safety. Where a negative impact on safety would result, soft conversion shall be used.

(D) Compliance. Conversion from inch-pound units to SI units shall be permitted to be an approximate conversion. Compliance with the numbers shown in either the SI system or the inch-pound system shall constitute compliance with this *Code*.

FPN No. 1: Hard conversion is considered a change in dimensions or properties of an item into new sizes that might or might not be interchangeable with the sizes used in the original measurement. Soft conversion is considered a direct mathematical conversion and involves a change in the description of an existing measurement but not in the actual dimension.

FPN No. 2: SI conversions are based on IEEE/ASTM SI 10-1997, *Standard for the Use of the International System of Units (SI): The Modern Metric System*.

Chapter 1 General

ARTICLE 100
Definitions

Scope. This article contains only those definitions essential to the proper application of this *Code*. It is not intended to include commonly defined general terms or commonly defined technical terms from related codes (~~(and)~~) or standards. In general, only those terms that are used in two or more articles are defined in Article 100. Other definitions are included in the article in which they are used but may be referenced in Article 100.

Part I of this article contains definitions intended to apply wherever the terms are used throughout this *Code*. Part II contains definitions applicable only to the parts of articles specifically covering installations and equipment operating at over 600 volts, nominal.

Terms or phrases used but not defined in this *Code* shall be as defined in the *Seattle Building Code* or the *Seattle Mechanical Code*.

FPN: WAC 296-46B-100, which includes additional terms and definitions, is by this reference made part of the 2008 *Seattle Electrical Code*.

I. General

Accessible (as applied to equipment). Admitting close approach; not guarded by locked doors, elevation, or other effective means.

Accessible (as applied to wiring methods). Capable of being removed or exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building.

Accessible, Readily (Readily Accessible). Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, and so forth.

Ampacity. The current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

Appliance. Utilization equipment, generally other than industrial, that is normally built in standardized sizes or types and is installed or connected as a unit to perform one or more functions such as clothes washing, air conditioning, food mixing, deep frying, and so forth.

Approved. Acceptable to the authority having jurisdiction.

Askarel. A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. Askarels of various compositional types are used. Under arcing conditions, the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases, depending on the askarel type.

Attachment Plug (Plug Cap) (Plug). A device that, by insertion in a receptacle, establishes a connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle.

Authority Having Jurisdiction (AHJ). ~~((An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.))~~ The Department of Planning and Development is authorized to administer and enforce this *Code*. The Department is under the administration and operational control of the Director, who is the *authority having jurisdiction*.

FPN: The Director may designate deputies, officers, inspectors, assistants and other persons to carry out the functions of the authority having jurisdiction as permitted in Article 80.

~~((FPN: The phrase “authority having jurisdiction,” or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.))~~

Automatic. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current, pressure, temperature, or mechanical configuration.

Bathroom. An area including a basin with one or more of the following: a toilet, a tub, or a shower.

Bonded (Bonding). Connected to establish electrical continuity and conductivity.

Bonding Jumper. A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected.

Bonding Jumper, Equipment. The connection between two or more portions of the equipment grounding conductor.

Bonding Jumper, Main. The connection between the grounded circuit conductor and the equipment grounding conductor at the service.

Branch Circuit. The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).

Branch Circuit, Appliance. A branch circuit that supplies energy to one or more outlets to which appliances are to be

FPN: A current in excess of rating may be accommodated by certain equipment and conductors for a given set of conditions. Therefore, the rules for overcurrent protection are specific for particular situations.

Overload. Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front.

Plenum. A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.

Power Outlet. An enclosed assembly that may include receptacles, circuit breakers, fuseholders, fused switches, buses, and watt-hour meter mounting means; intended to supply and control power to mobile homes, recreational vehicles, park trailers, or boats or to serve as a means for distributing power required to operate mobile or temporarily installed equipment.

Premises Wiring (System). Interior and exterior wiring, including power, lighting, control, and signal circuit wiring together with all their associated hardware, fittings, and wiring devices, both permanently and temporarily installed. This includes (a) wiring from the service point or power source to the outlets or (b) wiring from and including the power source to the outlets where there is no service point.

Such wiring does not include wiring internal to appliances, luminaires, motors, controllers, motor control centers, and similar equipment.

Qualified Person. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.

FPN: Refer to NFPA 70E®-2004, *Standard for Electrical Safety in the Workplace*, for electrical safety training requirements.

Raceway. An enclosed channel of metal or nonmetallic materials designed expressly for holding wires, cables, or busbars, with additional functions as permitted in this Code. Raceways include, but are not limited to, rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical nonmetallic tubing, electrical metallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways.

Rainproof. Constructed, protected, or treated so as to prevent rain from interfering with the successful operation of the apparatus under specified test conditions.

Raintight. Constructed or protected so that exposure to a beating rain will not result in the entrance of water under specified test conditions.

Receptacle. A receptacle is a contact device installed at the outlet for the connection of an attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.

Receptacle Outlet. An outlet where one or more receptacles are installed.

Remote-Control Circuit. Any electrical circuit that controls any other circuit through a relay or an equivalent device.

Sealable Equipment. Equipment enclosed in a case or cabinet that is provided with a means of sealing or locking so that live parts cannot be made accessible without opening the enclosure. The equipment may or may not be operable without opening the enclosure.

Separately Derived System. A premises wiring system whose power is derived from a source of electric energy or equipment other than a service. Such systems have no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system.

Service. The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

Service Cable. Service conductors made up in the form of a cable.

Service Conductors. The conductors from the service point to the service disconnecting means.

Service Drop. The overhead service conductors from the last pole or other aerial support to and including the splices, if any, connecting to the service-entrance conductors at the building or other structure.

Service-Entrance Conductors, Overhead System. The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop.

Service-Entrance Conductors, Underground System. The service conductors between the terminals of the service equipment and the point of connection to the service lateral.

FPN: Where service equipment is located outside the building walls, there may be no service-entrance conductors or they may be entirely outside the building.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service conductors to a building or other structure, or an otherwise designated area, and intended to constitute the main control and cutoff of the supply.

Service Lateral. The underground service conductors between the street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service-entrance conductors in a terminal box or meter or other enclosure, inside or outside the building wall. Where there is no terminal box, meter, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building.

Service Point. The point of connection between the facilities of the serving utility and the premises wiring. For requirements for service point connections, see Section 230.12.

Service Terminal Box. An approved box to be used exclusively for the connection of the utility distribution system to the consumer's service entrance conductors.

Short-Circuit Current Rating. The prospective symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding defined acceptance criteria.

Show Window. Any window used or designed to be used for the display of goods or advertising material, whether it is fully or partly enclosed or entirely open at the rear and whether or not it has a platform raised higher than the street floor level.

Signaling Circuit. Any electrical circuit that energizes signaling equipment.

Solar Photovoltaic System. The total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to a utilization load.

Special Permission. The written consent of the authority having jurisdiction.

Structure. That which is built or constructed.

Supplementary Overcurrent Protective Device. A device intended to provide limited overcurrent protection for specific applications and utilization equipment such as luminaires and appliances. This limited protection is in addition to the protection provided in the required branch circuit by the branch circuit overcurrent protective device.

Surge Arrester. A protective device for limiting surge voltages by discharging or bypassing surge current; it also prevents continued flow of follow current while remaining capable of repeating these functions.

Surge-Protective Device (SPD). A protective device for limiting transient voltages by diverting or limiting surge

current; it also prevents continued flow of follow current while remaining capable of repeating these functions and is designated as follows:

Type 1: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.

Type 2: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

Type 3: Point of utilization SPDs.

Type 4: Component SPDs, including discrete components, as well as assemblies.

FPN: For further information on Type 1, Type 2, Type 3, and Type 4 SPDs, see UL 1449, *Standard for Surge Protective Devices*.

Switch, Bypass Isolation. A manually operated device used in conjunction with a transfer switch to provide a means of directly connecting load conductors to a power source and of disconnecting the transfer switch.

Switch, General-Use. A switch intended for use in general distribution and branch circuits. It is rated in amperes, and it is capable of interrupting its rated current at its rated voltage.

Switch, General-Use Snap. A form of general-use switch constructed so that it can be installed in device boxes or on box covers, or otherwise used in conjunction with wiring systems recognized by this *Code*.

Switch, Isolating. A switch intended for isolating an electrical circuit from the source of power. It has no interrupting rating, and it is intended to be operated only after the circuit has been opened by some other means.

Switch, Motor-Circuit. A switch rated in horsepower that is capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage.

Switch, Transfer. An automatic or nonautomatic device for transferring one or more load conductor connections from one power source to another.

Switchboard. A large single panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments. Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets.

Thermally Protected (as applied to motors). The words *Thermally Protected* appearing on the nameplate of a motor or motor-compressor indicate that the motor is provided with a thermal protector.

Thermal Protector (as applied to motors). A protective device for assembly as an integral part of a motor or motor-compressor that, when properly applied, protects the motor against dangerous overheating due to overload and failure to start.

FPN: The thermal protector may consist of one or more sensing elements integral with the motor or motor-compressor and an external control device.

Ungrounded. Not connected to ground or to a conductive body that extends the ground connection.

Utility-Interactive Inverter. An inverter intended for use in parallel with an electric utility to supply common loads that may deliver power to the utility.

Utilization Equipment. Equipment that utilizes electric energy for electronic, electromechanical, chemical, heating, lighting, or similar purposes.

Ventilated. Provided with a means to permit circulation of air sufficient to remove an excess of heat, fumes, or vapors.

Volatile Flammable Liquid. A flammable liquid having a flash point below 38°C (100°F), or a flammable liquid whose temperature is above its flash point, or a Class II combustible liquid that has a vapor pressure not exceeding 276 kPa (40 psia) at 38°C (100°F) and whose temperature is above its flash point.

Voltage (of a circuit). The greatest root-mean-square (rms) (effective) difference of potential between any two conductors of the circuit concerned.

FPN: Some systems, such as 3-phase 4-wire, single-phase 3-wire, and 3-wire direct current, may have various circuits of various voltages.

Voltage, Nominal. A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240 volts, 480Y/277 volts, 600 volts). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

FPN: See ANSI C84.1-2006, *Voltage Ratings for Electric Power Systems and Equipment (60 Hz)*.

Voltage to Ground. For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded; for ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit.

Watertight. Constructed so that moisture will not enter the enclosure under specified test conditions.

Weatherproof. Constructed or protected so that exposure to the weather will not interfere with successful operation.

FPN: Rainproof, raintight, or watertight equipment can fulfill the requirements for weatherproof where varying weather conditions other than wetness, such as snow, ice, dust, or temperature extremes, are not a factor.

II. Over 600 Volts, Nominal

Whereas the preceding definitions are intended to apply wherever the terms are used throughout this Code, the following definitions are applicable only to parts of the article specifically covering installations and equipment operating at over 600 volts, nominal.

Electronically Actuated Fuse. An overcurrent protective device that generally consists of a control module that provides current sensing, electronically derived time-current characteristics, energy to initiate tripping, and an interrupting module that interrupts current when an overcurrent occurs. Electronically actuated fuses may or may not operate in a current-limiting fashion, depending on the type of control selected.

Fuse. An overcurrent protective device with a circuit-opening fusible part that is heated and severed by the passage of overcurrent through it.

FPN: A fuse comprises all the parts that form a unit capable of performing the prescribed functions. It may or may not be the complete device necessary to connect it into an electrical circuit.

Controlled Vented Power Fuse. A fuse with provision for controlling discharge circuit interruption such that no solid material may be exhausted into the surrounding atmosphere.

FPN: The fuse is designed so that discharged gases will not ignite or damage insulation in the path of the discharge or propagate a flashover to or between grounded members or conduction members in the path of the discharge where the distance between the vent and such insulation or conduction members conforms to manufacturer's recommendations.

Expulsion Fuse Unit (Expulsion Fuse). A vented fuse unit in which the expulsion effect of gases produced by the arc and lining of the fuseholder, either alone or aided by a spring, extinguishes the arc.

Nonvented Power Fuse. A fuse without intentional provision for the escape of arc gases, liquids, or solid particles to the atmosphere during circuit interruption.

Power Fuse Unit. A vented, nonvented, or controlled vented fuse unit in which the arc is extinguished by being drawn through solid material, granular material, or liquid, either alone or aided by a spring.

Vented Power Fuse. A fuse with provision for the escape of arc gases, liquids, or solid particles to the surrounding atmosphere during circuit interruption.

Multiple Fuse. An assembly of two or more single-pole fuses.

Switching Device. A device designed to close, open, or both, one or more electrical circuits.

Circuit Breaker. A switching device capable of making, carrying, and interrupting currents under normal circuit conditions, and also of making, carrying for a specified time,

and interrupting currents under specified abnormal circuit conditions, such as those of short circuit.

Cutout. An assembly of a fuse support with either a fuseholder, fuse carrier, or disconnecting blade. The fuseholder or fuse carrier may include a conducting element (fuse link) or may act as the disconnecting blade by the inclusion of a nonfusible member.

Disconnecting Means. A device, group of devices, or other means whereby the conductors of a circuit can be disconnected from their source of supply.

Disconnecting (or Isolating) Switch (Disconnecter, Isolator). A mechanical switching device used for isolating a circuit or equipment from a source of power.

Interrupter Switch. A switch capable of making, carrying, and interrupting specified currents.

Oil Cutout (Oil-Filled Cutout). A cutout in which all or part of the fuse support and its fuse link or disconnecting blade is mounted in oil with complete immersion of the contacts and the fusible portion of the conducting element (fuse link) so that arc interruption by severing of the fuse link or by opening of the contacts will occur under oil.

Oil Switch. A switch having contacts that operate under oil (or askarel or other suitable liquid).

Regulator Bypass Switch. A specific device or combination of devices designed to bypass a regulator.

ARTICLE 110 Requirements for Electrical Installations

I. General

110.1 Scope. This article covers general requirements for the examination and approval, installation and use, access to and spaces about electrical conductors and equipment; enclosures intended for personnel entry; and tunnel installations.

110.2 Approval. The conductors and equipment required or permitted by this *Code* shall be ~~((acceptable))~~ approved only if ~~((approved))~~ the conductors or equipment meet minimum safety standards by conforming to applicable electrical product standards recognized by the authority having jurisdiction. Suitability of compliance may be demonstrated by listing or labeling from a Nationally Recognized Testing Laboratory (NRTL).

FPN: See 90.7, Examination of Equipment for Safety, and 110.3, Examination, Identification, Installation, and Use of Equipment. See definitions of *Approved*, *Identified*, *Labeled*, and *Listed*.

110.3 Examination, Identification, Installation, and Use of Equipment.

(A) Examination. In judging equipment, considerations such as the following shall be evaluated:

(1) Suitability for installation and use in conformity with the provisions of this *Code*

FPN: Suitability of equipment use may be identified by a description marked on or provided with a product to identify the suitability of the product for a specific purpose, environment, or application. Suitability of equipment may be evidenced by listing or labeling.

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

(3) Wire-bending and connection space

(4) Electrical insulation

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

(6) Arcing effects

(7) Classification by type, size, voltage, current capacity, and specific use

(8) Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment

(B) Installation and Use. Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling.

110.4 Voltages. Throughout this *Code*, the voltage considered shall be that at which the circuit operates. The voltage rating of electrical equipment shall not be less than the nominal voltage of a circuit to which it is connected.

110.5 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 material and the sizes given in this *Code* shall apply to copper conductors. Where other materials are used, the size shall be changed accordingly.

FPN: For aluminum and copper-clad aluminum conductors, see 310.15.

110.6 Conductor Sizes. Conductor sizes are expressed in American Wire Gage (AWG) or in circular mils.

110.7 Wiring Integrity. Completed wiring installations shall be free from short circuits, ground faults, or any connections to ground other than as required or permitted elsewhere in this *Code*.

110.8 Wiring Methods. Only wiring methods recognized as suitable are included in this *Code*. The recognized methods of wiring shall be permitted to be installed in any type of building or occupancy, except as otherwise provided in this *Code*.

110.9 Interrupting Rating. Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment.

Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted.

110.10 Circuit Impedance and Other Characteristics. The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit-protective devices 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.

110.11 Deteriorating Agents. Unless identified for use in the operating environment, no conductors or equipment shall be located in damp or wet locations; where exposed to gases, fumes, vapors, liquids, or other agents that have a deteriorating effect on the conductors or equipment; or where exposed to excessive temperatures.

FPN No. 1: See 300.6 for protection against corrosion.

FPN No. 2: Some cleaning and lubricating compounds can cause severe deterioration of many plastic materials used for insulating and structural applications in equipment.

Equipment not identified for outdoor use and equipment identified only for indoor use, such as “dry locations,” “indoor use only,” “damp locations,” or enclosure Types 1, 2, 5, 12, 12K, and/or 13, shall be protected against permanent damage from the weather during building construction.

FPN No. 3: See Table 110.20 for appropriate enclosure-type designations.

FPN No. 4: WAC 296-46B-110.011, which addresses requirements for electrical equipment and wiring submerged or exposed to water is by this reference made part of the 2008 *Seattle Electrical Code*.

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

FPN: Accepted industry practices are described in ANSI/NECA 1-2006, *Standard Practices for Good Workmanship in Electrical Contracting*, and other ANSI-approved installation standards.

(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.

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.

(C) Locations.

(1) Required Egress. Electrical equipment shall not project beyond the face of the wall or ceiling in halls, corridors or other locations that would reduce the width or height required by the *Seattle Building Code* for such locations.

(2) Overcurrent Protection. Equipment containing overcurrent protection shall be placed so that the lowest possible overcurrent device is no less than one foot above the floor or working platform.

Exception: Supplementary overcurrent devices installed in listed utilization equipment.

FPN: See Chapter 10 of the *Seattle Building Code* for prohibitions of electrical equipment in exit enclosures.

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 (such as copper and aluminum, copper and copper-clad aluminum, or aluminum and copper-clad aluminum), 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.

FPN: Many terminations and equipment are marked with a tightening torque.

(A) **Terminals.** Connection of conductors to terminal parts shall ensure 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. Connection by means of wire-binding screws or studs and nuts that have upturned lugs or the equivalent shall be permitted for 10 AWG or smaller conductors.

Terminals for more than one conductor and terminals used to connect aluminum shall be so identified.

(B) **Splices.** Conductors shall be spliced or joined with splicing devices identified for the use or by brazing, welding, or soldering with a fusible metal or alloy. Soldered splices shall first be spliced or joined so as to be mechanically and electrically secure without solder and then be soldered. All 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 identified for the purpose.

Wire connectors or splicing means installed on conductors for direct burial shall be listed for such use.

(C) **Temperature Limitations.** The temperature rating associated with the ampacity of a conductor shall be selected and coordinated so as not to exceed the lowest temperature rating of any connected termination, conductor, or device. Conductors with temperature ratings higher than specified for terminations shall be permitted to be used for ampacity adjustment, correction, or both.

(1) **Equipment Provisions.** The determination of termination provisions of equipment shall be based on 110.14(C)(1)(a) or (C)(1)(b). Unless the equipment is listed and marked otherwise, conductor ampacities used in determining equipment termination provisions shall be based on Table 310.16 as appropriately modified by 310.15(B)(6).

(a) Termination provisions of equipment for circuits rated 100 amperes or less, or marked for 14 AWG through 1 AWG conductors, shall be used only for one of the following:

- (1) Conductors rated 60°C (140°F).
- (2) Conductors with higher temperature ratings, provided the ampacity of such conductors is determined based on the 60°C (140°F) ampacity of the conductor size used.
- (3) Conductors with higher temperature ratings if the equipment is listed and identified for use with such conductors.
- (4) For motors marked with design letters B, C, or D, conductors having an insulation rating of 75°C (167°F) or higher shall be permitted to be used, provided the ampacity of such conductors does not exceed the 75°C (167°F) ampacity.

(b) Termination provisions of equipment for circuits rated over 100 amperes, or marked for conductors larger than 1 AWG, shall be used only for one of the following:

- (1) Conductors rated 75°C (167°F)
- (2) Conductors with higher temperature ratings, provided the ampacity of such conductors does not exceed the 75°C (167°F) ampacity of the conductor size used, or up to their ampacity if the equipment is listed and identified for use with such conductors

(2) **Separate Connector Provisions.** Separately installed pressure connectors shall be used with conductors at the ampacities not exceeding the ampacity at the listed and identified temperature rating of the connector.

FPN: With respect to 110.14(C)(1) and (C)(2), equipment markings or listing information may additionally restrict the sizing and temperature ratings of connected conductors.

110.15 High-Leg Marking. On a 4-wire, delta-connected system where the midpoint of one phase winding is grounded, only the conductor or busbar having the higher phase voltage to ground shall be durably and permanently marked by an outer finish that is orange in color or by other effective means. Such identification shall be placed at each point on the system where a connection is made if the grounded conductor is also present.

110.16 Flash Protection. Electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling occupancies, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

FPN No. 1: NFPA 70E-2004, *Standard for Electrical Safety in the Workplace*, provides assistance in determining severity of potential exposure, planning safe work practices, and selecting personal protective equipment.

FPN No. 2: ANSI Z535.4-1998, *Product Safety Signs and Labels*, provides guidelines for the design of safety signs and labels for application to products.

FPN No. 3: WAC 296-46B-110.016 for flash protection markings is by this reference made part of the 2008 Seattle Electrical Code.

110.18 Arcing Parts. Parts of electrical equipment that in ordinary operation produce arcs, sparks, flames, or molten metal shall be enclosed or separated and isolated from all combustible material.

FPN: For hazardous (classified) locations, see Articles 500 through 517. For motors, see 430.14.

110.19 Light and Power from Railway Conductors. Circuits for lighting and power shall not be connected to any system that contains trolley wires with a ground return.

Exception: Such circuit connections shall be permitted in car houses, power houses, or passenger and freight stations operated in connection with electric railways.

intended for such locations, shall be marked with an enclosure-type number as shown in Table 110.20.

110.20 Enclosure Types. Enclosures (other than surrounding fences or walls) of switchboards, panelboards, industrial control panels, motor control centers, meter sockets, and motor controllers, rated not over 600 volts nominal and

Table 110.20 shall be used for selecting these enclosures for use in specific locations other than hazardous (classified) locations. The enclosures are not intended to protect against conditions such as condensation, icing, corrosion, or contamination that may occur within the enclosure or enter via the conduit or unsealed openings.

Table 110.20 Enclosure Selection

Provides a Degree of Protection Against the Following Environmental Conditions	For Outdoor Use									
	Enclosure-Type Number									
	3	3R	3S	3X	3RX	3SX	4	4X	6	6P
Incidental contact with the enclosed equipment	X	X	X	X	X	X	X	X	X	X
Rain, snow, and sleet										
Sleet*	X	X	X	X	X	X	X	X	X	X
Windblown dust	--	--	X	--	--	X	--	--	--	--
Hosedown	X	--	X	X	--	X	X	X	X	X
Corrosive agents	--	--	--	--	--	--	X	X	X	X
Temporary submersion	--	--	--	X	X	X	--	X	--	X
Prolonged submersion	--	--	--	--	--	--	--	--	X	X
	--	--	--	--	--	--	--	--	--	X

Provides a Degree of Protection Against the Following Environmental Conditions	For Indoor Use									
	Enclosure-Type Number									
	1	2	4	4X	5	6	6P	12	12K	13
Incidental contact with the enclosed equipment	X	X	X	X	X	X	X	X	X	X
Falling dirt	X	X	X	X	X	X	X	X	X	X
Falling liquids and light splashing	--	X	X	X	X	X	X	X	X	X
Circulating dust, lint, fibers, and flyings	--	--	X	X	--	X	X	X	X	X
Settling airborne dust, lint, fibers, and flyings	--	--	X	X	X	X	X	X	X	X
Hosedown and splashing water	--	--	X	X	--	X	X	--	--	--
Oil and coolant seepage	--	--	--	--	--	--	--	X	X	X
Oil or coolant spraying and splashing	--	--	--	--	--	--	--	--	--	X
Corrosive agents	--	--	--	X	--	--	X	--	--	--
Temporary submersion	--	--	--	--	--	X	X	--	--	--
Prolonged submersion	--	--	--	--	--	--	X	--	--	--

*Mechanism shall be operable when ice covered.

FPN: The term *raintight* is typically used in conjunction with Enclosure Types 3, 3S, 3SX, 3X, 4, 4X, 6, and 6P. The term *watertight* is typically used in conjunction with Enclosure Types 4, 4X, 6, 6P. The term *driptight* is typically used in conjunction with Enclosure Types 2, 5, 12, 12K, and 13. The term *dusttight* is typically used in conjunction with Enclosure Types 3, 3S, 3SX, 3X, 5, 12, 12K, and 13.

110.21 Marking.

(A) Manufacturer's Marking. 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 electrical equipment. ~~((Other—))~~ Markings that indicate voltage, current, wattage, or other ratings shall be provided as specified elsewhere in this *Code*. The marking shall be of sufficient durability to withstand the environment involved.

(B) Marking or Labeling. Marking or labeling required in this *Code* shall be of sufficient durability to withstand the environment in which it is used. Unless otherwise required by this *Code*, both marking and labeling shall have lettering of not less than 6 mm (¼ in.) high and the letters shall be in contrast to the background. Marking or labeling shall be affixed using one of the following materials:

- (1) **Identification Plate.** Where an identification plate is required, it shall be made of phenolic, metallic or other similar rigid-plate material, engraved with block letters and affixed by screws, rivets or other methods required in this *Code*.
- (2) **Adhesive Sticker.** When an identification plate is not required, an adhesive sticker may be used. The sticker shall have permanent lettering and have an adhesive that securely and permanently affixes the sticker.

Exception to (B): Manufacturer's marking shall not be required to have lettering of not less than 6 mm (¼ in.).

110.22 Identification of Disconnecting Means.

(A) General. Each disconnecting means 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.

FPN: WAC 296-46B-110.022 for marking requirements is by this reference made part of the 2008 *Seattle Electrical Code*.

(B) Engineered Series Combination Systems. Where circuit breakers or fuses are applied in compliance with series combination ratings selected under engineering supervision and marked on the equipment as directed by the engineer, the equipment enclosure(s) shall be legibly marked in the field to indicate the equipment has been applied with a series combination rating. The marking shall be readily visible and state the following:

CAUTION — ENGINEERED SERIES COMBINATION SYSTEM RATED _____ AMPERES. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED.

FPN: See 240.86(A) for engineered series combination systems.

(C) Tested Series Combination Systems. Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturer, the equipment enclosure(s) shall be legibly marked in the field to indicate the equipment has been applied with a series combination rating. The marking shall be readily visible and state the following:

CAUTION — SERIES COMBINATION SYSTEM RATED _____ AMPERES. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED.

FPN: See 240.86(B) for tested series combination systems.

110.23 Current Transformers. Unused current transformers associated with potentially energized circuits shall be short-circuited.

110.24 Electrified Fences. Electrified fences, associated equipment and similar devices shall be permitted only by special permission from the authority having jurisdiction.

II. 600 Volts, Nominal, or Less

110.26 Spaces About Electrical Equipment. Sufficient access and working space shall be provided and maintained about all electrical equipment to permit ready and safe operation and maintenance of such equipment.

(A) Working Space. Working space for equipment operating at 600 volts, nominal, or less to ground and likely to require examination, adjustment, servicing, or maintenance while energized shall comply with the dimensions of 110.26(A)(1), (A)(2), and (A)(3) or as required or permitted elsewhere in this *Code*.

(1) Depth of Working Space. The depth of the working space in the direction of live parts shall not be less than that specified in Table 110.26(A)(1) unless the requirements of 110.26(A)(1)(a), (A)(1)(b), or (A)(1)(c) are met. Distances shall be measured from the exposed live parts or from the enclosure or opening if the live parts are enclosed.

Table 110.26(A)(1) Working Spaces

Nominal Voltage to Ground	Minimum Clear Distance		
	Condition 1	Condition 2	Condition 3
0–150	914 mm (3 ft)	914 mm (3 ft)	914 mm (3 ft)
151–600	914 mm (3 ft)	1.07 m (3 ft 6 in.)	1.22 m (4 ft)

Note: Where the conditions are as follows:

Condition 1 — Exposed live parts on one side of the working space and no live or grounded parts on the other side of the working space, or exposed live parts on both sides of the working space that are effectively guarded by insulating materials.

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

Condition 3 — Exposed live parts on both sides of the working space.

(a) **Dead-Front Assemblies.** Working space shall not be required in the back or sides of assemblies, such as dead-front switchboards or motor control centers, where all connections and all renewable or adjustable parts, such as fuses or switches, are accessible from locations other than the back or sides. Where rear access is required to work on nonelectrical parts on the back of enclosed equipment, a minimum horizontal working space of 762 mm (30 in.) shall be provided.

(b) *Low Voltage.* By special permission, smaller working spaces shall be permitted where all exposed live parts operate at not greater than 30 volts rms, 42 volts peak, or 60 volts dc.

(c) *Existing Buildings.* In existing buildings where electrical equipment is being replaced, Condition 2 working clearance shall be permitted between dead-front switchboards, panelboards, or motor control centers located across the aisle from each other where conditions of maintenance and supervision ensure that written procedures have been adopted to prohibit equipment on both sides of the aisle from being open at the same time and qualified persons who are authorized will service the installation.

(2) Width of Working Space. The width of the working space in front of the electrical equipment shall be the width of the equipment or 762 mm (30 in.), whichever is greater. In all cases, the work space shall permit at least a 90 degree opening of equipment doors or hinged panels.

(3) Height of Working Space. The work space shall be clear and extend from the grade, floor, or platform to the height required by 110.26(E). Within the height requirements of this section, other equipment that is associated with the electrical installation and is located above or below the electrical equipment shall be permitted to extend not more than 150 mm (6 in.) beyond the front of the electrical equipment.

(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) Entrance to and Egress from Working Space.

(1) Minimum Required. At least one entrance of sufficient area shall be provided to give access to and egress from working space about electrical equipment.

(2) Large Equipment. For equipment rated 1200 amperes or more and over 1.8 m (6 ft) wide that contains overcurrent devices, switching devices, or control devices, there shall be one entrance to and egress from the required working space not less than 610 mm (24 in.) wide and 2.0 m (6½ ft) high at each end of the working space.

A single entrance to and egress from the required working space shall be permitted where either of the conditions in 110.26(C)(2)(a) or (C)(2)(b) is met.

(a) *Unobstructed Egress.* Where the location permits a continuous and unobstructed way of egress travel, a single entrance to the working space shall be permitted.

(b) *Extra Working Space.* Where the depth of the working space is twice that required by 110.26(A)(1), a single entrance shall be permitted. It shall be located such that the distance from the equipment to the nearest edge of the entrance is not less than the minimum clear distance specified in Table 110.26(A)(1) for equipment operating at that voltage and in that condition.

(3) Personnel Doors. Where equipment rated 1200 A or more that contains overcurrent devices, switching devices, or control devices is installed and there is a personnel door(s) intended for entrance to and egress from the working space less than 7.6 m (25 ft) from the nearest edge of the working space, the door(s) shall open in the direction of egress and be equipped with panic bars, pressure plates, or other devices that are normally latched but open under simple pressure.

(D) Illumination. Illumination shall be provided for all working spaces about service equipment, switchboards, panelboards, or motor control centers installed indoors. Additional lighting outlets shall not be required where the work space is illuminated by an adjacent light source or as permitted by 210.70(A)(1), Exception No. 1, for switched receptacles. In electrical equipment rooms, the illumination shall not be controlled by automatic means only.

In residential installations, illumination shall be provided for all working spaces where panelboards are installed outdoors.

(E) Headroom. The minimum headroom of working spaces about service equipment, switchboards, panelboards, or motor control centers shall be 2.0 m (6½ ft). Where the electrical equipment exceeds 2.0 m (6½ ft) in height, the minimum headroom shall not be less than the height of the equipment.

~~((Exception: In existing dwelling units, service equipment or panelboards that do not exceed 200 amperes shall be permitted in spaces where the headroom is less than 2.0 m (6½ ft).))~~

(F) Dedicated Equipment Space. All switchboards, panelboards, distribution boards, and motor control centers shall be located in dedicated spaces and protected from damage.

Exception: Control equipment that by its very nature or because of other rules of the Code must be adjacent to or within sight of its operating machinery shall be permitted in those locations.

(1) Indoor. Indoor installations shall comply with 110.26(F)(1)(a) through (F)(1)(d).

(a) *Dedicated Electrical Space.* The space equal to the width and depth of the equipment and extending from the floor to a height of 1.8 m (6 ft) above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone.

Exception: Suspended ceilings with removable panels shall be permitted within the 1.8-m (6-ft) zone.

(b) *Foreign Systems.* The area above the dedicated space required by 110.26(F)(1)(a) shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks, or breaks in such foreign systems.

(c) *Sprinkler Protection.* Sprinkler protection shall be permitted for the dedicated space where the piping complies with this section.

(d) *Suspended Ceilings.* A dropped, suspended, or similar ceiling that does not add strength to the building structure shall not be considered a structural ceiling.

(2) **Outdoor.** Outdoor electrical equipment shall be installed in suitable enclosures and shall be protected from accidental contact by unauthorized personnel, or by vehicular traffic, or by accidental spillage or leakage from piping systems. The working clearance space shall include the zone described in 110.26(A). No architectural appurtenance or other equipment shall be located in this zone.

(G) Locked Electrical Equipment Rooms or Enclosures. Electrical equipment rooms or enclosures housing electrical apparatus that are controlled by a lock(s) shall be considered accessible to qualified persons.

110.27 Guarding of Live Parts.

(A) **Live Parts Guarded Against Accidental Contact.** 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 enclosures or by any of the following means:

- (1) By location in a room, vault, or similar enclosure that is accessible only to qualified persons.
- (2) By suitable permanent, substantial partitions or screens arranged so that only qualified persons have access to the space within reach of the live parts. Any openings in such partitions or screens shall be sized and located so 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 location on a suitable balcony, gallery, or platform elevated and arranged so as to exclude unqualified persons.
- (4) By elevation of 2.5 m (8 ft) or more above the floor or other working surface.

(B) **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.

(C) **Warning Signs.** Entrances to rooms and other guarded locations that contain exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

FPN: For motors, see 430.232 and 430.233. For over 600 volts, see 110.34.

III. Over 600 Volts, Nominal

110.30 General. Conductors and equipment used on circuits over 600 volts, nominal, shall comply with Part I of this article and with 110.30 through 110.40, which supplement or modify Part I. In no case shall the provisions of this part apply to equipment on the supply side of the service point.

FPN: WAC 296-46B-110.030 for cable marking requirements is by this reference made part of the 2008 Seattle Electrical Code.

110.31 Enclosure for Electrical Installations. Electrical installations in a vault, room, or closet or in an area surrounded by a wall, screen, or fence, access to which is controlled by a lock(s) or other approved means, shall be considered to be accessible to qualified persons only. The type of enclosure used in a given case shall be designed and constructed according to the nature and degree of the hazard(s) associated with the installation.

For installations other than equipment as described in 110.31(D), a wall, screen, or fence shall be used to enclose an outdoor electrical installation to deter access by persons who are not qualified. A fence shall not be less than 2.1 m (7 ft) in height or a combination of 1.8 m (6 ft) or more of fence fabric and a 300-mm (1-ft) or more extension utilizing three or more strands of barbed wire or equivalent. The distance from the fence to live parts shall be not less than given in Table 110.31.

Table 110.31 Minimum Distance from Fence to Live Parts

Nominal Voltage	Minimum Distance to live Parts	
	m	ft
601 - 13,799	3.05	10
13,800 - 230,000	4.57	15
Over 230,000	5.49	18

Note: For clearances of conductors for specific system voltages and typical BIL ratings, see ANSI C2-2007, *National Electrical Safety Code*.

FPN: See Article 450 for construction requirements for transformer vaults.

(A) **Fire Resistance of Electrical Vaults.** The walls, roof, floors, and doorways of vaults containing conductors and equipment over 600 volts, nominal, shall be constructed of materials that have adequate structural strength for the conditions, with a minimum fire rating of 3 hours. The floors of vaults in contact with the earth shall be of concrete that is not less than 4 in. (102 mm) thick, but where the vault is constructed with a vacant space or other stories below it, the floor shall have adequate structural strength for the load imposed on it and a minimum fire resistance of 3 hours. For the purpose of this section, studs and wallboards shall not be considered acceptable.

(B) Indoor Installations.

(1) **In Places Accessible to Unqualified Persons.** Indoor electrical installations that are accessible to unqualified persons shall be made with metal-enclosed equipment. Metal-enclosed switchgear, unit substations, transformers, pull boxes, connection boxes, and other similar associated equipment shall be marked with appropriate caution signs. Openings in ventilated dry-type transformers or similar openings in other equipment shall be designed so that foreign objects

- (3) Luminaires equipped with mogul-base screw shell lampholders
- (4) Lampholders, other than the screw shell type, applied within their voltage ratings
- (5) Auxiliary equipment of electric-discharge lamps
- (6) Cord-and-plug-connected or permanently connected utilization equipment

(D) 600 Volts Between Conductors. Circuits exceeding 277 volts, nominal, to ground and not exceeding 600 volts, nominal, between conductors shall be permitted to supply the following:

- (1) The auxiliary equipment of electric-discharge lamps mounted in permanently installed luminaires where the luminaires are mounted in accordance with one of the following:
 - a. Not less than a height of 6.7 m (22 ft) on poles or similar structures for the illumination of outdoor areas such as highways, roads, bridges, athletic fields, or parking lots
 - b. Not less than a height of 5.5 m (18 ft) on other structures such as tunnels
- (2) Cord-and-plug-connected or permanently connected utilization equipment other than luminaires
- (3) Luminaires powered from direct-current systems where the luminaire contains a listed, dc-rated ballast that provides isolation between the dc power source and the lamp circuit and protection from electric shock when changing lamps.

FPN: See 410.138 for auxiliary equipment limitations.

Exception No. 1 to (B), (C), and (D): For lampholders of infrared industrial heating appliances as provided in 422.14.

Exception No. 2 to (B), (C), and (D): For railway properties as described in 110.19.

(E) Over 600 Volts Between Conductors. Circuits exceeding 600 volts, nominal, between conductors shall be permitted to supply utilization equipment in installations where conditions of maintenance and supervision ensure that only qualified persons service the installation.

210.7 Branch-Circuit Requirements for Device Connections and Locations.

(A) Receptacle Outlet Location. Receptacle outlets shall be located in branch circuits in accordance with Part III of Article 210.

(B) Multiple Branch Circuits. Where two or more branch circuits supply devices or equipment on the same yoke, a means to simultaneously disconnect the ungrounded conductors supplying those devices shall be provided at the point at which the branch circuits originate.

210.8 Ground-Fault Circuit-Interrupter Protection for Personnel.

FPN: See 215.9 for ground-fault circuit-interrupter protection for personnel on feeders.

(A) Dwelling Units. All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the locations specified in (1) through (8) shall have ground-fault circuit-interrupter protection for personnel.

- (1) Bathrooms
- (2) Garages, and also accessory buildings that have a floor located at or below grade level not intended as habitable rooms and limited to storage areas, work areas, and areas of similar use.

Exception to (2): Receptacles for electrical equipment that are not readily accessible.

FPN: WAC 296-46B-210.008(A)(1) which addresses requirements for fire alarm outlets in garages, is by this reference made part of the 2008 Seattle Electrical Code.

- (3) Outdoors

Exception to (3): Receptacles that are not readily accessible and are supplied by a dedicated branch circuit for electric snow-melting or deicing equipment shall be permitted to be installed in accordance with 426.28.

- (4) Crawl spaces — at or below grade level
- (5) Unfinished basements — for purposes of this section, unfinished basements are defined as portions or areas of the basement not intended as habitable rooms and limited to storage areas, work areas, and the like

Exception to (5): A receptacle supplying only a permanently installed fire alarm or burglar alarm system shall not be required to have ground-fault circuit-interrupter protection.

FPN: See 760.41(B) and 760.121(B) for power supply requirements for fire alarm systems.

Receptacles installed under the exception to 210.8(A)(5) shall not be considered as meeting the requirements of 210.52(G).

- (6) Kitchens and wet bars — where the receptacles are installed to serve the countertop surfaces
- (7) ~~(Laundry, utility, and wet bar)~~ All other sinks — where the receptacles are installed within 1.8 m (6 ft) of the outside edge of the sink
- (8) Boathouses

(B) Other Than Dwelling Units. All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the locations specified in (1) through ~~((5))~~ (8) shall have ground-fault circuit-interrupter protection for personnel:

- (1) Bathrooms
- (2) Kitchens
- (3) Rooftops
- (4) Outdoors

Exception No. 1 to (3) and (4): Receptacles that are not readily accessible and are supplied from a dedicated branch circuit for electric snow-melting or deicing equipment shall be permitted to be installed without GFCI protection.

Exception No. 2 to (4): In industrial establishments only, where the conditions of maintenance and supervision ensure that only qualified personnel are involved, an assured equipment grounding conductor program as specified in 590.6(B)(2) shall be permitted for only those receptacle outlets used to supply equipment that would create a greater hazard if power is interrupted or having a design that is not compatible with GFCI protection.

- (5) **Sinks** — where receptacles are installed within 1.8 m (6 ft) of the outside edge of the sink.

Exception No. 1 to (5): In industrial laboratories, receptacles used to supply equipment where removal of power would introduce a greater hazard shall be permitted to be installed without GFCI protection.

Exception No. 2 to (5): For receptacles located in patient care areas of health care facilities other than those covered under 210.8(B)(1), GFCI protection shall not be required.

- (6) Countertops and work surfaces where food and beverage preparation occurs
- (7) Wet locations and receptacles that serve wet locations
- (8) Crawl spaces – at or below grade level

(C) **Boat Hoists.** GFCI protection shall be provided for outlets not exceeding 240 volts that supply boat hoists installed in dwelling unit locations.

210.9 Circuits Derived from Autotransformers. Branch circuits shall not be derived from autotransformers unless the circuit supplied has a grounded conductor that is electrically connected to a grounded conductor of the system supplying the autotransformer.

Exception No. 1: An autotransformer shall be permitted without the connection to a grounded conductor where transforming from a nominal 208 volts to a nominal 240-volt supply or similarly from 240 volts to 208 volts.

Exception No. 2: In industrial occupancies, where conditions of maintenance and supervision ensure that only qualified persons service the installation, autotransformers shall be permitted to supply nominal 600-volt loads from nominal 480-volt systems, and 480-volt loads from nominal 600-volt systems, without the connection to a similar grounded conductor.

210.10 Ungrounded Conductors Tapped from Grounded Systems. Two-wire dc circuits and ac circuits of two or more ungrounded conductors shall be permitted to be tapped from the ungrounded conductors of circuits that have a grounded neutral conductor. Switching devices in each tapped circuit shall have a pole in each ungrounded conductor. All poles of multipole switching devices shall manually switch together

where such switching devices also serve as a disconnecting means as required by the following:

- (1) 410.93 for double-pole switched lampholders
- (2) 410.104(B) for electric-discharge lamp auxiliary equipment switching devices
- (3) 422.31(B) for an appliance
- (4) 424.20 for a fixed electric space-heating unit
- (5) 426.51 for electric deicing and snow-melting equipment
- (6) 430.85 for a motor controller
- (7) 430.103 for a motor

210.11 Branch Circuits Required. Branch circuits for lighting and for appliances, including motor-operated appliances, shall be provided to supply the loads calculated in accordance with 220.10. In addition, branch circuits shall be provided for specific loads not covered by 220.10 where required elsewhere in this Code and for dwelling unit loads as specified in 210.11(C).

(A) **Number of Branch Circuits.** The minimum number of branch circuits shall be determined from the total calculated load and the size or rating of the circuits used. In all installations, the number of circuits shall be sufficient to supply the load served. In no case shall the load on any circuit exceed the maximum specified by 220.18.

(B) **Load Evenly Proportioned Among Branch Circuits.** Where the load is calculated on the basis of volt-amperes per square meter or per square foot, the wiring system up to and including the branch-circuit panelboard(s) shall be provided to serve not less than the calculated load. This load shall be evenly proportioned among multioutlet branch circuits within the panelboard(s). Branch-circuit overcurrent devices and circuits shall be required to be installed only to serve the connected load.

(C) **Dwelling Units.**

(1) **Small-Appliance Branch Circuits.** In addition to the number of branch circuits required by other parts of this section, two or more 20-ampere small-appliance branch circuits shall be provided for all receptacle outlets specified by 210.52(B).

(2) **Laundry Branch Circuits.** In addition to the number of branch circuits required by other parts of this section, at least one additional 20-ampere branch circuit shall be provided to supply the laundry receptacle outlet(s) required by 210.52(F). This circuit shall have no other outlets.

(3) **Bathroom Branch Circuits.** In addition to the number of branch circuits required by other parts of this section, at least one 20-ampere branch circuit shall be provided to supply bathroom receptacle outlet(s). Such circuits shall have no other outlets.

FPN: WAC 296-46B-210.011(3), which addresses unfinished space requirements, is by this reference made a part of this 2008 Seattle Electrical Code.

Table 210.21(B)(2) Maximum Cord-and-Plug-Connected Load to Receptacle

Circuit Rating (Amperes)	Receptacle Rating (Amperes)	Maximum Load (Amperes)
15 or 20	15	12
20	20	16
30	30	24

and-plug-connected load in excess of the maximum specified in Table 210.21(B)(2).

(3) Receptacle Ratings. Where connected to a branch circuit supplying two or more receptacles or outlets, receptacle ratings shall conform to the values listed in Table 210.21(B)(3), or where larger than 50 amperes, the receptacle rating shall not be less than the branch-circuit rating.

Exception No. 1: Receptacles for one or more cord-and-plug-connected arc welders shall be permitted to have ampere ratings not less than the minimum branch-circuit conductor ampacity permitted by 630.11(A) or (B) as applicable for arc welders.

Exception No. 2: The ampere rating of a receptacle installed for electric discharge lighting shall be permitted to be based on 410.62(C).

Table 210.21(B)(3) Receptacle Ratings for Various Size Circuits

Circuit Rating (Amperes)	Receptacle Rating (Amperes)
15	Not over 15
20	15 or 20
30	30
40	40 or 50
50	50

(4) Range Receptacle Rating. The ampere rating of a range receptacle shall be permitted to be based on a single range demand load as specified in Table 220.55.

210.23 Permissible Loads. In no case shall the load exceed the branch-circuit ampere rating. An individual branch circuit shall be permitted to supply any load for which it is rated. A branch circuit supplying two or more outlets or receptacles shall supply only the loads specified according to its size as specified in 210.23(A) through (D) and as summarized in 210.24 and Table 210.24.

(A) 15- and 20-Ampere Branch Circuits. A 15- or 20-ampere branch circuit shall be permitted to supply lighting units or other utilization equipment, or a combination of both, and shall comply with 210.23(A)(1) and (A)(2).

Exception: The small-appliance branch circuits, laundry branch circuits, and bathroom branch circuits required in a dwelling unit(s) by 210.11(C)(1), (C)(2), and (C)(3) shall supply only the receptacle outlets specified in that section.

(1) Cord-and-Plug-Connected Equipment Not Fastened in Place. The rating of any one cord-and-plug-connected utilization equipment not fastened in place shall not exceed 80 percent of the branch-circuit ampere rating.

(2) Utilization Equipment Fastened in Place. The total rating of utilization equipment fastened in place, other than luminaires, shall not exceed 50 percent of the branch-circuit ampere rating where lighting units, cord-and-plug-connected utilization equipment not fastened in place, or both, are also supplied.

(B) 30-Ampere Branch Circuits. A 30-ampere branch circuit shall be permitted to supply fixed lighting units with heavy-duty lampholders in other than a dwelling unit(s) or utilization equipment in any occupancy. A rating of any one cord-and-plug-connected utilization equipment shall not exceed 80 percent of the branch-circuit ampere rating.

(C) 40- and 50-Ampere Branch Circuits. A 40- or 50-ampere branch circuit shall be permitted to supply cooking appliances that are fastened in place in any occupancy. In other than dwelling units, such circuits shall be permitted to supply fixed lighting units with heavy-duty lampholders, infrared heating units, or other utilization equipment.

(D) Branch Circuits Larger Than 50 Amperes. Branch circuits larger than 50 amperes shall supply only nonlighting outlet loads.

210.24 Branch-Circuit Requirements — Summary. The requirements for circuits that have two or more outlets or receptacles, other than the receptacle circuits of 210.11(C)(1) and (C)(2), are summarized in Table 210.24. This table provides only a summary of minimum requirements. See 210.19, 210.20, and 210.21 for the specific requirements applying to branch circuits.

210.25 Branch Circuits in Buildings with More Than One Occupancy.

(A) Dwelling Unit Branch Circuits. Branch circuits in each dwelling unit shall supply only loads within that dwelling unit or loads associated only with that dwelling unit.

(B) Common Area Branch Circuits. Branch circuits required for the purpose of lighting, central alarm, signal, communications, or other needs for public or common areas of a two-family dwelling, a multifamily dwelling, or a multi-occupancy building shall not be supplied from equipment that supplies an individual dwelling unit or tenant space.

FPN: WAC 296-46B-210.25 requirements for common area branch circuits for shared septic or water well systems are by this reference made part of the 2008 Seattle Electrical Code.

Table 210.24 Summary of Branch-Circuit requirements

Circuit Rating	15 A	20 A	30 A	40 A	50 A
Conductors(min. size):					
Circuit wires ¹	14	12	10	8	6
Taps	14	14	14	12	12
Fixture wires and cords -see 240.5					
Overcurrent Protection	15 A	20 A	30 A	40 A	50 A
Outlet devices:					
Lampholders permitted	Any type	Any type	Heavy duty	Heavy duty	Heavy duty
Receptacle rating ²	15 max. A	15 or 20 A	30 A	40 or 50 A	50 A
Maximum Load	15 A	20 A	30 A	40 A	50 A
Permissible load	See 210.23(A)	See 210.23(A)	See 210.23(B)	See 210.23(C)	See 210.23(C)

¹These gauges are for copper conductors.

²For receptacle rating of cord-connected electric-discharge luminaires, see 410.30(C).

III. Required Outlets

210.50 General. Receptacle outlets shall be installed as specified in 210.52 through 210.63.

(A) Cord Pendants. A cord connector that is supplied by a permanently connected cord pendant shall be considered a receptacle outlet.

(B) Cord Connections. A receptacle outlet shall be installed wherever flexible cords with attachment plugs are used. Where flexible cords are permitted to be permanently connected, receptacles shall be permitted to be omitted for such cords.

(C) Appliance Receptacle Outlets. Appliance receptacle outlets installed in a dwelling unit for specific appliances, such as laundry equipment, shall be installed within 1.8 m (6 ft) of the intended location of the appliance.

210.52 Dwelling Unit Receptacle Outlets. This section provides requirements for 125-volt, 15- and 20-ampere receptacle outlets. The receptacles required by this section shall be in addition to any receptacle that is:

- (1) Part of a luminaire or appliance, or
- (2) Controlled by a wall switch in accordance with 210.70(A)(1), Exception No. 1, or
- (3) Located within cabinets or cupboards, or
- (4) Located more than 1.7 m (5½ ft) above the floor

Permanently installed electric baseboard heaters equipped with factory-installed receptacle outlets or outlets provided as a separate assembly by the manufacturer shall be permitted as the required outlet or outlets for the wall space utilized by such permanently installed heaters. Such receptacle outlets shall not be connected to the heater circuits.

FPN: Listed baseboard heaters include instructions that may not permit their installation below receptacle outlets.

(A) General Provisions. In every kitchen, family room, dining room, living room, parlor, library, den, sunroom, bedroom, recreation room, or similar room or area of dwelling units, receptacle outlets shall be installed in accordance with the general provisions specified in 210.52(A)(1) through (A)(3).

(1) Spacing. Receptacles shall be installed such that no point measured horizontally along the floor line in any wall space is more than 1.8 m (6 ft) from a receptacle outlet.

(2) Wall Space. As used in this section, a wall space shall include the following:

- (1) Any space 600 mm (2 ft) or more in width (including space measured around corners) and unbroken along the floor line by doorways, fireplaces, and similar openings
- (2) The space occupied by fixed panels in exterior walls, excluding sliding panels
- (3) The space afforded by fixed room dividers such as freestanding bar-type counters or railings

FPN: WAC 296-46B-210.052(A)(2)(6), addressing window seating, cabinet and bookcase requirements, is by this reference made part of the 2008 *Seattle Electrical Code*.

(3) Floor Receptacles. Receptacle outlets in floors shall not be counted as part of the required number of receptacle outlets unless located within 450 mm (18 in.) of the wall.

(B) Small Appliances.

(1) Receptacle Outlets Served. In the kitchen, pantry, breakfast room, dining room, or similar area of a dwelling

unit, the two or more 20-ampere small-appliance branch circuits required by 210.11(C)(1) shall serve all wall and floor receptacle outlets covered by 210.52(A), all countertop outlets covered by 210.52(C), and receptacle outlets for refrigeration equipment.

Exception No. 1: In addition to the required receptacles specified by 210.52, switched receptacles supplied from a general-purpose branch circuit as defined in 210.70(A)(1), Exception No. 1, shall be permitted.

Exception No. 2: The receptacle outlet for refrigeration equipment shall be permitted to be supplied from an individual branch circuit rated 15 amperes or greater.

(2) No Other Outlets. The two or more small-appliance branch circuits specified in 210.52(B)(1) shall have no other outlets.

Exception No. 1: A receptacle installed solely for the electrical supply to and support of an electric clock in any of the rooms specified in 210.52(B)(1).

Exception No. 2: Receptacles installed to provide power for supplemental equipment and lighting on gas-fired ranges, ovens, or counter-mounted cooking units.

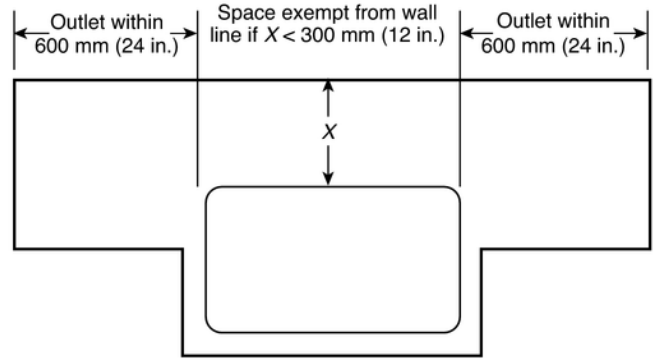
(3) Kitchen Receptacle Requirements. Receptacles installed in a kitchen to serve countertop surfaces shall be supplied by not fewer than two small-appliance branch circuits, either or both of which shall also be permitted to supply receptacle outlets in the same kitchen and in other rooms specified in 210.52(B)(1). Additional small-appliance branch circuits shall be permitted to supply receptacle outlets in the kitchen and other rooms specified in 210.52(B)(1). No small-appliance branch circuit shall serve more than one kitchen.

(C) Countertops. In kitchens, pantries, breakfast rooms, dining rooms, and similar areas of dwelling units, receptacle outlets for countertop spaces shall be installed in accordance with 210.52(C)(1) through (C)(5).

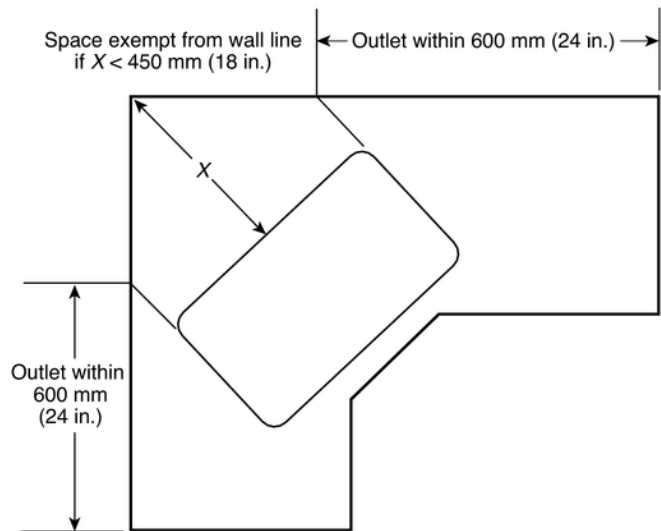
Where a range, counter-mounted cooking unit, or sink is installed in an island or peninsular countertop and the width of the countertop behind the range, counter-mounted cooking unit, or sink is less than 300 mm (12 in.), the range, counter-mounted cooking unit, or sink is considered to divide the countertop space into two separate countertop spaces as defined in 210.52(C)(4). Each separate countertop space shall comply with the applicable requirements in 210.52(C).

(1) Wall Countertop Spaces. A receptacle outlet shall be installed at each wall countertop space that is 300 mm (12 in.) or wider. Receptacle outlets shall be installed so that no point along the wall line is more than 600 mm (24 in.) measured horizontally from a receptacle outlet in that space.

Exception: Receptacle outlets shall not be required on a wall directly behind a range, counter-mounted cooking unit, or sink in the installation described in Figure 210.52(C)(1).



Range, counter-mounted cooking unit extending from face of counter



Range, counter-mounted cooking unit mounted in corner

Figure 210.52(C)(1) Determination of Area Behind a Range, or Counter-Mounted Cooking Unit or Sink.

(2) Island Countertop Spaces. At least one receptacle shall be installed at each island countertop space with a long dimension of 600 mm (24 in.) or greater and a short dimension of 300 mm (12 in.) or greater.

(3) Peninsular Countertop Spaces. At least one receptacle outlet shall be installed at each peninsular countertop space with a long dimension of 600 mm (24 in.) or greater and a short dimension of 300 mm (12 in.) or greater. A peninsular countertop is measured from the connecting edge.

(4) Separate Spaces. Countertop spaces separated by rangetops, refrigerators, or sinks shall be considered as

separate countertop spaces in applying the requirements of 210.52(C)(1), (C)(2), and (C)(3).

(5) Receptacle Outlet Location. Receptacle outlets shall be located above, but not more than 500 mm (20 in.) above, the countertop. Receptacle outlets rendered not readily accessible by appliances fastened in place, appliance garages, sinks, or rangetops as covered in 210.52(C)(1), Exception, or appliances occupying dedicated space shall not be considered as these required outlets.

Exception to (5): To comply with the conditions specified in (1) or (2), receptacle outlets shall be permitted to be mounted not more than 300 mm (12 in.) below the countertop. Receptacles mounted below a countertop in accordance with this exception shall not be located where the countertop extends more than 150 mm (6 in.) beyond its support base.

(1) Construction for the physically impaired

(2) On island and peninsular countertops where the countertop is flat across its entire surface (no backsplashes, dividers, etc.) and there are no means to mount a receptacle within 500 mm (20 in.) above the countertop, such as an overhead cabinet

FPN: WAC 296-46B-210.052(B)(8) which addresses receptacle outlets in appliance garages that may be counted as countertop outlets is by this reference made part of the 2008 Seattle Electrical Code.

(D) Bathrooms. In dwelling units, at least one receptacle outlet shall be installed in bathrooms within 900 mm (3 ft) of the outside edge of each basin. The receptacle outlet shall be located on a wall or partition that is adjacent to the basin or basin countertop, or installed on the side or face of the basin cabinet not more than 300 mm (12 in.) below the countertop.

(E) Outdoor Outlets. Outdoor receptacle outlets shall be installed in accordance with (E)(1) through (E)(3). [See 210.8(A)(3).]

(1) One-Family and Two-Family Dwellings. For a one-family dwelling and each unit of a two-family dwelling that is at grade level, at least one receptacle outlet accessible while standing at grade level and located not more than 2.0 m (6½ ft) above grade shall be installed at the front and back of the dwelling.

(2) Multifamily Dwellings. For each dwelling unit of a multifamily dwelling where the dwelling unit is located at grade level and provided with individual exterior entrance/egress, at least one receptacle outlet accessible from grade level and not more than 2.0 m (6½ ft) above grade shall be installed.

(3) Balconies, Decks, and Porches. Balconies, decks, and porches that are accessible from inside the dwelling unit shall have at least one receptacle outlet installed within the perimeter of the balcony, deck, or porch. The receptacle shall

not be located more than 2.0 m (6½ ft) above the balcony, deck, or porch surface.

Exception to (3): Balconies, decks, or porches with an (usable) area of less than 1.86 m² (20 ft²) are not required to have a receptacle installed.

(F) Laundry Areas. In dwelling units, at least one receptacle outlet shall be installed for the laundry.

Exception No. 1: In a dwelling unit that is an apartment or living area in a multifamily building where laundry facilities are provided on the premises and are available to all building occupants, a laundry receptacle shall not be required.

Exception No. 2: In other than one-family dwellings where laundry facilities are not to be installed or permitted, a laundry receptacle shall not be required.

(G) Basements and Garages. For a one-family dwelling, the following provisions shall apply:

(1) At least one receptacle outlet, in addition to those for specific equipment, shall be installed in each basement, in each attached garage, and in each detached garage with electric power.

(2) Where a portion of the basement is finished into one or more habitable rooms, each separate unfinished portion shall have a receptacle outlet installed in accordance with this section.

(H) Hallways. In dwelling units, hallways of 3.0 m (10 ft) or more in length shall have at least one receptacle outlet.

As used in this subsection, the hall length shall be considered the length along the centerline of the hall without passing through a doorway.

210.60 Guest Rooms, Guest Suites, Dormitories, and Similar Occupancies.

(A) General. Guest rooms or guest suites in hotels, motels, sleeping rooms in dormitories, and similar occupancies shall have receptacle outlets installed in accordance with 210.52(A) and 210.52(D). Guest rooms or guest suites provided with permanent provisions for cooking shall have receptacle outlets installed in accordance with all of the applicable rules in 210.52.

(B) Receptacle Placement. In applying the provisions of 210.52(A), the total number of receptacle outlets shall not be less than the minimum number that would comply with the provisions of that section. These receptacle outlets shall be permitted to be located conveniently for permanent furniture layout. At least two receptacle outlets shall be readily accessible. Where receptacles are installed behind the bed, the receptacle shall be located to prevent the bed from

215.5 Diagrams of Feeders. If required by the authority having jurisdiction, a diagram showing feeder details shall be provided prior to the installation of the feeders. Such a diagram shall show the area in square feet of the building or other structure supplied by each feeder, the total calculated load before applying demand factors, the demand factors used, the calculated load after applying demand factors, and the size and type of conductors to be used.

FPN: The line drawing requirements from WAC 296-46B-215.005(1) are by this reference made part of the 2008 Seattle Electrical Code.

215.6 Feeder Equipment Grounding Conductor. Where a feeder supplies branch circuits in which equipment grounding conductors are required, the feeder shall include or provide an equipment grounding conductor in accordance with the provisions of 250.134, to which the equipment grounding conductors of the branch circuits shall be connected. Where the feeder supplies a separate building or structure, the requirements of 250.32(B) shall apply.

215.7 Ungrounded Conductors Tapped from Grounded Systems. Two-wire dc circuits and ac circuits of two or more ungrounded conductors shall be permitted to be tapped from the ungrounded conductors of circuits having a grounded neutral conductor. Switching devices in each tapped circuit shall have a pole in each ungrounded conductor.

215.9 Ground-Fault Circuit-Interrupter Protection for Personnel. Feeders supplying 15- and 20-ampere receptacle branch circuits shall be permitted to be protected by a ground-fault circuit interrupter in lieu of the provisions for such interrupters as specified in 210.8 and 590.6(A).

215.10 Ground-Fault Protection of Equipment. Each feeder disconnect rated 1000 amperes or more and installed on solidly grounded wye electrical systems of more than 150 volts to ground, but not exceeding 600 volts phase-to-phase, shall be provided with ground-fault protection of equipment in accordance with the provisions of 230.95.

Feeders equipped with ground fault protection shall be tested and inspected prior to being placed into service.

The testing shall verify that the system is installed and operates as required by the manufacturer's instructions. Testing shall be performed by qualified personnel having proper equipment to complete the acceptance testing in the manner prescribed by the manufacturer. The testing personnel shall sign a written performance acceptance test record. The record shall provide testing details including, but not limited to, measurements and trip settings used during the test.

The written acceptance test record, together with a copy of the manufacturer's performance testing instructions, shall be made available to the inspector for the authority having jurisdiction.

FPN: For buildings that contain health care occupancies, see the requirements of 517.17.

Exception No. 1: The provisions of this section shall not apply to a disconnecting means for a continuous industrial process where a nonorderly shutdown will introduce additional or increased hazards.

Exception No. 2: The provisions of this section shall not apply if ground-fault protection of equipment is provided on the supply side of the feeder and on the load side of any transformer supplying the feeder.

215.11 Circuits Derived from Autotransformers. Feeders shall not be derived from autotransformers unless the system supplied has a grounded conductor that is electrically connected to a grounded conductor of the system supplying the autotransformer.

Exception No. 1: An autotransformer shall be permitted without the connection to a grounded conductor where transforming from a nominal 208 volts to a nominal 240-volt supply or similarly from 240 volts to 208 volts.

Exception No. 2: In industrial occupancies, where conditions of maintenance and supervision ensure that only qualified persons service the installation, autotransformers shall be permitted to supply nominal 600-volt loads from nominal 480-volt systems, and 480-volt loads from nominal 600-volt systems, without the connection to a similar grounded conductor.

215.12 Identification for Feeders.

(A) Grounded Conductor. The grounded conductor of a feeder shall be identified in accordance with 200.6.

(B) Equipment Grounding Conductor. The equipment grounding conductor shall be identified in accordance with 250.119.

(C) Ungrounded Conductors. Where the premises wiring system has feeders supplied from more than one nominal voltage system, each ungrounded conductor of a feeder shall be identified by phase or line and system at all termination, connection, and splice points. The means of identification shall be permitted to be by separate color coding, marking tape, tagging, or other approved means. The method utilized for conductors originating within each feeder panelboard or similar feeder distribution equipment shall be documented in a manner that is readily available or shall be permanently posted at each feeder panelboard or similar feeder distribution equipment.

215.13 Panelboards. Panelboards, existing or installed in an individual unit of multifamily dwellings, shall be supplied by one feeder.

215.14 One Dwelling Unit Not to Be Supplied Through Another. Feeder conductors supplying electricity to an individual dwelling unit shall not pass through another dwelling unit.

ARTICLE 220
Branch-Circuit, Feeder, and Service Calculations

I. General

220.1 Scope. This article provides requirements for calculating branch-circuit, feeder, and service loads. Part I provides for general requirements for calculation methods. Part II provides calculation methods for branch-circuit loads. Parts III and IV provide calculation methods for feeders and services. Part V provides calculation methods for farms.

FPN: See Figure 220.1 for information on the organization of Article 220.

220.3 Application of Other Articles. In other articles applying to the calculation of loads in specialized applications, there are requirements provided in Table 220.3 that are in addition to, or modifications of, those within this article.

220.5 Calculations.

(A) Voltages. Unless other voltages are specified, for purposes of calculating branch-circuit and feeder loads, nominal system voltages of 120, 120/240, 208Y/120, 240, 347, 480Y/277, 480, 600Y/347, and 600 volts shall be used.

(B) Fractions of an Ampere. Where calculations result in a fraction of an ampere that is less than 0.5, such fractions shall be permitted to be dropped.

II. Branch-Circuit Load Calculations

220.10 General. Branch-circuit loads shall be calculated as shown in 220.12, 220.14, and 220.16.

220.12 Lighting Load for Specified Occupancies. A unit load of not less than that specified in Table 220.12 for occupancies specified therein shall constitute the minimum lighting load. The floor area for each floor shall be calculated from the outside dimensions of the building, dwelling unit, or other area involved. For dwelling units, the calculated floor area shall not include open porches, garages, or unused or unfinished spaces not adaptable for future use.

FPN: The unit values herein are based on minimum load conditions and 100 percent power factor and may not provide sufficient capacity for the installation contemplated.

Exception: Occupancy Lighting Loads. In determining feeder and service entrance conductor sizes and equipment ratings, the currently adopted Washington State Energy Code with Seattle Amendments (Seattle Energy Code) Table 15-1, Unit Lighting Power Allowance, may be used in lieu of NEC Table 220.12.

Table 220.12 General Lighting Loads by Occupancy

Type of Occupancy	Unit Load	
	Volt-Amperes per Square Meter	Volt-Amperes per Square Foot
Armories and auditoriums	11	1
Banks	39 ^b	3 ½ ^b
Barber shops and beauty parlors	33	3
Churches	11	1
Clubs	22	2
Court rooms	22	2
Dwelling units ^a	33	3
Garages – commercial (storage)	6	½
Hospitals	22	2
Hotels and motels, including apartment houses without provision for cooking by tenants ^a	22	2
Industrial commercial (loft) buildings	22	2
Lodge rooms	17	1 ½
Office buildings	39 ^b	3 ½ ^b
Restaurants	22	2
Schools	33	3
Stores	33	3
Warehouses (storage)	3	¼
In any of the preceding occupancies except one-family dwellings and individual dwelling units of two-family and multifamily dwellings:		
Assembly halls and auditoriums	11	1
Halls, corridors, closets stairways	6	½
Storage spaces	3	¼

^a See 220.14(J).

^b See 220.14(K).

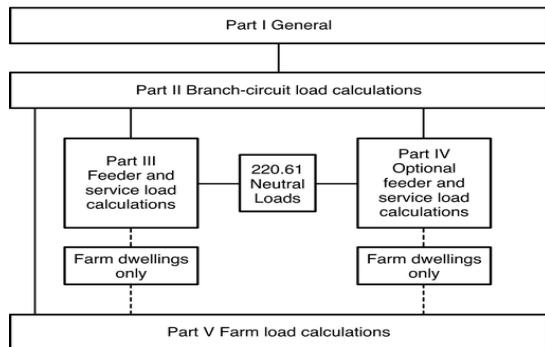


Figure 220.1 Branch-Circuit, Feeder, and Service Calculation Methods.

Table 220.3 Additional Load Calculation References

Calculation	Article	Section (or Part)
Calculation	Article	Section (or Part)
Air-conditioning and refrigerating equipment, branch-circuit conductor sizing	440	Part IV
Cranes and hoists, rating and size of conductors	610	610.14
Electric welders, ampacity calculations	630	630.11, 630.31
Electrically driven or controlled irrigation machines	675	675.7(A), 675.22(A)
<u>Electric vehicle outlets</u>	<u>220</u>	<u>220.54, 220.57</u>
<u>Electrified truck parking space</u>	<u>626</u>	
Electrolytic cell lines	668	668.3(C)
Electroplating, branch-circuit conductor sizing	669	669.5
Elevator feeder demand factors	620	620.14
Fire pumps, voltage drop (mandatory calculation)	695	695.7
Fixed electric heating equipment for pipelines and vessels, branch-circuit sizing	427	427.4
Fixed electric space-heating equipment, branch-circuit sizing	424	424.3
Fixed outdoor electric deicing and snow-melting equipment, branch-circuit sizing	426	426.4
Industrial machinery, supply conductor sizing	670	670.4(A)
Marinas and boatyards, feeder and service load calculations	555	555.12
Mobile homes, manufactured homes, and mobile home parks, total load for determining power supply	550	550.18(B)
Mobile homes, manufactured homes, and mobile home parks, allowable demand factors for park electrical wiring systems	550	550.31
Motion picture and television studios and similar locations – sizing of feeder conductors for television studio sets	530	530.19
Motors, feeder demand factor	430	430.26
Motors, multimotor and combination-load equipment	430	430.25
Motors, several motors or a motor(s) and other load(s)	430	430.24
Over 600-volt branch-circuit calculations	210	210.19(B)
Over 600-volt feeder calculations	215	215.2(B)
Phase converters, conductors	455	455.6
Recreational vehicle parks, basis of calculations	551	551.73(A)
Sensitive electrical equipment, voltage drop (mandatory calculation)	647	647.4(D)

220.14 Other Loads—All Occupancies. In all occupancies, the minimum load for each outlet for general-use receptacles and outlets not used for general illumination shall not be less than that calculated in 220.14(A) through (L), the loads shown being based on nominal branch-circuit voltages.

Exception: The loads of outlets serving switchboards and switching frames in telephone exchanges shall be waived from the calculations.

(A) Specific Appliances or Loads. An outlet for a specific appliance or other load not covered in 220.14(B) through (L) shall be calculated based on the ampere rating of the appliance or load served.

(B) Electric Dryers and Household Electric Cooking Appliances. Load calculations shall be permitted as specified in 220.54 for electric dryers and in 220.55 for electric ranges and other cooking appliances.

(C) Motor Loads. Outlets for motor loads shall be calculated in accordance with the requirements in 430.22, 430.24, and 440.6.

(D) Luminaires. An outlet supplying luminaire(s) shall be calculated based on the maximum volt-ampere rating of the equipment and lamps for which the luminaire(s) is rated.

(E) Heavy-Duty Lampholders. Outlets for heavy-duty lampholders shall be calculated at a minimum of 600 volt-amperes.

(F) Sign and Outline Lighting. Sign and outline lighting outlets shall be calculated at a minimum of 1200 volt-amperes for each required branch circuit specified in 600.5(A).

(G) Show Windows. Show windows shall be calculated in accordance with either of the following:

- (1) The unit load per outlet as required in other provisions of this section
- (2) At 200 volt-amperes per 300 mm (1 ft) of show window

(H) Fixed Multioutlet Assemblies. Fixed multioutlet assemblies used in other than dwelling units or the guest rooms or guest suites of hotels or motels shall be calculated

in accordance with (H)(1) or (H)(2). For the purposes of this section, the calculation shall be permitted to be based on the portion that contains receptacle outlets.

- (1) Where appliances are unlikely to be used simultaneously, each 1.5 m (5 ft) or fraction thereof of each separate and continuous length shall be considered as one outlet of not less than 180 volt-amperes.
- (2) Where appliances are likely to be used simultaneously, each 300 mm (1 ft) or fraction thereof shall be considered as an outlet of not less than 180 volt-amperes.

(I) Receptacle Outlets. Except as covered in 220.14(J) and (K), receptacle outlets shall be calculated at not less than 180 volt-amperes for each single or for each multiple receptacle on one yoke. A single piece of equipment consisting of a multiple receptacle comprised of four or more receptacles shall be calculated at not less than 90 volt-amperes per receptacle. This provision shall not be applicable to the receptacle outlets specified in 210.11(C)(1) and (C)(2).

(J) Dwelling Occupancies. In one-family, two-family, and multifamily dwellings and in guest rooms or guest suites of hotels and motels, the outlets specified in (J)(1), (J)(2), and (J)(3) are included in the general lighting load calculations of 220.12. No additional load calculations shall be required for such outlets.

- (1) All general-use receptacle outlets of 20-ampere rating or less, including receptacles connected to the circuits in 210.11(C)(3)
- (2) The receptacle outlets specified in 210.52(E) and (G)
- (3) The lighting outlets specified in 210.70(A) and (B)

(K) Banks and Office Buildings. In banks or office buildings, the receptacle loads shall be calculated to be the larger of (1) or (2):

- (1) The **calculated** load from 220.14(I)
- (2) 11 volt-amperes/m² or 1 volt-ampere/ft²

(L) Other Outlets. Other outlets not covered in 220.14(A) through (K) shall be calculated based on 180 volt-amperes per outlet.

220.16 Loads for Additions to Existing Installations.

(A) Dwelling Units. Loads added to an existing dwelling unit(s) shall comply with the following as applicable:

- (1) Loads for structural additions to an existing dwelling unit or for a previously unwired portion of an existing dwelling unit, either of which exceeds 46.5 m² (500 ft²), shall be calculated in accordance with 220.12 and 220.14.
- (2) Loads for new circuits or extended circuits in previously wired dwelling units shall be calculated in accordance with either 220.12 or 220.14, as applicable.

(B) Other Than Dwelling Units. Loads for new circuits or extended circuits in other than dwelling units shall be calculated in accordance with either 220.12 or 220.14, as applicable.

220.18 Maximum Loads. The total load shall not exceed the rating of the branch circuit, and it shall not exceed the maximum loads specified in 220.18(A) through (C) under the conditions specified therein.

(A) Motor-Operated and Combination Loads. Where a circuit supplies only motor-operated loads, Article 430 shall apply. Where a circuit supplies only air-conditioning equipment, refrigerating equipment, or both, Article 440 shall apply. For circuits supplying loads consisting of motor-operated utilization equipment that is fastened in place and has a motor larger than hp in combination with other loads, the total calculated load shall be based on 125 percent of the largest motor load plus the sum of the other loads.

(B) Inductive Lighting Loads. For circuits supplying lighting units that have ballasts, transformers, or autotransformers, the calculated load shall be based on the total ampere ratings of such units and not on the total watts of the lamps.

(C) Range Loads. It shall be permissible to apply demand factors for range loads in accordance with Table 220.55, including Note 4.

III. Feeder and Service Load Calculations

220.40 General. The calculated load of a feeder or service shall not be less than the sum of the loads on the branch circuits supplied, as determined by Part II of this article, after any applicable demand factors permitted by Part III or IV or required by Part V have been applied.

FPN: See Examples D1(a) through D10 in Annex D. See 220.18(B) for the maximum load in amperes permitted for lighting units operating at less than 100 percent power factor.

220.42 General Lighting. The demand factors specified in Table 220.42 shall apply to that portion of the total branch-circuit load calculated for general illumination. They shall not be applied in determining the number of branch circuits for general illumination.

220.43 Show-Window and Track Lighting.

(A) Show Windows. For show-window lighting, a load of not less than 660 volt-amperes/linear meter or 200 volt-amperes/linear foot shall be included for a show window, measured horizontally along its base.

FPN: See 220.14(G) for branch circuits supplying show windows.

(B) Track Lighting. For track lighting in other than dwelling units or guest rooms or guest suites of hotels or motels, an additional load of 150 volt-amperes shall be included for every 600 mm (2 ft) of lighting track or fraction thereof. Where multicircuit track is installed, the load shall be considered to be divided equally between the track circuits.

220.44 Receptacle Loads — Other Than Dwelling Units. Receptacle loads calculated in accordance with 220.14(H) and (I) shall be permitted to be made subject to the demand factors given in Table 220.42 or Table 220.44.

Table 220.42 Lighting Demand Factors

Type of Occupancy	Portion of Lighting Load to Which Demand Factor Applies (Volt-Amperes)	Demand Factor (%)
Dwelling units	First 3000 or less at	100
	From 3001 to 120,000 at	35
	Remainder over 120,000 at	25
Hospitals*	First 50,000 or less at	40
	Remainder over 50,000 at	20
Hotels and motels, including apartment houses without provision for cooking by tenants*	First 20,000 or less at	50
	From 20,001 to 100,000 at	40
	Remainder over 100,000 at	30
Warehouses (storage)	First 12,500 or less at	100
	Remainder over 12,500 at	50
All others	Total volt-amperes	100

*The demand factors of this table shall not apply to the calculated load of feeders or services supplying areas in hospitals, hotels, and motels, where the entire lighting is likely to be used at one time, as in operating rooms, ballrooms, or dining rooms.

Table 220.44 Demand Factors for Non-Dwelling Receptacle Loads

Portion of Receptacle Load to Which Demand Factor Applies (Volt-Amperes)	Demand Factor (%)
First 10 kVA or less at	100
Remainder over 10 kVA at	50

220.50 Motors. Motor loads shall be calculated in accordance with 430.24, 430.25, and 430.26 and with 440.6 for hermetic refrigerant motor compressors.

220.51 Fixed Electric Space Heating. Fixed electric space-heating loads shall be calculated at 100 percent of the total connected load. However, in no case shall a feeder or service load current rating be less than the rating of the largest branch circuit supplied.

Exception: ((Where reduced loading of the conductors results from units operating on duty cycle, intermittently, or from all units not operating at the same time, the authority having jurisdiction may grant permission for feeder and service conductors to have an ampacity less than 100 percent, provided the conductors have an ampacity for the load so determined.)) A demand factor of 75 percent of the installed heating capacity may be used in sizing service entrance and feeder equipment for dwelling, commercial and industrial occupancies when electric service is provided to four or more fixed space heaters, or electric furnaces sequentially controlled. These exceptions shall not apply when optional calculations allowed by Section 220.84 are used.

220.52 Small-Appliance and Laundry Loads — Dwelling Unit.

(A) Small-Appliance Circuit Load. In each dwelling unit, the load shall be calculated at 1500 volt-amperes for each 2-wire small-appliance branch circuit as covered by 210.11(C)(1). Where the load is subdivided through two or more feeders, the calculated load for each shall include not less than 1500 volt-amperes for each 2-wire small-appliance branch circuit. These loads shall be permitted to be included with the general lighting load and subjected to the demand factors provided in Table 220.42.

Exception: The individual branch circuit permitted by 210.52(B)(1), Exception No. 2, shall be permitted to be excluded from the calculation required by 220.52.

(B) Laundry Circuit Load. A load of not less than 1500 volt-amperes shall be included for each 2-wire laundry branch circuit installed as covered by 210.11(C)(2). This load shall be permitted to be included with the general lighting load and subjected to the demand factors provided in Table 220.42.

220.53 Appliance Load — Dwelling Unit(s). It shall be permissible to apply a demand factor of 75 percent to the nameplate rating load of four or more appliances fastened in place, other than electric ranges, clothes dryers, space-heating equipment, or air-conditioning equipment, that are served by the same feeder or service in a one-family, two-family, or multifamily dwelling. For space heating equipment, see Section 220.51.

220.54 Electric Clothes Dryers — Dwelling Unit(s). The load for household electric clothes dryers in a dwelling unit(s) shall be either 5000 watts (volt-amperes) or the nameplate rating, whichever is larger, for each dryer served. The use of the demand factors in Table 220.54 shall be permitted. Where two or more single-phase dryers are supplied by a 3-phase, 4-wire feeder or service, the total load shall be calculated on the basis of twice the maximum number connected between any two phases. Kilovolt-amperes (kVA) shall be considered equivalent to kilowatts (kW) for loads calculated in this section.

220.55 Electric Ranges and Other Cooking Appliances — Dwelling Unit(s). The load for household electric ranges, wall-mounted ovens, counter-mounted cooking units, and other household cooking appliances individually rated in excess of 1¼ kW shall be permitted to be calculated in accordance with Table 220.55. Kilovolt-amperes (kVA) shall be considered equivalent to kilowatts (kW) for loads calculated under this section.

Where two or more single-phase ranges are supplied by a 3-phase, 4-wire feeder or service, the total load shall be calculated on the basis of twice the maximum number connected between any two phases.

FPN No. 1: See Example D5(A) in Annex D.

FPN No. 2: See Table 220.56 for commercial cooking equipment.

FPN No. 3: See the examples in Annex D.

Table 220.54 Demand Factors for Household Clothes Dryers

Number of Dryers	Demand Factor (%)
1-4	100
5	85
6	75
7	65
8	60
9	55
10	50
11	47
12-23	47% minus 1% for each dryer exceeding 11
24-42	35% minus 0.5% for each dryer exceeding 23
43 and over	25%

220.56 Kitchen Equipment — Other Than Dwelling Unit(s). It shall be permissible to calculate the load for commercial electric cooking equipment, dishwasher booster heaters, water heaters, and other kitchen equipment in accordance with Table 220.56. These demand factors shall be applied to all equipment that has either thermostatic control or intermittent use as kitchen equipment. These demand factors shall not apply to space-heating, ventilating, or air-conditioning equipment.

However, in no case shall the feeder or service calculated load be less than the sum of the largest two kitchen equipment loads.

220.57 Electric Vehicle Outlet Load—Residential Occupancies. It shall be permissible to calculate the load for electric vehicle charging systems and outlets serving parking areas for residential occupancies in accordance with Table 220.57. The number of outlets these demand factors apply to shall be equal to the number of required parking spaces. If the size or rating of the vehicle charging system is unknown an amperage rating of 20 amps shall be assumed.

FPN No. 1: The calculated demand load for electric vehicle charging systems may be used in section IV, Optional Calculations.

FPN No. 2: See also Article 625.27, Installation Requirements for Outlets.

FPN No 3: Residential Occupancies are defined in Chapter 3 of the Seattle Building Code.

220.60 Noncoincident Loads. Where it is unlikely that two or more noncoincident loads will be in use simultaneously, it shall be permissible to use only the largest load(s) that will be used at one time for calculating the total load of a feeder or service.

220.61 Feeder or Service Neutral Load.

(A) Basic Calculation. The feeder or service neutral load shall be the maximum unbalance of the load determined by this article. The maximum unbalanced load shall be the maximum net calculated load between the neutral conductor and any one ungrounded conductor.

Exception: For 3-wire, 2-phase or 5-wire, 2-phase systems, the maximum unbalanced load shall be the maximum net calculated load between the neutral conductor and any one ungrounded conductor multiplied by 140 percent.

(B) Permitted Reductions. A service or feeder supplying the following loads shall be permitted to have an additional demand factor of 70 percent applied to the amount in

220.61(B)(1) or portion of the amount in 220.61(B)(2) determined by the basic calculation:

- (1) A feeder or service supplying household electric ranges, wall-mounted ovens, counter-mounted cooking units, and electric dryers, where the maximum unbalanced load has been determined in accordance with Table 220.55 for ranges and Table 220.54 for dryers
- (2) That portion of the unbalanced load in excess of 200 amperes where the feeder or service is supplied from a 3-wire dc or single-phase ac system; or a 4-wire, 3-phase, 3-wire, 2-phase system; or a 5-wire, 2-phase system

(C) Prohibited Reductions. There shall be no reduction of the neutral or grounded conductor capacity applied to the amount in 220.61(C)(1), or portion of the amount in (C)(2), from that determined by the basic calculation:

- (1) Any portion of a 3-wire circuit consisting of 2 ungrounded conductors and the neutral conductor of a 4-wire, 3-phase, wye-connected system
- (2) That portion consisting of nonlinear loads supplied from a 4-wire, wye-connected, 3-phase system

FPN No. 1: See Examples D1(a), D1(b), D2(b), D4(a), and D5(a) in Annex D.

FPN No. 2: A 3-phase, 4-wire, wye-connected power system used to supply power to nonlinear loads may necessitate that the power system design allow for the possibility of high harmonic neutral-conductor currents.

IV. Optional Feeder and Service Load Calculations

220.80 General. Optional feeder and service load calculations shall be permitted in accordance with Part IV.

Table 220.56 Demand Factors for Kitchen Equipment – Other Than Dwelling Unit(s)

Number of Units of Equipment	Demand Factor (%)
1	100
2	100
3	90
4	80
5	70
6 and over	65

Table 220.57 Demand Factors for Electric Vehicle Outlets

Number of Electric Vehicle Outlets	Demand Factor (%)
Less than 4	50
4-8	45
9-11	33
12-17	24
18-19	22
20-21	20
22-23	19
24-25	18
26-27	17
28-29	16
Over 29	15

Other loads shall include the following:

- (1) General lighting and general-use receptacles at 33 volt-amperes/m² or 3 volt-amperes/ft² as determined by 220.12
- (2) 1500 volt-amperes for each 2-wire, 20-ampere small-appliance branch circuit and each laundry branch circuit covered in 210.11(C)(1) and (C)(2)
- (3) The nameplate rating of the following:
 - a. All appliances that are fastened in place, permanently connected, or located to be on a specific circuit
 - b. Ranges, wall-mounted ovens, counter-mounted cooking units
 - c. Clothes dryers that are not connected to the laundry branch circuit specified in (2)
 - d. Water heaters

220.84 Multifamily Dwelling.

(A) Feeder or Service Load. It shall be permissible to calculate the load of a feeder or service that supplies three or more dwelling units of a multifamily dwelling in accordance with Table 220.84 instead of Part III of this article if all the following conditions are met:

- (1) No dwelling unit is supplied by more than one feeder.
- (2) Each dwelling unit is equipped with electric cooking equipment.

Exception: When the calculated load for multifamily dwellings without electric cooking in Part III of this article exceeds that calculated under Part IV for the identical load plus electric cooking (based on 8 kW per unit), the lesser of the two loads shall be permitted to be used.

- (3) Each dwelling unit is equipped with either electric space heating or air conditioning, or both. Feeders and service conductors whose calculated load is determined by this optional calculation shall be permitted to have the neutral load determined by 220.61.

(B) House Loads. House loads shall be calculated in accordance with Part III of this article and shall be in addition to the dwelling unit loads calculated in accordance with Table 220.84.

Exception: The demand load of electric vehicle charging outlets calculated in accordance with Section 220.57 shall be permitted to be included in the dwelling unit loads using Table 220.84.

(C) Connected Loads. The calculated load to which the demand factors of Table 220.84 apply shall include the following:

- (1) 33 volt-amperes/m² or 3 volt-amperes/ft² for general lighting and general-use receptacles

Table 220.84 Optional Calculations – Demand Factors for Three or More Multifamily Dwelling Units

Number of Dwelling Units	Demand Factor (%)
3-5	45
6-7	44
8-10	43
11	42
12-13	41
14-15	40
16-17	39
18-20	38
21	37
22-23	36
24-25	35
26-27	34
28-30	33
31	32
32-33	31
34-36	30
37-38	29
39-42	28
43-45	27
46-50	26
51-55	25
56-61	24
62 and over	23

- (2) 1500 volt-amperes for each 2-wire, 20-ampere small-appliance branch circuit and each laundry branch circuit covered in 210.11(C)(1) and (C)(2)
- (3) The nameplate rating of the following:
 - a. All appliances that are fastened in place, permanently connected, or located to be on a specific circuit
 - b. Ranges, wall-mounted ovens, counter-mounted cooking units
 - c. Clothes dryers that are not connected to the laundry branch circuit specified in item (2)
 - d. Water heaters
- (4) The nameplate ampere or kVA rating of all permanently connected motors not included in item (3)
- (5) The larger of the air-conditioning load or the fixed electric space-heating load

220.85 Two Dwelling Units. Where two dwelling units are supplied by a single feeder and the calculated load under Part III of this article exceeds that for three identical units calculated under 220.84, the lesser of the two loads shall be permitted to be used.

220.86 Schools. The calculation of a feeder or service load for schools shall be permitted in accordance with Table 220.86 in lieu of Part III of this article where equipped with electric space heating, air conditioning, or both. The connected load to which the demand factors of Table 220.86 apply shall include all of the interior and exterior lighting, power, water heating, cooking, other loads, and the larger of the air-conditioning load or space-heating load within the building or structure.

Feeders and service conductors whose calculated load is determined by this optional calculation shall be permitted to have the neutral load determined by 220.61. Where the building or structure load is calculated by this optional method, feeders within the building or structure shall have ampacity as permitted in Part III of this article; however, the ampacity of an individual feeder shall not be required to be larger than the ampacity for the entire building.

This section shall not apply to portable classroom buildings.

Table 220.86 Optional Method – Demand Factors for Feeders and Service Conductors for Schools

Connected Load	Demand Factor (Percent)
First 33 VA/m ² (3 VA/ft ²) at Plus,	100
Over 33 to 220 VA/m ² (3 to 20 VA/ft ²) at Plus,	75
Remainder over 220 (20 VA/ft ²) at VA/m ²	25

220.87 Determining Existing Loads. The calculation of a feeder or service load for existing installations shall be permitted to use actual maximum demand to determine the existing load under all of the following conditions:

- (1) The maximum demand data is available for a 1-year period.

Exception: If the maximum demand data for a 1-year period is not available, the calculated load shall be permitted to be based on the maximum demand (measure of average power demand over a 15-minute period) continuously recorded over a minimum 30-day period using a recording ammeter or power meter connected to the highest loaded phase of the feeder or service, based on the initial loading at the start of the recording. The recording shall reflect the maximum demand of the feeder or service by being taken when the building or space is occupied and shall include by measurement or calculation the larger of the heating or cooling equipment load, and other loads that may be periodic in nature due to seasonal or similar conditions.

- (2) The maximum demand at 125 percent plus the new load does not exceed the ampacity of the feeder or rating of the service.
- (3) The feeder has overcurrent protection in accordance with 240.4, and the service has overload protection in accordance with 230.90.

220.88 New Restaurants. Calculation of a service or feeder load, where the feeder serves the total load, for a new restaurant shall be permitted in accordance with Table 220.88 in lieu of Part III of this article.

The overload protection of the service conductors shall be in accordance with 230.90 and 240.4.

Feeder conductors shall not be required to be of greater ampacity than the service conductors.

Service or feeder conductors whose calculated load is determined by this optional calculation shall be permitted to have the neutral load determined by 220.61.

V. Farm Load Calculations

220.100 General. Farm loads shall be calculated in accordance with Part V.

220.102 Farm Loads — Buildings and Other Loads.

(A) Dwelling Unit. The feeder or service load of a farm dwelling unit shall be calculated in accordance with the provisions for dwellings in Part III or IV of this article. Where the dwelling has electric heat and the farm has electric grain-drying systems, Part IV of this article shall not be used to calculate the dwelling load where the dwelling and farm loads are supplied by a common service.

(B) Other Than Dwelling Unit. Where a feeder or service supplies a farm building or other load having two or more separate branch circuits, the load for feeders, service conductors, and service equipment shall be calculated in accordance with demand factors not less than indicated in Table 220.102.

220.103 Farm Loads – Total. Where supplied by a common service, the total load of the farm for service conductors and service equipment shall be calculated in accor-

Table 220.88 Optional Method—Permitted Load Calculations for Service and Feeder Conductors for New Restaurants

Total Connected Load (kVA)	All Electrical Restaurant Calculated Loads (kVA)	Not All Electric Restaurant Calculated Loads (kVA)
0-200	80%	100%
201-325	10% (amount over 200) + 160.0	50% (amount over 200) + 200.0
326-800	50% (amount over 325) + 172.5	45% (amount over 325) + 262.5
Over 800	50% (amount over 800) + 410.0	20% (amount over 800) + 476.3

Note: Add all electrical loads, including both heating and cooling loads, to calculate the total connected load. Select the one demand factor that applies from the table, then multiply the total connected load by this single demand factor

(B) Means of Attachment. The means of attachment to a building shall be in accordance with 230.27.

225.17 Masts as Supports. Where a mast is used for the support of final spans of feeders or branch circuits, it shall be of adequate strength or be supported by braces or guys to withstand safely the strain imposed by the overhead drop. Where raceway-type masts are used, all raceway fittings shall be identified for use with masts. Only the feeder or branch-circuit conductors specified within this section shall be permitted to be attached to the feeder and/or branch-circuit mast.

FPN: WAC 296-46B-230.028 regarding mast supports for feeders and branch circuits is by this reference made part of the 2008 Seattle Electrical Code.

225.18 Clearance for Overhead Conductors and Cables.

Overhead spans of open conductors and open multiconductor cables of not over 600 volts, nominal, shall have a clearance of not less than the following:

- (1) 3.0 m (10 ft) — above finished grade, sidewalks, or from any platform or projection from which they might be reached where the voltage does not exceed 150 volts to ground and accessible to pedestrians only
- (2) 3.7 m (12 ft) — over residential property and driveways, and those commercial areas not subject to truck traffic where the voltage does not exceed 300 volts to ground
- (3) 4.5 m (15 ft) — for those areas listed in the 3.7-m (12-ft) classification where the voltage exceeds 300 volts to ground
- (4) 5.5 m (18 ft) — over public streets, alleys, roads, parking areas subject to truck traffic, driveways on other than residential property, and other land traversed by vehicles, such as cultivated, grazing, forest, and orchard

225.19 Clearances from Buildings for Conductors of Not over 600 Volts, Nominal.

(A) Above Roofs. Overhead spans of open conductors and open multiconductor cables shall have a vertical clearance of not less than 2.5 m (8 ft) above the roof surface. The vertical clearance above the roof level shall be maintained for a distance not less than 900 mm (3 ft) in all directions from the edge of the roof.

Exception No. 1: The area above a roof surface subject to pedestrian or vehicular traffic shall have a vertical clearance from the roof surface in accordance with the clearance requirements of 225.18.

Exception No. 2: Where the voltage between conductors does not exceed 300, and the roof has a slope of 100 mm in 300 mm (4 in. in 12 in.) or greater, a reduction in clearance to 900 mm (3 ft) shall be permitted.

Exception No. 3: Where the voltage between conductors does not exceed 300, a reduction in clearance above only the

overhanging portion of the roof to not less than 450 mm (18 in.) shall be permitted if (1) not more than 1.8 m (6 ft) of the conductors, 1.2 m (4 ft) horizontally, pass above the roof overhang and (2) they are terminated at a through-the-roof raceway or approved support.

Exception No. 4: The requirement for maintaining the vertical clearance 900 mm (3 ft) from the edge of the roof shall not apply to the final conductor span where the conductors are attached to the side of a building.

(B) From Nonbuilding or Nonbridge Structures. From signs, chimneys, radio and television antennas, tanks, and other nonbuilding or nonbridge structures, clearances — vertical, diagonal, and horizontal — shall not be less than 900 mm (3 ft).

(C) Horizontal Clearances. Clearances shall not be less than 900 mm (3 ft).

(D) Final Spans. Final spans of feeders or branch circuits shall comply with 225.19(D)(1), (D)(2), and (D)(3).

(1) Clearance from Windows. Final spans to the building they supply, or from which they are fed, shall be permitted to be attached to the building, but they shall be kept not less than 900 mm (3 ft) from windows that are designed to be opened, and from doors, porches, balconies, ladders, stairs, fire escapes, or similar locations.

Exception: Conductors run above the top level of a window shall be permitted to be less than the 900-mm (3-ft) requirement.

(2) Vertical Clearance. The vertical clearance of final spans above, or within 900 mm (3 ft) measured horizontally of, platforms, projections, or surfaces from which they might be reached shall be maintained in accordance with 225.18.

(3) Building Openings. The overhead branch-circuit and feeder conductors shall not be installed beneath openings through which materials may be moved, such as openings in farm and commercial buildings, and shall not be installed where they obstruct entrance to these buildings' openings.

(E) Zone for Fire Ladders. Where buildings exceed three stories or 15 m (50 ft) in height, overhead lines shall be arranged, where practicable, so that a clear space (or zone) at least 1.8 m (6 ft) wide will be left either adjacent to the buildings or beginning not over 2.5 m (8 ft) from them to facilitate the raising of ladders when necessary for fire fighting.

225.20 Mechanical Protection of Conductors. Mechanical protection of conductors on buildings, structures, or poles shall be as provided for services in 230.50.

225.21 Multiconductor Cables on Exterior Surfaces of Buildings. Supports for multiconductor cables on exterior surfaces of buildings shall be as provided in 230.51.

225.22 Raceways on Exterior Surfaces of Buildings or Other Structures. Raceways on exteriors of buildings or other structures shall be arranged to drain and shall be raintight in wet locations.

225.24 Outdoor Lampholders. Where outdoor lampholders are attached as pendants, the connections to the circuit wires shall be staggered. Where such lampholders have terminals of a type that puncture the insulation and make contact with the conductors, they shall be attached only to conductors of the stranded type.

225.25 Location of Outdoor Lamps. Locations of lamps for outdoor lighting shall be below all energized conductors, transformers, or other electric utilization equipment, unless either of the following apply:

- (1) Clearances or other safeguards are provided for re-lamping operations.
- (2) Equipment is controlled by a disconnecting means that can be locked in the open position.

225.26 Vegetation as Support. Vegetation such as trees shall not be used for support of overhead conductor spans.

II. More Than One Building or Other Structure

225.30 Number of Supplies. Where more than one building or other structure is on the same property and under single management, each additional building or other structure that is served by a branch circuit or feeder on the load side of the service disconnecting means shall be supplied by only one feeder or branch circuit unless permitted in 225.30(A) through (E). For the purpose of this section, a multiwire branch circuit shall be considered a single circuit.

(A) Special Conditions. Additional feeders or branch circuits shall be permitted to supply the following:

- (1) Fire pumps
- (2) Emergency systems
- (3) Legally required standby systems
- (4) Optional standby systems
- (5) Parallel power production systems
- (6) Systems designed for connection to multiple sources of supply for the purpose of enhanced reliability

(B) Special Occupancies. By special permission, additional feeders or branch circuits shall be permitted for either of the following:

- (1) Multiple-occupancy buildings where there is no space available for supply equipment accessible to all occupants
- (2) A single building or other structure sufficiently large to make two or more supplies necessary

(C) Capacity Requirements. Additional feeders or branch circuits shall be permitted where the capacity requirements are in excess of 2000 amperes at a supply voltage of 600 volts or less.

(D) Different Characteristics. Additional feeders or branch circuits shall be permitted for different voltages, frequencies, or phases or for different uses, such as control of outside lighting from multiple locations.

(E) Documented Switching Procedures. Additional feeders or branch circuits shall be permitted to supply installations under single management where documented safe switching procedures are established and maintained for disconnection.

225.31 Disconnecting Means. Means shall be provided for disconnecting all ungrounded conductors that supply or pass through the building or structure.

225.32 Location. The disconnecting means shall be installed either inside or outside of the building or structure served or where the conductors pass through the building or structure. The disconnecting means shall be at a readily accessible location nearest the point of entrance of the conductors. For the purposes of this section, the requirements in 230.6 shall be utilized.

FPN: WAC 296-46B-225.032 regarding the location of outside feeder disconnecting means is by this reference made part of the 2008 Seattle Electrical Code.

Exception No. 1: For installations under single management, where documented safe switching procedures are established and maintained for disconnection, and where the installation is monitored by qualified individuals, the disconnecting means shall be permitted to be located elsewhere on the premises.

Exception No. 2: For buildings or other structures qualifying under the provisions of Article 685, the disconnecting means shall be permitted to be located elsewhere on the premises.

Exception No. 3: For towers or poles used as lighting standards, the disconnecting means shall be permitted to be located elsewhere on the premises.

Exception No. 4: For poles or similar structures used only for support of signs installed in accordance with Article 600, the disconnecting means shall be permitted to be located elsewhere on the premises.

225.33 Maximum Number of Disconnects.

(A) General. The disconnecting means for each supply permitted by 225.30 shall consist of not more than six switches or six circuit breakers mounted in a single enclosure, in a group of separate enclosures, or in or on a switch-

Table 225.61 Clearances over Buildings and Other Structures

Clearances from Conductors or Live Parts from:	Horizontal		Vertical	
	m	ft	ft	m
Building walls, projections, and windows	2.3	7.5	--	--
Balconies, catwalks, and similar areas accessible to people	2.3	7.5	4.1	13.5
Over or under roofs or projections not readily accessible to people	--	--	3.8	12.5
Over roofs accessible to vehicles but not trucks	--	--	4.1	13.5
Over roof accessible to trucks	--	--	5.6	18.5
Other structures	2.3	7.5	--	--

(B) Over 22 kV Nominal to Ground. Clearances for the categories shown in Table 225.61 shall be increased by 10 mm (0.4 in.) per kV above 22,000 volts.

FPN: For additional information, see ANSI C2-2007, *National Electrical Safety Code*.

ARTICLE 230
Services

230.1 ((Scope))General.

(A) Scope. This article covers service conductors and equipment for control and protection of services and their installation requirements.

FPN: See **Figure 230.1**.

(B) Service Requirements. The serving utility shall be consulted by the owner, the owner's agent or the contractor making the installation regarding service entrance location before installing equipment. Provisions for metering equipment, attachment of service drop, or for an underground service lateral shall be made at a location acceptable to the serving utility.

I. General

230.2 Number of Services. A building or other structure served shall be supplied by only one service unless permitted in 230.2(A) through (D). For the purpose of 230.40, Exception No. 2 only, underground sets of conductors, 1/0 AWG and larger, running to the same location and connected together at their supply end but not connected together at their load end shall be considered to be supplying one service.

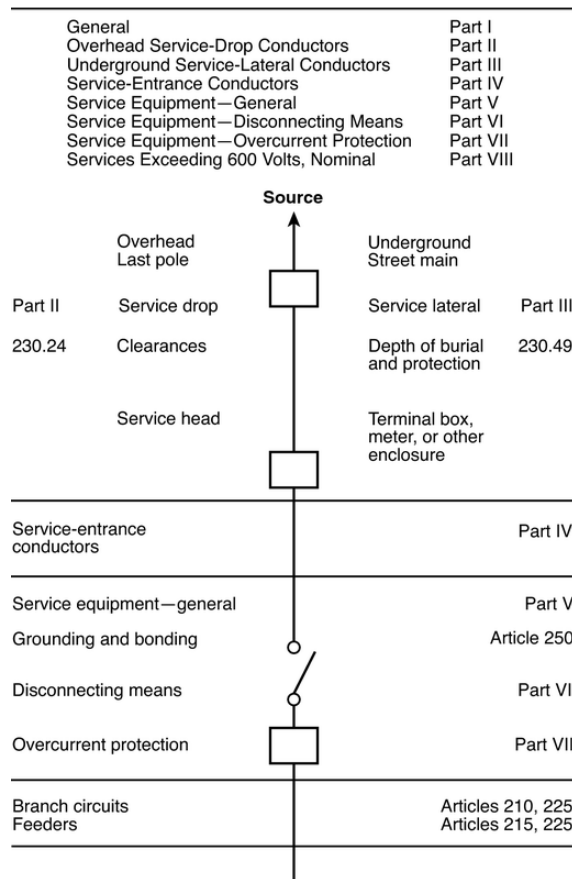


Figure 230.1 Services.

(A) Special Conditions. Additional services shall be permitted to supply the following:

- (1) Fire pumps
- (2) Emergency systems
- (3) Legally required standby systems
- (4) Optional standby systems
- (5) Parallel power production systems
- (6) Systems designed for connection to multiple sources of supply for the purpose of enhanced reliability

(B) Special Occupancies. By special permission, additional services shall be permitted for either of the following:

- (1) Multiple-occupancy buildings where there is no available space for service equipment accessible to all occupants
- (2) A single building or other structure sufficiently large to make two or more services necessary

(C) Capacity Requirements. Additional services shall be permitted under any of the following:

- (1) Where the capacity requirements are in excess of 2000 amperes at a supply voltage of 600 volts or less
- (2) Where the load requirements of a single-phase installation are greater than the serving agency normally supplies through one service
- (3) By special permission

(D) Different Characteristics. Additional services shall be permitted for different voltages, frequencies, or phases, or for different uses, such as for different rate schedules.

(E) Identification. Where a building or structure is supplied by more than one service, or any combination of branch circuits, feeders, and services, a permanent plaque or directory shall be installed at each service disconnect location denoting all other services, feeders, and branch circuits supplying that building or structure and the area served by each. See 225.37.

230.3 One Building or Other Structure Not to Be Supplied Through Another. Service conductors supplying a building or other structure shall not pass through the interior of another building or other structure.

230.5 Types of Services. All services shall be grounded single-phase or grounded three-phase 4-wire systems. Three-phase 3-wire services shall not be installed unless prior approval is granted by the utility and the authority having jurisdiction.

230.6 Conductors Considered Outside the Building. Conductors shall be considered outside of a building or other structure under any of the following conditions:

- (1) Where installed under not less than 50 mm (2 in.) of concrete beneath a building or other structure
- (2) Where installed within a building or other structure in a raceway that is encased in concrete or brick not less than 50 mm (2 in.) thick
- (3) Where installed in any vault that meets the construction requirements of Article 450, Part III
- (4) Where installed in conduit and under not less than 450 mm (18 in.) of earth beneath a building or other structure

230.7 Other Conductors in Raceway or Cable. Conductors other than service conductors shall not be installed in the same service raceway or service cable.

Exception No. 1: Grounding conductors and bonding jumpers.

Exception No. 2: Load management control conductors having overcurrent protection.

230.8 Raceway Seal. Where a service raceway enters a building or structure from an underground distribution system, it shall be sealed in accordance with 300.5(G). Spare or unused raceways shall also be sealed. Sealants shall be identified for use with the cable insulation, shield, or other components.

230.9 Clearances on Buildings. Service conductors and final spans shall comply with 230.9(A), (B), and (C).

(A) Clearances. Service conductors installed as open conductors or multiconductor cable without an overall outer jacket shall have a clearance of not less than 900 mm (3 ft) from windows that are designed to be opened, doors, porches, balconies, ladders, stairs, fire escapes, or similar locations.

Exception: Conductors run above the top level of a window shall be permitted to be less than the 900-mm (3-ft) requirement.

(B) Vertical Clearance. The vertical clearance of final spans above, or within 900 mm (3 ft) measured horizontally of, platforms, projections, or surfaces from which they might be reached shall be maintained in accordance with 230.24(B).

(C) Building Openings. Overhead service conductors shall not be installed beneath openings through which materials may be moved, such as openings in farm and commercial buildings, and shall not be installed where they obstruct entrance to these building openings.

230.10 Vegetation as Support. Vegetation such as trees shall not be used for support of overhead service conductors.

230.12 Service Point Connection. Service point connections shall comply with paragraphs (A), (B) or (C) below.

(A) Overhead Service Drop. For overhead service drop conductors from the utility pole to the point of attachment to the building, connections of the service entrance conductors shall be at a weatherhead outside the building.

(B) Underground Service Connections Outside of Buildings. For underground service connections outside of buildings, connection shall be made in one of the following:

- (1) A service terminal box or current transformer cabinet;
- (2) A handhole or power transformer installed outdoors in accordance with requirements of the utility, the *Seattle Building Code*, or any other applicable ordinance;
- (3) A meter socket(s) of 200 amperes minimum size, direct-metered;
- (4) A termination compartment of service equipment that is used exclusively for the connection of the utility distribution system.

(C) Underground Service Connections Inside of Buildings. For underground service connections inside of buildings, connection shall be made at one of the following:

- (1) Where utility-supplied conductors are used:
 - (a) A service terminal box or current transformer cabinet connected by no more than 457 mm (18 in.) of rigid steel or rigid nonmetallic conduit inside the building;
 - (b) A direct metered, flush mounted meter socket of 200 amperes minimum size mounted in a perimeter wall of a single family dwelling connected by no more than 2.4 m (8 ft) of rigid steel or rigid nonmetallic conduit inside the building;
 - (c) A termination or current transformer section of built, sectionalized service equipment that is used exclusively for the connection of the utility distribution system. This section must be fed from underground or concrete encased conduit and the service equipment must sit directly on the floor or a concrete housekeeping pad.

- (2) A transformer vault within the building.

II. Overhead Service-Drop Conductors

230.22 Insulation or Covering. Individual conductors shall be insulated or covered.

Exception: The grounded conductor of a multiconductor cable shall be permitted to be bare.

230.23 Size and Rating.

(A) General. Conductors shall have sufficient ampacity to carry the current for the load as calculated in accordance with Article 220 and shall have adequate mechanical strength.

(B) Minimum Size. The conductors shall not be smaller than 8 AWG copper or 6 AWG aluminum or copper-clad aluminum.

Exception: Conductors supplying only limited loads of a single branch circuit — such as small polyphase power, controlled water heaters, and similar loads — shall not be smaller than 12 AWG hard-drawn copper or equivalent.

(C) Grounded Conductors. The grounded conductor shall not be less than the minimum size as required by 250.24(C).

230.24 Clearances. Service-drop conductors shall not be readily accessible and shall comply with 230.24(A) through (D) for services not over 600 volts, nominal.

(A) Above Roofs. Conductors shall have a vertical clearance of not less than 2.5 m (8 ft) above the roof surface. The vertical clearance above the roof level shall be maintained for a distance of not less than 900 mm (3 ft) in all directions from the edge of the roof.

Exception No. 1: The area above a roof surface subject to pedestrian or vehicular traffic shall have a vertical clearance from the roof surface in accordance with the clearance requirements of 230.24(B).

Exception No. 2: Where the voltage between conductors does not exceed 300 and the roof has a slope of 100 mm in 300 mm (4 in. in 12 in.) or greater, a reduction in clearance to 900 mm (3 ft) shall be permitted.

Exception No. 3: Where the voltage between conductors does not exceed 300, a reduction in clearance above only the overhanging portion of the roof to not less than 450 mm (18 in.) shall be permitted if (1) not more than 1.8 m (6 ft) of service-drop conductors, 1.2 m (4 ft) horizontally, pass above the roof overhang, and (2) they are terminated at a through-the-roof raceway or approved support.

FPN: See 230.28 for mast supports.

Exception No. 4: The requirement for maintaining the vertical clearance 900 mm (3 ft) from the edge of the roof shall not apply to the final conductor span where the service drop is attached to the side of a building.

(B) Vertical Clearance for Service-Drop Conductors. Service-drop conductors, where not in excess of 600 volts, nominal, shall have the following minimum clearance from final grade:

- (1) 3.0 m (10 ft) — at the electrical service entrance to buildings, also at the lowest point of the drip loop of the building electrical entrance, and above areas or

sidewalks accessible only to pedestrians, measured from final grade or other accessible surface only for service-drop cables supported on and cabled together with a grounded bare messenger where the voltage does not exceed 150 volts to ground

- (2) 3.7 m (12 ft) — over residential property and driveways, and those commercial areas not subject to truck traffic where the voltage does not exceed 300 volts to ground
- (3) 4.5 m (15 ft) — for those areas listed in the 3.7-m (12-ft) classification where the voltage exceeds 300 volts to ground
- (4) 5.5 m (18 ft) — over public streets, alleys, roads, parking areas subject to truck traffic, driveways on other than residential property, and other land such as cultivated, grazing, forest, and orchard

(C) Clearance from Building Openings. See 230.9.

(D) Clearance from Swimming Pools. See 680.8.

230.26 Point of Attachment. The point of attachment of the service-drop conductors to a building or other structure shall provide the minimum clearances as specified in 230.9 and 230.24. In no case shall this point of attachment be less than 3.0 m (10 ft) above finished grade.

230.27 Means of Attachment. Multiconductor cables used for service drops shall be attached to buildings or other structures by fittings identified for use with service conductors. Open conductors shall be attached to fittings identified for use with service conductors or to noncombustible, nonabsorbent insulators securely attached to the building or other structure.

230.28 Service Masts as Supports. ~~((Where a service mast is used for the support of service drop conductors, it shall be of adequate strength or be supported by braces or guys to withstand safely the strain imposed by the service drop. Where raceway type service masts are used, all raceway fittings shall be identified for use with service masts. Only power service drop conductors shall be permitted to be attached to a service mast.))~~ Service masts used to support service-drop conductors shall comply with the following:

- (1) All raceway fittings shall be identified for use with service masts.
- (2) Service masts shall be rigid steel galvanized conduit no smaller than 51 mm (2 in.).
- (3) Service masts shall support only power service-drop conductors.
- (4) Service-drops shall be attached to a bracket on the mast, or other approved structure located with 610 mm (24 in.) of the mast.
- (5) Masts over 661 mm (26 in.) above the roof shall be rigidly supported with brackets or guy wires. The serving utility shall be consulted for bracket and guy wire requirements.
- (6) Service conduits for mast type services shall be supported by one of the methods identified in WAC 296-46B-230 028 and drawings E-101 through E-103 with

corresponding notes. Snuggle bars properly installed between wood framing members are permitted.

(7) Openings where service conduits pass through the roof shall be made watertight with approved neoprene or lead flashings.

(8) Couplings shall be permitted only below the roofline and shall be below a point of support for the mast.

FPN: WAC 296-46B-230.028 which addresses mast supports for feeders and branch circuits is by this reference made part of the 2008 Seattle Electrical Code.

230.29 Supports over Buildings and Wires On or About Buildings or Structures Over Water. ~~((Service drop~~

~~conductors passing over a roof shall be securely supported by substantial structures. Where practicable, such supports shall be independent of the building.))~~

(A) All service entrance conductors for piers, docks, wharves and other structures over water shall terminate in a disconnecting means or service equipment at the street side or end of such structure, or as otherwise approved by the authority having jurisdiction.

Exception: When the vault for the utility transformer is located over water, a disconnecting means for the service entrance conductors shall be provided immediately outside the vault at a location acceptable to the authority having jurisdiction.

FPN: For utility service conductors on piers, docks or wharves, refer to "Requirements for Electric Service Connection" published by Seattle City Light.

(B) Service entrance conduit containing wires not protected by circuit breakers or switches and fuses shall follow and be supported on parapets or other walls and shall not be laid upon or across roofs.

(C) All service entrance conduits in the Fire District shall terminate on the side of the building nearest to the lines or mains of the utility. The service shall not terminate over adjacent private property, and shall extend to the street or alley wall of the buildings. The Seattle Building Code defines "Fire District" in Section 401.2 and the boundaries are illustrated in Figure 401.2.

(D) Open wiring for service conductors shall contact the building at only one point except where the utility will agree to contact the building at more than one point.

(E) No wire access fittings or junction boxes of any type shall be permitted within 4.6 m (15 ft) of the ground level on street, alley or driveway margins.

III. Underground Service-Lateral Conductors

230.30 Insulation. Service-lateral conductors shall be insulated for the applied voltage.

Exception: A grounded conductor shall be permitted to be uninsulated as follows:

(1) Bare copper used in a raceway.

(2) Bare copper for direct burial where bare copper is judged to be suitable for the soil conditions.

(3) Bare copper for direct burial without regard to soil conditions where part of a cable assembly identified for underground use.

(4) Aluminum or copper-clad aluminum without individual insulation or covering where part of a cable assembly identified for underground use in a raceway or for direct burial.

230.31 Size and Rating.

(A) General. Service-lateral conductors shall have sufficient ampacity to carry the current for the load as calculated in accordance with Article 220 and shall have adequate mechanical strength.

(B) Minimum Size. The conductors shall not be smaller than 8 AWG copper or 6 AWG aluminum or copper-clad aluminum.

Exception: Conductors supplying only limited loads of a single branch circuit — such as small polyphase power, controlled water heaters, and similar loads — shall not be smaller than 12 AWG copper or 10 AWG aluminum or copper-clad aluminum.

(C) Grounded Conductors. The grounded conductor shall not be less than the minimum size required by 250.24(C).

230.32 Protection Against Damage. Underground service-lateral conductors shall be protected against damage in accordance with 300.5. Service-lateral conductors entering a building shall be installed in accordance with 230.6 or protected by a raceway wiring method identified in 230.43.

~~((230.33 Spliced Conductors. — Service lateral conductors shall be permitted to be spliced or tapped in accordance with 110.14, 300.5(E), 300.13, and 300.15.))~~

230.34 Conversion to Underground Service or Increasing Existing Overhead Services. Where service for an existing single-family dwelling is converted to an underground service or where existing overhead services are increased, the following requirements shall be met:

(1) Unless a 200 ampere meter enclosure was provided for the existing service, a new 200 ampere approved wide meter enclosure shall be permitted to be installed over an existing meter enclosure that is embedded in a finished exterior wall. Service grounding continuity shall be maintained and the perimeter of such new enclosure shall be sealed watertight with a silicone sealant or approved equivalent.

(2) Conversions to an underground service shall have existing overhead service conductors removed and the top opening of the existing conduit at the weatherhead shall be closed.

(3) Where a new meter enclosure is installed the interior of the existing meter enclosure shall be removed and service conductors of the same size as those removed shall be installed from the new meter enclosure to the existing service panel. Conductors shall be run through a

51 mm (2 in.) bushing in the back of such new enclosure, through the void area between enclosures, and continue in the existing conduit to the panel.

(4) Any exposed wood or combustible material between the two meter enclosures shall be covered with noncombustible material.

(5) On installations where a meter has been moved outdoors, the existing meter shall be removed. An approved fitting shall be installed on the existing conduit with new conduit of the same size as the existing, to extend from such fitting to a new 200 ampere meter enclosure.

(6) Conductors shall be continuous from the new meter enclosure to the service panel.

(7) On existing services, a weatherhead-to-weatherhead connection shall be permitted. The distance between weatherheads shall not exceed 610 mm (24 in.).

IV. Service-Entrance Conductors

230.40 Number of Service-Entrance Conductor Sets. Each service drop or lateral shall supply only one set of service-entrance conductors.

Exception No. 1: A building with more than one occupancy shall be permitted to have one set of service-entrance conductors for each service, as defined in 230.2, run to each occupancy or group of occupancies.

Exception No. 2: Where two to six service disconnecting means in separate enclosures are grouped at one location and supply separate loads from one service drop or lateral, one set of service-entrance conductors shall be permitted to supply each or several such service equipment enclosures.

Exception No. 3: A single-family dwelling unit and a separate structure shall be permitted to have one set of service-entrance conductors run to each from a single service drop or lateral.

Exception No. 4: A two-family dwelling or a multifamily dwelling shall be permitted to have one set of service-entrance conductors installed to supply the circuits covered in 210.25.

Exception No. 5: One set of service-entrance conductors connected to the supply side of the normal service disconnecting means shall be permitted to supply each or several systems covered by 230.82(5) or 230.82(6).

FPN: WAC 296-46B-230.040(5), which addresses second or additional service conductor requirements is by this reference made part of the 2008 Seattle Electrical Code.

230.41 Insulation of Service-Entrance Conductors. Service-entrance conductors entering or on the exterior of buildings or other structures shall be insulated.

Exception: A grounded conductor shall be permitted to be uninsulated as follows:

(1) Bare copper used in a raceway or part of a service cable assembly.

(2) Bare copper for direct burial where bare copper is judged to be suitable for the soil conditions.

(3) Bare copper for direct burial without regard to soil conditions where part of a cable assembly identified for underground use.

(4) Aluminum or copper-clad aluminum without individual insulation or covering where part of a cable assembly or identified for underground use in a raceway, or for direct burial.

(5) Bare conductors used in an auxiliary gutter.

230.42 Minimum Size and Rating.

(A) General. The ampacity of the service-entrance conductors before the application of any adjustment or correction factors shall not be less than either (A)(1) or (A)(2). Loads shall be determined in accordance with Part III, IV, or V of Article 220, as applicable. Ampacity shall be determined from 310.15. The maximum allowable current of busways shall be that value for which the busway has been listed or labeled.

(1) The sum of the noncontinuous loads plus 125 percent of continuous loads

(2) The sum of the noncontinuous load plus the continuous load if the service-entrance conductors terminate in an overcurrent device where both the overcurrent device and its assembly are listed for operation at 100 percent of their rating

(B) Specific Installations. In addition to the requirements of 230.42(A), the minimum ampacity for ungrounded conductors for specific installations shall not be less than the rating of the service disconnecting means specified in 230.79(A) through (D).

(C) Grounded Conductors. The grounded conductor shall not be smaller than the minimum size as required by 250.24(C).

FPN: WAC 296-46B-230.042 which addresses labeling of service equipment, is by this reference made part of the 2008 Seattle Electrical Code.

230.43 Wiring Methods for 600 Volts, Nominal, or Less. Service-entrance conductors shall be installed in accordance with the applicable requirements of this Code covering the type of wiring method used and shall be limited to the following methods:

(1) (~~Open wiring on insulators~~) Reserved

(2) (~~Type IGS cable~~) Reserved

(3) Rigid metal conduit

(4) Intermediate metal conduit

(5) (~~Electrical metallic tubing~~) Reserved

(6) (~~Electrical nonmetallic tubing (ENT)~~) Reserved

(7) (~~Service entrance cables~~) Reserved

(8) (~~Wireways~~) Reserved

(9) Busways

(10) (~~Auxiliary gutters~~) Reserved

- (11) Rigid polyvinyl chloride conduit (schedule 40 minimum size)
- (12) Cablebus
- (13) Type MC cable that complies with Section 330.10(A)(11), with prior approval of the authority having jurisdiction
- (14) Mineral-insulated, metal-sheathed cable
- (15) ~~((Flexible metal conduit not over 1.8 m (6 ft) long or liquidtight flexible metal conduit not over 1.8 m (6 ft) long between raceways, or between raceway and service equipment, with equipment bonding jumper routed with the flexible metal conduit or the liquidtight flexible metal conduit according to the provisions of 250.102(A), (B), (C), and (E)))~~
Reserved
- (16) ~~((Liquidtight flexible nonmetallic conduit)) reserved~~

230.44 Cable Trays. Cable tray systems ~~((shall))~~ may, with prior approval of the authority having jurisdiction, be permitted to support service-entrance conductors. Cable trays used to support service-entrance conductors shall contain only service-entrance conductors.

Exception: Conductors, other than service-entrance conductors, shall be permitted to be installed in a cable tray with service-entrance conductors, provided a solid fixed barrier of a material compatible with the cable tray is installed to separate the service-entrance conductors from other conductors installed in the cable tray. Cable trays shall be identified with permanently affixed labels with the wording "Service-Entrance Conductors." The labels shall be located so as to be visible after installation and placed so that the service-entrance conductors may be readily traced through the entire length of the cable tray.

230.46 Spliced Conductors. Service-entrance conductors shall be permitted to be spliced or tapped in accordance with 110.14, 300.5(E), 300.13, and 300.15, only by special permission of the authority having jurisdiction.

230.50 Protection Against Physical Damage.

(A) Underground Service-Entrance Conductors.

Underground service-entrance conductors shall be protected against physical damage in accordance with 300.5.

(B) All Other Service-Entrance Conductors. All other service-entrance conductors, other than underground service entrance conductors, shall be protected against physical damage as specified in 230.50(B)(1) or (B)(2).

(1) Service Cables. Service cables, where subject to physical damage, shall be protected by any of the following:

- (1) Rigid metal conduit
- (2) Intermediate metal conduit
- (3) Schedule 80 PVC conduit
- (4) ~~((Electrical metallic tubing))~~ Reserved.
- (5) Other approved means

(2) Other Than Service Cable. Individual open conductors and cables, other than service cables, shall not be installed

within 3.0 m (10 ft) of grade level or where exposed to physical damage.

Exception: Type MI and Type MC cable shall be permitted within 3.0 m (10 ft) of grade level where not exposed to physical damage or where protected in accordance with 300.5(D).

230.51 Mounting Supports. Cables or individual open service conductors shall be supported as specified in 230.51(A), (B), or (C).

(A) Service Cables. Service cables shall be supported by straps or other approved means within 300 mm (12 in.) of every service head, gooseneck, or connection to a raceway or enclosure and at intervals not exceeding 750 mm (30 in.).

(B) Other Cables. Cables that are not approved for mounting in contact with a building or other structure shall be mounted on insulating supports installed at intervals not exceeding 4.5 m (15 ft) and in a manner that maintains a clearance of not less than 50 mm (2 in.) from the surface over which they pass.

(C) Individual Open Conductors. Individual open conductors shall be installed in accordance with Table 230.51(C). Where exposed to the weather, the conductors shall be mounted on insulators or on insulating supports attached to racks, brackets, or other approved means. Where not exposed to the weather, the conductors shall be mounted on glass or porcelain knobs.

~~((230.52 Individual Conductors Entering Buildings or Other Structures. Where individual open conductors enter a building or other structure, they shall enter through roof bushings or through the wall in an upward slant through individual, noncombustible, nonabsorbent insulating tubes. Drip loops shall be formed on the conductors before they enter the tubes.))~~

230.53 Raceways to Drain. Where exposed to the weather, raceways enclosing service-entrance conductors shall be suitable for use in wet locations and arranged to drain. Where embedded in masonry, raceways shall be arranged to drain.

230.54 Overhead Service Locations.

(A) Service Head. Service raceways shall be equipped with a service head at the point of connection to service-drop conductors. The service head shall comply with the requirement for fittings in 314.15.

(B) Service Cable Equipped with Service Head or Gooseneck. Service cables shall be equipped with a service head. The service head shall comply with the requirement for fittings in 314.15.

Exception: Type SE cable shall be permitted to be formed in a gooseneck and taped with a self-sealing weather-resistant thermoplastic.

(C) Service Heads and Goosenecks Above Service-Drop Attachment. Service heads and goosenecks in service-entrance cables shall be located above the point of attachment of the service-drop conductors to the building or other structure.

Table 230.51(C) Supports

Maximum Volts	Maximum Distance Between Supports		Minimum Clearances			
	m	ft	Between Conductors		From Surface	
			mm	in.	mm	in.
600	2.7	9	150	6	50	2
600	4.5	15	300	12	50	2
300	14	4 ½	75	3	50	2
600*	14*	4 ½ *	65*	2 ½ *	25*	1 *

*Where not exposed to weather.

Exception: Where it is impracticable to locate the service head or gooseneck above the point of attachment, the service head or gooseneck location shall be permitted not farther than 600 mm (24 in.) from the point of attachment.

(D) Secured. Service cables shall be held securely in place.

(E) Separately Bushed Openings. Service heads shall have conductors of different potential brought out through separately bushed openings.

Exception: For jacketed multiconductor service cable without splice.

(F) Drip Loops. Drip loops shall be formed on individual conductors. To prevent the entrance of moisture, service-entrance conductors shall be connected to the service-drop conductors either (1) below the level of the service head or (2) below the level of the termination of the service-entrance cable sheath.

(G) Arranged That Water Will Not Enter Service Raceway or Equipment. Service-drop conductors and service-entrance conductors shall be arranged so that water will not enter service raceway or equipment.

(H) Length at Weatherhead. Service-entrance conductors shall extend at least 457 mm (18 in.) from the weatherhead to allow connection. Where multiple service-entrance raceways are provided, each service-entrance conductor shall extend at least 762 mm (30 in.) from the weatherhead to allow connection.

FPN: Drawings E-101, E-102, and E-103 from WAC 296-46B-230 are by this reference made part of the 2008 Seattle Electrical Code.

230.56 Service Conductor with the Higher Voltage to Ground. On a 4-wire, delta-connected service where the midpoint of one phase winding is grounded, the service conductor having the higher phase voltage to ground shall be durably and permanently marked by an outer finish that is orange in color, or by other effective means, at each termination or junction point.

V. Service Equipment — General

230.62 Service Equipment — Enclosed or Guarded. Energized parts of service equipment shall be enclosed as specified in 230.62(A) or guarded as specified in 230.62(B).

(A) Enclosed. Energized parts shall be enclosed so that they will not be exposed to accidental contact or shall be guarded as in 230.62(B).

(B) Guarded. Energized parts that are not enclosed shall be installed on a switchboard, panelboard, or control board and guarded in accordance with 110.18 and 110.27. Where energized parts are guarded as provided in 110.27(A)(1) and (A)(2), a means for locking or sealing doors providing access to energized parts shall be provided.

230.66 Marking. Service equipment rated at 600 volts or less shall be marked to identify it as being suitable for use as service equipment. Individual meter socket enclosures shall not be considered service equipment.

VI. Service Equipment — Disconnecting Means

230.70 General. Means shall be provided to disconnect all conductors in a building or other structure from the service-entrance conductors.

(A) Location. The service disconnecting means shall be installed in accordance with 230.70(A)(1), (A)(2), ~~((and))~~ (A)(3) and (A)(4).

(1) Readily Accessible Location. The service disconnecting means shall be installed at a readily accessible location either outside of a building or structure or inside nearest the point of entrance of the service conductors. Service disconnecting means shall be readily accessible, including after any subsequent building alterations or additions.

FPN: The inside and outside location requirements contained in WAC 296-46B-230.070(11) are by this reference made part of the 2008 Seattle Electrical Code.

(2) Bathrooms and Other Wet Locations. Service disconnecting means shall not be installed in bathrooms,

toilet rooms, shower rooms, nor above washers, ranges, dryers, water heaters, sinks, plumbing fixtures or drain boards.

(3) Other Locations. Service disconnecting means shall not be installed in clothes closets, cupboards or attics, nor under or over stairways, or within any stairway enclosure.

Exception: In one- and two-family dwellings, service disconnecting means may be installed over a stairway landing that has no less than the clear working space required by this Code.

~~((3))~~ **(4) Remote Control.** Where a remote control devices(s) is used to actuate the service disconnecting means, the service disconnecting means shall be located in accordance with 230.70(A)(1).

(B) Marking. Each service disconnect shall be permanently marked to identify it as a service disconnect.

(C) Suitable for Use. Each service disconnecting means shall be suitable for the prevailing conditions. Service equipment installed in hazardous (classified) locations shall comply with the requirements of Articles 500 through 517.

230.71 Maximum Number of Disconnects.

(A) General. The service disconnecting means for each service permitted by 230.2, or for each set of service-entrance conductors permitted by 230.40, Exception No. 1, 3, 4, or 5, shall consist of not more than six switches or sets of circuit breakers, or a combination of not more than six switches and sets of circuit breakers, mounted in a single enclosure, in a group of separate enclosures, or in or on a switchboard. There shall be not more than six sets of disconnects per service grouped in any one location.

For the purpose of this section, disconnecting means installed as part of listed equipment and used solely for the following shall not be considered a service disconnecting means:

- (1) Power monitoring equipment
- (2) Surge-protective device(s)
- (3) Control circuit of the ground-fault protection system
- (4) Power-operable service disconnecting means

(B) Single-Pole Units. Two or three single-pole switches or breakers, capable of individual operation, shall be permitted on multiwire circuits, one pole for each ungrounded conductor, as one multipole disconnect, provided they are equipped with identified handle ties or a master handle to disconnect all conductors of the service with no more than six operations of the hand.

FPN: See 408.36, Exception No. 1 and Exception No. 3, for service equipment in certain panelboards, and see 430.95 for service equipment in motor control centers.

230.72 Grouping of Disconnects.

(A) General. The two to six disconnects as permitted in 230.71 shall be grouped. Each disconnect shall be marked to indicate the load served.

Exception: One of the two to six service disconnecting means permitted in 230.71, where used only for a water pump also intended to provide fire protection, shall be permitted to be located remote from the other disconnecting means.

(B) Additional Service Disconnecting Means. The one or more additional service disconnecting means for fire pumps, emergency systems, legally required standby, or optional standby services permitted by 230.2 shall be installed remote from the one to six service disconnecting means for normal service to minimize the possibility of simultaneous interruption of supply.

(C) Access to Occupants. In a multiple-occupancy building, each occupant shall have access to the occupant's service disconnecting means.

Exception: In a multiple-occupancy building where electric service and electrical maintenance are provided by the building management and where these are under continuous building management supervision, the service disconnecting means supplying more than one occupancy shall be permitted to be accessible to authorized management personnel only.

230.74 Simultaneous Opening of Poles. Each service disconnect shall simultaneously disconnect all ungrounded service conductors that it controls from the premises wiring system.

230.75 Disconnection of Grounded Conductor. Where the service disconnecting means does not disconnect the grounded conductor from the premises wiring, other means shall be provided for this purpose in the service equipment. A terminal or bus to which all grounded conductors can be attached by means of pressure connectors shall be permitted for this purpose. In a multisection switchboard, disconnects for the grounded conductor shall be permitted to be in any section of the switchboard, provided any such switchboard section is marked.

230.76 Manually or Power Operable. The service disconnecting means for ungrounded service conductors shall consist of one of the following:

- (1) A manually operable switch or circuit breaker equipped with a handle or other suitable operating means
- (2) A power-operated switch or circuit breaker, provided the switch or circuit breaker can be opened by hand in the event of a power supply failure

230.77 Indicating. The service disconnecting means shall plainly indicate whether it is in the open or closed position.

230.79 Rating of Service Disconnecting Means. The service disconnecting means shall have a rating not less than the calculated load to be carried, determined in accordance with Part III, IV, or V of Article 220, as applicable. In no case shall the rating be lower than specified in 230.79(A), (B), (C), or (D).

(A) One-Circuit Installations. For installations to supply only limited loads of a single branch circuit, the service disconnecting means shall have a rating of not less than 15 amperes.

(B) Two-Circuit Installations. For installations consisting of not more than two 2-wire branch circuits, the service disconnecting means shall have a rating of not less than 30 amperes.

(C) One-Family Dwellings. For a one-family dwelling, the service disconnecting means shall have a rating of not less than 100 amperes, 3-wire.

(D) All Others. For all other installations, the service disconnecting means shall have a rating of not less than 60 amperes.

230.80 Combined Rating of Disconnects. Where the service disconnecting means consists of more than one switch or circuit breaker, as permitted by 230.71, the combined ratings of all the switches or circuit breakers used shall not be less than the rating required by 230.79.

230.81 Connection to Terminals. The service conductors shall be connected to the service disconnecting means by pressure connectors, clamps, or other approved means. Connections that depend on solder shall not be used.

230.82 Equipment Connected to the Supply Side of Service Disconnect. Only the following equipment shall be permitted to be connected to the supply side of the service disconnecting means:

- (1) ~~(Cable)~~ Existing installations of cable limiters or other current-limiting devices by special permission of the authority having jurisdiction.

- (2) Meters and meter sockets nominally rated not in excess of 600 volts, provided all metal housings and service enclosures are grounded in accordance with Part VII and bonded in accordance with Part V of Article 250. Taps under meter socket lugs shall not be permitted, except by prior approval from the authority having jurisdiction.
- (3) Meter disconnect switches nominally rated not in excess of 600 volts that have a short-circuit current rating equal to or greater than the available short-circuit current, provided all metal housings and service enclosures are grounded in accordance with Part VII and bonded in accordance with Part V of Article 250. A meter disconnect switch shall be capable of interrupting the load served.
- (4) Instrument transformers (current and voltage), impedance shunts, load management devices, surge arresters, and Type 1 surge-protective devices.
- (5) Taps used only to supply load management devices, circuits for standby power systems, fire pump equipment, and fire and sprinkler alarms, if provided with service equipment and installed in accordance with requirements for service-entrance conductors.
- (6) Solar photovoltaic systems, fuel cell systems, or interconnected electric power production sources.
- (7) Control circuits for power-operable service disconnecting means, if suitable overcurrent protection and disconnecting means are provided.
- (8) Ground-fault protection systems or Type 2 surge-protective devices, where installed as part of listed equipment, if suitable overcurrent protection and disconnecting means are provided.
- (9) Current transformer cabinets shall contain only the main service conductors, metering equipment and secondary wiring. One tap shall be permitted on the load side of the current transformers for a legally-required standby service and one tap shall be permitted on the load side of the current transformers for a fire pump service. One additional normal power service tap from the current transformer enclosure may be made by special permission of the service utility. In a single-family dwelling, two connections shall be permitted on the load side of the current transformers. No other taps shall be permitted. Approved terminal lugs shall be provided for the main service conductors and for all taps.
- (10) Listed service accessory bus gutters or termination boxes that are approved for use on the line side of service equipment. Junction and pull boxes are not permitted.

VII. Service Equipment — Overcurrent Protection

230.90 Where Required. Each ungrounded service conductor shall have overload protection.

(A) Ungrounded Conductor. Such protection shall be provided by an overcurrent device in series with each ungrounded service conductor that has a rating or setting not higher than the allowable ampacity of the conductor. A set of fuses shall be considered all the fuses required to protect all the ungrounded conductors of a circuit. Single-pole circuit breakers, grouped in accordance with 230.71(B), shall be considered as one protective device.

Exception No. 1: For motor-starting currents, ratings that comply with 430.52, 430.62, and 430.63 shall be permitted.

Exception No. 2: Fuses and circuit breakers with a rating or setting that complies with 240.4(B) or (C) and 240.6 shall be permitted.

Exception No. 3: Two to six circuit breakers or sets of fuses shall be permitted as the overcurrent device to provide the overload protection. The sum of the ratings of the circuit breakers or fuses shall be permitted to exceed the ampacity of the service conductors, provided the calculated load does not exceed the ampacity of the service conductors.

FPN: WAC 296-46B-230.042(6) requirement for an identification plate is by this reference made part of the 2008 Seattle Electrical Code.

Exception No. 4: Overload protection for fire pump supply conductors shall comply with 695.4(B)(1).

Exception No. 5: Overload protection for 120/240-volt, 3-wire, single-phase dwelling services shall be permitted in accordance with the requirements of 310.15(B)(6).

(B) Not in Grounded Conductor. No overcurrent device shall be inserted in a grounded service conductor except a circuit breaker that simultaneously opens all conductors of the circuit.

230.91 Location. The service overcurrent device shall be an integral part of the service disconnecting means or shall be located immediately adjacent thereto.

230.92 Locked Service Overcurrent Devices. Where the service overcurrent devices are locked or sealed or are not readily accessible to the occupant, branch-circuit overcurrent devices shall be installed on the load side, shall be mounted in a readily accessible location, and shall be of lower ampere rating than the service overcurrent device.

230.93 Protection of Specific Circuits. Where necessary to prevent tampering, an automatic overcurrent device that protects service conductors supplying only a specific load,

such as a water heater, shall be permitted to be locked or sealed where located so as to be accessible.

230.94 Relative Location of Overcurrent Device and Other Service Equipment. The overcurrent device shall protect all circuits and devices.

Exception No. 1: The service switch shall be permitted on the supply side.

Exception No. 2: High-impedance shunt circuits, surge arresters, Type 1 surge-protective devices, surge-protective capacitors, and instrument transformers (current and voltage) shall be permitted to be connected and installed on the supply side of the service disconnecting means as permitted by 230.82.

Exception No. 3: Circuits for load management devices shall be permitted to be connected on the supply side of the service overcurrent device where separately provided with overcurrent protection.

Exception No. 4: Circuits used only for the operation of fire alarm, other protective signaling systems, or the supply to fire pump equipment shall be permitted to be connected on the supply side of the service overcurrent device where separately provided with overcurrent protection.

Exception No. 5: Meters nominally rated not in excess of 600 volts shall be permitted, provided all metal housings and service enclosures are grounded.

Exception No. 6: Where service equipment is power operable, the control circuit shall be permitted to be connected ahead of the service equipment if suitable overcurrent protection and disconnecting means are provided.

230.95 Ground-Fault Protection of Equipment. Ground-fault protection of equipment shall be provided for solidly grounded wye electric services of more than 150 volts to ground but not exceeding 600 volts phase-to-phase for each service disconnect rated 1000 amperes or more. The grounded conductor for the solidly grounded wye system shall be connected directly to ground through a grounding electrode system, as specified in 250.50, without inserting any resistor or impedance device.

The rating of the service disconnect shall be considered to be the rating of the largest fuse that can be installed or the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted.

Exception: The ground-fault protection provisions of this section shall not apply to a service disconnect for a continuous industrial process where a nonorderly shutdown will introduce additional or increased hazards.

(A) Setting. The ground-fault protection system shall operate to cause the service disconnect to open all ungrounded conductors of the faulted circuit. The maximum setting of the ground-fault protection shall be 1200 amperes, and the maximum time delay shall be one second for ground-fault currents equal to or greater than 3000 amperes.

(B) Fuses. If a switch and fuse combination is used, the fuses employed shall be capable of interrupting any current higher than the interrupting capacity of the switch during a time that the ground-fault protective system will not cause the switch to open.

(C) Performance Testing. The ground-fault protection system shall be performance tested when first installed on site. ~~((The test shall be conducted in accordance with instructions that shall be provided with the equipment. A written record of this test shall be made and shall be available to the authority having jurisdiction.))~~

The testing shall verify that the system is installed and operates in accordance with the manufacturer's instructions. Testing shall be performed by qualified personnel having proper equipment to complete the acceptance testing in the manner prescribed by the manufacturer. The testing personnel shall sign a written performance acceptance test record. The record shall provide testing details including, but not limited to, measurements and trip settings used during the test.

The written acceptance test record, together with a copy of the manufacturer's performance testing instructions, shall be made available to the inspector for the authority having jurisdiction.

(D) Added Ground-fault Protection System. Ground fault protection systems added to an existing energized service shall be tested and inspected prior to being placed into service.

FPN No. 1: Ground-fault protection that functions to open the service disconnect affords no protection from faults on the line side of the protective element. It serves only to limit damage to conductors and equipment on the load side in the event of an arcing ground fault on the load side of the protective element.

FPN No. 2: This added protective equipment at the service equipment may make it necessary to review the overall wiring system for proper selective overcurrent protection coordination. Additional installations of ground-fault protective equipment may be needed on feeders and branch

circuits where maximum continuity of electric service is necessary.

FPN No. 3: Where ground-fault protection is provided for the service disconnect and interconnection is made with another supply system by a transfer device, means or devices may be needed to ensure proper ground-fault sensing by the ground-fault protection equipment.

FPN No. 4: See 517.17(A) for information on where an additional step of ground-fault protection is required for hospitals and other buildings with critical areas or life support equipment.

VIII. Services Exceeding 600 Volts, Nominal

230.200 General. Service conductors and equipment used on circuits exceeding 600 volts, nominal, shall comply with all the applicable provisions of the preceding sections of this article and with the following sections that supplement or modify the preceding sections. In no case shall the provisions of Part VIII apply to equipment on the supply side of the service point.

FPN: For clearances of conductors of over 600 volts, nominal, see ANSI C2-2007, *National Electrical Safety Code*.

230.202 Service-Entrance Conductors. Service-entrance conductors to buildings or enclosures shall be installed to conform to 230.202(A) and (B).

(A) Conductor Size. Service-entrance conductors shall not be smaller than 6 AWG unless in multiconductor cable. Multiconductor cable shall not be smaller than 8 AWG.

(B) Wiring Methods. Service-entrance conductors shall be installed by one of the following wiring methods: ~~((covered in 300.37 and 300.50.))~~

- (1) Rigid metal conduit
- (2) Intermediate metal conduit
- (3) Schedule 80 rigid polyvinyl chloride conduit
- (4) Busways
- (5) Cablebus
- (6) Cable trays only with prior permission of the authority having jurisdiction.

230.204 Isolating Switches.

(A) Where Required. Where oil switches or air, oil, vacuum, or sulfur hexafluoride circuit breakers constitute the service disconnecting means, an isolating switch with visible break contacts shall be installed on the supply side of the disconnecting means and all associated service equipment.

Exception: An isolating switch shall not be required where the circuit breaker or switch is mounted on removable truck panels or metal-enclosed switchgear units where both of the following conditions apply:

- (1) *Cannot be opened unless the circuit is disconnected.*
- (2) *Where all energized parts are automatically disconnected when the circuit breaker or switch is removed from the normal operating position.*

(B) Fuses as Isolating Switch. Where fuses are of the type that can be operated as a disconnecting switch, a set of such fuses shall be permitted as the isolating switch.

(C) Accessible to Qualified Persons Only. The isolating switch shall be accessible to qualified persons only.

(D) Connection to Ground. Isolating switches shall be provided with a means for readily connecting the load side conductors to a grounding electrode system, equipment ground busbar, or grounded steel structure when disconnected from the source of supply.

A means for grounding the load side conductors to a grounding electrode system, equipment grounding busbar, or grounded structural steel shall not be required for any duplicate isolating switch installed and maintained by the electric supply company.

230.205 Disconnecting Means.

(A) Location. The service disconnecting means shall be located in accordance with 230.70.

For either overhead or underground primary distribution systems on private property, the service disconnect shall be permitted to be located in a location that is not readily accessible.

(B) Type. Each service disconnect shall simultaneously disconnect all ungrounded service conductors that it controls and shall have a fault-closing rating that is not less than the maximum short-circuit current available at its supply terminals.

Where fused switches or separately mounted fuses are installed, the fuse characteristics shall be permitted to

contribute to the fault-closing rating of the disconnecting means.

(C) Remote Control. For multibuilding, industrial installations under single management, the service disconnecting means shall be permitted to be located at a separate building or structure. In such cases, the service disconnecting means shall be permitted to be electrically operated by a readily accessible, remote-control device.

230.206 Overcurrent Devices as Disconnecting Means.

Where the circuit breaker or alternative for it, as specified in 230.208 for service overcurrent devices, meets the requirements specified in 230.205, they shall constitute the service disconnecting means.

230.208 Protection Requirements. A short-circuit protective device shall be provided on the load side of, or as an integral part of, the service disconnect, and shall protect all ungrounded conductors that it supplies. The protective device shall be capable of detecting and interrupting all values of current, in excess of its trip setting or melting point, that can occur at its location. A fuse rated in continuous amperes not to exceed three times the ampacity of the conductor, or a circuit breaker with a trip setting of not more than six times the ampacity of the conductors, shall be considered as providing the required short-circuit protection.

FPN: See Table 310.67 through Table 310.86 for ampacities of conductors rated 2001 volts and above.

Overcurrent devices shall conform to 230.208(A) and (B).

(A) Equipment Type. Equipment used to protect service-entrance conductors shall meet the requirements of Article 490, Part II.

(B) Enclosed Overcurrent Devices. The restriction to 80 percent of the rating for an enclosed overcurrent device for continuous loads shall not apply to overcurrent devices installed in systems operating at over 600 volts.

230.209 Surge Arresters (Lightning Arresters). Surge arresters installed in accordance with the requirements of Article 280 shall be permitted on each ungrounded overhead service conductor.

- (1) The secondary conductors shall have an ampacity that is not less than the value of the primary-to-secondary voltage ratio multiplied by one-third of the rating of the overcurrent device protecting the primary of the transformer.
- (2) The secondary conductors terminate in a single circuit breaker or set of fuses that limit the load current to not more than the conductor ampacity that is permitted by 310.15.
- (3) The secondary conductors are protected from physical damage by being enclosed in an approved raceway or by other approved means.

(D) Service Conductors. Service conductors shall be permitted to be protected by overcurrent devices in accordance with 230.91.

(E) Busway Taps. Busways and busway taps shall be permitted to be protected against overcurrent in accordance with 368.17.

(F) Motor Circuit Taps. Motor-feeder and branch-circuit conductors shall be permitted to be protected against overcurrent in accordance with 430.28 and 430.53, respectively.

(G) Conductors from Generator Terminals. Conductors from generator terminals that meet the size requirement in 445.13 shall be permitted to be protected against overload by the generator overload protective device(s) required by 445.12.

(H) Battery Conductors. Overcurrent protection shall be permitted to be installed as close as practicable to the storage battery terminals in a non-hazardous location. Installation of the overcurrent protection within a hazardous location shall also be permitted.

240.22 Grounded Conductor. No overcurrent device shall be connected in series with any conductor that is intentionally grounded, unless one of the following two conditions is met:

- (1) The overcurrent device opens all conductors of the circuit, including the grounded conductor, and is designed so that no pole can operate independently.
- (2) Where required by 430.36 or 430.37 for motor overload protection.

240.23 Change in Size of Grounded Conductor. Where a change occurs in the size of the ungrounded conductor, a similar change shall be permitted to be made in the size of the grounded conductor.

240.24 Location in or on Premises.

(A) Accessibility. Overcurrent devices shall be readily accessible and shall be installed so that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, is not more than 2.0 m (6 ft 7 in.) and no less than one foot above the floor or working platform, unless one of the following applies:

- (1) For busways, as provided in 368.17(C).
- (2) For supplementary overcurrent protection, as described in 240.10.
- (3) For overcurrent devices, as described in 225.40 and 230.92.
- (4) For overcurrent devices adjacent to utilization equipment that they supply, access shall be permitted to be by portable means.

(B) Occupancy. Each occupant shall have ready access to all overcurrent devices protecting the conductors supplying that occupancy, unless otherwise permitted in 240.24(B)(1) and (B)(2).

(1) Service and Feeder Overcurrent Devices. Where electric service and electrical maintenance are provided by the building management and where these are under continuous building management supervision, the service overcurrent devices and feeder overcurrent devices supplying more than one occupancy shall be permitted to be accessible only to authorized management personnel in the following:

- (1) Multiple-occupancy buildings
- (2) Guest rooms or guest suites

(2) Branch-Circuit Overcurrent Devices. Where electric service and electrical maintenance are provided by the building management and where these are under continuous building management supervision, the branch-circuit overcurrent devices supplying any guest rooms or guest suites without permanent provisions for cooking shall be permitted to be accessible only to authorized management personnel.

(3) Accessory Dwelling Unit, Two-Family and Multi-family Occupancies. Branch circuit overcurrent devices shall be located either within the dwelling unit that they serve or in common areas accessible to all occupants.

(C) Not Exposed to Physical Damage. Overcurrent devices shall be located where they will not be exposed to physical damage.

FPN: See 110.11, Deteriorating Agents.

(D) Not in Vicinity of Easily Ignitable Material. Overcurrent devices shall not be located in the vicinity of easily ignitable material, such as in clothes closets.

(E) Not Located in Bathrooms. In dwelling units and guest rooms or guest suites of hotels and motels, overcurrent devices, other than supplementary overcurrent protection, shall not be located in bathrooms.

(F) Not Located over Steps. Overcurrent devices shall not be located over steps of a stairway.

(G) Other Locations. Overcurrent protection devices, other than supplementary overcurrent protection, shall not be located in a shower room, cupboard, attic, nor above a washer, range, dryer, water heater, sink, plumbing fixture, drain board, or similar locations.

III. Enclosures

240.30 General.

(A) Protection from Physical Damage. Overcurrent devices shall be protected from physical damage by one of the following:

- (1) Installation in enclosures, cabinets, cutout boxes, or equipment assemblies
- (2) Mounting on open-type switchboards, panelboards, or control boards that are in rooms or enclosures free from dampness and easily ignitable material and are accessible only to qualified personnel

(B) Operating Handle. The operating handle of a circuit breaker shall be permitted to be accessible without opening a door or cover.

240.32 Damp or Wet Locations. Enclosures for overcurrent devices in damp or wet locations shall comply with 312.2.

240.33 Vertical Position. Enclosures for overcurrent devices shall be mounted in a vertical position unless that is shown to be impracticable. Circuit breaker enclosures shall be permitted to be installed horizontally where the circuit breaker is installed in accordance with 240.81. Listed busway plug-in units shall be permitted to be mounted in orientations corresponding to the busway mounting position.

IV. Disconnecting and Guarding

240.40 Disconnecting Means for Fuses. Cartridge fuses in circuits of any voltage where accessible to other than qualified persons, and all fuses in circuits over 150 volts to ground, shall be provided with a disconnecting means on their supply side so that each circuit containing fuses can be independently disconnected from the source of power. A current-limiting device without a disconnecting means shall be permitted on the supply side of the service disconnecting means as permitted by 230.82. A single disconnecting means shall be permitted on the supply side of more than one set of fuses as permitted by 430.112, Exception, for group operation of motors and 424.22(C) for fixed electric space-heating equipment.

240.41 Arcing or Suddenly Moving Parts. Arcing or suddenly moving parts shall comply with 240.41(A) and (B).

(A) Location. Fuses and circuit breakers shall be located or shielded so that persons will not be burned or otherwise injured by their operation.

(B) Suddenly Moving Parts. Handles or levers of circuit breakers, and similar parts that may move suddenly in such a way that persons in the vicinity are likely to be injured by being struck by them, shall be guarded or isolated.

V. Plug Fuses, Fuseholders, and Adapters

240.50 General.

(A) Maximum Voltage. Plug fuses shall be permitted to be used in the following circuits:

- (1) Circuits not exceeding 125 volts between conductors
- (2) Circuits supplied by a system having a grounded neutral point where the line-to-neutral voltage does not exceed 150 volts

(B) Marking. Each fuse, fuseholder, and adapter shall be marked with its ampere rating.

(C) Hexagonal Configuration. Plug fuses of 15-ampere and lower rating shall be identified by a hexagonal configuration of the window, cap, or other prominent part to distinguish them from fuses of higher ampere ratings.

(D) No Energized Parts. Plug fuses, fuseholders, and adapters shall have no exposed energized parts after fuses or fuses and adapters have been installed.

(E) Screw Shell. The screw shell of a plug-type fuseholder shall be connected to the load side of the circuit.

240.51 Edison-Base Fuses.

(A) Classification. Plug fuses of the Edison-base type shall be classified at not over 125 volts and 30 amperes and below.

(B) Replacement Only. Plug fuses of the Edison-base type shall be used only for replacements in existing installations where there is no evidence of overfusing or tampering.

240.52 Edison-Base Fuseholders. Fuseholders of the Edison-base type shall be installed only where they are made to accept Type S fuses by the use of adapters.

240.53 Type S Fuses. Type S fuses shall be of the plug type and shall comply with 240.53(A) and (B).

(A) Classification. Type S fuses shall be classified at not over 125 volts and 0 to 15 amperes, 16 to 20 amperes, and 21 to 30 amperes.

(B) Noninterchangeable. Type S fuses of an ampere classification as specified in 240.53(A) shall not be interchangeable with a lower ampere classification. They shall be designed so that they cannot be used in any fuseholder other than a Type S fuseholder or a fuseholder with a Type S adapter inserted.

(10 ft) or more (including any metal well casing bonded to the pipe) and electrically continuous (or made electrically continuous by bonding around insulating joints or insulating pipe) to the points of connection of the grounding electrode conductor and the bonding conductors. Interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building shall not be used as a part of the grounding electrode system or as a conductor to interconnect electrodes that are part of the grounding electrode system.

Exception: In industrial, commercial, and institutional buildings or structures where conditions of maintenance and supervision ensure that only qualified persons service the installation, interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building shall be permitted as a part of the grounding electrode system or as a conductor to interconnect electrodes that are part of the grounding electrode system, provided that the entire length, other than short sections passing perpendicularly through walls, floors, or ceilings, of the interior metal water pipe that is being used for the conductor is exposed.

(2) Metal Frame of the Building or Structure. The metal frame of the building or structure that is connected to the earth by any of the following methods:

- (1) 3.0 m (10 ft) or more of a single structural metal member in direct contact with the earth or encased in concrete that is in direct contact with the earth
- (2) Connecting the structural metal frame to the reinforcing bars of a concrete-encased electrode as provided in 250.52(A)(3) or ground ring as provided in 250.52(A)(4)
- (3) Bonding the structural metal frame to one or more of the grounding electrodes as defined in 250.52(A)(5) or (A)(7) that comply with 250.56
- (4) Other approved means of establishing a connection to earth

(3) Concrete-Encased Electrode. An electrode encased by at least 50 mm (2 in.) of concrete, located horizontally near the bottom or vertically, and within that portion of a concrete foundation or footing that is in direct contact with the earth, consisting of at least 6.0 m (20 ft) of one or more bare or zinc galvanized or other electrically conductive coated steel reinforcing bars or rods of not less than 13 mm (½ in.) in diameter, or consisting of at least 6.0 m (20 ft) of bare copper conductor not smaller than 4 AWG. Reinforcing bars shall be permitted to be bonded together by the usual steel tie wires or other effective means. Where multiple concrete-encased electrodes are present at a building or structure, it shall be permissible to bond only one into the grounding electrode system.

(4) Ground Ring. A ground ring encircling the building or structure, in direct contact with the earth, consisting of at least 6.0 m (20 ft) of bare copper conductor not smaller than 2 AWG.

(5) Rod and Pipe Electrodes. Rod and pipe electrodes shall not be less than 2.44 m (8 ft) in length and shall consist of the following materials.

- (a) Grounding electrodes of pipe or conduit shall not be smaller than metric designator 21 (trade size ¾) and, where of steel, shall have the outer surface galvanized or otherwise metal-coated for corrosion protection.
- (b) Grounding electrodes of stainless steel and copper or zinc coated steel shall be at least 15.87 mm (⅝ in.) in diameter, unless listed and not less than 12.70 mm (½ in.) in diameter.

(6) Other Listed Electrodes. Other listed grounding electrodes shall be permitted.

(7) Plate Electrodes. Each plate electrode shall expose not less than 0.186 m² (2 ft²) of surface to exterior soil. Electrodes of iron or steel plates shall be at least 6.4 mm (¼ in.) in thickness. Electrodes of nonferrous metal shall be at least 1.5 mm (0.06 in.) in thickness.

(8) Other Local Metal Underground Systems or Structures. Other local metal underground systems or structures such as piping systems, underground tanks, and underground metal well casings that are not bonded to a metal water pipe.

(B) Not Permitted for Use as Grounding Electrodes. The following systems and materials shall not be used as grounding electrodes:

- (1) Metal underground gas piping systems
- (2) Aluminum

FPN: See 250.104(B) for bonding requirements of gas piping.

250.53 Grounding Electrode System Installation.

FPN: See 547.9 and 547.10 for special grounding and bonding requirements for agricultural buildings.

(A) Rod, Pipe, and Plate Electrodes. Where practicable, rod, pipe, and plate electrodes shall be embedded below permanent moisture level. Rod, pipe, and plate electrodes shall be free from nonconductive coatings such as paint or enamel.

(B) Electrode Spacing. Where more than one of the electrodes of the type specified in 250.52(A)(5) or (A)(7) are used, each electrode of one grounding system (including that used for air terminals) shall not be less than 1.83 m (6 ft) from any other electrode of another grounding system. Two or more grounding electrodes that are bonded together shall be considered a single grounding electrode system.

(C) Bonding Jumper. The bonding jumper(s) used to connect the grounding electrodes together to form the grounding electrode system shall be installed in accordance with 250.64(A), (B), and (E), shall be sized in accordance with 250.66, and shall be connected in the manner specified in 250.70.

(D) Metal Underground Water Pipe. Where used as a grounding electrode, metal underground water pipe shall meet the requirements of 250.53(D)(1) and (D)(2).

(1) Continuity. Continuity of the grounding path or the bonding connection to interior piping shall not rely on water meters or filtering devices and similar equipment.

(2) Supplemental Electrode Required. A metal underground water pipe shall be supplemented by an additional electrode of a type specified in 250.52(A)(2) through (A)(8). Where the supplemental electrode is a rod, pipe, or plate type, it shall comply with 250.56. The supplemental electrode shall be permitted to be bonded to the grounding electrode conductor, the grounded service-entrance conductor, the nonflexible grounded service raceway, or any grounded service enclosure.

Exception: The supplemental electrode shall be permitted to be bonded to the interior metal water piping at any convenient point as covered in 250.52(A)(1), Exception.

(E) Supplemental Electrode Bonding Connection Size. Where the supplemental electrode is a rod, pipe, or plate electrode, that portion of the bonding jumper that is the sole connection to the supplemental grounding electrode shall not be required to be larger than 6 AWG copper wire or 4 AWG aluminum wire.

(F) Ground Ring. The ground ring shall be buried at a depth below the earth's surface of not less than 750 mm (30 in.).

(G) Rod and Pipe Electrodes. The electrode shall be installed such that at least 2.44 m (8 ft) of length is in contact with the soil. It shall be driven to a depth of not less than 2.44 m (8 ft) except that, where rock bottom is encountered, the electrode shall be driven at an oblique angle not to exceed 45 degrees from the vertical or, where rock bottom is encountered at an angle up to 45 degrees, the electrode shall be permitted to be buried in a trench that is at least 750 mm (30 in.) deep. The upper end of the electrode shall be flush with or below ground level unless the aboveground end and the grounding electrode conductor attachment are protected against physical damage as specified in 250.10.

(H) Plate Electrode. Plate electrodes shall be installed not less than 750 mm (30 in.) below the surface of the earth.

250.54 Auxiliary Grounding Electrodes. One or more grounding electrodes shall be permitted to be connected to the equipment grounding conductors specified in 250.118 and shall not be required to comply with the electrode bonding requirements of 250.50 or 250.53(C) or the resistance requirements of 250.56, but the earth shall not be

used as an effective ground-fault current path as specified in 250.4(A)(5) and 250.4(B)(4).

250.56 Resistance of Rod, Pipe, and Plate Electrodes. A single electrode consisting of a rod, pipe, or plate (~~that does not have a resistance to ground of 25 ohms or less~~) shall be augmented by one additional electrode of any of the types specified by 250.52(A)(4) through (A)(8). Where multiple rod, pipe, or plate electrodes are installed to meet the requirements of this section, they shall not be less than ~~(1.8 m (6 ft))~~ 2.5 m (8 ft) apart.

FPN: The paralleling efficiency of rods longer than 2.5 m (8 ft) is improved by spacing greater than 1.8 m (6 ft).

250.58 Common Grounding Electrode. Where an ac system is connected to a grounding electrode in or at a building or structure, the same electrode shall be used to ground conductor enclosures and equipment in or on that building or structure. Where separate services, feeders, or branch circuits supply a building and are required to be connected to a grounding electrode(s), the same grounding electrode(s) shall be used.

Two or more grounding electrodes that are bonded together shall be considered as a single grounding electrode system in this sense.

250.60 Use of Air Terminals. Air terminal conductors and driven pipes, rods, or plate electrodes used for grounding air terminals shall not be used in lieu of the grounding electrodes required by 250.50 for grounding wiring systems and equipment. This provision shall not prohibit the required bonding together of grounding electrodes of different systems.

FPN No. 1: See 250.106 for spacing from air terminals. See 800.100(D), 810.21(J), and 820.100(D) for bonding of electrodes.

FPN No. 2: Bonding together of all separate grounding electrodes will limit potential differences between them and between their associated wiring systems.

250.62 Grounding Electrode Conductor Material. The grounding electrode conductor shall be of copper, aluminum, or copper-clad aluminum. The material selected shall be resistant to any corrosive condition existing at the installation or shall be suitably protected against corrosion. The conductor shall be solid or stranded, insulated, covered, or bare.

ensure the grounding path for a metal piping system used as a grounding electrode, bonding shall be provided around insulated joints and around any equipment likely to be disconnected for repairs or replacement. Bonding jumpers shall be of sufficient length to permit removal of such equipment while retaining the integrity of the grounding path.

250.70 Methods of Grounding and Bonding Conductor Connection to Electrodes. The grounding or bonding conductor shall be connected to the grounding electrode by exothermic welding, listed lugs, listed pressure connectors, listed clamps, or other listed means. Connections depending on solder shall not be used. Ground clamps shall be listed for the materials of the grounding electrode and the grounding electrode conductor and, where used on pipe, rod, or other buried electrodes, shall also be listed for direct soil burial or concrete encasement. Not more than one conductor shall be connected to the grounding electrode by a single clamp or fitting unless the clamp or fitting is listed for multiple conductors. One of the following methods shall be used:

- (1) A pipe fitting, pipe plug, or other approved device screwed into a pipe or pipe fitting
- (2) A listed bolted clamp of cast bronze or brass, or plain or malleable iron
- (3) For indoor telecommunications purposes only, a listed sheet metal strap-type ground clamp having a rigid metal base that seats on the electrode and having a strap of such material and dimensions that it is not likely to stretch during or after installation
- (4) An equally substantial approved means

IV. Enclosure, Raceway, and Service Cable Connections

250.80 Service Raceways and Enclosures. Metal enclosures and raceways for service conductors and equipment shall be connected to the grounded system conductor if the electrical system is grounded or to the grounding electrode conductor for electrical systems that are not grounded.

Exception: A metal elbow that is installed in an underground installation of rigid nonmetallic conduit and is isolated from possible contact by a minimum cover of 450 mm (18 in.) to any part of the elbow shall not be required to be connected to the grounded system conductor or grounding electrode conductor.

250.84 Underground Service Cable or Raceway.

(A) Underground Service Cable. The sheath or armor of a continuous underground metal-sheathed or armored service cable system that is connected to the grounded system conductor on the supply side shall not be required to be connected to the grounded system conductor at the building or structure. The sheath or armor shall be permitted to be insulated from the interior metal raceway or piping.

(B) Underground Service Raceway Containing Cable. An underground metal service raceway that contains a metal-sheathed or armored cable connected to the grounded system conductor shall not be required to be connected to the grounded system conductor at the building or structure. The sheath or armor shall be permitted to be insulated from the interior metal raceway or piping.

250.86 Other Conductor Enclosures and Raceways. Except as permitted by 250.112(I), metal enclosures and raceways for other than service conductors shall be connected to the equipment grounding conductor.

Exception No. 1: Metal enclosures and raceways for conductors added to existing installations of open wire, knob-and-tube wiring, and nonmetallic-sheathed cable shall not be required to be connected to the equipment grounding conductor where these enclosures or wiring methods comply with (1) through (4) as follows:

- (1) Do not provide an equipment ground
- (2) Are in runs of less than 7.5 m (25 ft)
- (3) Are free from probable contact with ground, grounded metal, metal lath, or other conductive material
- (4) Are guarded against contact by persons

Exception No. 2: Short sections of metal enclosures or raceways used to provide support or protection of cable assemblies from physical damage shall not be required to be connected to the equipment grounding conductor.

Exception No. 3: A metal elbow shall not be required to be connected to the equipment grounding conductor where it is installed in a nonmetallic raceway and is isolated from possible contact by a minimum cover of 450 mm (18 in.) to any part of the elbow or is encased in not less than 50 mm (2 in.) of concrete.

V. Bonding

250.90 General. Bonding shall be provided where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.

FPN: WAC 296-46B-250.090(6) & (7), which address requirements for bonding in plumbing systems or lines, is by this reference made part of the 2008 Seattle Electrical Code.

250.92 Services.

(A) Bonding of Services. The non-current-carrying metal parts of equipment indicated in 250.92(A)(1) and (A)(2) shall be bonded together.

- (1) The service raceways, utility raceways that are metallically connected to other service equipment, cable trays, cablebus framework, auxiliary gutters, or service cable armor or sheath except as permitted in 250.84
- (2) All service enclosures containing service conductors, including meter fittings, boxes, or the like, interposed in the service raceway or armor

(B) Method of Bonding at the Service. Electrical continuity at service equipment, service raceways, and service conductor enclosures shall be ensured by one of the following methods:

(1) Bonding equipment to the grounded service conductor in a manner provided in 250.8

Exception: Connection to the grounded service conductor shall not be used to bond service terminals boxes and current transformer enclosures.

(2) Connections utilizing threaded couplings or threaded bosses on enclosures where made up wrenchtight

(3) Threadless couplings and connectors where made up tight for metal raceways and metal-clad cables

(4) Other listed devices, such as bonding-type locknuts, bushings, or bushings with bonding jumpers

Bonding jumpers meeting the other requirements of this article shall be used around concentric or eccentric knockouts that are punched or otherwise formed so as to impair the electrical connection to ground. Standard locknuts or bushings shall not be the sole means for the bonding required by this section.

250.94 Bonding for Other Systems. An intersystem bonding termination for connecting intersystem bonding and grounding conductors required for other systems shall be provided external to enclosures at the service equipment and at the disconnecting means for any additional buildings or structures. The intersystem bonding termination shall be accessible for connection and inspection. The intersystem bonding termination shall have the capacity for connection of not less than three intersystem bonding conductors. The intersystem bonding termination device shall not interfere with opening a service or metering equipment enclosure. The intersystem bonding termination shall be one of the following:

(1) A set of terminals securely mounted to the meter enclosure and electrically connected to the meter enclosure. The terminals shall be listed as grounding and bonding equipment.

(2) A bonding bar near the service equipment enclosure, meter enclosure, or raceway for service conductors. The bonding bar shall be connected with a minimum 6 AWG copper conductor to an equipment grounding conductor(s) in the service equipment enclosure, meter enclosure, or exposed nonflexible metallic raceway.

(3) A bonding bar near the grounding electrode conductor. The bonding bar shall be connected to the grounding electrode conductor with a minimum 6 AWG copper conductor.

Exception: In existing buildings or structures where any of the intersystem bonding and grounding conductors required by 770.93, 800.100(B), 810.21(F), 820.100(B), 830.100(B) exist, installation of the intersystem bonding termination is not required. An accessible means external to enclosures for connecting intersystem bonding and grounding electrode

conductors shall be permitted at the service equipment and at the disconnecting means for any additional buildings or structures by at least one of the following means:

(1) Exposed nonflexible metallic raceways

(2) An exposed grounding electrode conductor

(3) Approved means for the external connection of a copper or other corrosion-resistant bonding or grounding conductor to the grounded raceway or equipment

FPN No. 1: A 6 AWG copper conductor with one end bonded to the grounded nonflexible metallic raceway or equipment and with 150 mm (6 in.) or more of the other end made accessible on the outside wall is an example of the approved means covered in 250.94, Exception item (3).

FPN No. 2: See 800.100, 810.21, and 820.100 for bonding and grounding requirements for communications circuits, radio and television equipment, and CATV circuits.

250.96 Bonding Other Enclosures.

(A) General. Metal raceways, cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as grounding conductors, with or without the use of supplementary equipment grounding conductors, shall be bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed on them. Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces or be connected by means of fittings designed so as to make such removal unnecessary.

(B) Isolated Grounding Circuits. Where installed for the reduction of electrical noise (electromagnetic interference) on the grounding circuit, an equipment enclosure supplied by a branch circuit shall be permitted to be isolated from a raceway containing circuits supplying only that equipment by one or more listed nonmetallic raceway fittings located at the point of attachment of the raceway to the equipment enclosure. The metal raceway shall comply with provisions of this article and shall be supplemented by an internal insulated equipment grounding conductor installed in accordance with 250.146(D) to ground the equipment enclosure.

FPN: Use of an isolated equipment grounding conductor does not relieve the requirement for grounding the raceway system.

250.97 Bonding for Over 250 Volts. For circuits of over 250 volts to ground, the electrical continuity of metal raceways and cables with metal sheaths that contain any conductor other than service conductors shall be ensured by one or more of the methods specified for services in 250.92(B), except for (B)(1).

Exception: Where oversized, concentric, or eccentric knockouts are not encountered, or where a box or enclosure

with concentric or eccentric knockouts is listed to provide a reliable **bonding connection**, the following methods shall be permitted:

- (1) Threadless couplings and connectors for cables with metal sheaths
- (2) Two locknuts, on rigid metal conduit or intermediate metal conduit, one inside and one outside of boxes and cabinets
- (3) Fittings with shoulders that seat firmly against the box or cabinet, such as electrical metallic tubing connectors, flexible metal conduit connectors, and cable connectors, with one locknut on the inside of boxes and cabinets
- (4) Listed fittings

250.98 Bonding Loosely Jointed Metal Raceways. Expansion fittings and telescoping sections of metal raceways shall be made electrically continuous by equipment bonding jumpers or other means.

250.100 Bonding in Hazardous (Classified) Locations. Regardless of the voltage of the electrical system, the electrical continuity of non-current-carrying metal parts of equipment, raceways, and other enclosures in any hazardous (classified) location as defined in 500.5 shall be ensured by any of the **bonding** methods specified in 250.92(B)(2) through (B)(4). One or more of these bonding methods shall be used whether or not equipment grounding conductors of the wire type are installed.

250.102 Equipment Bonding Jumpers.

(A) Material. Equipment bonding jumpers shall be of copper or other corrosion-resistant material. A bonding jumper shall be a wire, bus, screw, or similar suitable conductor.

(B) Attachment. Equipment bonding jumpers shall be attached in the manner specified by the applicable provisions of 250.8 for circuits and equipment and by 250.70 for grounding electrodes.

(C) Size — Equipment Bonding Jumper on Supply Side of Service. The bonding jumper shall not be smaller than the sizes shown in Table 250.66 for grounding electrode conductors. Where the service-entrance phase conductors are larger than 1100 kcmil copper or 1750 kcmil aluminum, the bonding jumper shall have an area not less than 12½ percent of the area of the largest phase conductor except that, where the phase conductors and the bonding jumper are of different materials (copper or aluminum), the minimum size of the bonding jumper shall be based on the assumed use of phase conductors of the same material as the bonding jumper and with an ampacity equivalent to that of the installed phase conductors. Where the service-entrance conductors are paralleled in two or more raceways or cables, the equipment bonding jumper, where routed with the raceways or cables, shall be run in parallel. The size of the bonding jumper for

each raceway or cable shall be based on the size of the service-entrance conductors in each raceway or cable.

(D) Size — Equipment Bonding Jumper on Load Side of Service. The equipment bonding jumper on the load side of the service overcurrent devices shall be sized, as a minimum, in accordance with the sizes listed in Table 250.122, but shall not be required to be larger than the largest ungrounded circuit conductors supplying the equipment and shall not be smaller than 14 AWG.

A single common continuous equipment bonding jumper shall be permitted to **connect** two or more raceways or cables where the bonding jumper is sized in accordance with Table 250.122 for the largest overcurrent device supplying circuits therein.

(E) Installation. The equipment bonding jumper shall be permitted to be installed inside or outside of a raceway or enclosure. Where installed on the outside, the length of the equipment bonding jumper shall not exceed 1.8 m (6 ft) and shall be routed with the raceway or enclosure. Where installed inside a raceway, the equipment bonding jumper shall comply with the requirements of 250.119 and 250.148.

Exception: An equipment bonding jumper longer than 1.8 m (6 ft) shall be permitted at outside pole locations for the purpose of bonding or grounding isolated sections of metal raceways or elbows installed in exposed risers of metal conduit or other metal raceway.

250.104 Bonding of Piping Systems and Exposed Structural Steel.

(A) Metal Water Piping. The metal water piping system shall be bonded as required in (A)(1), (A)(2), or (A)(3) of this section. The bonding jumper(s) shall be installed in accordance with 250.64(A), (B), and (E). The points of attachment of the bonding jumper(s) shall be accessible.

(1) General. Metal water piping system(s) installed in or attached to a building or structure shall be bonded to the service equipment enclosure, the grounded conductor at the service, the grounding electrode conductor where of sufficient size, or to the one or more grounding electrodes used. The bonding jumper(s) shall be sized in accordance with Table 250.66 except as permitted in 250.104(A)(2) and (A)(3).

(2) Buildings of Multiple Occupancy. In buildings of multiple occupancy where the metal water piping system(s) installed in or attached to a building or structure for the individual occupancies is metallicity isolated from all other occupancies by use of nonmetallic water piping, the metal water piping system(s) for each occupancy shall be permitted to be bonded to the equipment grounding terminal of the panelboard or switchboard enclosure (other than service equipment) supplying that occupancy. The bonding jumper shall be sized in accordance with Table 250.122, based on the rating of the overcurrent protective device for the circuit supplying the occupancy.

(3) Multiple Buildings or Structures Supplied by a Feeder(s) or Branch Circuit(s). The metal water piping system(s) installed in or attached to a building or structure shall be bonded to the building or structure disconnecting means enclosure where located at the building or structure, to the equipment grounding conductor run with the supply conductors, or to the one or more grounding electrodes used. The bonding jumper(s) shall be sized in accordance with 250.66, based on the size of the feeder or branch circuit conductors that supply the building. The bonding jumper shall not be required to be larger than the largest ungrounded feeder or branch circuit conductor supplying the building.

(B) Other Metal Piping. Where installed in or attached to a building or structure, a metal piping system(s), including gas piping, that is likely to become energized shall be bonded to the service equipment enclosure, the grounded conductor at the service, the grounding electrode conductor where of sufficient size, or the one or more grounding electrodes used. The bonding jumper(s) shall be sized in accordance with 250.122, using the rating of the circuit that is likely to energize the piping system(s). The equipment grounding conductor for the circuit that is likely to energize the piping shall be permitted to serve as the bonding means. The points of attachment of the bonding jumper(s) shall be accessible.

Exception: Flexible gas piping shall be bonded to the grounding electrode system at any accessible location at the point where the flexible piping receives its supply. The bonding conductor connection shall not terminate on the flexible gas piping. The minimum size bonding conductor shall be #6 AWG copper or as required by the manufacturer's installation instructions.

FPN: Bonding all piping and metal air ducts within the premises will provide additional safety.

(C) Structural Metal. Exposed structural metal that is interconnected to form a metal building frame and is not intentionally grounded and is likely to become energized shall be bonded to the service equipment enclosure, the grounded conductor at the service, the grounding electrode conductor where of sufficient size, or the one or more grounding electrodes used. The bonding jumper(s) shall be sized in accordance with Table 250.66 and installed in accordance with 250.64(A), (B), and (E). The points of attachment of the bonding jumper(s) shall be accessible.

(D) Separately Derived Systems. Metal water piping systems and structural metal that is interconnected to form a building frame shall be bonded to separately derived systems in accordance with (D)(1) through (D)(3).

(1) Metal Water Piping System(s). The grounded conductor of each separately derived system shall be bonded to the nearest available point of the metal water piping system(s) in the area served by each separately derived system. This connection shall be made at the same point on the separately derived system where the grounding electrode conductor is

connected. Each bonding jumper shall be sized in accordance with Table 250.66 based on the largest ungrounded conductor of the separately derived system.

Exception No. 1: A separate bonding jumper to the metal water piping system shall not be required where the metal water piping system is used as the grounding electrode for the separately derived system and the water piping system is in the area served.

Exception No. 2: A separate water piping bonding jumper shall not be required where the metal frame of a building or structure is used as the grounding electrode for a separately derived system and is bonded to the metal water piping in the area served by the separately derived system.

(2) Structural Metal. Where exposed structural metal that is interconnected to form the building frame exists in the area served by the separately derived system, it shall be bonded to the grounded conductor of each separately derived system. This connection shall be made at the same point on the separately derived system where the grounding electrode conductor is connected. Each bonding jumper shall be sized in accordance with Table 250.66 based on the largest ungrounded conductor of the separately derived system.

Exception No. 1: A separate bonding jumper to the building structural metal shall not be required where the metal frame of a building or structure is used as the grounding electrode for the separately derived system.

Exception No. 2: A separate bonding jumper to the building structural metal shall not be required where the water piping of a building or structure is used as the grounding electrode for a separately derived system and is bonded to the building structural metal in the area served by the separately derived system.

(3) Common Grounding Electrode Conductor. Where a common grounding electrode conductor is installed for multiple separately derived systems as permitted by 250.30(A)(4), and exposed structural metal that is interconnected to form the building frame or interior metal piping exists in the area served by the separately derived system, the metal piping and the structural metal member shall be bonded to the common grounding electrode conductor.

Exception: A separate bonding jumper from each derived system to metal water piping and to structural metal members shall not be required where the metal water piping and the structural metal members in the area served by the separately derived system are bonded to the common grounding electrode conductor.

(E) Water System Requirements. It is unlawful to connect to or use any water main or water pipe belonging to Seattle Public Utilities distribution and transmission systems for electrical grounding purposes.

- (1) Circuits exceeding 1 kV
- (2) On ungrounded systems, impedance grounded systems, or corner grounded delta systems unless listed specifically for use on these systems.
- (3) Where the rating of the SPD (surge arrester or TVSS) is less than the maximum continuous phase-to-ground power frequency voltage available at the point of application

FPN: For further information on SPDs (TVSSs), see NEMA LS 1-1992, Standard for Low Voltage Surge Suppression Devices. The selection of a properly rated SPD (TVSS) is based on criteria such as maximum continuous operating voltage, the magnitude and duration of overvoltages at the suppressor location as affected by phase-to-ground faults, system grounding techniques, and switching surges.

285.4 Number Required. Where used at a point on a circuit, the SPD (surge arrester or TVSS) shall be connected to each ungrounded conductor.

285.5 Listing. An SPD (surge arrester or TVSS) shall be a listed device.

285.6 Short-Circuit Current Rating. The SPD (surge arrester or TVSS) shall be marked with a short-circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating. This marking requirement shall not apply to receptacles.

II. Installation

285.11 Location. SPDs (surge arresters or TVSSs) shall be permitted to be located indoors or outdoors and shall be made inaccessible to unqualified persons, unless listed for installation in accessible locations.

285.12 Routing of Connections. The conductors used to connect the SPD (surge arrester or TVSS) to the line or bus and to ground shall not be any longer than necessary and shall avoid unnecessary bends.

III. Connecting SPDs.

285.21 Connection. Where an SPD (surge arrester or TVSS) device is installed, it shall comply with 285.23 through 285.28.

285.23 Type 1 SPDs (Surge Arresters). Type 1 SPDs shall be installed in accordance with 285.23(A) and (B).

(A) Installation. Type 1 SPDs (surge arresters) shall be installed as follows:

- (1) Type 1 SPDs (surge arresters) shall be permitted to be connected to the supply side of the service disconnect as permitted in 230.82(4) or

- (2) Type 1 SPDs (surge arresters) shall be permitted to be connected as specified in 285.24.

(B) At the Service. When installed at services, the grounding conductor of a Type 1 SPD shall be connected to one of the following:

- (1) Grounded service conductor
- (2) Grounding electrode conductor
- (3) Grounding electrode for the service
- (4) Equipment grounding terminal in the service equipment

285.24 Type 2 SPDs (TVSSs). Type 2 SPDs (TVSSs) shall be installed in accordance with 285.24(A) through (C).

(A) Service-Supplied Building or Structure. Type 2 SPDs (TVSSs) shall be connected anywhere on the load side of a service disconnect overcurrent device required in 230.91, unless installed in accordance with 230.82(8).

(B) Feeder-Supplied Building or Structure. Type 2 SPDs (TVSSs) shall be connected at the building or structure anywhere on the load side of the first overcurrent device at the building or structure.

(C) Separately Derived System. The SPD (TVSS) shall be connected on the load side of the first overcurrent device in a separately derived system.

285.25 Type 3 SPDs. Type 3 SPDs (TVSSs) shall be permitted to be installed anywhere on the load side of branch-circuit overcurrent protection up to the equipment served, provided the connection is a minimum 10 m (30 ft) of conductor distance from the service or separately derived system disconnect.

285.26 Conductor Size. Line and grounding conductors shall not be smaller than 14 AWG copper or 12 AWG aluminum.

285.27 Connection Between Conductors. An SPD (surge arrester or TVSS) shall be permitted to be connected between any two conductors — ungrounded conductor(s), grounded conductor, grounding conductor. The grounded conductor and the grounding conductor shall be interconnected only by the normal operation of the SPD (surge arrester or TVSS) during a surge.

285.28 Grounding Conductor Connections and Enclosures. Except as indicated in this article, SPD grounding connections shall be made as specified in Article 250, Part III. Grounding conductors installed in metal enclosures shall comply with 250.64(E).

Chapter 3 Wiring Methods and Materials

ARTICLE 300 Wiring Methods

I. General Requirements

300.1 Scope.

(A) **All Wiring Installations.** This article covers wiring methods for all wiring installations unless modified by other articles.

FPN: WAC 296-46B-010(13) & (14), Tables 010-1 & 010-2, WAC 296-49B-900(1); and WAC Tables 900-1 and 900-2, which address, among other things, requirements for wiring methods for designated building occupancies are by this reference made part of the 2008 Seattle Electrical Code.

(B) **Integral Parts of Equipment.** The provisions of this article are not intended to apply to the conductors that form an integral part of equipment, such as motors, controllers, motor control centers, or factory assembled control equipment or listed utilization equipment.

(C) **Metric Designators and Trade Sizes.** Metric designators and trade sizes for conduit, tubing, and associated fittings and accessories shall be as designated in Table 300.1(C).

Table 300.1(C) Metric Designators and Trade Sizes

Metric Designator	Trade Size
12	$\frac{3}{8}$
16	$\frac{1}{2}$
21	$\frac{3}{4}$
27	1
35	$1\frac{1}{4}$
41	$1\frac{1}{2}$
53	2
63	$2\frac{1}{2}$
78	3
91	$3\frac{1}{2}$
103	4
129	5
155	6

Note: The metric designators and trade sizes are for identification purposes only and are not actual dimensions.

300.2 Limitations.

(A) **Voltage.** Wiring methods specified in Chapter 3 shall be used for 600 volts, nominal, or less where not specifically limited in some section of Chapter 3. They shall be permitted for over 600 volts, nominal, where specifically permitted elsewhere in this Code.

(B) **Temperature.** Temperature limitation of conductors shall be in accordance with 310.10.

300.3 Conductors.

(A) **Single Conductors.** Single conductors specified in Table 310.13(A) shall only be installed where part of a recognized wiring method of Chapter 3.

Exception: Individual conductors shall be permitted where installed as separate overhead conductors in accordance with 225.6.

(B) **Conductors of the Same Circuit.** All conductors of the same circuit and, where used, the grounded conductor and all equipment grounding conductors and bonding conductors shall be contained within the same raceway, auxiliary gutter, cable tray, cablebus assembly, trench, cable, or cord, unless otherwise permitted in accordance with 300.3(B)(1) through (B)(4).

(1) **Paralleled Installations.** Conductors shall be permitted to be run in parallel in accordance with the provisions of 310.4. The requirement to run all circuit conductors within the same raceway, auxiliary gutter, cable tray, trench, cable, or cord shall apply separately to each portion of the paralleled installation, and the equipment grounding conductors shall comply with the provisions of 250.122. Parallel runs in cable tray shall comply with the provisions of 392.8(D).

Exception: Conductors installed in nonmetallic raceways run underground shall be permitted to be arranged as isolated phase installations. The raceways shall be installed in close proximity, and the conductors shall comply with the provisions of 300.20(B).

(2) **Grounding and Bonding Conductors.** Equipment grounding conductors shall be permitted to be installed outside a raceway or cable assembly where in accordance with the provisions of 250.130(C) for certain existing installations or in accordance with 250.134(B), Exception No. 2, for dc circuits. Equipment bonding conductors shall be permitted to be installed on the outside of raceways in accordance with 250.102(E).

(3) **Nonferrous Wiring Methods.** Conductors in wiring methods with a nonmetallic or other nonmagnetic sheath, where run in different raceways, auxiliary gutters, cable trays, trenches, cables, or cords, shall comply with the provisions of 300.20(B). Conductors in single-conductor Type MI cable with a nonmagnetic sheath shall comply with the provisions of 332.31. Conductors of single-conductor Type MC cable with a nonmagnetic sheath shall comply with the provisions of 330.31, 330.116, and 300.20(B).

(4) **Enclosures.** Where an auxiliary gutter runs between a column-width panelboard and a pull box, and the pull box includes neutral terminations, the neutral conductors of circuits supplied from the panelboard shall be permitted to originate in the pull box.

(C) Conductors of Different Systems.

(1) 600 Volts, Nominal, or Less. Conductors of ac and dc circuits, rated 600 volts, nominal, or less, shall be permitted to occupy the same equipment wiring enclosure, cable, or raceway. All conductors shall have an insulation rating equal to at least the maximum circuit voltage applied to any conductor within the enclosure, cable, or raceway.

Exception: For solar photovoltaic systems in accordance with 690.4(B).

FPN: See 725.136(A) for Class 2 and Class 3 circuit conductors.

(2) Over 600 Volts, Nominal. Conductors of circuits rated over 600 volts, nominal, shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts, nominal, or less unless otherwise permitted in (C)(2)(a) through (C)(2)(e).

(a) Secondary wiring to electric-discharge lamps of 1000 volts or less, if insulated for the secondary voltage involved, shall be permitted to occupy the same luminaire, sign, or outline lighting enclosure as the branch-circuit conductors.

(b) Primary leads of electric-discharge lamp ballasts insulated for the primary voltage of the ballast, where contained within the individual wiring enclosure, shall be permitted to occupy the same luminaire, sign, or outline lighting enclosure as the branch-circuit conductors.

(c) Excitation, control, relay, and ammeter conductors used in connection with any individual motor or starter shall be permitted to occupy the same enclosure as the motor-circuit conductors.

(d) In motors, switchgear and control assemblies, and similar equipment, conductors of different voltage ratings shall be permitted.

(e) In manholes, if the conductors of each system are permanently and effectively separated from the conductors of the other systems and securely fastened to racks, insulators, or other approved supports, conductors of different voltage ratings shall be permitted.

Conductors having nonshielded insulation and operating at different voltage levels shall not occupy the same enclosure, cable, or raceway.

300.4 Protection Against Physical Damage. Where subject to physical damage, conductors shall be protected.

(A) Cables and Raceways Through Wood Members.

(1) Bored Holes. In both exposed and concealed locations, where a cable- or raceway-type wiring method is installed through bored holes in joists, rafters, or wood members, holes shall be bored so that the edge of the hole is not less than 32 mm (1¼ in.) from the nearest edge of the wood member. Where this distance cannot be maintained, the cable or raceway shall be protected from penetration by screws or

nails by a steel plate(s) or bushing(s), at least 1.6 mm (1/16 in.) thick, and of appropriate length and width installed to cover the area of the wiring.

Exception No. 1: Steel plates shall not be required to protect rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, or electrical metallic tubing.

Exception No. 2: A listed and marked steel plate less than 1.6 mm (1/16 in.) thick that provides equal or better protection against nail or screw penetration shall be permitted.

FPN: WAC 296-46B-010(7) requires wiring and device boxes to have a minimum of 63 mm (2 ½ in.) clearance from the exterior surface of framing members; this WAC subsection is by this reference made part of the 2008 Seattle Electrical Code.

(2) Notches in Wood. Where there is no objection because of weakening the building structure, in both exposed and concealed locations, cables or raceways shall be permitted to be laid in notches in wood studs, joists, rafters, or other wood members where the cable or raceway at those points is protected against nails or screws by a steel plate at least 1.6 mm (1/16 in.) thick, and of appropriate length and width, installed to cover the area of the wiring. The steel plate shall be installed before the building finish is applied.

Exception No. 1: Steel plates shall not be required to protect rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, or electrical metallic tubing.

Exception No. 2: A listed and marked steel plate less than 1.6 mm (1/16 in.) thick that provides equal or better protection against nail or screw penetration shall be permitted.

(B) Nonmetallic Cables and Electrical Nonmetallic Tubing Through Metal Framing Members.**(1) Nonmetallic Cable.**

(a) In both exposed and concealed locations where nonmetallic cables, operating at less than 120 volts nominal, pass through either factory- or field-punched, cut, or drilled slots or holes in metal members, the cable shall be protected by listed bushings or listed grommets covering all metal edges that are securely fastened in the opening prior to installation of the cable.

(b) Where nonmetallic-sheathed cables operate at 120 volts nominal or greater pass through either factory- or field-punched, cut, or drilled slots or holes in metal members, listed two-piece interlocking bushings or grommets shall be installed prior to passing the cable through such openings.

(2) Nonmetallic-Sheathed Cable and Electrical Nonmetallic Tubing. Where nails or screws are likely to penetrate nonmetallic-sheathed cable or electrical nonmetallic tubing, a steel sleeve, steel plate, or steel clip not less than 1.6 mm (1/16 in.) in thickness shall be used to protect the cable or tubing.

Exception: A listed and marked steel plate less than 1.6 mm ($1/16$ in.) thick that provides equal or better protection against nail or screw penetration shall be permitted.

(C) Cables Through Spaces Behind Panels Designed to Allow Access. Cables or raceway-type wiring methods, installed behind panels designed to allow access, shall be supported according to their applicable articles.

(D) Cables and Raceways Parallel to Framing Members and Furring Strips. In both exposed and concealed locations, where a cable- or raceway-type wiring method is installed parallel to framing members, such as joists, rafters, or studs, or is installed parallel to furring strips, the cable or raceway shall be installed and supported so that the nearest outside surface of the cable or raceway is not less than 32 mm ($1\frac{1}{4}$ in.) from the nearest edge of the framing member or furring strips where nails or screws are likely to penetrate. Where this distance cannot be maintained, the cable or raceway shall be protected from penetration by nails or screws by a steel plate, sleeve, or equivalent at least 1.6 mm ($1/16$ in.) thick.

Exception No. 1: Steel plates, sleeves, or the equivalent shall not be required to protect rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, or electrical metallic tubing.

Exception No. 2: For concealed work in finished buildings, or finished panels for prefabricated buildings where such supporting is impracticable, it shall be permissible to fish the cables between access points.

Exception No. 3: A listed and marked steel plate less than 1.6 mm ($1/16$ in.) thick that provides equal or better protection against nail or screw penetration shall be permitted.

(E) Cables and Raceways Installed Under Roof Decking. A cable- or raceway-type wiring method, installed in exposed or concealed locations under metal-corrugated sheet roof decking, shall be installed and supported so the nearest outside surface of the cable or raceway is not less than 38 mm ($1\frac{1}{2}$ in.) from the nearest surface of the roof decking.

FPN: Roof decking material is often repaired or replaced after the initial raceway or cabling and roofing installation and may be penetrated by the screws or other mechanical devices designed to provide “hold down” strength of the waterproof membrane or roof insulating material.

Exception: Rigid metal conduit and intermediate metal conduit shall not be required to comply with 300.4(E).

(F) Cables and Raceways Installed in Shallow Grooves. Cable- or raceway- type wiring methods installed in a groove, to be covered by wallboard, siding, paneling, carpeting, or similar finish, shall be protected by 1.6 mm ($1/16$ in.) thick steel plate, sleeve, or equivalent or by not less than 32 mm ($1\frac{1}{4}$ in.) free space for the full length of the groove in which the cable or raceway is installed.

Exception No. 1: Steel plates, sleeves, or the equivalent shall not be required to protect rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, or electrical metallic tubing.

Exception No. 2: A listed and marked steel plate less than 1.6 mm ($1/16$ in.) thick that provides equal or better protection against nail or screw penetration shall be permitted.

(G) Insulated Fittings. Where raceways contain 4 AWG or larger insulated circuit conductors and these conductors enter a cabinet, box, enclosure, or raceway, the conductors shall be protected by a substantial fitting providing a smoothly rounded insulating surface, unless the conductors are separated from the fitting or raceway by substantial insulating material that is securely fastened in place.

Exception: Where threaded hubs or bosses that are an integral part of a cabinet, box, enclosure, or raceway provide a smoothly rounded or flared entry for conductors.

Conduit bushings constructed wholly of insulating material shall not be used to secure a fitting or raceway. The insulating fitting or insulating material shall have a temperature rating not less than the insulation temperature rating of the installed conductors.

300.5 Underground Installations.

(A) Minimum Cover Requirements. Direct-buried cable or conduit or other raceways shall be installed to meet the minimum cover requirements of Table 300.5.

(B) Wet Locations. The interior of enclosures or raceways installed underground shall be considered to be a wet location. Insulated conductors and cables installed in these enclosures or raceways in underground installations shall be listed for use in wet locations and shall comply with 310.8(C). Any connections or splices in an underground installation shall be approved for wet locations.

(C) Underground Cables Under Buildings. Underground cable installed under a building shall be in a raceway.

(D) Protection from Damage. Direct-buried conductors and cables shall be protected from damage in accordance with 300.5(D)(1) through (D)(4).

(1) Emerging from Grade. Direct-buried conductors and cables emerging from grade and specified in columns 1 and 4 of Table 300.5 shall be protected by enclosures or raceways extending from the minimum cover distance below grade required by 300.5(A) to a point at least 2.5 m (8 ft) above finished grade. In no case shall the protection be required to exceed 450 mm (18 in.) below finished grade.

(2) Conductors Entering Buildings. Conductors entering a building shall be protected to the point of entrance.

(3) Service Conductors. Underground service conductors that are not encased in concrete and that are buried 450 mm (18 in.) or more below grade shall have their location

(B) Aluminum Metal Equipment. Aluminum raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, nipples, fittings, supports, and support hardware embedded or encased in concrete or in direct contact with the earth shall be provided with supplementary corrosion protection.

(C) Nonmetallic Equipment. Nonmetallic raceways, cable trays, cablebus, auxiliary gutters, boxes, cables with a nonmetallic outer jacket and internal metal armor or jacket, cable sheathing, cabinets, elbows, couplings, nipples, fittings, supports, and support hardware shall be made of material approved for the condition and shall comply with (C)(1) and (C)(2) as applicable to the specific installation.

(1) Exposed to Sunlight. Where exposed to sunlight, the materials shall be listed as sunlight resistant or shall be identified as sunlight resistant.

(2) Chemical Exposure. Where subject to exposure to chemical solvents, vapors, splashing, or immersion, materials or coatings shall either be inherently resistant to chemicals based on their listing or be identified for the specific chemical reagent.

(D) Indoor Wet Locations. In portions of dairy processing facilities, 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, where installed exposed, including all boxes, fittings, raceways, and cable used therewith, shall be mounted so that there is at least a 6-mm (¼-in.) airspace between it and the wall or supporting surface.

Exception: Nonmetallic raceways, boxes, and fittings shall be permitted to be installed without the airspace on a concrete, masonry, tile, or similar surface.

FPN: In general, areas where acids and alkali chemicals are handled and stored may present such corrosive conditions, particularly when wet or damp. Severe corrosive conditions may also be present in portions of meatpacking plants, tanneries, glue houses, and some stables; in installations immediately adjacent to a seashore and swimming pool areas; in areas where chemical deicers are used; and in storage cellars or rooms for hides, casings, fertilizer, salt, and bulk chemicals.

300.7 Raceways Exposed to Different Temperatures.

(A) Sealing. Where portions of a cable raceway or sleeve are known to be subjected to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway or sleeve shall be filled with an approved material to prevent the circulation of warm air to a colder section of the raceway or sleeve. An explosion-proof seal shall not be required for this purpose.

(B) Expansion Fittings. Raceways shall be provided with expansion fittings where necessary to compensate for thermal expansion and contraction.

FPN: Table 352.44 and Table 355.44 provide the expansion information for polyvinyl chloride (PVC) and for reinforced thermosetting resin conduit (RTRC), respectively. A nominal number for steel conduit can be determined by multiplying the expansion length in Table 352.44 by 0.20. The coefficient of expansion for steel electrical metallic tubing, intermediate metal conduit, and rigid conduit is 1.170×10^{-5} (0.0000117 mm per mm of conduit for each °C in temperature change) [0.650×10^{-3}] (0.0000065 in. per inch of conduit for each °F in temperature change)].

A nominal number for aluminum conduit and aluminum electrical metallic tubing can be determined by multiplying the expansion length in Table 352.44 by 0.40. The coefficient of expansion for aluminum electrical metallic tubing and aluminum rigid metal conduit is 2.34×10^{-5} (0.0000234 mm per mm of conduit for each °C in temperature change) [1.30×10^{-5}] (0.000013 in. per inch of conduit for each °F in temperature change)].

300.8 Installation of Conductors with Other Systems.

Raceways or cable trays containing electrical conductors shall not contain any pipe, tube, or equal for steam, water, air, gas, drainage, or any service other than electrical.

300.9 Raceways in Wet Locations Above Grade. Where raceways are installed in wet locations abovegrade, the interior of these raceways shall be considered to be a wet location. Insulated conductors and cables installed in raceways in wet locations abovegrade shall comply with 310.8(C).

300.10 Electrical Continuity of Metal Raceways and Enclosures.

Metal raceways, cable armor, and other metal enclosures for conductors shall be metallicity joined together into a continuous electrical conductor and shall be connected to all boxes, fittings, and cabinets so as to provide effective electrical continuity. Unless specifically permitted elsewhere in this Code, raceways and cable assemblies shall be mechanically secured to boxes, fittings, cabinets, and other enclosures.

Exception No. 1: Short sections of raceways used to provide support or protection of cable assemblies from physical damage shall not be required to be made electrically continuous.

Exception No. 2: Equipment enclosures to be isolated, as permitted by 250.96(B), shall not be required to be metallicity joined to the metal raceway.

300.11 Securing and Supporting.

(A) Secured in Place. Raceways, cable assemblies, boxes, cabinets, and fittings shall be securely fastened in place. Support wires that do not provide secure support shall not be permitted as the sole support. Support wires and associated fittings that provide secure support and that are installed in addition to the ceiling grid support wires shall be permitted as the sole support. Where independent support wires are used, they shall be secured at both ends. Cables and raceways shall not be supported by ceiling grids.

FPN: WAC 296-46B-300.011 contains additional requirements for support of raceways, cables, or boxes in suspended ceilings; this WAC requirement is by this reference made part of the 2008 Seattle Electrical Code.

(1) Fire-Rated Assemblies. Wiring located within the cavity of a fire-rated floor–ceiling or roof–ceiling assembly shall not be secured to, or supported by, the ceiling assembly, including the ceiling support wires. An independent means of secure support shall be provided and shall be permitted to be attached to the assembly. Where independent support wires are used, they shall be distinguishable by color, tagging, or other effective means from those that are part of the fire-rated design.

Exception: The ceiling support system shall be permitted to support wiring and equipment that have been tested as part of the fire-rated assembly.

FPN: One method of determining fire rating is testing in accordance with NFPA 251-2006, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*.

(2) Non-Fire-Rated Assemblies. Wiring located within the cavity of a non-fire-rated floor–ceiling or roof–ceiling assembly shall not be secured to, or supported by, the ceiling assembly, including the ceiling support wires. An independent means of secure support shall be provided and shall be permitted to be attached to the assembly.

Exception: The ceiling support system shall be permitted to support branch-circuit wiring and associated equipment where installed in accordance with the ceiling system manufacturer's instructions.

(B) Raceways Used as Means of Support. Raceways shall be used only as a means of support for other raceways, cables, or nonelectrical equipment under any of the following conditions:

- (1) Where the raceway or means of support is identified for the purpose
- (2) Where the raceway contains power supply conductors for electrically controlled equipment and is used to support Class 2 circuit conductors or cables that are solely for the purpose of connection to the equipment control circuits
- (3) Where the raceway is used to support boxes or conduit bodies in accordance with 314.23 or to support luminaires in accordance with 410.36(E)

(C) Cables Not Used as Means of Support. Cable wiring methods shall not be used as a means of support for other cables, raceways, or nonelectrical equipment.

300.12 Mechanical Continuity — Raceways and Cables. Metal or nonmetallic raceways, cable armors, and cable sheaths shall be continuous between cabinets, boxes, fittings, or other enclosures or outlets.

Exception No. 1: Short sections of raceways used to provide support or protection of cable assemblies from physical damage shall not be required to be mechanically continuous.

Exception No. 2: Raceways and cables installed into the bottom of open bottom equipment, such as switchboards, motor control centers, and floor or pad-mounted transformers, shall not be required to be mechanically secured to the equipment.

300.13 Mechanical and Electrical Continuity — Conductors.

(A) General. Conductors in raceways shall be continuous between outlets, boxes, devices, and so forth. There shall be no splice or tap within a raceway unless permitted by 300.15; 368.56(A); 376.56; 378.56; 384.56; 386.56; 388.56; or 390.6.

(B) Device Removal. In multiwire branch circuits, the continuity of a grounded conductor shall not depend on device connections such as lampholders, receptacles, and so forth, where the removal of such devices would interrupt the continuity.

300.14 Length of Free Conductors at Outlets, Junctions, and Switch Points. At least 150 mm (6 in.) of free conductor, measured from the point in the box where it emerges from its raceway or cable sheath, shall be left at each outlet, junction, and switch point for splices or the connection of luminaires or devices. Where the opening to an outlet, junction, or switch point is less than 200 mm (8 in.) in any dimension, each conductor shall be long enough to extend at least 75 mm (3 in.) outside the opening.

Exception: Conductors that are not spliced or terminated at the outlet, junction, or switch point shall not be required to comply with 300.14.

300.15 Boxes, Conduit Bodies, or Fittings — Where Required. A box shall be installed at each outlet and switch point for concealed knob-and-tube wiring.

Fittings and connectors shall be used only with the specific wiring methods for which they are designed and listed.

Where the wiring method is conduit, tubing, Type AC cable, Type MC cable, Type MI cable, nonmetallic-sheathed cable, or other cables, a box or conduit body shall be installed at each conductor splice point, outlet point, switch point, junction point, termination point, or pull point, unless otherwise permitted in 300.15(A) through (M).

(A) Wiring Methods with Interior Access. A box or conduit body shall not be required for each splice, junction, switch, pull, termination, or outlet points in wiring methods with removable covers, such as wireways, multioutlet assemblies, auxiliary gutters, and surface raceways. The covers shall be accessible after installation.

(B) Equipment. An integral junction box or wiring compartment as part of approved equipment shall be permitted in lieu of a box.

(C) Protection. A box or conduit body shall not be required where cables enter or exit from conduit or tubing that is used to provide cable support or protection against physical damage. A fitting shall be provided on the end(s) of the conduit or tubing to protect the cable from abrasion.

(D) Type MI Cable. A box or conduit body shall not be required where accessible fittings are used for straight-through splices in mineral-insulated metal-sheathed cable.

(E) Integral Enclosure. A wiring device with integral enclosure identified for the use, having brackets that securely fasten the device to walls or ceilings of conventional on-site frame construction, for use with nonmetallic-sheathed cable, shall be permitted in lieu of a box or conduit body.

FPN: See 334.30(C); 545.10; 550.15(I); 551.47(E), Exception No. 1; and 552.48(E), Exception No. 1.

(F) Fitting. A fitting identified for the use shall be permitted in lieu of a box or conduit body where conductors are not spliced or terminated within the fitting. The fitting shall be accessible after installation.

(G) Direct-Buried Conductors. As permitted in 300.5(E), a box or conduit body shall not be required for splices and taps in direct-buried conductors and cables.

(H) Insulated Devices. As permitted in 334.40(B), a box or conduit body shall not be required for insulated devices supplied by nonmetallic-sheathed cable.

(I) Enclosures. A box or conduit body shall not be required where a splice, switch, terminal, or pull point is in a cabinet or cutout box, in an enclosure for a switch or overcurrent device as permitted in 312.8, in a motor controller as permitted in 430.10(A), or in a motor control center.

(J) Luminaires. A box or conduit body shall not be required where a luminaire is used as a raceway as permitted in 410.64 and 410.65.

(K) Embedded. A box or conduit body shall not be required for splices where conductors are embedded as permitted in 424.40, 424.41(D), 426.22(B), 426.24(A), and 427.19(A).

(L) Manholes and Handhole Enclosures. A box or conduit body shall not be required for conductors in manholes or handhole enclosures, except where connecting to electrical equipment. The installation shall comply with the provisions of Part V of Article 110 for manholes, and 314.30 for handhole enclosures.

(M) Closed Loop. A box shall not be required with a closed-loop power distribution system where a device identified and listed as suitable for installation without a box is used.

300.16 Raceway or Cable to Open or Concealed Wiring.

(A) Box, Conduit Body, or Fitting. A box, conduit body, or terminal fitting having a separately bushed hole for each conductor shall be used wherever a change is made from conduit, electrical metallic tubing, electrical nonmetallic tubing, nonmetallic-sheathed cable, Type AC cable, Type MC cable, or mineral-insulated, metal-sheathed cable and surface raceway wiring to open wiring or to concealed knob-and-tube wiring. A fitting used for this purpose shall contain no taps or splices and shall not be used at luminaire outlets. A conduit body used for this purpose shall contain no taps or splices, unless it complies with 314.16(C)(2).

(B) Bushing. A bushing shall be permitted in lieu of a box or terminal where the conductors emerge from a raceway and enter or terminate at equipment, such as open switchboards, unenclosed control equipment, or similar equipment. The bushing shall be of the insulating type for other than lead-sheathed conductors.

300.17 Number and Size of Conductors in Raceway. The number and size of conductors in any raceway shall not be more than will permit dissipation of the heat and ready installation or withdrawal of the conductors without damage to the conductors or to their insulation.

FPN: See the following sections of this *Code*: intermediate metal conduit, 342.22; rigid metal conduit, 344.22; flexible metal conduit, 348.22; liquidtight flexible metal conduit, 350.22; PVC conduit, 352.22; HDPE conduit, 353.22; RTRC, 355.22; liquidtight nonmetallic flexible conduit, 356.22; electrical metallic tubing, 358.22; flexible metallic tubing, 360.22; electrical nonmetallic tubing, 362.22; cellular concrete floor raceways, 372.11; cellular metal floor raceways, 374.5; metal wireways, 376.22; nonmetallic wireways, 378.22; surface metal raceways, 386.22; surface nonmetallic raceways, 388.22; underfloor raceways, 390.5; fixture wire, 402.7; theaters, 520.6; signs, 600.31(C); elevators, 620.33; audio signal processing, amplification, and reproduction equipment, 640.23(A) and 640.24; Class 1, Class 2, and Class 3 circuits, Article 725; fire alarm circuits, Article 760; and optical fiber cables and raceways, Article 770.

300.18 Raceway Installations.

(A) Complete Runs. Raceways, other than busways or exposed raceways having hinged or removable covers, shall be installed complete between outlet, junction, or splicing points prior to the installation of conductors. Where required to facilitate the installation of utilization equipment, the raceway shall be permitted to be initially installed without a terminating connection at the equipment. Prewired raceway assemblies shall be permitted only where specifically permitted in this *Code* for the applicable wiring method.

Exception: Short sections of raceways used to contain conductors or cable assemblies for protection from physical damage shall not be required to be installed complete between outlet, junction, or splicing points.

(B) Welding. Metal raceways shall not be supported, terminated, or connected by welding to the raceway unless specifically designed to be or otherwise specifically permitted to be in this *Code*.

300.19 Supporting Conductors and Cable Assemblies in Vertical Raceways.

(A) Spacing Intervals — Maximum. Conductors and cables in vertical raceways shall be supported if the vertical rise exceeds the values in Table 300.19(A). One ~~((cable))~~ support shall be provided at the top of the vertical ~~((raceway))~~ installation or as close to the top as practical. Intermediate supports shall be provided as necessary to limit supported ~~((conductor))~~ lengths to not greater than those values specified in Table 300.19(A).

Exception: Steel wire armor cable shall be supported at the top of the riser with a cable support that clamps the steel wire armor. A safety device shall be permitted at the lower end of the riser to hold the cable in the event there is slippage of the cable in the wire-armored cable support. Additional wedge-type supports shall be permitted to relieve the strain on the equipment terminals caused by expansion of the cable under load.

(B) Fire-Rated Cables and Conductors. Support methods and spacing intervals for fire-rated cables and conductors shall comply with any restrictions provided in the listing of the electrical circuit protective system used and in no case shall exceed the values in Table 300.19(A).

(C) Support Methods. One of the following methods of support shall be used:

- (1) By clamping devices constructed of or employing insulating wedges inserted in the ends of the raceways. Where clamping of insulation does not adequately support the cable, the conductor also shall be clamped.
- (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. Where this method is used, cables shall be supported at intervals not greater than 20 percent of those mentioned in the preceding tabulation.
- (4) By a method of equal effectiveness.

300.20 Induced Currents in **Ferrous** Metal Enclosures or **Ferrous** Metal Raceways.

(A) Conductors Grouped Together. Where conductors carrying alternating current are installed in **ferrous** metal enclosures or **ferrous** metal raceways, they shall be arranged so as to avoid heating the surrounding **ferrous** metal by induction. To accomplish this, all phase conductors and, where used, the grounded conductor and all equipment grounding conductors shall be grouped together.

Exception No. 1: Equipment grounding conductors for certain existing installations shall be permitted to be installed separate from their associated circuit conductors where run in accordance with the provisions of 250.130(C).

Table 300.19(A) Spacings for Conductor Supports

Size of Wire	Support of Conductors in Vertical Raceways	Conductors			
		Aluminum or Copper-Clad Aluminum		Copper	
		m	ft	m	ft
18 AWG through 8 AWG	Not greater than	30	100	30	100
6 AWG through 1/0 AWG	Not greater than	60	200	30	100
2/0 AWG through 4/0 350 kcmil	Not greater than	55	180	25	80
Over 4/0 AGW through 350 kcmil	Not greater than	41	135	18	60
Over 350 kcmil through 500 kcmil	Not greater than	36	120	15	50
Over 500 kcmil through 750 kcmil	Not greater than	28	95	12	40
Over 750 kcmil	Not greater than	26	85	11	35

Exception No. 2: A single conductor shall be permitted to be installed in a ferromagnetic enclosure and used for skin-effect heating in accordance with the provisions of 426.42 and 427.47.

(B) Individual Conductors. Where a single conductor carrying alternating current 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 can be ignored where these conductors are placed in metal enclosures or pass through metal.

FPN: Because aluminum is not a magnetic metal, there will be no heating due to hysteresis; however, induced currents will be present. They will not be of sufficient magnitude to require grouping of conductors or special treatment in passing conductors through aluminum wall sections.

300.21 Spread of Fire or Products of Combustion.

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. Openings around electrical penetrations through fire-resistant-rated walls, partitions, floors, or ceilings shall be firestopped using approved methods to maintain the fire resistance rating. All out-of-service cable shall be removed from accessible ceiling spaces.

FPN: Directories of electrical construction materials published by qualified testing laboratories contain many listing installation restrictions necessary to maintain the fire-resistive rating of assemblies where penetrations or openings are made. Building codes also contain restrictions on membrane penetrations on opposite sides of a fire-resistance-rated wall assembly. An example is the 600-mm (24-in.) minimum horizontal separation that usually applies between boxes installed on opposite sides of the wall. Assistance in complying with 300.21 can be found in building codes, fire resistance directories, and product listings.

300.22 Wiring in Ducts, Plenums, and Other Air-Handling Spaces. The provisions of this section apply to the installation and uses of electrical wiring and equipment in ducts, plenums, and other air-handling spaces.

FPN: See Article 424, Part VI, for duct heaters.

(A) Ducts for Dust, Loose Stock, or Vapor Removal. No wiring systems of any type shall be installed in ducts used to transport dust, loose stock, or flammable vapors. No wiring system of any type shall be installed in any duct, or shaft containing only such ducts, used for vapor removal or for ventilation of commercial-type cooking equipment.

(B) Ducts or Plenums Used for Environmental Air. Only wiring methods consisting of Type MI cable, Type MC cable employing a smooth or corrugated impervious metal sheath without an overall nonmetallic covering, electrical metallic tubing, flexible metallic tubing, intermediate metal conduit, or rigid metal conduit without an overall nonmetallic covering shall be installed in ducts or plenums specifically fabricated to transport environmental air. Flexible metal conduit shall be permitted, in lengths not to exceed 1.2 m (4 ft), 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 shall be permitted within such ducts or plenum chambers only 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 luminaires shall be permitted.

(C) Other Space Used for Environmental Air. This section applies to space used for environmental air-handling purposes other than ducts and plenums as specified in 300.22(A) and (B). It does not include habitable rooms or areas of buildings, the prime purpose of which is not air handling.

FPN: The space over a hung ceiling used for environmental air-handling purposes is an example of the type of other space to which this section applies.

Exception: This section shall not apply to the joist or stud spaces of dwelling units where the wiring passes through such spaces perpendicular to the long dimension of such spaces.

(1) Wiring Methods. The wiring methods for such other space shall be limited to totally enclosed, nonventilated, insulated busway having no provisions for plug-in connections, Type MI cable, Type MC cable without an overall nonmetallic covering, Type AC cable, or other factory-assembled multiconductor control or power cable that is specifically listed for the use, or listed prefabricated cable assemblies of metallic manufactured wiring systems without nonmetallic sheath. Other types of cables, conductors, and raceways shall be permitted to be installed in electrical metallic tubing, flexible metallic tubing, intermediate metal conduit, rigid metal conduit without an overall nonmetallic covering, flexible metal conduit, or, where accessible, surface metal raceway or metal wireway with metal covers or solid bottom metal cable tray with solid metal covers.

(2) Equipment. Electrical equipment with a metal enclosure, or with a nonmetallic enclosure listed for the use and having adequate fire-resistant and low-smoke-producing characteristics, and associated wiring material suitable for the

ambient temperature shall be permitted to be installed in such other space unless prohibited elsewhere in this Code.

Exception: Integral fan systems shall be permitted where specifically identified for such use.

(D) Information Technology Equipment. Electrical wiring in air-handling areas beneath raised floors for information technology equipment shall be permitted in accordance with Article 645.

300.23 Panels Designed to Allow Access. Cables, raceways, and equipment installed behind panels designed to allow access, including suspended ceiling panels, shall be arranged and secured so as to allow the removal of panels and access to the equipment.

II. Requirements for over 600 Volts, Nominal

300.31 Covers Required. Suitable covers shall be installed on all boxes, fittings, and similar enclosures to prevent accidental contact with energized parts or physical damage to parts or insulation.

300.32 Conductors of Different Systems. See 300.3(C)(2).

300.34 Conductor Bending Radius. The conductor shall not be bent to a radius less than 8 times the overall diameter for nonshielded conductors or 12 times the overall diameter for shielded or lead-covered conductors during or after installation. For multiconductor or multiplexed single-conductor cables having individually shielded conductors, the minimum bending radius is 12 times the diameter of the individually shielded conductors or 7 times the overall diameter, whichever is greater.

300.35 Protection Against Induction Heating. Metallic raceways and associated conductors shall be arranged so as to avoid heating of the raceway in accordance with the applicable provisions of 300.20.

300.37 Aboveground Wiring Methods. Aboveground conductors shall be installed in rigid metal conduit, in intermediate metal conduit, in electrical metallic tubing, in rigid nonmetallic conduit, in cable trays, as busways, as cablebus, in other identified raceways, or as exposed runs of metal-clad cable suitable for the use and purpose. In locations accessible to qualified persons only, exposed runs of Type MV cables, bare conductors, and bare busbars shall also be permitted. Busbars shall be permitted to be either copper or aluminum.

300.39 Braid-Covered Insulated Conductors — Exposed Installation. Exposed runs of braid-covered insulated conductors shall have a flame-retardant braid. If the conductors used do not have this protection, a flame-retardant saturant shall be applied to the braid covering after installation. This treated braid covering shall be stripped back a safe distance at conductor terminals, according to the

operating voltage. Where practicable, this distance shall not be less than 25 mm (1 in.) for each kilovolt of the conductor-to-ground voltage of the circuit.

300.40 Insulation Shielding. Metallic and semiconducting insulation shielding components of shielded cables shall be removed for a distance dependent on the circuit voltage and insulation. Stress reduction means shall be provided at all terminations of factory-applied shielding.

Metallic shielding components such as tapes, wires, or braids, or combinations thereof, shall be connected to a grounding conductor, grounding busbar, or a grounding electrode.

300.42 Moisture or Mechanical Protection for Metal-Sheathed Cables. Where cable conductors emerge from a metal sheath and where protection against moisture or physical damage is necessary, the insulation of the conductors shall be protected by a cable sheath terminating device.

300.50 Underground Installations.

(A) General. Underground conductors shall be identified for the voltage and conditions under which they are installed. Direct burial cables shall comply with the provisions of 310.7. Underground cables shall be installed in accordance with 300.50(A)(1) or (A)(2), and the installation shall meet the depth requirements of Table 300.50.

(1) Shielded Cables and Nonshielded Cables in Metal-Sheathed Cable Assemblies. Underground cables, including nonshielded, Type MC and moisture-impervious metal sheath cables, shall have those sheaths grounded through an effective grounding path meeting the requirements of 250.4(A)(5) or (B)(4). They shall be direct buried or installed in raceways identified for the use.

(2) Other Nonshielded Cables. Other nonshielded cables not covered in 300.50(A)(1) shall be installed in rigid metal conduit, intermediate metal conduit, or rigid nonmetallic conduit encased in not less than 75 mm (3 in.) of concrete.

(B) Protection from Damage. Conductors emerging from the ground shall be enclosed in listed raceways. Raceways installed on poles shall be of rigid metal conduit, intermediate metal conduit, Schedule 80 PVC conduit, or equivalent, extending from the minimum cover depth specified in Table 300.50 to a point 2.5 m (8 ft) above finished grade. Conductors entering a building shall be protected by an

ample strength and rigidity. If constructed of sheet steel, the metal thickness shall not be less than 1.35 mm (0.053 in.) uncoated.

(C) Nonmetallic Cabinets. Nonmetallic cabinets shall be listed, or they shall be submitted for approval prior to installation.

312.11 Spacing. The spacing within cabinets and cutout boxes shall comply with 312.11(A) through (D).

(A) General. Spacing within cabinets and cutout boxes shall be sufficient to provide ample room for the distribution of wires and cables placed in them and for a separation between metal parts of devices and apparatus mounted within them in accordance with (A)(1), (A)(2), and (A)(3).

(1) Base. Other than at points of support, there shall be an airspace of at least 1.59 mm (0.0625 in.) between the base of the device and the wall of any metal cabinet or cutout box in which the device is mounted.

(2) Doors. There shall be an airspace of at least 25.4 mm (1.00 in.) between any live metal part, including live metal parts of enclosed fuses, and the door.

Exception: Where the door is lined with an approved insulating material or is of a thickness of metal not less than 2.36 mm (0.093 in.) uncoated, the airspace shall not be less than 12.7 mm (0.500 in.).

(3) Live Parts. There shall be an airspace of at least 12.7 mm (0.500 in.) between the walls, back, gutter partition, if of metal, or door of any cabinet or cutout box and the nearest exposed current-carrying part of devices mounted within the cabinet where the voltage does not exceed 250. This spacing shall be increased to at least 25.4 mm (1.00 in.) for voltages of 251 to 600, nominal.

Exception: Where the conditions in 312.11(A)(2), Exception, are met, the airspace for nominal voltages from 251 to 600 shall be permitted to be not less than 12.7 mm (0.500 in.).

(B) Switch Clearance. Cabinets and cutout boxes shall be deep enough to allow the closing of the doors when 30-ampere branch-circuit panelboard switches are in any position, when combination cutout switches are in any position, or when other single-throw switches are opened as far as their construction permits.

(C) Wiring Space. Cabinets and cutout boxes that contain devices or apparatus connected within the cabinet or box to more than eight conductors, including those of branch circuits, meter loops, feeder circuits, power circuits, and similar circuits, but not including the supply circuit or a continuation thereof, shall have back-wiring spaces or one or more side-wiring spaces, side gutters, or wiring compartments.

(D) Wiring Space — Enclosure. Side-wiring spaces, side gutters, or side-wiring compartments of cabinets and cutout boxes shall be made tight enclosures by means of covers, barriers, or partitions extending from the bases of the devices contained in the cabinet, to the door, frame, or sides of the cabinet.

Exception: Side-wiring spaces, side gutters, and side-wiring compartments of cabinets shall not be required to be made tight enclosures where those side spaces contain only conductors that enter the cabinet directly opposite to the devices where they terminate.

Partially enclosed back-wiring spaces shall be provided with covers to complete the enclosure. Wiring spaces that are required by 312.11(C) and are exposed when doors are open shall be provided with covers to complete the enclosure. Where adequate space is provided for feed-through conductors and for splices as required in 312.8, additional barriers shall not be required.

ARTICLE 314

Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures

I. Scope and General

314.1 Scope. This article covers the installation and use of all boxes and conduit bodies used as outlet, device, junction, or pull boxes, depending on their use, and handhole enclosures. Cast, sheet metal, nonmetallic, and other boxes such as FS, FD, and larger boxes are not classified as conduit bodies. This article also includes installation requirements for fittings used to join raceways and to connect raceways and cables to boxes and conduit bodies.

FPN: See Chapter 12 of the *Seattle Building Code* and Chapter 3 of the *Seattle Residential Code* for location of outlet boxes in sound transmission control assemblies.

314.2 Round Boxes. Round boxes shall not be used where conduits or connectors requiring the use of locknuts or bushings are to be connected to the side of the box.

314.3 Nonmetallic Boxes. Nonmetallic boxes shall be permitted only with open wiring on insulators, concealed knob-and-tube wiring, cabled wiring methods with entirely nonmetallic sheaths, flexible cords, and nonmetallic raceways.

Exception No. 1: Where internal bonding means are provided between all entries, nonmetallic boxes shall be permitted to be used with metal raceways or metal-armored cables.

Exception No. 2: Where integral bonding means with a provision for attaching an equipment bonding jumper inside the box are provided between all threaded entries in

nonmetallic boxes listed for the purpose, nonmetallic boxes shall be permitted to be used with metal raceways or metal-armored cables.

314.4 Metal Boxes. Metal boxes shall be grounded and bonded in accordance with Parts I, IV, V, VI, VII, and X of Article 250 as applicable, except as permitted in 250.112(I).

314.5 Short-Radius Conduit Bodies. Conduit bodies such as capped elbows and service-entrance elbows that enclose conductors 6 AWG or smaller, and are only intended to enable the installation of the raceway and the contained conductors, shall not contain splices, taps, or devices and shall be of sufficient size to provide free space for all conductors enclosed in the conduit body.

II. Installation

314.15 Damp or Wet Locations. In damp or wet locations, boxes, conduit bodies, and fittings shall be placed or equipped so as to prevent moisture from entering or accumulating within the box, conduit body, or fitting. Boxes, conduit bodies, and fittings installed in wet locations shall be listed for use in wet locations.

FPN No. 1: For boxes in floors, see 314.27(C).

FPN No. 2: For protection against corrosion, see 300.6.

314.16 Number of Conductors in Outlet, Device, and Junction Boxes, and Conduit Bodies. Boxes and conduit bodies shall be of sufficient size to provide free space for all enclosed conductors. In no case shall the volume of the box, as calculated in 314.16(A), be less than the fill calculation as calculated in 314.16(B). The minimum volume for conduit bodies shall be as calculated in 314.16(C).

The provisions of this section shall not apply to terminal housings supplied with motors or generators.

FPN: For volume requirements of motor or generator terminal housings, see 430.12.

Boxes and conduit bodies enclosing conductors 4 AWG or larger shall also comply with the provisions of 314.28.

(A) Box Volume Calculations. The volume of a wiring enclosure (box) shall be the total volume of the assembled sections and, where used, the space provided by plaster rings, domed covers, extension rings, and so forth, that are marked with their volume or are made from boxes the dimensions of which are listed in Table 314.16(A).

(1) Standard Boxes. The volumes of standard boxes that are not marked with their volume shall be as given in Table 314.16(A).

(2) Other Boxes. Boxes 1650 cm³ (100 in.³) or less, other than those described in Table 314.16(A), and nonmetallic boxes shall be durably and legibly marked by the manufacturer with their volume. Boxes described in Table 314.16(A) that have a volume larger than is designated in the table shall be permitted to have their volume marked as required by this section.

(B) Box Fill Calculations. The volumes in paragraphs 314.16(B)(1) through (B)(5), as applicable, shall be added together. No allowance shall be required for small fittings such as locknuts and bushings.

(1) Conductor Fill. Each conductor that originates outside the box and terminates or is spliced within the box shall be counted once, and each conductor that passes through the box without splice or termination shall be counted once. Each loop or coil of unbroken conductor not less than twice the minimum length required for free conductors in 300.14 shall be counted twice. The conductor fill shall be calculated using Table 314.16(B). A conductor, no part of which leaves the box, shall not be counted.

Exception: An equipment grounding conductor or conductors or not over four fixture wires smaller than 14 AWG, or both, shall be permitted to be omitted from the calculations where they enter a box from a domed luminaire or similar canopy and terminate within that box.

(2) Clamp Fill. Where one or more internal cable clamps, whether factory or field supplied, are present in the box, a single volume allowance in accordance with Table 314.16(B) shall be made based on the largest conductor present in the box. No allowance shall be required for a cable connector with its clamping mechanism outside the box.

(3) Support Fittings Fill. Where one or more luminaire studs or hickies are present in the box, a single volume allowance in accordance with Table 314.16(B) shall be made for each type of fitting based on the largest conductor present in the box.

(4) Device or Equipment Fill. For each yoke or strap containing one or more devices or equipment, a double volume allowance in accordance with Table 314.16(B) shall be made for each yoke or strap based on the largest conductor connected to a device(s) or equipment supported by that yoke or strap. A device or utilization equipment wider than a single 50 mm (2 in.) device box as described in Table 314.16(A) shall have double volume allowances provided for each gang required for mounting.

(5) Equipment Grounding Conductor Fill. Where one or more equipment grounding conductors or equipment bonding jumpers enter a box, a single volume allowance in accordance with Table 314.16(B) shall be made based on the largest equipment grounding conductor or equip-

(C) Floors. Use of FCC systems shall be permitted on hard, sound, smooth, continuous floor surfaces made of concrete, ceramic, or composition flooring, wood, and similar materials.

(D) Walls. Use of FCC systems shall be permitted on wall surfaces in surface metal raceways.

(E) Damp Locations. Use of FCC systems in damp locations shall be permitted.

(F) Heated Floors. Materials used for floors heated in excess of 30°C (86°F) shall be identified as suitable for use at these temperatures.

(G) System Height. Any portion of an FCC system with a height above floor level exceeding 2.3 mm (0.090 in.) shall be tapered or feathered at the edges to floor level.

324.12 Uses Not Permitted. FCC systems shall not be used in the following locations:

- (1) Outdoors or in wet locations
- (2) Where subject to corrosive vapors
- (3) In any hazardous (classified) location
- (4) In residential, school, and hospital buildings

324.18 Crossings. Crossings of more than two Type FCC cable runs shall not be permitted at any one point. Crossings of a Type FCC cable over or under a flat communications or signal cable shall be permitted. In each case, a grounded layer of metal shielding shall separate the two cables, and crossings of more than two flat cables shall not be permitted at any one point.

324.30 Securing and Supporting. All FCC system components shall be firmly anchored to the floor or wall using an adhesive or mechanical anchoring system identified for this use. Floors shall be prepared to ensure adherence of the FCC system to the floor until the carpet squares are placed.

324.40 Boxes and Fittings.

(A) Cable Connections and Insulating Ends. All Type FCC cable connections shall use connectors identified for their use, installed such that electrical continuity, insulation, and sealing against dampness and liquid spillage are provided. All bare cable ends shall be insulated and sealed against dampness and liquid spillage using listed insulating ends.

(B) Polarization of Connections. All receptacles and connections shall be constructed and installed so as to maintain proper polarization of the system.

(C) Shields.

(1) Top Shield. A metal top shield shall be installed over all floor-mounted Type FCC cable, connectors, and insulating ends. The top shield shall completely cover all cable runs, corners, connectors, and ends.

(2) Bottom Shield. A bottom shield shall be installed beneath all Type FCC cable, connectors, and insulating ends.

(D) Connection to Other Systems. Power feed, grounding connection, and shield system connection between the FCC system and other wiring systems shall be accomplished in a transition assembly identified for this use.

(E) Metal-Shield Connectors. Metal shields shall be connected to each other and to boxes, receptacle housings, self-contained devices, and transition assemblies using metal-shield connectors.

324.41 Floor Coverings. Floor-mounted Type FCC cable, cable connectors, and insulating ends shall be covered with carpet squares not larger than 914 mm (36 in.) square. Carpet squares that are adhered to the floor shall be attached with release-type adhesives.

324.42 Devices.

(A) Receptacles. All receptacles, receptacle housings, and self-contained devices used with the FCC system shall be identified for this use and shall be connected to the Type FCC cable and metal shields. Connection from any grounding conductor of the Type FCC cable shall be made to the shield system at each receptacle.

(B) Receptacles and Housings. Receptacle housings and self-contained devices designed either for floor mounting or for in-wall or on-wall mounting shall be permitted for use with the FCC system. Receptacle housings and self-contained devices shall incorporate means for facilitating entry and termination of Type FCC cable and for electrically connecting the housing or device with the metal shield. Receptacles and self-contained devices shall comply with 406.3. Power and communications outlets installed together in common housing shall be permitted in accordance with 800.133(A)(1)(c), Exception No. 2.

324.56 Splices and Taps.

(A) FCC Systems Alterations. Alterations to FCC systems shall be permitted. New cable connectors shall be used at new connection points to make alterations. It shall be permitted to leave unused cable runs and associated cable connectors in place and energized. All cable ends shall be covered with insulating ends.

(B) Transition Assemblies. All transition assemblies shall be identified for their use. Each assembly shall incorporate means for facilitating entry of the Type FCC cable into the assembly, for connecting the Type FCC cable to grounded conductors, and for electrically connecting the assembly to

the metal cable shields and to equipment grounding conductors.

324.60 Grounding. All metal shields, boxes, receptacle housings, and self-contained devices shall be electrically continuous to the equipment grounding conductor of the supplying branch circuit. All such electrical connections shall be made with connectors identified for this use. The electrical resistivity of such shield system shall not be more than that of one conductor of the Type FCC cable used in the installation.

III. Construction

324.100 Construction.

(A) Type FCC Cable. Type FCC cable shall be listed for use with the FCC system and shall consist of three, four, or five flat copper conductors, one of which shall be an equipment grounding conductor.

(B) Shields.

(1) Materials and Dimensions. All top and bottom shields shall be of designs and materials identified for their use. Top shields shall be metal. Both metallic and nonmetallic materials shall be permitted for bottom shields.

(2) Resistivity. Metal shields shall have cross-sectional areas that provide for electrical resistivity of not more than that of one conductor of the Type FCC cable used in the installation.

324.101 Corrosion Resistance. Metal components of the system shall be either corrosion resistant, coated with corrosion-resistant materials, or insulated from contact with corrosive substances.

324.112 Insulation. The insulating material of the cable shall be moisture resistant and flame retardant. All insulating materials in the FCC systems shall be identified for their use.

324.120 Markings.

(A) Cable Marking. Type FCC cable shall be clearly and durably marked on both sides at intervals of not more than 610 mm (24 in.) with the information required by 310.11(A) and with the following additional information:

- (1) Material of conductors
- (2) Maximum temperature rating
- (3) Ampacity

(B) Conductor Identification. Conductors shall be clearly and durably identified on both sides throughout their length as specified in 310.12.

ARTICLE 326

Integrated Gas Spacer Cable: Type IGS

I. General

326.1 Scope. This article covers the use, installation, and construction specifications for integrated gas spacer cable, Type IGS.

326.2 Definition. Integrated Gas Spacer Cable, Type IGS.

A factory assembly of one or more conductors, each individually insulated and enclosed in a loose fit, nonmetallic flexible conduit as an integrated gas spacer cable rated 0 through 600 volts.

II. Installation

326.10 Uses Permitted. Type IGS cable shall be permitted for use under ground, including direct burial in the earth, as the following:

- (1) ~~((Service entrance conductors))~~ Reserved.
- (2) Feeder or branch-circuit conductors

326.12 Uses Not Permitted. Type IGS cable shall not be used as interior wiring or be exposed in contact with buildings.

326.24 Bending Radius. Where the coilable nonmetallic conduit and cable is bent for installation purposes or is flexed or bent during shipment or installation, the radii of bends measured to the inside of the bend shall not be less than specified in Table 326.24.

Table 326.24 Minimum Radii of Bends

Conduit Size		Minimum Radii	
Metric Designator	Trade Size	mm	in.
53	2	600	24
78	3	900	358
103	4	1150	45

326.26 Bends. A run of Type IGS cable between pull boxes or terminations shall not contain more than the equivalent of four quarter bends (360 degrees total), including those bends located immediately at the pull box or terminations.

326.40 Fittings. Terminations and splices for Type IGS cable shall be identified as a type that is suitable for maintaining the gas pressure within the conduit. A valve and cap shall be provided for each length of the cable and conduit to check the gas pressure or to inject gas into the conduit.

326.80 Ampacity. The ampacity of Type IGS cable shall not exceed the values shown in Table 326.80.

Table 326.80 Ampacity of Type IGS Cable

Size (kcmil)	Amperes	Size (kcmil)	Amperes
250	119	2500	376
500	168	3000	412
750	206	3250	429
1000	238	3500	445
1250	266	3750	461
1500	292	4000	476
1750	315	4250	491
2000	336	4500	505
2250	357	4750	519

III. Construction Specifications

326.104 Conductors. The conductors shall be solid aluminum rods, laid parallel, consisting of one to nineteen 12.7 mm (½ in.) diameter rods. The minimum conductor size shall be 250 kcmil, and the maximum size shall be 4750 kcmil.

326.112 Insulation. The insulation shall be dry kraft paper tapes and a pressurized sulfur hexafluoride gas (SF6), both approved for electrical use. The nominal gas pressure shall be 138 kPa gauge (20 pounds per square inch gauge). The thickness of the paper spacer shall be as specified in Table 326.112.

Table 326.112 Paper Spacer Thickness

Size (kcmil)	Thickness	
	mm	in.
250–1000	1.02	0.040
1250–4750	1.52	0.060

326.116 Conduit. The conduit shall be a medium density polyethylene identified as suitable for use with natural gas rated pipe in metric designator 53, 78, or 103 (trade size 2, 3, or 4). The percent fill dimensions for the conduit are shown in Table 326.116.

The size of the conduit permitted for each conductor size shall be calculated for a percent fill not to exceed those found in Table 1, Chapter 9.

Table 326.116 Conduit Dimensions

Conduit Size		Actual Outside Diameter		Actual Inside Diameter	
Metric Designator	Trade Size	mm	in.	mm	in.
53	2	60	2.375	49.46	1.947
78	3	89	3.500	73.30	2.886
103	4	114	4.500	94.23	3.710

326.120 Marking. The cable shall be marked in accordance with 310.11(A), 310.11(B)(1), and 310.11(D).

ARTICLE 328
Medium Voltage Cable: Type MV

I. General

328.1 Scope. This article covers the use, installation, and construction specifications for medium voltage cable, Type MV.

328.2 Definition.

Medium Voltage Cable, Type MV. A single or multi-conductor solid dielectric insulated cable rated 2001 volts or higher.

II. Installation

328.10 Uses Permitted. Type MV cable shall be permitted for use on power systems rated up to 35,000 volts nominal as follows:

- (1) In wet or dry locations
- (2) In raceways
- (3) In cable trays, where identified for the use, in accordance with 392.3, 392.6(F), 392.8, and 392.12.

Exception: Type MV cable that has an overall metallic sheath or armor, also complies with the requirements for Type MC cable, and is identified as “MV or MC” shall be permitted to be installed in cable trays in accordance with 392.3(B)(2).

- (4) Direct buried in accordance with 300.50
- (5) In messenger-supported wiring in accordance with Part II of Article 396
- (6) As exposed runs in accordance with 300.37

Exception: Type MV cable that has an overall metallic sheath or armor, also complies with the requirements for Type MC cable, and is identified as “MV or MC” shall be permitted to be installed as exposed runs of metal-clad cable in accordance with 300.37.

FPN: The “Uses Permitted” is not an all-inclusive list.

328.12 Uses Not Permitted. Type MV cable shall not be used where exposed to direct sunlight, unless identified for the use.

328.80 Ampacity. The ampacity of Type MV cable shall be determined in accordance with 310.60. The ampacity of Type MV cable installed in cable tray shall be determined in accordance with 392.13.

III. Construction Specifications

328.100 Construction. Type MV cables shall have copper, aluminum, or copper-clad aluminum conductors and shall

comply with **Table 310.13(C)** and Table 310.13(D) or Table 310.13(E).

328.120 Marking. Medium voltage cable shall be marked as required by 310.11.

ARTICLE 330
Metal-Clad Cable: Type MC

I. General

330.1 Scope. This article covers the use, installation, and construction specifications of metal-clad cable, Type MC.

330.2 Definition. Metal Clad Cable, Type MC. A factory assembly of one or more insulated circuit conductors with or without optical fiber members enclosed in an armor of interlocking metal tape, or a smooth or corrugated metallic sheath.

II. Installation

330.10 Uses Permitted.

(A) General Uses. Type MC cable shall be permitted as follows:

- (1) For ((services,)) feeders((,)) and branch circuits. Type MC cable may be used for services provided each of the following conditions are met:
 - a. Obtain prior approval of the authority having jurisdiction for the specific installation.
 - b. The metallic covering is impervious to moisture.
 - c. A lead sheath or moisture-impervious jacket is provided under the metal covering.
 - d. The insulated conductors under the metallic covering are listed for use in wet locations and a corrosion-resistant jacket is provided over the metallic sheath.
- (2) For power, lighting, control, and signal circuits
 - (3) Indoors or outdoors
 - (4) Exposed or concealed
 - (5) To be direct buried where identified for such use
 - (6) In cable tray where identified for such use
 - (7) In any raceway
 - (8) As aerial cable on a messenger
 - (9) In hazardous (classified) locations as permitted
 - (10) In dry locations and embedded in plaster finish on brick or other masonry except in damp or wet locations
 - (11) In wet locations where any of the following conditions are met:
 - a. The metallic covering is impervious to moisture.

- b. A lead sheath or moisture-impervious jacket is provided under the metal covering.
- c. The insulated conductors under the metallic covering are listed for use in wet locations and a corrosion-resistant jacket is provided over the metallic sheath.

- (12) Where single-conductor cables are used, all phase conductors and, where used, the neutral conductor shall be grouped together to minimize induced voltage on the sheath.

(B) Specific Uses. Type MC cable shall be permitted to be installed in compliance with Parts II and III of Article 725 and 770.133 as applicable and in accordance with 330.10(B)(1) through (B)(4).

(1) Cable Tray. Type MC cable installed in cable tray shall comply with 392.3, 392.4, 392.6, and 392.8 through 392.13.

(2) Direct Buried. Direct-buried cable shall comply with 300.5 or 300.50, as appropriate.

(3) Installed as Service-Entrance Cable. Type MC cable installed as service-entrance cable shall be permitted in accordance with 230.43.

(4) Installed Outside of Buildings or Structures or as Aerial Cable. Type MC cable installed outside of buildings or structures or as aerial cable shall comply with 225.10, 396.10, and 396.12.

FPN: The “Uses Permitted” is not an all-inclusive list.

330.12 Uses Not Permitted. Type MC cable shall not be used under either of the following conditions:

- (1) Where subject to physical damage
- (2) Where exposed to any of the destructive corrosive conditions in (a) or (b), unless the metallic sheath or armor is resistant to the conditions or is protected by material resistant to the conditions:
 - a. Direct buried in the earth or embedded in concrete unless identified for direct burial
 - b. Exposed to cinder fills, strong chlorides, caustic alkalis, or vapors of chlorine or of hydrochloric acids

330.17 Through or Parallel to Framing Members. Type MC cable shall be protected in accordance with 300.4(A), (C), and (D) where installed through or parallel to framing members.

330.23 In Accessible Attics. The installation of Type MC cable in accessible attics or roof spaces shall also comply with 320.23.

330.24 Bending Radius. Bends in Type MC cable shall be so made that the cable will not be damaged. The radius of the curve of the inner edge of any bend shall not be less than required in 330.24(A) through (C).

332.80 Ampacity. The ampacity of Type MI cable shall be determined in accordance with 310.15. The conductor temperature at the end seal fitting shall not exceed the temperature rating of the listed end seal fitting, and the installation shall not exceed the temperature ratings of terminations or equipment.

(A) Type MI Cable Installed in Cable Tray. The ampacities for Type MI cable installed in cable tray shall be determined in accordance with 392.11.

(B) Single Type MI Conductors Grouped Together. Where single Type MI conductors are grouped together in a triangular or square configuration, as required by 332.31, and installed on a messenger or exposed with a maintained free air space of not less than 2.15 times one conductor diameter ($2.15 \times O.D.$) of the largest conductor contained within the configuration and adjacent conductor configurations or cables, the ampacity of the conductors shall not exceed the allowable ampacities of Table 310.17.

III. Construction Specifications

332.104 Conductors. Type MI cable conductors shall be of solid copper, nickel, or nickel-coated copper with a resistance corresponding to standard AWG and kcmil sizes.

332.108 Equipment Grounding Conductor. Where the outer sheath is made of copper, it shall provide an adequate path to serve as an equipment grounding conductor. Where the outer sheath is made of steel, a separate equipment grounding conductor shall be provided.

332.112 Insulation. The conductor insulation in Type MI cable shall be a highly compressed refractory mineral that provides proper spacing for all conductors.

332.116 Sheath. The outer sheath shall be of a continuous construction to provide mechanical protection and moisture seal.

ARTICLE 334 Nonmetallic-Sheathed Cable: Types NM, NMC, and NMS

I. General

334.1 Scope. This article covers the use, installation, and construction specifications of nonmetallic-sheathed cable.

334.2 Definitions.

Nonmetallic-Sheathed Cable. A factory assembly of two or more insulated conductors enclosed within an overall nonmetallic jacket.

Type NM. Insulated conductors enclosed within an overall nonmetallic jacket.

Type NMC. Insulated conductors enclosed within an overall, corrosion resistant, nonmetallic jacket.

Type NMS. Insulated power or control conductors with signaling, data, and communications conductors within an overall nonmetallic jacket.

334.6 Listed. Type NM, Type NMC, and Type NMS cables shall be listed.

II. Installation

334.10 Uses Permitted. Type NM, Type NMC, and Type NMS cables shall be permitted to be used in the following:

- (1) One- and two-family dwellings.
- (2) Multifamily dwellings (~~((permitted to be))~~) of Types III, IV, and V construction except as prohibited in 334.12. Cables shall be concealed within walls, floors, or ceilings that provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies.
- (3) Other structures (~~((permitted to be))~~) of Types III, IV, and V construction except as prohibited in 334.12. Cables shall be concealed within walls, floors, or ceilings that provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies.

~~FPN((No. 4): Types of building construction and occupancy classifications are defined in ((NFPA 220 2006, *Standard on Types of Building Construction*, or the applicable building code, or both)) the Seattle Building Code.~~

~~((FPN No. 2: See Annex E for determination of building types [NFPA 220, Table 3-1]-))~~

- (4) Cable trays in structures permitted to be Types III, IV, or V where the cables are identified for the use and the installation is not prohibited by 334.12.

FPN: See 310.10 for temperature limitation of conductors.

(A) Type NM. Type NM cable shall be permitted as follows:

- (1) For (~~((both exposed and))~~) concealed work in normally dry locations except as prohibited in 334.10(3)
- (2) To be installed or fished in air voids in masonry block or tile walls

(B) Type NMC. Type NMC cable shall be permitted as follows:

- (1) For (~~((both exposed and))~~) concealed work in dry, moist, damp, or corrosive locations, except as prohibited by 334.10(3)
- (2) In outside and inside walls of masonry block or tile
- (3) In a shallow chase in masonry, concrete, or adobe protected against nails or screws by a steel plate at least 1.59 mm ($1/16$ in.) thick and covered with plaster, adobe, or similar finish

(C) Type NMS. Type NMS cable shall be permitted as follows:

- (1) For (~~((both exposed and))~~) concealed work in normally dry locations except as prohibited by 334.10(3)

- (2) To be installed or fished in air voids in masonry block or tile walls

334.12 Uses Not Permitted.

(A) **Types NM, NMC, and NMS.** Types NM, NMC, and NMS cables shall not be permitted as follows:

- (1) In any dwelling or structure not specifically permitted in 334.10(1), (2), and (3)

Exception: Type NM, NMC, and NMS cable shall be permitted in Type I and II construction when installed within raceways permitted to be installed in Type I and II construction.

- (2) Exposed in dropped or suspended ceilings in other than one- and two-family and multifamily dwellings
- (3) As service-entrance cable
- (4) In commercial garages having hazardous (classified) locations as defined in 511.3
- (5) In theaters and similar locations, except where permitted in 518.4(B)
- (6) In motion picture studios
- (7) In storage battery rooms
- (8) In hoistways or on elevators or escalators
- (9) Embedded in poured cement, concrete, or aggregate
- (10) In hazardous (classified) locations, except where permitted by the following:
- 501.10(B)(3)
 - 502.10(B)(3)
 - 504.20

(B) **Types NM and NMS.** Types NM and NMS cables shall not be used under the following conditions or in the following locations:

- (1) Where exposed to corrosive fumes or vapors
- (2) Where embedded in masonry, concrete, adobe, fill, or plaster
- (3) In a shallow chase in masonry, concrete, or adobe and covered with plaster, adobe, or similar finish
- (4) In wet or damp locations

334.15 Exposed Work. In exposed work, except as provided in 300.11(A), cable shall be installed as specified in 334.15(A) through (C).

(A) ~~((To Follow Surface. Cable shall closely follow the surface of the building finish or of running boards.))~~ **Work Considered as Concealed.** Nonmetallic-sheathed cable shall be considered as concealed where installed in inaccessible void areas of buildings or where run between or through bored holes of studs, joists and similar members as required in Section 300.4. All outlet, junction or device boxes shall be installed as required for concealed work.

(B) **Protection from Physical Damage.** Cable shall be protected from physical damage where necessary by rigid metal conduit, intermediate metal conduit, electrical metallic tubing, Schedule 80 PVC conduit, or other approved means.

~~((Where passing through a floor, the cable shall be enclosed in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, Schedule 80 PVC conduit, or other approved means extending at least 150 mm (6 in.) above the floor.))~~

Type NMC cable installed in shallow chases or grooves in masonry, concrete, or adobe, shall be protected in accordance with the requirements in 300.4(F) and covered with plaster, adobe, or similar finish.

Exception: Exposed nonmetallic-sheathed cable that is properly supported may enter the top section only of a surface-mounted main service panel where the distance from the top of the panel to the bottom of the ceiling joist above does not exceed 2 1/2 feet.

(C) **In Unfinished Basements** ~~((and Crawl Spaces)).~~ Where cable is run at angles with joists in unfinished basements ~~((and crawl spaces)),~~ it shall be ~~((permissible to secure cables not smaller than two 6 AWG or three 8 AWG conductors directly to the lower edges of the joists. Smaller cables shall be))~~ run ~~((either))~~ through bored holes in joists ~~((or on running boards)).~~ NM cable installed on the wall of an unfinished basement shall be ~~((permitted to be))~~ installed in a listed conduit or tubing ~~((or shall be protected in accordance with 300.4)).~~ Conduit or tubing shall be provided with a suitable insulating bushing or adapter at the point the cable enters the raceway. The NM cable sheath shall extend through the conduit or tubing and into the outlet or device box not less than 6 mm (1/4 in.). The cable shall be secured within 300 mm (12 in.) of the point where the cable enters the conduit or tubing. Metal conduit, tubing, and metal outlet boxes shall be connected to an equipment grounding conductor.

(D) In Crawl Spaces. Where cable is run at angles with joists in crawl spaces, it shall be permissible to secure cables directly to the lower edges of the joists or through bored holes in the joists. For the purpose of this section, "crawl space" is defined as any unoccupied space of limited height, usually less than a full story but of sufficient height to permit workers access to otherwise concealed ductwork, piping, or wiring, and the space is usually enclosed by a foundation wall.

334.17 Through or Parallel to Framing Members. Types NM, NMC, or NMS cable shall be protected in accordance with 300.4 where installed through or parallel to framing members. Grommets used as required in 300.4(B)(1) shall remain in place and be listed for the purpose of cable protection.

334.23 In Accessible Attics. The installation of cable in accessible attics or roof spaces shall also comply with 320.23.

334.24 Bending Radius. Bends in Types NM, NMC, and NMS cable shall be so made that the cable will not be damaged. The radius of the curve of the inner edge of any bend during or after installation shall not be less than five times the diameter of the cable.

334.30 Securing and Supporting. Nonmetallic-sheathed cable shall be supported and secured by staples, cable ties, straps, hangers, or similar fittings designed and installed so as not to damage the cable, at intervals not exceeding 1.4 m (4½ ft) and within 300 mm (12 in.) of every outlet box, junction box, cabinet, or fitting. Flat cables shall not be stapled on edge.

Sections of cable protected from physical damage by raceway shall not be required to be secured within the raceway.

(A) Horizontal Runs Through Holes and Notches. In other than vertical runs, cables installed in accordance with 300.4 shall be considered to be supported and secured where such support does not exceed 1.4-m (4½-ft) intervals and the nonmetallic-sheathed cable is securely fastened in place by an approved means within 300 mm (12 in.) of each box, cabinet, conduit body, or other nonmetallic-sheathed cable termination.

FPN: See 314.17(C) for support where nonmetallic boxes are used.

(B) Unsupported Cables. Nonmetallic-sheathed cable shall be permitted to be unsupported where the cable:

- (1) Is fished between access points through concealed spaces in finished buildings or structures and supporting is impracticable.
- (2) Is not more than 1.4 m (4½ ft) from the last point of cable support to the point of connection to a luminaire or other piece of electrical equipment and the cable and point of connection are within an accessible ceiling.

(C) Wiring Device Without a Separate Outlet Box. A wiring device identified for the use, without a separate outlet box, and incorporating an integral cable clamp shall be permitted where the cable is secured in place at intervals not exceeding 1.4 m (4½ ft) and within 300 mm (12 in.) from the wiring device wall opening, and there shall be at least a 300 mm (12 in.) loop of unbroken cable or 150 mm (6 in.) of a cable end available on the interior side of the finished wall to permit replacement.

334.40 Boxes and Fittings.

(A) Boxes of Insulating Material. Nonmetallic outlet boxes shall be permitted as provided by 314.3.

~~**(B) (Devices of Insulating Material.** Switch, outlet, and tap devices of insulating material shall be permitted to be used without boxes in exposed cable wiring and for rewiring in existing buildings where the cable is concealed and fished. Openings in such devices shall form a close fit around the outer covering of the cable, and the device shall fully enclose the part of the cable from which any part of the covering has been removed. Where connections to conductors are by binding screw terminals, there shall be available as many terminals as conductors.)~~ Reserved.

(C) Devices with Integral Enclosures. Wiring devices with integral enclosures identified for such use shall be permitted as provided by 300.15(E).

334.80 Ampacity. The ampacity of Types NM, NMC, and NMS cable shall be determined in accordance with 310.15. The ampacity shall be in accordance with the 60°C (140°F) conductor temperature rating. The 90°C (194°F) rating shall be permitted to be used for ampacity derating purposes, provided the final derated ampacity does not exceed that for a 60°C (140°F) rated conductor. The ampacity of Types NM, NMC, and NMS cable installed in cable tray shall be determined in accordance with 392.11.

Where more than two NM cables containing two or more current-carrying conductors are installed, without maintaining spacing between the cables, through the same opening in wood framing that is to be fire- or draft-stopped using thermal insulation, caulk, or sealing foam, the allowable ampacity of each conductor shall be adjusted in accordance with Table 310.15(B)(2)(a) and the provisions of 310.15(A)(2), Exception, shall not apply.

Where more than two NM cables containing two or more current-carrying conductors are installed in contact with thermal insulation without maintaining spacing between cables, the allowable ampacity of each conductor shall be adjusted in accordance with Table 310.15(B)(2)(a).

III. Construction Specifications

334.100 Construction. The outer cable sheath of nonmetallic-sheathed cable shall be a nonmetallic material.

334.104 Conductors. The 600-volt insulated conductors shall be sizes 14 AWG through 2 AWG copper conductors or sizes 12 AWG through 2 AWG aluminum or copper-clad aluminum conductors. The communications conductors shall comply with Part V of Article 800.

334.108 Equipment Grounding Conductor. In addition to the insulated conductors, the cable shall have an insulated, covered, or bare equipment grounding conductor.

334.112 Insulation. The insulated power conductors shall be one of the types listed in Table 310.13(A) that are suitable for branch-circuit wiring or one that is identified for use in these cables. Conductor insulation shall be rated at 90°C (194°F).

FPN: Types NM, NMC, and NMS cable identified by the markings NM-B, NMC-B, and NMS-B meet this requirement.

334.116 Sheath. The outer sheath of nonmetallic-sheathed cable shall comply with 334.116(A), (B), and (C).

(A) Type NM. The overall covering shall be flame retardant and moisture resistant.

(B) Type NMC. The overall covering shall be flame retardant, moisture resistant, fungus resistant, and corrosion resistant.

(C) Type NMS. The overall covering shall be flame retardant and moisture resistant. The sheath shall be applied so as to separate the power conductors from the communications conductors.

ARTICLE 336**Power and Control Tray Cable: Type TC****I. General**

336.1 Scope. This article covers the use, installation, and construction specifications for power and control tray cable, Type TC.

336.2 Definition.

Power and Control Tray Cable, Type TC. A factory assembly of two or more insulated conductors, with or without associated bare or covered grounding conductors, under a nonmetallic jacket.

II. Installation

336.10 Uses Permitted. Type TC cable shall be permitted to be used as follows:

- (1) For power, lighting, control, and signal circuits.
- (2) In cable trays.
- (3) In raceways.
- (4) In outdoor locations supported by a messenger wire.
- (5) For Class 1 circuits as permitted in Parts II and III of Article 725.
- (6) For non-power-limited fire alarm circuits if conductors comply with the requirements of 760.49.
- (7) In industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation, and where the cable is continuously supported and protected against physical damage using mechanical protection, such as struts, angles, or channels, Type TC tray cable that complies with the crush and impact requirements of Type MC cable and is identified for such use with the marking Type TC-ER shall be permitted between a cable tray and the utilization equipment or device. The cable shall be secured at intervals not exceeding 1.8 m (6 ft). Equipment grounding for the utilization equipment shall be provided by an equipment grounding conductor within the cable. In cables containing conductors sized 6 AWG or smaller, the equipment grounding conductor shall be provided within the cable or, at the time of installation, one or more insulated conductors shall be permanently identified as an equipment grounding conductor in accordance with 250.119(B).

Exception: Where not subject to physical damage, Type TC-ER shall be permitted to transition between cable trays and between cable trays and utilization equipment or devices for

a distance not to exceed 1.8 m (6 ft) without continuous support. The cable shall be mechanically supported where exiting the cable tray to ensure that the minimum bending radius is not exceeded.

- (8) Where installed in wet locations, Type TC cable shall also be resistant to moisture and corrosive agents.
FPN: See 310.10 for temperature limitation of conductors.

336.12 Uses Not Permitted. Type TC tray cable shall not be installed or used as follows:

- (1) Installed where it will be exposed to physical damage
- (2) Installed outside a raceway or cable tray system, except as permitted in 336.10(7)
- (3) Used where exposed to direct rays of the sun, unless identified as sunlight resistant
- (4) Direct buried, unless identified for such use

336.24 Bending Radius. Bends in Type TC cable shall be made so as not to damage the cable. For Type TC cable without metal shielding, the minimum bending radius shall be as follows:

- (1) Four times the overall diameter for cables 25 mm (1 in.) or less in diameter
- (2) Five times the overall diameter for cables larger than 25 mm (1 in.) but not more than 50 mm (2 in.) in diameter
- (3) Six times the overall diameter for cables larger than 50 mm (2 in.) in diameter

Type TC cables with metallic shielding shall have a minimum bending radius of not less than 12 times the cable overall diameter.

336.80 Ampacity. The ampacity of Type TC tray cable shall be determined in accordance with 392.11 for 14 AWG and larger conductors, in accordance with 402.5 for 18 AWG through 16 AWG conductors where installed in cable tray, and in accordance with 310.15 where installed in a raceway or as messenger-supported wiring.

III. Construction Specifications

336.100 Construction. A metallic sheath or armor as defined in 330.116 shall not be permitted either under or over the nonmetallic jacket. Metallic shield(s) shall be permitted over groups of conductors, under the outer jacket, or both.

336.104 Conductors. The insulated conductors of Type TC cables shall be in sizes 18 AWG to 1000 kcmil copper,

nickel, or nickel-coated copper, and sizes 12 AWG through 1000 kcmil aluminum or copper-clad aluminum. Insulated conductors of sizes 14 AWG, and larger copper, nickel, or nickel-coated copper, and sizes 12 AWG through 1000 kcmil aluminum or copper-clad aluminum shall be one of the types listed in Table 310.13(A) or Table 310.13(B) that is suitable for branch circuit and feeder circuits or one that is identified for such use.

(A) Fire Alarm Systems. Where used for fire alarm systems, conductors shall also be in accordance with 760.49.

(B) Thermocouple Circuits. Conductors in Type TC cable used for thermocouple circuits in accordance with Part III of Article 725 shall also be permitted to be any of the materials used for thermocouple extension wire.

(C) Class 1 Circuit Conductors. Insulated conductors of 18 AWG and 16 AWG copper shall also be in accordance with 725.49.

336.116 Jacket. The outer jacket shall be a flame-retardant, nonmetallic material.

336.120 Marking. There shall be no voltage marking on a Type TC cable employing thermocouple extension wire.

ARTICLE 338
Service-Entrance Cable:
Types SE and USE

I. General

338.1 Scope. This article covers the use, installation, and construction specifications of service-entrance cable.

338.2 Definitions.

Service-Entrance Cable. A single conductor or multiconductor assembly provided with or without an overall covering, primarily used for services, and of the following types:

Type SE. Service-entrance cable having a flame-retardant, moisture-resistant covering.

Type USE. Service-entrance cable, identified for underground use, having a moisture-resistant covering, but not required to have a flame-retardant covering.

II. Installation

338.10 Uses Permitted.

~~(A) ((Service-Entrance Conductors. Service-entrance cable shall be permitted to be used as service-entrance conductors~~

~~and shall be installed in accordance with 230.6, 230.7, and Parts II, III, and IV of Article 230.)) Reserved.~~

(B) Branch Circuits or Feeders.

(1) Grounded Conductor Insulated. Type SE service-entrance cables shall be permitted in wiring systems where all of the circuit conductors of the cable are of the thermoset or thermoplastic type.

(2) Grounded Conductor Not Insulated. Type SE service-entrance cable shall be permitted for use where the insulated conductors are used for circuit wiring and the uninsulated conductor is used only for equipment grounding purposes.

Exception: Uninsulated conductors shall be permitted as a grounded conductor in accordance with 250.32 and 250.140 where the uninsulated grounded conductor of the cable originates in service equipment, and 225.30 through 225.40.

(3) Temperature Limitations. Type SE service-entrance cable used to supply appliances shall not be subject to conductor temperatures in excess of the temperature specified for the type of insulation involved.

(4) Installation Methods for Branch Circuits and Feeders.

(a) Interior Installations. In addition to the provisions of this article, Type SE service-entrance cable used for interior wiring shall comply with the installation requirements of Part II of Article 334.

FPN: See 310.10 for temperature limitation of conductors.

(b) Exterior Installations. In addition to the provisions of this article, service-entrance cable used for feeders or branch circuits, where installed as exterior wiring, shall be installed in accordance with Part I of Article 225. The cable shall be supported in accordance with 334.30. Type USE cable installed as underground feeder and branch circuit cable shall comply with Part II of Article 340.

338.12 Uses Not Permitted.

(A) Service-Entrance Cable. Service-entrance cable (SE) shall not be used under the following conditions or in the following locations:

- (1) Where subject to physical damage unless protected in accordance with 230.50(A)
- (2) Underground with or without a raceway
- (3) For exterior branch circuits and feeder wiring unless the installation complies with the provisions of Part I of Article 225 and is supported in accordance with 334.30 or is used as messenger-supported wiring as permitted in Part II of Article 396
- (4) As service entrance conductors.

(B) Underground Service-Entrance Cable. Underground service-entrance cable (USE) shall not be used under the following conditions or in the following locations:

- (1) For interior wiring
- (2) For aboveground installations except where USE cable emerges from the ground and is terminated in an enclosure at an outdoor location and the cable is protected in accordance with 300.5(D)
- (3) As aerial cable unless it is a multiconductor cable identified for use aboveground and installed as messenger-supported wiring in accordance with 225.10 and Part II of Article 396
- (4) As service entrance conductors.

338.24 Bending Radius. Bends in Types USE and SE cable shall be so made that the cable will not be damaged. The radius of the curve of the inner edge of any bend, during or after installation, shall not be less than five times the diameter of the cable.

III. Construction

338.100 Construction. Cabled, single-conductor, Type USE constructions recognized for underground use shall be permitted to have a bare copper conductor cabled with the assembly. Type USE single, parallel, or cabled conductor assemblies recognized for underground use shall be permitted to have a bare copper concentric conductor applied. These constructions shall not require an outer overall covering.

FPN: See 230.41, Exception, item (2), for directly buried, uninsulated service-entrance conductors.

Type SE or USE cable containing two or more conductors shall be permitted to have one conductor uninsulated.

338.120 Marking. Service-entrance cable shall be marked as required in 310.11. Cable with the neutral conductor smaller than the ungrounded conductors shall be so marked.

ARTICLE 340 Underground Feeder and Branch-Circuit Cable: Type UF

I. General

340.1 Scope.

This article covers the use, installation, and construction specifications for underground feeder and branch-circuit cable, Type UF.

340.2 Definition.

Underground Feeder and Branch-Circuit Cable, Type UF. A factory assembly of one or more insulated conductors with an integral or an overall covering of nonmetallic material suitable for direct burial in the earth.

340.6 Listing Requirements.

Type UF cable shall be listed.

II. Installation

340.10 Uses Permitted.

Type UF cable shall be permitted as follows:

- (1) For use underground, including direct burial in the earth. For underground requirements, see 300.5.
- (2) As single-conductor cables. Where installed as single-conductor cables, all conductors of the feeder grounded conductor or branch circuit, including the grounded conductor and equipment grounding conductor, if any, shall be installed in accordance with 300.3.
- (3) For wiring in wet, dry, or corrosive locations under the recognized wiring methods of this Code.
- (4) Installed as nonmetallic-sheathed cable. Where so installed, the installation and conductor requirements shall comply with Parts II and III of Article 334 and shall be of the multiconductor type.
- (5) For solar photovoltaic systems in accordance with 690.31.
- (6) As single-conductor cables as the nonheating leads for heating cables as provided in 424.43.
- (7) Supported by cable trays. Type UF cable supported by cable trays shall be of the multiconductor type.

FPN: See 310.10 for temperature limitation of conductors.

340.12 Uses Not Permitted. Type UF cable shall not be used as follows:

- (1) As service-entrance cable
- (2) In commercial garages
- (3) In theaters and similar locations
- (4) In motion picture studios
- (5) In storage battery rooms
- (6) In hoistways or on elevators or escalators
- (7) In any hazardous (classified) location, except as otherwise permitted in this Code
- (8) Embedded in poured cement, concrete, or aggregate, except where embedded in plaster as nonheating leads where permitted in 424.43
- (9) Where exposed to direct rays of the sun, unless identified as sunlight resistant
- (10) Where subject to physical damage
- (11) As overhead cable, except where installed as messenger-supported wiring in accordance with Part II of Article 396

340.24 Bending Radius. Bends in Type UF cable shall be so made that the cable is not damaged. The radius of

(6 ft) from the last point where the raceway is securely fastened for connections within an accessible ceiling to luminaire(s) or other equipment.

356.42 Couplings and Connectors. Only fittings listed for use with LFNC shall be used. Angle connectors shall not be used for concealed raceway installations. Straight LFNC fittings are permitted for direct burial or encasement in concrete.

356.56 Splices and Taps. Splices and taps shall be made in accordance with 300.15.

356.60 Grounding and Bonding. Where used to connect equipment where flexibility is required, an equipment grounding conductor shall be installed.

Where required or installed, equipment grounding conductors shall be installed in accordance with 250.134(B).

Where required or installed, equipment bonding jumpers shall be installed in accordance with 250.102.

III. Construction Specifications

356.100 Construction. LFNC-B as a prewired manufactured assembly shall be provided in continuous lengths capable of being shipped in a coil, reel, or carton without damage.

356.120 Marking. LFNC shall be marked at least every 600 mm (2 ft) in accordance with 110.21. The marking shall include a type designation in accordance with 356.2 and the trade size. Conduit that is intended for outdoor use or direct burial shall be marked.

The type, size, and quantity of conductors used in prewired manufactured assemblies shall be identified by means of a printed tag or label attached to each end of the manufactured assembly and either the carton, coil, or reel. The enclosed conductors shall be marked in accordance with 310.11.

ARTICLE 358 Electrical Metallic Tubing: Type EMT

I. General

358.1 Scope. This article covers the use, installation, and construction specifications for electrical metallic tubing (EMT) and associated fittings.

358.2 Definition.

Electrical Metallic Tubing (EMT). An unthreaded thinwall raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed

utilizing appropriate fittings. EMT is generally made of steel (ferrous) with protective coatings or aluminum (nonferrous).

358.6 Listing Requirements. EMT, factory elbows, and associated fittings shall be listed.

II. Installation

358.10 Uses Permitted.

(A) Exposed and Concealed. The use of EMT shall be permitted for both exposed and concealed work.

(B) Corrosion Protection. Ferrous or nonferrous EMT, elbows, couplings, and fittings shall be permitted to be installed in concrete, (~~in direct contact with the earth,~~) above grade or in areas subject to severe corrosive influences where protected by corrosion protection and judged suitable for the condition.

(C) Wet Locations. All supports, bolts, straps, screws, and so forth shall be of corrosion-resistant materials or protected against corrosion by corrosion-resistant materials.

Circuits installed in electrical metallic tubing in wet locations shall use equipment grounding wires sized according to Section 250.122.

FPN: See 300.6 for protection against corrosion.

358.12 Uses Not Permitted. EMT shall not be used under the following conditions:

- (1) Where, during installation or afterward, it will be subject to severe physical damage.
- (2) Where protected from corrosion solely by enamel.
- (3) In cinder concrete or cinder fill where subject to permanent moisture unless protected on all sides by a layer of noncinder concrete at least 50 mm (2 in.) thick or unless the tubing is at least 450 mm (18 in.) under the fill.
- (4) In any hazardous (classified) location except as permitted by other articles in this Code.
- (5) For the support of luminaires or other equipment except conduit bodies no larger than the largest trade size of the tubing.
- (6) Where practicable, dissimilar metals in contact anywhere in the system shall be avoided to eliminate the possibility of galvanic action.

Exception: Aluminum fittings and enclosures shall be permitted to be used with steel EMT where not subject to severe corrosive influences.

358.20 Size.

(A) Minimum. EMT smaller than metric designator 16 (trade size ½) shall not be used.

Exception: For enclosing the leads of motors as permitted in 430.245(B).

(B) Maximum. The maximum size of EMT shall be metric designator 103 (trade size 4).

FPN: See 300.1(C) for the metric designators and trade sizes. These are for identification purposes only and do not relate to actual dimensions.

358.22 Number of Conductors. The number of conductors shall not exceed that permitted by the percentage fill specified in Table 1, Chapter 9.

Cables shall be permitted to be installed where such use is not prohibited by the respective cable articles. The number of cables shall not exceed the allowable percentage fill specified in Table 1, Chapter 9.

358.24 Bends — How Made. Bends shall be made so that the tubing is not damaged and the internal diameter of the tubing is not effectively reduced. The radius of the curve of any field bend to the centerline of the tubing shall not be less than shown in Table 2, Chapter 9 for one-shot and full shoe benders.

358.26 Bends — Number in One Run. There shall not be more than the equivalent of four quarter bends (360 degrees total) between pull points, for example, conduit bodies and boxes.

358.28 Reaming and Threading.

(A) Reaming. All cut ends of EMT shall be reamed or otherwise finished to remove rough edges.

(B) Threading. EMT shall not be threaded.

Exception: EMT with factory threaded integral couplings complying with 358.100.

358.30 Securing and Supporting. EMT shall be installed as a complete system in accordance with 300.18 and shall be securely fastened in place and supported in accordance with 358.30(A) and (B) or permitted to be unsupported in accordance with 358.30(C).

(A) Securely Fastened. EMT shall be securely fastened in place at least every 3 m (10 ft). In addition, each EMT run between termination points shall be securely fastened within 900 mm (3 ft) of each outlet box, junction box, device box, cabinet, conduit body, or other tubing termination.

Exception No. 1: Fastening of unbroken lengths shall be permitted to be increased to a distance of 1.5 m (5 ft) where structural members do not readily permit fastening within 900 mm (3 ft).

Exception No. 2: For concealed work in finished buildings or prefinished wall panels where such securing is impracticable, unbroken lengths (without coupling) of EMT shall be permitted to be fished.

(B) Supports. Horizontal runs of EMT supported by openings through framing members at intervals not greater than 3 m (10 ft) and securely fastened within 900 mm (3 ft) of termination points shall be permitted.

(C) Unsupported Raceways. Where oversized, concentric or eccentric knockouts are not encountered, Type EMT shall be permitted to be unsupported where the raceway is not more than 450 mm (18 in.) and remains in unbroken lengths (without coupling). Such raceways shall terminate in an outlet box, device box, cabinet, or other termination at each end of the raceway.

358.42 Couplings and Connectors. Couplings and connectors used with EMT shall be made up tight. Where buried in masonry or concrete, they shall be concretetight type. Where installed in wet locations, they shall comply with 314.15.

358.56 Splices and Taps. Splices and taps shall be made in accordance with 300.15.

358.60 Grounding. EMT shall be permitted as an equipment grounding conductor.

III. Construction Specifications

358.100 Construction. Factory-threaded integral couplings shall be permitted. Where EMT with a threaded integral coupling is used, threads for both the tubing and coupling shall be factory-made. The coupling and EMT threads shall be designed so as to prevent bending of the tubing at any part of the thread.

358.120 Marking. EMT shall be clearly and durably marked at least every 3 m (10 ft) as required in the first sentence of 110.21.

ARTICLE 360 **Flexible Metallic Tubing: Type FMT**

I. General

360.1 Scope. This article covers the use, installation, and construction specifications for flexible metallic tubing (FMT) and associated fittings.

360.2 Definition.

Flexible Metallic Tubing (FMT). A raceway that is circular in cross section, flexible, metallic, and liquidtight without a nonmetallic jacket.

exterior, shall be suitably protected from corrosion. Corner joints shall be made tight, and where the assembly is held together by rivets, bolts, or screws, such fasteners shall be spaced not more than 300 mm (12 in.) apart.

(C) Smooth Rounded Edges. Suitable bushings, shields, or fittings having smooth, rounded edges shall be provided where conductors pass between wireways, through partitions, around bends, between wireways and cabinets or junction boxes, and at other locations where necessary to prevent abrasion of the insulation of the conductors.

(D) Covers. Covers shall be securely fastened to the wireway.

376.120 Marking. Metal wireways shall be so marked that their manufacturer's name or trademark will be visible after installation.

ARTICLE 378 Nonmetallic Wireways

I. General

378.1 Scope. This article covers the use, installation, and construction specifications for nonmetallic wireways and associated fittings.

378.2 Definition.

Nonmetallic Wireways. Flame retardant, nonmetallic troughs with removable covers for housing and protecting electrical wires and cables in which conductors are laid in place after the wireway has been installed as a complete system.

378.6 Listing Requirements. Nonmetallic wireways and associated fittings shall be listed.

II. Installation

378.10 Uses Permitted. The use of nonmetallic wireways shall be permitted in the following:

- (1) Only for exposed work, except as permitted in 378.10(4).
- (2) Where subject to corrosive environments where identified for the use.
- (3) In wet locations where listed for the purpose.

FPN: Extreme cold may cause nonmetallic wireways to become brittle and therefore more susceptible to damage from physical contact.

- (4) As extensions to pass transversely through walls if the length passing through the wall is unbroken. Access to

the conductors shall be maintained on both sides of the wall.

378.12 Uses Not Permitted. Nonmetallic wireways shall not be used in the following:

- (1) Where subject to physical damage
- (2) In any hazardous (classified) location, except as permitted by other articles in this *Code*
- (3) Where exposed to sunlight unless listed and marked as suitable for the purpose
- (4) Where subject to ambient temperatures other than those for which nonmetallic wireway is listed
- (5) For conductors whose insulation temperature limitations would exceed those for which the nonmetallic wireway is listed

378.21 Size of Conductors. No conductor larger than that for which the nonmetallic wireway is designed shall be installed in any nonmetallic wireway.

378.22 Number of Conductors. The sum of cross-sectional areas of all contained conductors at any cross section of the nonmetallic wireway shall not exceed 20 percent of the interior cross-sectional area of the nonmetallic wireway. Conductors for signaling circuits or controller conductors between a motor and its starter and used only for starting duty shall not be considered as current-carrying conductors.

The derating factors specified in 310.15(B)(2)(a) shall be applicable to the current-carrying conductors up to and including the 20 percent fill specified above.

378.23 Insulated Conductors. Insulated conductors installed in a nonmetallic wireway shall comply with 378.23(A) and (B).

(A) Deflected Insulated Conductors. Where insulated conductors are deflected within a nonmetallic wireway, either at the ends or where conduits, fittings, or other raceways or cables enter or leave the nonmetallic wireway, or where the direction of the nonmetallic wireway is deflected greater than 30 degrees, dimensions corresponding to one wire per terminal in Table 312.6(A) shall apply.

(B) Nonmetallic Wireways Used as Pull Boxes. Where insulated conductors 4 AWG or larger are pulled through a wireway, the distance between raceway and cable entries enclosing the same conductor shall not be less than that required in 314.28(A)(1) for straight pulls and in 314.28(A)(2) for angle pulls. When transposing cable size into raceway size, the minimum metric designator (trade size) raceway required for the number and size of conductors in the cable shall be used.

378.30 Securing and Supporting. Nonmetallic wireway shall be supported in accordance with 378.30(A) and (B).

(A) Horizontal Support. Nonmetallic wireways shall be supported where run horizontally at intervals not to exceed 900 mm (3 ft), and at each end or joint, unless listed for other support intervals. In no case shall the distance between supports exceed 3 m (10 ft).

(B) Vertical Support. Vertical runs of nonmetallic wireway shall be securely supported at intervals not exceeding 1.2 m (4 ft), unless listed for other support intervals, and shall not have more than one joint between supports. Adjoining nonmetallic wireway sections shall be securely fastened together to provide a rigid joint.

378.44 Expansion Fittings. Expansion fittings for nonmetallic wireway shall be provided to compensate for thermal expansion and contraction where the length change is expected to be 6 mm (0.25 in.) or greater in a straight run.

FPN: See Table 352.44 for expansion characteristics of PVC conduit. The expansion characteristics of PVC nonmetallic wireway are identical.

378.56 Splices and Taps. Splices and taps shall be permitted within a nonmetallic wireway, provided they are accessible. The conductors, including splices and taps, shall not fill the nonmetallic wireway to more than 75 percent of its area at that point.

378.58 Dead Ends. Dead ends of nonmetallic wireway shall be closed using listed fittings.

378.60 Grounding. Where equipment grounding is required, a separate equipment grounding conductor shall be installed in the nonmetallic wireway. A separate equipment grounding conductor shall not be required where the grounded conductor is used to ground equipment as permitted in 250.142.

378.70 Extensions from Nonmetallic Wireways. Extensions from nonmetallic wireway shall be made with cord pendants or any wiring method of Chapter 3. A separate equipment grounding conductor shall be installed in, or an equipment grounding connection shall be made to, any of the wiring methods used for the extension.

III. Construction Specifications

378.120 Marking. Nonmetallic wireways shall be marked so that the manufacturer's name or trademark and interior cross-sectional area in square inches shall be visible after installation. Marking for limited smoke shall be permitted on the nonmetallic wireways that have limited smoke-producing characteristics.

ARTICLE 380 Multioutlet Assembly

80.1 Scope. This article covers the use and installation requirements for multioutlet assemblies.

380.2 Use.

(A) Permitted. The use of a multioutlet assembly shall be permitted in dry locations.

(B) Not Permitted. A multioutlet assembly shall not be installed as follows:

- (1) Where concealed, except that it shall be permissible to surround the back and sides of a metal multioutlet assembly by the building finish or recess a nonmetallic multioutlet assembly in a baseboard
- (2) Where subject to severe physical damage
- (3) Where the voltage is 300 volts or more between conductors unless the assembly is of metal having a thickness of not less than 1.02 mm (0.040 in.)
- (4) Where subject to corrosive vapors
- (5) In hoistways
- (6) In any hazardous (classified) location, except as permitted by other articles in this Code

380.3 Metal Multioutlet Assembly Through Dry Partitions. It shall be permissible to extend a metal multioutlet assembly through (not run within) dry partitions if arrangements are made for removing the cap or cover on all exposed portions and no outlet is located within the partitions.

ARTICLE 382 Nonmetallic Extensions

Article 382 is not adopted.

I. General

~~**382.1 Scope.** This article covers the use, installation, and construction specifications for nonmetallic extensions.~~

~~**382.2 Definitions.**~~

~~**Concealable Nonmetallic Extension.** A listed assembly of two, three, or four insulated circuit conductors within a nonmetallic jacket, an extruded thermoplastic covering, or a sealed nonmetallic covering. The classification includes surface extensions intended for mounting directly on the surface of walls or ceilings, and concealed with paint, texture, joint compound, plaster, wallpaper, tile, wall paneling, or other similar materials.~~

Nonmetallic Extension. An assembly of two insulated conductors within a nonmetallic jacket or an extruded thermoplastic covering. The classification includes surface extensions intended for mounting directly on the surface of walls or ceilings.

382.6 Listing Requirements. Concealable nonmetallic extensions and associated fittings and devices shall be listed. The starting/source tap device for the extension shall contain and provide the following protection for all load side extensions and devices:

- (1) Supplementary overcurrent protection
- (2) Level of protection equivalent to a Class A GFCI
- (3) Level of protection equivalent to a portable GFCI
- (4) Line and load side miswire protection
- (5) Provide protection from the effects of arc faults

H. Installation

382.10 Uses Permitted. Nonmetallic extensions shall be permitted only in accordance with 382.10(A), (B), and (C).

(A) From an Existing Outlet. The extension shall be from an existing outlet on a 15 or 20 ampere branch circuit. Where a concealable nonmetallic extension originates from a non-grounding type receptacle, the installation shall comply with 250.130(C), 406.3(D)(3)(b), or 406.3(D)(3)(c).

(B) Exposed and in a Dry Location. The extension shall be run exposed, or concealed as permitted in 382.15, and in a dry location.

(C) Residential or Offices. For nonmetallic surface extensions mounted directly on the surface of walls or ceilings, the building shall be occupied for residential or office purposes and shall not exceed three floors above grade. Where identified for the use, concealable nonmetallic extensions shall be permitted more than three floors above grade.

FPN No. 1: See 310.10 for temperature limitation of conductors.

FPN No. 2: See 362.10 for definition of First Floor.

382.12 Uses Not Permitted. Nonmetallic extensions shall not be used as follows:

- (1) In unfinished basements, attics, or roof spaces
- (2) Where the voltage between conductors exceeds 150 volts for nonmetallic surface extensions and 300 volts for aerial cable
- (3) Where subject to corrosive vapors
- (4) Where run through a floor or partition, or outside the room in which it originates

382.15 Exposed.

(A) Nonmetallic Extensions. One or more extensions shall be permitted to be run in any direction from an existing

outlet, but not on the floor or within 50 mm (2 in.) from the floor.

(B) Concealable Nonmetallic Extensions. Where identified for the use, nonmetallic extensions may be concealed with paint, texture, concealing compound, plaster, wallpaper, tile, wall paneling, or other similar materials and installed per 382.15(A).

382.26 Bends.

(A) Nonmetallic Extensions. A bend that reduces the normal spacing between the conductors shall be covered with a cap to protect the assembly from physical damage.

(B) Concealable Nonmetallic Extensions. Concealable extensions shall be permitted to be folded back over themselves and flattened as required for installation.

382.30 Securing and Supporting.

(A) Nonmetallic Extensions. Nonmetallic surface extensions shall be secured in place by approved means at intervals not exceeding 200 mm (8 in.), with an allowance for 300 mm (12 in.) to the first fastening where the connection to the supplying outlet is by means of an attachment plug. There shall be at least one fastening between each two adjacent outlets supplied. An extension shall be attached to only woodwork or plaster finish and shall not be in contact with any metal work or other conductive material other than with metal plates on receptacles.

(B) Concealable Nonmetallic Extensions. All surface-mounted concealable nonmetallic extension components shall be firmly anchored to the wall or ceiling using an adhesive or mechanical anchoring system identified for this use.

382.40 Boxes and Fittings. Each run shall terminate in a fitting, connector, or box that covers the end of the assembly. All fittings, connectors, and devices shall be of a type identified for the use.

382.42 Devices.

(A) Receptacles. All receptacles, receptacle housings, and self-contained devices used with concealable nonmetallic extensions shall be identified for this use.

(B) Receptacles and Housings. Receptacle housings and self-contained devices designed either for surface or for recessed mounting shall be permitted for use with concealable nonmetallic extensions. Receptacle housings and self-contained devices shall incorporate means for facilitating entry and termination of concealable nonmetallic extensions and for electrically connecting the housing or device. Receptacle and self-contained devices shall comply with 406.3. Power and communications outlets installed together

~~in common housing shall be permitted in accordance with 800.133(A)(1)(c), Exception No. 2.~~

~~**382.56 Splices and Taps.** Extensions shall consist of a continuous unbroken length of the assembly, without splices, and without exposed conductors between fittings, connectors, or devices. Taps shall be permitted where approved fittings completely covering the tap connections are used. Aerial cable and its tap connectors shall be provided with an approved means for polarization. Receptacle type tap connectors shall be of the locking type.~~

~~III. Construction Specifications (Concealable Nonmetallic Extensions only)~~

~~**382.100 Construction.** Concealable nonmetallic extensions shall be a multilayer flat conductor design consisting of a center ungrounded conductor enclosed by a sectioned grounded conductor, and an overall sectioned grounding conductor.~~

~~**382.104 Flat Conductors.** Concealable nonmetallic extensions shall be constructed, using flat copper conductors equivalent to 14 AWG or 12 AWG conductor sizes, and constructed per 382.104(A), (B), and (C).~~

~~**(A) Ungrounded Conductor (Center Layer).** The ungrounded conductor shall consist of one or more ungrounded flat conductor(s) enclosed per 382.104(B) and (C) and identified in accordance with 310.12(C).~~

~~**(B) Grounded Conductor (Inner Sectioned Layers).** The grounded conductor shall consist of two sectioned inner flat conductors that enclose the center ungrounded conductor(s). The sectioned grounded conductor shall be enclosed by the sectioned grounding conductor and identified in accordance with 200.6.~~

~~**(C) Grounding Conductor (Outer Sectioned Layers).** The grounding conductor shall consist of two overall sectioned conductors that enclose the grounded conductor and ungrounded conductor(s) and shall comply with 250.4(A)(5). The grounding conductor layers shall be identified by any one of the following methods:~~

- ~~(1) As permitted in 250.119~~
- ~~(2) A clear covering~~
- ~~(3) One or more continuous green stripes or hash marks~~
- ~~(4) The term "Equipment Ground" printed at regular intervals throughout the cable~~

~~**382.112 Insulation.** The ungrounded and grounded flat conductor layers shall be individually insulated and comply with 310.10. The grounding conductor shall be covered or insulated.~~

~~382.120 Marking.~~

~~**(A) Cable.** Concealable nonmetallic extensions shall be clearly and durably marked on both sides at intervals of not more than 610 mm (24 in.) with the information required by 310.11(A) and with the following additional information:~~

- ~~(1) Material of conductors~~
- ~~(2) Maximum temperature rating~~
- ~~(3) Ampacity~~

~~**(B) Conductor Identification.** Conductors shall be clearly and durably identified on both sides throughout their length as specified in 382.104.~~

ARTICLE 384 Strut-Type Channel Raceway

I. General

384.1 Scope. This article covers the use, installation, and construction specifications of strut-type channel raceway.

384.2 Definition.

Strut-Type Channel Raceway. A metallic raceway that is intended to be mounted to the surface of or suspended from a structure, with associated accessories for the installation of electrical conductors and cables.

384.6 Listing Requirements. Strut-type channel raceways, closure strips, and accessories shall be listed and identified for such use.

II. Installation

384.10 Uses Permitted. The use of strut-type channel raceways shall be permitted in the following:

- (1) Where exposed.
- (2) In dry locations.
- (3) In locations subject to corrosive vapors where protected by finishes judged suitable for the condition.
- (4) Where the voltage is 600 volts or less.
- (5) As power poles.
- (6) In Class I, Division 2 hazardous (classified) locations as permitted in 501.10(B)(3).
- (7) As extensions of unbroken lengths through walls, partitions, and floors where closure strips are removable from either side and the portion within the wall, partition, or floor remains covered.

402.5 Allowable Ampacities for Fixture Wires. The allowable ampacity of fixture wire shall be as specified in Table 402.5.

No conductor shall be used under such conditions that its operating temperature exceeds the temperature specified in Table 402.3 for the type of insulation involved.

FPN: See 310.10 for temperature limitation of conductors.

Table 402.5 Allowable Ampacity for Fixture Wires

Size (AWG)	Allowable Ampacity
18	6
16	8
14	17
12	23
10	28

402.6 Minimum Size. Fixture wires shall not be smaller than 18 AWG.

402.7 Number of Conductors in Conduit or Tubing. The number of fixture wires permitted in a single conduit or tubing shall not exceed the percentage fill specified in Table 1, Chapter 9.

402.8 Grounded Conductor Identification. Fixture wires that are intended to be used as grounded conductors shall be identified by one or more continuous white stripes on other than green insulation or by the means described in 400.22(A) through (E).

402.9 Marking.

(A) Method of Marking. Thermoplastic insulated fixture wire shall be durably marked on the surface at intervals not exceeding 610 mm (24 in.). All other fixture wire shall be marked by means of a printed tag attached to the coil, reel, or carton.

(B) Optional Marking. Fixture wire types listed in Table 402.3 shall be permitted to be surface marked to indicate special characteristics of the cable materials. These markings include, but are not limited to, markings for limited smoke, sunlight resistance, and so forth.

402.10 Uses Permitted. Fixture wires shall be permitted (1) for installation in luminaires and in similar equipment where enclosed or protected and not subject to bending or twisting in use, or (2) for connecting luminaires to the branch-circuit conductors supplying the luminaires.

402.11 Uses Not Permitted. Fixture wires shall not be used as branch-circuit conductors **except as permitted elsewhere in the Code.**

402.12 Overcurrent Protection. Overcurrent protection for fixture wires shall be as specified in 240.5.

**ARTICLE 404
Switches**

I. Installation

404.1 Scope. The provisions of this article shall apply to all switches, switching devices, and circuit breakers where used as switches.

404.2 Switch Connections.

(A) Three-Way and Four-Way Switches. Three-way and four-way switches shall be wired so that all switching is done only in the ungrounded circuit conductor. Where in metal raceways or metal-armored cables, wiring between switches and outlets shall be in accordance with 300.20(A).

Exception: Switch loops shall not require a grounded conductor.

(B) Grounded Conductors. Switches or circuit breakers shall not disconnect the grounded conductor of a circuit.

Exception: A switch or circuit breaker shall be permitted to disconnect a grounded circuit conductor where all circuit conductors are disconnected simultaneously, or where the device is arranged so that the grounded conductor cannot be disconnected until all the ungrounded conductors of the circuit have been disconnected.

404.3 Enclosure.

(A) General. Switches and circuit breakers shall be of the externally operable type mounted in an enclosure listed for the intended use. The minimum wire-bending space at terminals and minimum gutter space provided in switch enclosures shall be as required in 312.6.

~~*(Exception No. 1: Pendant and surface type snap switches and knife switches mounted on an open face switchboard or panelboard shall be permitted without enclosures.)*~~

~~*Exception No. 2: Switches and circuit breakers installed in accordance with 110.27(A)(1), (A)(2), (A)(3), or (A)(4) shall be permitted without enclosures.)*~~

(B) Used as a Raceway. Enclosures shall not be used as junction boxes, auxiliary gutters, or raceways for conductors feeding through or tapping off to other switches or overcurrent devices, unless the enclosure complies with 312.8.

404.4 Damp or Wet Locations. A surface-mounted switch or circuit breaker in a damp or wet location shall be enclosed in a weatherproof enclosure or cabinet that shall comply with 312.2. A flush-mounted switch or circuit breaker in a damp or wet location shall be equipped with a weatherproof cover. Switches shall not be installed within wet locations in tub or shower spaces unless installed as part of a listed tub or shower assembly.

404.5 Time Switches, Flashers, and Similar Devices. Time switches, flashers, and similar devices shall be of the enclosed type or shall be mounted in cabinets or boxes or equipment enclosures. Energized parts shall be barriered to prevent operator exposure when making manual adjustments or switching.

Exception: Devices mounted so they are accessible only to qualified persons shall be permitted without barriers, provided they are located within an enclosure such that any energized parts within 152 mm (6.0 in.) of the manual adjustment or switch are covered by suitable barriers.

404.6 Position and Connection of Switches.

(A) Single-Throw Knife Switches. Single-throw knife switches shall be placed so that gravity will not tend to close them. Single-throw knife switches, approved for use in the inverted position, shall be provided with an integral mechanical means that ensures that the blades remain in the open position when so set.

(B) Double-Throw Knife Switches. Double-throw knife switches shall be permitted to be mounted so that the throw is either vertical or horizontal. Where the throw is vertical, integral mechanical means shall be provided to hold the blades in the open position when so set.

(C) Connection of Switches. Single-throw knife switches and switches with butt contacts shall be connected such that their blades are de-energized when the switch is in the open position. Bolted pressure contact switches shall have barriers that prevent inadvertent contact with energized blades. Single-throw knife switches, bolted pressure contact switches, molded case switches, switches with butt contacts, and circuit breakers used as switches shall be connected so that the terminals supplying the load are de-energized when the switch is in the open position.

Exception: The blades and terminals supplying the load of a switch shall be permitted to be energized when the switch is in the open position where the switch is connected to circuits or equipment inherently capable of providing a backfeed source of power. For such installations, a permanent sign shall be installed on the switch enclosure or immediately adjacent to open switches with the following words or equivalent: WARNING — LOAD SIDE TERMINALS MAY BE ENERGIZED BY BACKFEED.

404.7 Indicating. General-use and motor-circuit switches, circuit breakers, and molded case switches, where mounted in an enclosure as described in 404.3, shall clearly indicate whether they are in the open (off) or closed (on) position.

Where these switch or circuit breaker handles are operated vertically rather than rotationally or horizontally, the up position of the handle shall be the (on) position.

Exception No. 1: Vertically operated double-throw switches shall be permitted to be in the closed (on) position with the handle in either the up or down position.

Exception No. 2: On busway installations, tap switches employing a center-pivoting handle shall be permitted to be open or closed with either end of the handle in the up or down position. The switch position shall be clearly indicating and shall be visible from the floor or from the usual point of operation.

404.8 Accessibility and Grouping.

(A) Location. All switches and circuit breakers used as switches shall be located so that they may be operated from a readily accessible place. They shall be installed such that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, is not more than 2.0 m (6 ft 7 in.) above the floor or working platform.

Exception No. 1: On busway installations, fused switches and circuit breakers shall be permitted to be located at the same level as the busway. Suitable means shall be provided to operate the handle of the device from the floor.

Exception No. 2: Switches and circuit breakers installed adjacent to motors, appliances, or other equipment that they supply shall be permitted to be located higher than 2.0 m (6 ft 7 in.) and to be accessible by portable means.

Exception No. 3: Hookstick operable isolating switches shall be permitted at greater heights.

(B) Voltage Between Adjacent Devices. A snap switch shall not be grouped or ganged in enclosures with other snap switches, receptacles, or similar devices, unless they are arranged so that the voltage between adjacent devices does not exceed 300 volts, or unless they are installed in enclosures equipped with identified, securely installed barriers between adjacent devices.

(C) Multipole Snap Switches. A multipole, general-use snap switch shall not be permitted to be fed from more than a single circuit unless it is listed and marked as a two-circuit or three-circuit switch, or unless its voltage rating is not less than the nominal line-to-line voltage of the system supplying the circuits.

404.9 Provisions for General-Use Snap Switches.

(A) Faceplates. Faceplates provided for snap switches mounted in boxes and other enclosures shall be installed so

as to completely cover the opening and, where the switch is flush mounted, seat against the finished surface.

(B) Grounding. Snap switches, including dimmer and similar control switches, shall be connected to an equipment grounding conductor and shall provide a means to connect metal faceplates to the equipment grounding conductor, whether or not a metal faceplate is installed. Snap switches shall be considered to be part of an effective ground-fault current path if either of the following conditions is met:

- (1) The switch is mounted with metal screws to a metal box or metal cover that is connected to an equipment grounding conductor or to a nonmetallic box with integral means for connecting to an equipment grounding conductor.
- (2) An equipment grounding conductor or equipment bonding jumper is connected to an equipment grounding termination of the snap switch.

Exception to (B): Where no means exists within the snap-switch enclosure for connecting to the equipment grounding conductor or where the wiring method does not include or provide an equipment grounding conductor, a snap switch without a connection to an equipment grounding conductor shall be permitted for replacement purposes only. A snap switch wired under the provisions of this exception and located within reach of earth, grade, conducting floors, or other conducting surfaces shall be provided with a faceplate of nonconducting, noncombustible material or shall be protected by a ground-fault circuit interrupter.

(C) Construction. Metal faceplates shall be of ferrous metal not less than 0.76 mm (0.030 in.) in thickness or of nonferrous metal not less than 1.02 mm (0.040 in.) in thickness. Faceplates of insulating material shall be noncombustible and not less than 2.54 mm (0.010 in.) in thickness, but they shall be permitted to be less than 2.54 mm (0.010 in.) in thickness if formed or reinforced to provide adequate mechanical strength.

404.10 Mounting of Snap Switches.

~~(A) ((Surface-Type. Snap switches used with open wiring on insulators shall be mounted on insulating material that separates the conductors at least 13 mm (½ in.) from the surface wired over.)) Reserved.~~

(B) Box Mounted. Flush-type snap switches mounted in boxes that are set back of the finished surface as permitted in 314.20 shall be installed so that the extension plaster ears are seated against the surface. Flush-type snap switches mounted in boxes that are flush with the finished surface or project from it shall be installed so that the mounting yoke or strap of the switch is seated against the box.

404.11 Circuit Breakers as Switches. A hand-operable circuit breaker equipped with a lever or handle, or a power-operated circuit breaker capable of being opened by hand in the event of a power failure, shall be permitted to serve as a switch if it has the required number of poles.

FPN: See the provisions contained in 240.81 and 240.83.

404.12 Grounding of Enclosures. Metal enclosures for switches or circuit breakers shall be connected to an equipment grounding conductor as specified in Part IV of Article 250. Metal enclosures for switches or circuit breakers used as service equipment shall comply with the provisions of Part V of Article 250. Where nonmetallic enclosures are used with metal raceways or metal-armored cables, provision shall be made for connecting the equipment grounding conductor(s).

Except as covered in 404.9(B), Exception, nonmetallic boxes for switches shall be installed with a wiring method that provides or includes an equipment grounding conductor.

404.13 Knife Switches.

(A) Isolating Switches. Knife switches rated at over 1200 amperes at 250 volts or less, and at over 600 amperes at 251 to 600 volts, shall be used only as isolating switches and shall not be opened under load.

(B) To Interrupt Currents. To interrupt currents over 1200 amperes at 250 volts, nominal, or less, or over 600 amperes at 251 to 600 volts, nominal, a circuit breaker or a switch of special design listed for such purpose shall be used.

(C) General-Use Switches. Knife switches of ratings less than specified in 404.13(A) and (B) shall be considered general-use switches.

FPN: See the definition of *General-Use Switch* in Article 100.

(D) Motor-Circuit Switches. Motor-circuit switches shall be permitted to be of the knife-switch type.

FPN: See the definition of a *Motor-Circuit Switch* in Article 100.

(E) Interlocking. All switches shall be of the interlocking type to prevent the door from being opened when the circuit is energized. All switches used as service disconnecting means and those rated over 300 volts shall be of the two-way interlocking type.

For the purpose of this provision, “interlocking” means that the door is prevented from being opened when the switch is ON and prevents the switch from being turned ON when the door is open.

404.14 Rating and Use of Snap Switches. Snap switches shall be used within their ratings and as indicated in 404.14(A) through (E).

FPN No. 1: For switches on signs and outline lighting, see 600.6.

FPN No. 2: For switches controlling motors, see 430.83, 430.109, and 430.110.

(A) Alternating-Current General-Use Snap Switch. A form of general-use snap switch suitable only for use on ac circuits for controlling the following:

- (1) Resistive and inductive loads, including electric-discharge lamps, not exceeding the ampere rating of the switch at the voltage involved
- (2) Tungsten-filament lamp loads not exceeding the ampere rating of the switch at 120 volts
- (3) Motor loads not exceeding 80 percent of the ampere rating of the switch at its rated voltage

(B) Alternating-Current or Direct-Current General-Use Snap Switch. A form of general-use snap switch suitable for use on either ac or dc circuits for controlling the following:

- (1) Resistive loads not exceeding the ampere rating of the switch at the voltage applied.
- (2) Inductive loads not exceeding 50 percent of the ampere rating of the switch at the applied voltage. Switches rated in horsepower are suitable for controlling motor loads within their rating at the voltage applied.
- (3) Tungsten-filament lamp loads not exceeding the ampere rating of the switch at the applied voltage if T-rated.

(C) CO/ALR Snap Switches. Snap switches rated 20 amperes or less directly connected to aluminum conductors shall be listed and marked CO/ALR.

(D) Alternating-Current Specific-Use Snap Switches Rated for 347 Volts. Snap switches rated 347 volts ac shall be listed and shall be used only for controlling the loads permitted by (D)(1) and (D)(2).

(1) Noninductive Loads. Noninductive loads other than tungsten-filament lamps not exceeding the ampere and voltage ratings of the switch.

(2) Inductive Loads. Inductive loads not exceeding the ampere and voltage ratings of the switch. Where particular load characteristics or limitations are specified as a condition of the listing, those restrictions shall be observed regardless of the ampere rating of the load.

The ampere rating of the switch shall not be less than 15 amperes at a voltage rating of 347 volts ac. Flush-type snap switches rated 347 volts ac shall not be readily interchangeable in box mounting with switches identified in 404.14(A) and (B).

(E) Dimmer Switches. General-use dimmer switches shall be used only to control permanently installed incandescent luminaires unless listed for the control of other loads and installed accordingly.

II. Construction Specifications

404.15 Marking.

(A) Ratings. Switches shall be marked with the current, voltage, and, if horsepower rated, the maximum rating for which they are designed.

(B) Off Indication. Where in the off position, a switching device with a marked OFF position shall completely disconnect all ungrounded conductors to the load it controls.

404.16 600-Volt Knife Switches. Auxiliary contacts of a renewable or quick-break type or the equivalent shall be provided on all knife switches rated 600 volts and designed for use in breaking current over 200 amperes.

404.17 Fused Switches. A fused switch shall not have fuses in parallel except as permitted in 240.8.

404.18 Wire-Bending Space. The wire-bending space required by 404.3 shall meet Table 312.6(B) spacings to the enclosure wall opposite the line and load terminals.

ARTICLE 406 Receptacles, Cord Connectors, and Attachment Plugs (Caps)

406.1 Scope. This article covers the rating, type, and installation of receptacles, cord connectors, and attachment plugs (cord caps).

406.2 Receptacle Rating and Type.

(A) Receptacles. Receptacles shall be listed and marked with the manufacturer's name or identification and voltage and ampere ratings.

(B) Rating. Receptacles and cord connectors shall be rated not less than 15 amperes, 125 volts, or 15 amperes, 250 volts, and shall be of a type not suitable for use as lampholders.

FPN: See 210.21(B) for receptacle ratings where installed on branch circuits.

(C) Receptacles for Aluminum Conductors. Receptacles rated 20 amperes or less and designed for the direct connection of aluminum conductors shall be marked CO/ALR.

(D) Isolated Ground Receptacles. Receptacles incorporating an isolated grounding **conductor** connection intended for the reduction of electrical noise (electromagnetic interference) as permitted in 250.146(D) shall be identified by an orange triangle located on the face of the receptacle.

(1) Isolated Equipment Grounding Conductor Required. Receptacles so identified shall be used only with **equipment** grounding conductors that are isolated in accordance with 250.146(D).

410.12 Luminaires over Combustible Material. Lamp-holders installed over highly combustible material shall be of the unswitched type. Unless an individual switch is provided for each luminaire, lampholders shall be located at least 2.5 m (8 ft) above the floor or shall be located or guarded so that the lamps cannot be readily removed or damaged.

410.14 Luminaires in Show Windows. Chain-supported luminaires used in a show window shall be permitted to be externally wired. No other externally wired luminaires shall be used.

410.16 Luminaires in Clothes Closets.

(A) Luminaire Types Permitted. Listed luminaires of the following types shall be permitted to be installed in a closet:

- (1) A surface-mounted or recessed incandescent luminaire with a completely enclosed lamp
- (2) A surface-mounted or recessed fluorescent luminaire
- (3) Surface-mounted fluorescent or LED luminaires identified as suitable for installation within the storage area

(B) Luminaire Types Not Permitted. Incandescent luminaires with open or partially enclosed lamps and pendant luminaires or lampholders shall not be permitted.

(C) Location. The minimum clearance between luminaires installed in clothes closets and the nearest point of a storage space shall be as follows:

- (1) 300 mm (12 in.) for surface-mounted incandescent or LED luminaires with a completely enclosed light source installed on the wall above the door or on the ceiling
- (2) 150 mm (6 in.) for surface-mounted fluorescent luminaires installed on the wall above the door or on the ceiling
- (3) 150 mm (6 in.) for recessed incandescent or LED luminaires with a completely enclosed light source installed in the wall or the ceiling
- (4) 150 mm (6 in.) for recessed fluorescent luminaires installed in the wall or the ceiling
- (5) Surface-mounted fluorescent or LED luminaires shall be permitted to be installed within the storage space where identified for this use.

410.18 Space for Cove Lighting. Coves shall have adequate space and shall be located so that lamps and equipment can be properly installed and maintained.

III. Provisions at Luminaire Outlet Boxes, Canopies, and Pans

410.20 Space for Conductors. Canopies and outlet boxes taken together shall provide adequate space so that luminaire

conductors and their connecting devices can be properly installed.

410.21 Temperature Limit of Conductors in Outlet Boxes. Luminaires shall be of such construction or installed so that the conductors in outlet boxes shall not be subjected to temperatures greater than that for which the conductors are rated.

Branch-circuit wiring, other than 2-wire or multiwire branch circuits supplying power to luminaires connected together, shall not be passed through an outlet box that is an integral part of a luminaire unless the luminaire is identified for through-wiring.

FPN: See 410.65 for wiring supplying power to fixtures connected together.

410.22 Outlet Boxes to Be Covered. In a completed installation, each outlet box shall be provided with a cover unless covered by means of a luminaire canopy, lampholder, receptacle, or similar device.

410.23 Covering of Combustible Material at Outlet Boxes. Any combustible wall or ceiling finish exposed between the edge of a luminaire canopy or pan and an outlet box shall be covered with noncombustible material.

410.24 Connection of Electric-Discharge Luminaire.

(A) Independent of the Outlet Box. Electric-discharge luminaires supported independently of the outlet box shall be connected to the branch circuit through metal raceway, nonmetallic raceway, Type MC cable, Type AC cable, Type MI cable, nonmetallic sheathed cable, or by flexible cord as permitted in 410.62(B) or 410.62(C).

(B) Access to Boxes. Electric-discharge luminaires surface mounted over concealed outlet, pull, or junction boxes and designed not to be supported solely by the outlet box shall be provided with suitable openings in the back of the luminaire to provide access to the wiring in the box.

IV. Luminaire Supports

410.30 Supports.

(A) General. Luminaires and lampholders shall be securely supported. A luminaire that weighs more than 3 kg (6 lb) or exceeds 400 mm (16 in.) in any dimension shall not be supported by the screw shell of a lampholder.

(B) Metal or Nonmetallic Poles Supporting Luminaires. Metal or nonmetallic poles shall be permitted to be used to support luminaires and as a raceway to enclose supply conductors, provided the following conditions are met:

- (1) A pole shall have a handhole not less than 50 mm × 100 mm (2 in. × 4 in.) with a cover suitable for use in wet locations to provide access to the supply terminations within the pole or pole base.

Exception No. 1: No handhole shall be required in a pole 2.5 m (8 ft) or less in height abovegrade where the supply wiring method continues without splice or pull point, and where the interior of the pole and any splices are accessible by removing the luminaire.

Exception No. 2: No handhole shall be required in a pole 6.0 m (20 ft) or less in height abovegrade that is provided with a hinged base.

- (2) Where raceway risers or cable is not installed within the pole, a threaded fitting or nipple shall be brazed, welded, or attached to the pole opposite the handhole for the supply connection.
- (3) A metal pole shall be provided with an equipment grounding terminal as follows:
- A pole with a handhole shall have the equipment grounding terminal accessible from the handhole.
 - A pole with a hinged base shall have the equipment grounding terminal accessible within the base.

Exception to (3): No grounding terminal shall be required in a pole 2.5 m (8 ft) or less in height abovegrade where the supply wiring method continues without splice or pull, and where the interior of the pole and any splices are accessible by removing the luminaire.

- (4) A metal pole with a hinged base shall have the hinged base and pole bonded together.
- (5) Metal raceways or other equipment grounding conductors shall be bonded to the metal pole with an equipment grounding conductor recognized by 250.118 and sized in accordance with 250.122.
- (6) Conductors in vertical poles used as raceway shall be supported as provided in 300.19.

FPN: WAC 296-46B-410.030(2), which involves flexible cord connection requirements; this WAC requirement, is by this reference made part of the 2008 Seattle Electrical Code.

410.36 Means of Support.

(A) Outlet Boxes. Outlet boxes or fittings installed as required by 314.23 and complying with the provisions of 314.27(A) and 314.27(B) shall be permitted to support luminaires.

(B) Suspended Ceilings. Framing members of suspended ceiling systems used to support luminaires shall be securely fastened to each other and shall be securely attached to the building structure at appropriate intervals. Luminaires shall be securely fastened to the ceiling framing member by mechanical means such as bolts, screws, or rivets. Listed clips identified for use with the type of ceiling framing member(s) and luminaire(s) shall also be permitted.

(C) Luminaire Studs. Luminaire studs that are not a part of outlet boxes, hickeys, tripods, and crowfeet shall be made of steel, malleable iron, or other material suitable for the application.

(D) Insulating Joints. Insulating joints that are not designed to be mounted with screws or bolts shall have an exterior metal casing, insulated from both screw connections.

(E) Raceway Fittings. Raceway fittings used to support a luminaire(s) shall be capable of supporting the weight of the complete fixture assembly and lamp(s).

(F) Busways. Luminaires shall be permitted to be connected to busways in accordance with 368.17(C).

(G) Trees. Outdoor luminaires and associated equipment shall be permitted to be supported by trees.

FPN No. 1: See 225.26 for restrictions for support of overhead conductors.

FPN No. 2: See 300.5(D) for protection of conductors.

V. Grounding

410.40 General. Luminaires and lighting equipment shall be grounded as required in Article 250 and Part V of this article.

410.42 Exposed Luminaire.

(A) Exposed Conductive Parts. Exposed metal parts shall be connected to an equipment grounding conductor or insulated from the equipment grounding conductor and other conducting surfaces or be inaccessible to unqualified personnel. Lamp tie wires, mounting screws, clips, and decorative bands on glass spaced at least 38 mm (1½ in.) from lamp terminals shall not be required to be grounded.

(B) Made of Insulating Material. Luminaires directly wired or attached to outlets supplied by a wiring method that does not provide a ready means for grounding attachment to an equipment grounding conductor shall be made of insulating material and shall have no exposed conductive parts.

Exception No. 1: Replacement luminaires shall be permitted to connect an equipment grounding conductor from the outlet in compliance with 250.130(C). The luminaire shall then comply with 410.42(A).

Exception No. 2: Where no equipment grounding conductor exists at the outlet, replacement luminaires that are GFCI protected shall not be required to be connected to an equipment grounding conductor.

410.44 Equipment Grounding Conductor Attachment.

Luminaires with exposed metal parts shall be provided with a means for connecting an equipment grounding conductor for such luminaires.

(A) Mechanical Protection. Appropriate provisions shall be made to minimize the possibility of damage to transformers from external causes where the transformers are exposed to physical damage.

(B) Case or Enclosure. Dry-type transformers shall be provided with a noncombustible moisture-resistant case or enclosure that provides protection against the accidental insertion of foreign objects.

(C) Exposed Energized Parts. Switches or other equipment operating at 600 volts, nominal, or less and serving only equipment within a transformer enclosure shall be permitted to be installed in the transformer enclosure if accessible to qualified persons only. All energized parts shall be guarded in accordance with 110.27 and 110.34.

(D) Voltage Warning. The operating voltage of exposed live parts of transformer installations shall be indicated by signs or visible markings on the equipment or structures.

450.9 Ventilation. The ventilation shall be adequate to dispose of the transformer full-load losses without creating a temperature rise that is in excess of the transformer rating.

FPN No. 1: See ANSI/IEEE C57.12.00-1993, *General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers*, and ANSI/IEEE C57.12.01-1989, *General Requirements for Dry-Type Distribution and Power Transformers*.

FPN No. 2: Additional losses may occur in some transformers where nonsinusoidal currents are present, resulting in increased heat in the transformer above its rating. See ANSI/IEEE C57.110-1993, *Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents*, where transformers are utilized with nonlinear loads.

FPN No. 3: See Section 422 of the *Seattle Building Code* for vault ventilation system requirements.

Transformers with ventilating openings shall be installed so that the ventilating openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer.

450.10 Grounding. Where grounded, exposed non-current-carrying metal parts of transformer installations, including fences, guards, and so forth, shall be grounded and bonded under the conditions and in the manner specified for electrical equipment and other exposed metal parts in Parts V, VI, and VII of Article 250.

450.11 Marking. Each transformer shall be provided with a nameplate giving the name of the manufacturer, rated kilovolt-amperes, frequency, primary and secondary voltage, impedance of transformers 25 kVA and larger, required clearances for transformers with ventilating openings, and the amount and kind of insulating liquid where used. In addition, the nameplate of each dry-type transformer shall include the temperature class for the insulation system.

450.12 Terminal Wiring Space. The minimum wire-bending space at fixed, 600-volt and below terminals of transformer line and load connections shall be as required in 312.6. Wiring space for pigtail connections shall conform to Table 314.16(B).

450.13 Accessibility. All transformers and transformer vaults shall be readily accessible to qualified personnel for inspection and maintenance or shall meet the requirements of 450.13(A) or 450.13(B).

(A) Open Installations. Dry-type transformers 600 volts, nominal, or less, located in the open on walls, columns, or structures, shall not be required to be readily accessible.

(B) Hollow Space Installations. Dry-type transformers 600 volts, nominal, or less and not exceeding 50 kVA shall be permitted in hollow spaces of buildings not permanently closed in by structure, provided they meet the ventilation requirements of 450.9 and separation from combustible materials requirements of 450.21(A). Transformers so installed shall not be required to be readily accessible.

450.19 Locations and Construction.

(A) Location of Pad-Mounted Transformers. See Figures 450-1 and 450-2 in Section 450.27 of this Code.

(B) Total Underground Transformers. Openings in enclosures for total underground transformers shall not be located less than 3.0 m (10 ft) from a doorway, operable window, stairway or fire escape.

(C) Transformer Vault Construction. See Section 422 of the *Seattle Building Code* for construction requirements for public and private transformer vaults.

II. Specific Provisions Applicable to Different Types of Transformers

450.20 Rating of Dry-Type Transformers. Dry-type transformers shall be rated not less than the load served as determined in accordance with Article 220 of this Code.

450.21 Dry-Type Transformers Installed Indoors.

(A) Not over 112½ kVA. Dry-type transformers installed indoors and rated 112½ kVA or less shall have a separation of at least 300 mm (12 in.) from combustible material unless separated from the combustible material by a fire-resistant, heat-insulated barrier.

Exception: This rule shall not apply to transformers rated for 600 volts, nominal, or less that are completely enclosed, with or without ventilating openings.

(B) Over 112½ kVA. Individual dry-type transformers of more than 112½ kVA rating shall be installed in a transformer room of fire-resistant construction. Unless specified otherwise in this article, the term *fire resistant* means a construction having a minimum fire rating of 1 hour.

Exception No. 1: Transformers with Class 155 or higher insulation systems and separated from combustible material by a fire-resistant, heat-insulating barrier or by not less than 1.83 m (6 ft) horizontally and 3.7 m (12 ft) vertically.

Exception No. 2: Transformers with Class 155 or higher insulation systems and completely enclosed except for ventilating openings.

FPN: See ANSI/ASTM E119-1995, *Method for Fire Tests of Building Construction and Materials*, and NFPA 251-2006, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*.

(C) Over 35,000 Volts. Dry-type transformers rated over 35,000 volts shall be installed in a vault complying with Part III of this article.

450.22 Dry-Type Transformers Installed Outdoors. Dry-type transformers installed outdoors shall have a weatherproof enclosure.

Transformers exceeding 112½ kVA shall not be located within 300 mm (12 in.) of combustible materials of buildings unless the transformer has Class 155 insulation systems or

higher and is completely enclosed except for ventilating openings.

450.23 Less-Flammable Liquid-Insulated Transformers. Transformers insulated with listed less-flammable liquids that have a fire point of not less than 300°C shall be permitted to be installed in accordance with 450.23(A) or 450.23(B).

(A) Indoor Installations. Indoor installations shall be permitted in accordance with one of the following:

- (1) In Type I or Type II buildings, in areas where all of the following requirements are met:
 - a. The transformer is rated 35,000 volts or less.
 - b. No combustible materials are stored.
 - c. A liquid confinement area is provided.
 - d. The installation complies with all restrictions provided for in the listing of the liquid.
- (2) With an automatic fire extinguishing system and a liquid confinement area, provided the transformer is rated 35,000 volts or less
- (3) In accordance with 450.26

(B) Outdoor Installations. Less-flammable liquid-filled transformers shall be permitted to be installed outdoors, attached to, adjacent to, or on the roof of buildings, where installed in accordance with (1) or (2):

- (1) For Type I and Type II buildings, the installation shall comply with all restrictions provided for in the listing of the liquid.

FPN: Installations adjacent to combustible material, fire escapes, or door and window openings may require additional safeguards such as those listed in 450.27.

- (2) In accordance with 450.27.

FPN No. 1: As used in this section, *Type I and Type II buildings* refers to Type I and Type II building construction as defined in NFPA 220-2006, *Standard on Types of Building Construction*. *Combustible materials* refers to those materials not classified as noncombustible or limited-combustible as defined in NFPA 220-2006.

FPN No. 2: See definition of *Listed* in Article 100.

450.24 Nonflammable Fluid-Insulated Transformers. Transformers insulated with a dielectric fluid identified as nonflammable shall be permitted to be installed indoors or outdoors. Such transformers installed indoors and rated over 35,000 volts shall be installed in a vault. Such transformers installed indoors shall be furnished with a liquid confinement area and a pressure-relief vent. The transformers shall be furnished with a means for absorbing any gases generated by arcing inside the tank, or the pressure-relief vent shall be connected to a chimney or flue that will carry such gases to an environmentally safe area.

FPN: Safety may be increased if fire hazard analyses are performed for such transformer installations.

For the purposes of this section, a nonflammable dielectric fluid is one that does not have a flash point or fire point and is not flammable in air.

450.25 Askarel-Insulated Transformers Installed Indoors. Askarel-insulated transformers installed indoors and rated over 25 kVA shall be furnished with a pressure-relief vent. Where installed in a poorly ventilated place, they shall be furnished with a means for absorbing any gases generated by arcing inside the case, or the pressure-relief vent shall be

connected to a chimney or flue that carries such gases outside the building. Askarel-insulated transformers rated over 35,000 volts shall be installed in a vault.

450.26 Oil-Insulated Transformers Installed Indoors. Oil-insulated transformers installed indoors shall be installed in a vault constructed as specified in Section 422 of the *Seattle Building Code*. ~~((Part III of this article.))~~

*Exception No. 1: Where the total capacity does not exceed 112½ kVA, the vault specified in Section 422 of the *Seattle Building Code* ~~((Part III of this article))~~ shall be permitted to be constructed of reinforced concrete that is not less than 100 mm (4 in.) thick.*

Exception No. 2: Where the nominal voltage does not exceed 600, a vault shall not be required if suitable arrangements are made to prevent a transformer oil fire from igniting other materials and the total capacity in one location does not exceed 10 kVA in a section of the building classified as combustible or 75 kVA where the surrounding structure is classified as fire-resistant construction.

Exception No. 3: Electric furnace transformers that have a total rating not exceeding 75 kVA shall be permitted to be installed without a vault in a building or room of fire-resistant construction, provided suitable arrangements are made to prevent a transformer oil fire from spreading to other combustible material.

Exception No. 4: A transformer that has a total rating not exceeding 75 kVA and a supply voltage of 600 volts or less that is an integral part of charged-particle-accelerating equipment shall be permitted to be installed without a vault in a building or room of noncombustible or fire-resistant construction, provided suitable arrangements are made to prevent a transformer oil fire from spreading to other combustible material.

*Exception No. 5: Transformers shall be permitted to be installed in a detached building that does not comply with Section 422 of the *Seattle Building Code* ~~((Part III of this article))~~ if neither the building nor its contents present a fire hazard to any other building or property, and if the building is used only in supplying electric service and the interior is accessible only to qualified persons.*

Exception No. 6: Oil-insulated transformers shall be permitted to be used without a vault in portable and mobile surface mining equipment if each of the following conditions is met:

(a) Provision is made for containment of ~~((draining))~~ leaking fluid ~~((to the ground))~~.

(b) Safe egress is provided for personnel.

(c) A minimum 6-mm (¼-in.) steel barrier is provided for personnel protection.

450.27 Oil-Insulated Transformers Installed Outdoors. ~~((Combustible material, combustible buildings, and parts of buildings, fire escapes, and door and window openings shall be safeguarded from fires originating in oil-insulated transformers installed on roofs, attached to or adjacent to a building or combustible material.~~

~~In cases where the transformer installation presents a fire hazard, one or more of the following safeguards shall be applied according to the degree of hazard involved:~~

~~(1) Space separations~~

~~(2) Fire-resistant barriers~~

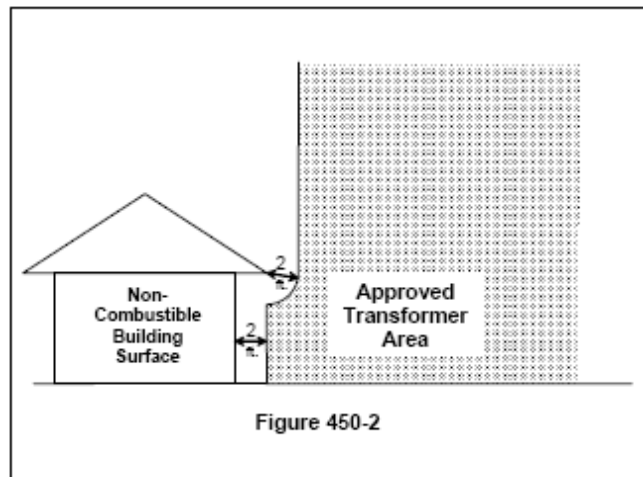
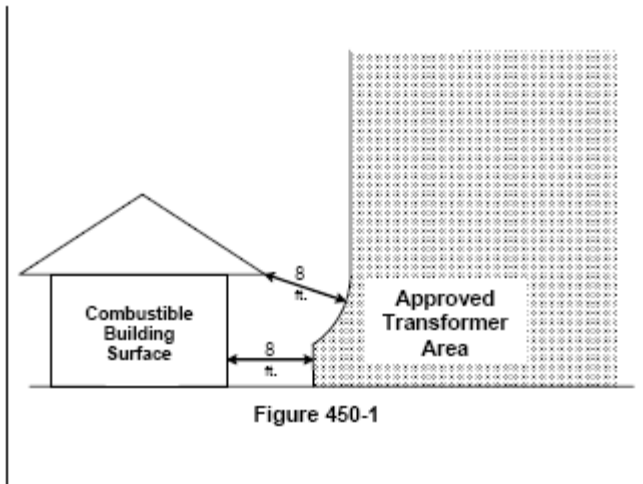
- (3) ~~Automatic fire suppression systems~~
 (4) ~~Enclosures that confine the oil of a ruptured transformer tank~~

Oil enclosures shall be permitted to consist of fire resistant dikes, curbed areas or basins, or trenches filled with coarse, crushed stone. Oil enclosures shall be provided with trapped drains where the exposure and the quantity of oil involved are such that removal of oil is important.

FPN: For additional information on transformers installed on poles or structures or underground, see ANSI C2-2007, *National Electrical Safety Code*.)

(A) Requirements. Oil-Insulated transformers installed outdoors shall meet the following requirements:

- (1) A transformer installed adjacent to a building or structure having a combustible surface shall be located no closer than 2.4 m (8 ft) to the building or structure and shall be outside a line extended vertically from the ends of the eaves or rooflines as illustrated in the shaded “Approved Transformer Area” shown in Figure 450-1;
- (2) A transformer installed adjacent to a building or structure with no combustible surface shall be located no closer than 610 mm (2 ft) to the building or structure and shall be outside a line extended vertically from the ends of the eaves or rooflines as illustrated in the shaded “Approved Transformer Area” shown in Figure 450-2.



- (3) A building or structure shall have no doorway, unprotected window, stairway or other openings closer than 3.0 m (10 ft) to the transformer;
- (4) The finished grade at the location of the transformer shall have a containment sill such that any oil leaking from a transformer will be contained. The containment sill shall be as high as necessary to contain the oil of one transformer but in no case less than 100 mm (4 in.) high.
- (5) If transformers are installed in areas subject to traffic other than pedestrian traffic, they shall be provided with adequate guarding.

(B) Locations. Openings in enclosures for total underground oil-filled transformers shall be located no closer than 3.0 m (10 ft) of a doorway, operable window, stairway or fire escape. Adequate space must be maintained above the enclosure so that a boom may be used to lift the transformer from the enclosure.

450.28 Modification of Transformers. When modifications are made to a transformer in an existing installation that change the type of the transformer with respect to Part II of this article, such transformer shall be marked to show the type of insulating liquid installed, and the modified transformer installation shall comply with the applicable requirements for that type of transformer.

III. Transformer Vaults

Sections 450.41 through 450.48 are not adopted. See Section 422 of the *Seattle Building Code* for transformer vault requirements.

~~(450.41 Location.~~ Vaults shall be located where they can be ventilated to the outside air without using flues or ducts wherever such an arrangement is practicable.

~~450.42 Walls, Roofs, and Floors.~~ The walls and roofs of vaults shall be constructed of materials that have adequate structural strength for the conditions with a minimum fire resistance of 3 hours. The floors of vaults in contact with the earth shall be of concrete that is not less than 100 mm (4 in.) thick, but where the vault is constructed with a vacant space or other stories below it, the floor shall have adequate structural strength for the load imposed thereon and a minimum fire resistance of 3 hours. For the purposes of this section, studs and wallboard construction shall not be acceptable.

~~Exception: Where transformers are protected with automatic sprinkler, water spray, carbon dioxide, or halon, construction of 1-hour rating shall be permitted.~~

FPN No. 1: For additional information, see ANSI/ASTM E119-1995, *Method for Fire Tests of Building Construction and Materials*, and NFPA 251-2006, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*.

FPN No. 2: A typical 3-hour construction is 150 mm (6 in.) thick reinforced concrete.

450.43 Doorways. Vault doorways shall be protected in accordance with 450.43(A), (B), and (C).

(A) Type of Door. Each doorway leading into a vault from the building interior shall be provided with a tight fitting door that has a minimum fire rating of 3 hours. The authority having jurisdiction shall be permitted to require such a door for an exterior wall opening where conditions warrant.

~~Exception: Where transformers are protected with automatic sprinkler, water spray, carbon dioxide, or halon, construction of 1-hour rating shall be permitted.~~

FPN: For additional information, see NFPA 80-2007, *Standard for Fire Doors and Other Opening Protectives*.

~~(B) Sills.~~ A door sill or curb that is of sufficient height to confine the oil from the largest transformer within the vault shall be provided, and in no case shall the height be less than 100 mm (4 in.).

~~(C) Locks.~~ Doors shall be equipped with locks, and doors shall be kept locked, access being allowed only to qualified persons. Personnel doors shall swing out and be equipped with panic bars, pressure plates, or other devices that are normally latched but open under simple pressure.

~~450.45 Ventilation Openings.~~ Where required by 450.9, openings for ventilation shall be provided in accordance with 450.45(A) through (F).

~~(A) Location.~~ Ventilation openings shall be located as far as possible from doors, windows, fire escapes, and combustible material.

~~(B) Arrangement.~~ A vault ventilated by natural circulation of air shall be permitted to have roughly half of the total area of openings required for ventilation in one or more openings near the floor and the remainder in one or more openings in the roof or in the sidewalls near the roof, or all of the area required for ventilation shall be permitted in one or more openings in or near the roof.

~~(C) Size.~~ For a vault ventilated by natural circulation of air to an outdoor area, the combined net area of all ventilating openings, after deducting the area occupied by screens, gratings, or louvers, shall not be less than 1900 mm² (3 in.²) per kVA of transformer capacity in service, and in no case shall the net area be less than 0.1 m² (1 ft²) for any capacity under 50 kVA.

~~(D) Covering.~~ Ventilation openings shall be covered with durable gratings, screens, or louvers, according to the treatment required in order to avoid unsafe conditions.

~~(E) Dampers.~~ All ventilation openings to the indoors shall be provided with automatic closing fire dampers that operate in response to a vault fire. Such dampers shall possess a standard fire rating of not less than 1½ hours.

FPN: See ANSI/UL 555-1995, *Standard for Fire Dampers*.

~~(F) Ducts.~~ Ventilating ducts shall be constructed of fire-resistant material.

~~450.46 Drainage.~~ Where practicable, vaults containing more than 100 kVA transformer capacity shall be provided with a drain or other means that will carry off any accumulation of oil or water in the vault unless local conditions make this impracticable. The floor shall be pitched to the drain where provided.

~~450.47 Water Pipes and Accessories.~~ Any pipe or duct system foreign to the electrical installation shall not enter or pass through a transformer vault. Piping or other facilities provided for vault fire protection, or for transformer cooling, shall not be considered foreign to the electrical installation.

~~450.48 Storage in Vaults.~~ Materials shall not be stored in transformer vaults.)

ARTICLE 455 Phase Converters

I. General

455.1 Scope. This article covers the installation and use of phase converters.

455.2 Definitions.

Manufactured Phase. The manufactured or derived phase originates at the phase converter and is not solidly connected to either of the single-phase input conductors.

Phase Converter. An electrical device that converts single-phase power to 3-phase electric power.

FPN: Phase converters have characteristics that modify the starting torque and locked-rotor current of motors served, and consideration is required in selecting a phase converter for a specific load.

Rotary-Phase Converter. A device that consists of a rotary transformer and capacitor panel(s) that permits the operation of 3-phase loads from a single-phase supply.

Static-Phase Converter. A device without rotating parts, sized for a given 3-phase load to permit operation from a single-phase supply.

455.3 Other Articles. Phase converters shall comply with this article and with the applicable provisions of other articles of this Code.

455.4 Marking. Each phase converter shall be provided with a permanent nameplate indicating the following:

- (1) Manufacturer's name
- (2) Rated input and output voltages
- (3) Frequency
- (4) Rated single-phase input full-load amperes
- (5) Rated minimum and maximum single load in kilovolt-amperes (kVA) or horsepower
- (6) Maximum total load in kilovolt-amperes (kVA) or horsepower
- (7) For a rotary-phase converter, 3-phase amperes at full load

455.5 Equipment Grounding Connection. A means for attachment of an equipment grounding conductor termination in accordance with 250.8 shall be provided.

455.6 Conductors.

(A) Ampacity. The ampacity of the single-phase supply conductors shall be determined by 455.6(A)(1) or (A)(2).

FPN: Single-phase conductors sized to prevent a voltage drop not exceeding 3 percent from the source of supply to the phase converter may help ensure proper starting and operation of motor loads.

(1) Variable Loads. Where the loads to be supplied are variable, the conductor ampacity shall not be less than 125 percent of the phase converter nameplate single-phase input full-load amperes.

system shall withstand the applied potential without electrical breakdown of a 1-minute, 900-volt dielectric strength test, or a 1-second, 1080-volt dielectric strength test, with all switches closed, between ungrounded and grounded conductors and the park trailer ground. During the test, all switches and other controls shall be in the on position. Fixtures, including luminaires, and permanently installed appliances shall not be required to withstand this test.

Each park trailer shall be subjected to the following:

- (1) A continuity test to ensure that all metal parts are properly bonded
- (2) Operational tests to demonstrate that all equipment is properly connected and in working order
- (3) Polarity checks to determine that connections have been properly made
- (4) Receptacles requiring GFCI protection shall be tested for correct function by the use of a GFCI testing device

(B) Low-Voltage Circuits. An operational test of low-voltage equipment is connected and in electrical working order. This test shall be performed in the final stages of production after all outer coverings and cabinetry have been secured.

ARTICLE 553 Floating Buildings

I. General

553.1 Scope. This article covers wiring, services, feeders, and grounding for floating buildings.

553.2 Definition.

Floating Building. A building unit as defined in Article 100 that floats on water, is moored in a permanent location, and has a premises wiring system served through connection by permanent wiring to an electrical supply system not located on the premises.

553.3 Application of Other Articles. Wiring for floating buildings shall comply with the applicable provisions of other articles of this *Code*, except as modified by this article.

II. Services and Feeders

553.4 Location of Service Equipment. The service equipment for a floating building shall be located adjacent to, but not in or on, the building or any floating structure.

Exception: In existing situations, the service may be located in or on the building only by special permission from the authority having jurisdiction.

553.5 Service Conductors. One set of service conductors shall be permitted to serve more than one set of service equipment.

553.6 Feeder Conductors. Each floating building shall be supplied by a single set of feeder conductors from its service equipment.

Exception: Where the floating building has multiple occupancy, each occupant shall be permitted to be supplied by a single set of feeder conductors extended from the occupant's service equipment to the occupant's panelboard.

553.7 Installation of Services and Feeders.

(A) Flexibility. Flexibility of the wiring system shall be maintained between floating buildings and the supply conductors. All wiring shall be installed so that motion of the water surface and changes in the water level will not result in unsafe conditions.

(B) Wiring Methods. Liquidtight flexible metal conduit or liquidtight flexible nonmetallic conduit with approved fittings shall be permitted for feeders and where flexible connections are required for services. Extra-hard usage portable power cable listed for both wet locations and sunlight resistance shall be permitted for a feeder to a floating building where flexibility is required. Other raceways suitable for the location shall be permitted to be installed where flexibility is not required.

FPN: See 555.1 and 555.13.

III. Grounding

553.8 General Requirements. Grounding at floating buildings shall comply with 553.8(A) through (D).

(A) Grounding of Electrical and Nonelectrical Parts. Grounding of both electrical and nonelectrical parts in a floating building shall be through connection to a grounding bus in the building panelboard.

(B) Installation and Connection of Equipment Grounding Conductor. The equipment grounding conductor shall be installed with the feeder conductors and connected to a grounding terminal in the service equipment.

(C) Identification of Equipment Grounding Conductor. The equipment grounding conductor shall be an insulated copper conductor with a continuous outer finish that is either green or green with one or more yellow stripes. For conductors larger than 6 AWG, or where multiconductor cables are used, re-identification of conductors as allowed in 250.119(A)(2)(2) and (A)(2)(3) or 250.119(B)(2) and (B)(3) shall be permitted.

(D) Grounding Electrode Conductor Connection. The grounding terminal in the service equipment shall be grounded by connection through an insulated grounding electrode conductor to a grounding electrode on shore.

553.9 Insulated Neutral. The grounded circuit conductor (neutral) shall be an insulated conductor identified in compliance with 200.6. The neutral conductor shall be connected to the equipment grounding terminal in the service equipment, and, except for that connection, it shall be insulated from the equipment grounding conductors, equipment enclosures, and all other grounded parts. The neutral conductor terminals in the panelboard and in ranges, clothes dryers, counter-mounted cooking units, and the like shall be insulated from the enclosures.

553.10 Equipment Grounding.

(A) Electrical Systems. All enclosures and exposed metal parts of electrical systems shall be connected to the grounding bus.

(B) Cord-Connected Appliances. Where required to be grounded, cord-connected appliances shall be grounded by means of an equipment grounding conductor in the cord and a grounding-type attachment plug.

553.11 Bonding of Non-Current-Carrying Metal Parts. All metal parts in contact with the water, all metal piping, and all non-current-carrying metal parts that may become energized shall be connected to the grounding bus in the panelboard.

ARTICLE 555 Marinas and Boatyards

555.1 Scope. This article covers the installation of wiring and equipment in the areas comprising fixed or floating piers, wharves, docks, and other areas in marinas, boatyards, boat basins, boathouses, yacht clubs, boat condominiums, docking facilities associated with residential condominiums, any multiple docking facility, or similar occupancies, and facilities that are used, or intended for use, for the purpose of repair, berthing, launching, storage, or fueling of small craft and the moorage of floating buildings.

Private, noncommercial docking facilities constructed or occupied for the use of the owner or residents of the associated single-family dwelling are not covered by this article.

FPN: See NFPA 303-2006, *Fire Protection Standard for Marinas and Boatyards*, for additional information.

555.2 Definitions.

Electrical Datum Plane. The electrical datum plane is defined as follows:

- (1) In land areas subject to tidal fluctuation, the electrical datum plane is a horizontal plane 606 mm (2 ft) above the highest tide level for the area occurring under normal circumstances, that is, highest high tide.
- (2) In land areas not subject to tidal fluctuation, the electrical datum plane is a horizontal plane 606 mm (2 ft) above the highest water level for the area occurring under normal circumstances.
- (3) The electrical datum plane for floating piers and landing stages that are (a) installed to permit rise and fall response to water level, without lateral movement, and (b) that are so equipped that they can rise to the datum plane established for (1) or (2), is a horizontal plane 762 mm (30 in.) above the water level at the floating pier or landing stage and a minimum of 305 mm (12 in.) above the level of the deck.

Marine Power Outlet. An enclosed assembly that can include receptacles, circuit breakers, fused switches, fuses, watt-hour meter(s), and monitoring means approved for marine use.

555.4 Distribution System. Yard and pier distribution systems shall not exceed 600 volts phase to phase.

555.5 Transformers. Transformers and enclosures shall be specifically approved for the intended location. The bottom of enclosures for transformers shall not be located below the electrical datum plane.

555.7 Location of Service Equipment. The service equipment for floating docks or marinas shall be located adjacent to, but not on or in, the floating structure.

555.9 Electrical Connections. Electrical connections shall be located at least 305 mm (12 in.) above the deck of a floating pier. Conductor splices, within approved junction boxes, utilizing sealed wire connector systems listed and identified for submersion shall be permitted where located above the waterline but below the electrical datum field for floating piers.

All electrical connections shall be located at least 305 mm (12 in.) above the deck of a fixed pier but not below the electrical datum plane.

555.10 Electrical Equipment Enclosures.

(A) Securing and Supporting. Electrical equipment enclosures installed on piers above deck level shall be securely and substantially supported by structural members, independent of any conduit connected to them. If enclosures are not attached to mounting surfaces by means of external ears or lugs, the internal screw heads shall be sealed to prevent seepage of water through mounting holes.

FPN: For various configurations and ratings of pin and sleeve receptacles, see ANSI/UL 1686, UL Standard for Safety Pin and Sleeve Configurations.

(B) Other Than Shore Power.

(1) Ground-Fault Circuit-Interrupter (GFCI) Protection for Personnel. Fifteen- and 20-ampere, single-phase, 125-volt receptacles installed outdoors, in boathouses, in buildings used for storage, maintenance, or repair where portable electrical hand tools, electrical diagnostic equipment, or portable lighting equipment are to be used shall be provided with GFCI protection for personnel. Receptacles in other locations shall be protected in accordance with 210.8(B).

(2) Marking. Receptacles other than those supplying shore power to boats shall be permitted to be housed in marine power outlets with the receptacles that provide shore power to boats, provided they are marked to clearly indicate that they are not to be used to supply power to boats.

555.21 Motor Fuel Dispensing Stations — Hazardous (Classified) Locations.

(A) General. Electrical wiring and equipment located at or serving motor fuel dispensing locations shall comply with Article 514 in addition to the requirements of this article. All electrical wiring for power and lighting shall be installed on the side of the wharf, pier, or dock opposite from the liquid piping system.

FPN: For additional information, see NFPA 303–2006, Fire Protection Standard for Marinas and Boatyards, and NFPA 30A-2008, Motor Fuel Dispensing Facilities and Repair Garages.

(B) Classification of Class I, Division 1 and 2 Areas. The following criteria shall be used for the purposes of applying Table 514.3(B)(1) and Table 514.3(B)(2) to motor fuel dispensing equipment on floating or fixed piers, wharfs, or docks.

(1) Closed Construction. Where the construction of floating docks, piers, or wharfs is closed so that there is no space between the bottom of the dock, pier, or wharf and the water, such as concrete enclosed expanded foam or similar construction, and having integral service boxes with supply chases, the following shall apply:

(a) The space above the surface of the floating dock, pier, or wharf shall be a Class I, Division 2 location with distances as identified in Table 514.3(B)(1), Dispenser and Outdoor.

(b) The space below the surface of the floating dock, pier, or wharf, having areas or enclosures such as tubs, voids, pits, vaults, boxes, depressions, fuel piping chases, or similar spaces where flammable liquid or vapor can accumulate, shall be a Class I, Division 1 location.

Exception No. 1: Dock, pier, or wharf sections that do not support fuel dispensers and abut but are 6.0 m (20 ft) or more from dock sections that support fuel dispenser(s) shall

be permitted to be Class I, Division 2 where documented air space is provided between dock sections to permit flammable liquids or vapors to dissipate and not travel to these dock sections. Such documentation shall comply with 500.4(A).

Exception No. 2: Dock, pier, or wharf sections that do not support fuel dispensers and do not directly abut sections that support fuel dispensers shall be permitted to be unclassified where documented air space is provided and where flammable liquids or vapors cannot travel to these dock sections. Such documentation shall comply with 500.4(A).

FPN: See 500.4(A) for documentation requirements.

(2) Open Construction. Where the construction of piers, wharfs, or docks is open, such as decks built on stringers supported by pilings, floats, pontoons, or similar construction, the following shall apply:

(a) The area 450 mm (18 in) above the surface of the dock, pier, or wharf and extending 6.0 m (20 ft) horizontally in all directions from the outside edge of the dispenser and down to the water level shall be Class I, Division 2.

(b) Enclosures such as tubs, voids, pits, vaults, boxes, depressions, piping chases, or similar spaces where flammable liquids or vapors can accumulate within 6.0 m (20 ft) of the dispenser shall be a Class I, Division 1 location.

555.22 Repair Facilities — Hazardous (Classified) Locations. Electrical wiring and equipment located at facilities for the repair of marine craft containing flammable or combustible liquids or gases shall comply with Article 511 in addition to the requirements of this article.

555.23 Marine Hoists, Railways, Cranes, and Monorails. Motors and controls for marine hoists, railways, cranes, and monorails shall not be located below the electrical datum plane. Where it is necessary to provide electric power to a mobile crane or hoist in the yard and a trailing cable is utilized, it shall be a listed portable power cable rated for the conditions of use and be provided with an outer jacket of distinctive color for safety.

555.24 Luminaires Required. All walkways over water shall be illuminated to provide safe access. All luminaires shall be listed for the use.

ARTICLE 590 Temporary Installations

590.1 Scope. The provisions of this article apply to temporary electric power and lighting installations.

590.2 All Wiring Installations.

(A) Other Articles. Except as specifically modified in this article, all other requirements of this Code for permanent wiring shall apply to temporary wiring installations.

(B) Approval. Temporary wiring methods shall be acceptable only if approved based on the conditions of use and any special requirements of the temporary installation.

590.3 Time Constraints.

(A) During the Period of Construction. Temporary electric power and lighting installations shall be permitted during the period of construction, remodeling, maintenance, repair, or demolition of buildings, structures, equipment, or similar activities.

(B) 90 Days. Temporary electric power and lighting installations shall be permitted for a period not to exceed 90 days for holiday decorative lighting and similar purposes.

(C) Emergencies and Tests. Temporary electric power and lighting installations shall be permitted during emergencies and for tests, experiments, and developmental work.

(D) Removal. Temporary wiring shall be removed immediately upon completion of construction or purpose for which the wiring was installed.

590.4 General.

(A) Services. Services shall be installed in conformance with Parts I through VIII of Article 230, as applicable.

(B) Feeders. Overcurrent protection shall be provided in accordance with 240.4, 240.5, 240.100, and 240.101. Feeders shall originate in an approved distribution center. Conductors shall be permitted within cable assemblies or within multiconductor cords or cables of a type identified in Table 400.4 for hard usage or extra-hard usage. For the purpose of this section, Type NM and Type NMC cables shall be permitted to be used in any dwelling, building, or structure without any height limitation or limitation by building construction type and without concealment within walls, floors, or ceilings.

Exception: Single insulated conductors shall be permitted where installed for the purpose(s) specified in 590.3(C), where accessible only to qualified persons.

(C) Branch Circuits. All branch circuits shall originate in an approved power outlet or panelboard. Conductors shall be permitted within cable assemblies or within multiconductor cord or cable of a type identified in Table 400.4 for hard usage or extra-hard usage. Conductors shall be protected from overcurrent as provided in 240.4, 240.5, and 240.100. For the purposes of this section, Type NM and Type NMC cables shall be permitted to be used in any dwelling, building, or structure without any height limitation or limitation by building construction type and without concealment within walls, floors, or ceilings.

Exception: Branch circuits installed for the purposes specified in 590.3(B) or 590.3(C) shall be permitted to be run

as single insulated conductors. Where the wiring is installed in accordance with 590.3(B), the voltage to ground shall not exceed 150 volts, the wiring shall not be subject to physical damage, and the conductors shall be supported on insulators at intervals of not more than 3.0 m (10 ft); or, for festoon lighting, the conductors shall be so arranged that excessive strain is not transmitted to the lampholders.

(D) Receptacles. All receptacles shall be of the grounding type. Unless installed in a continuous metal raceway that qualifies as an equipment grounding conductor in accordance with 250.118 or a continuous metal-covered cable that qualifies as an equipment grounding conductor in accordance with 250.118, all branch circuits shall include a separate equipment grounding conductor, and all receptacles shall be electrically connected to the equipment grounding conductor(s). Receptacles on construction sites shall not be installed on branch circuits that supply temporary lighting. Receptacles shall not be connected to the same ungrounded conductor of multiwire circuits that supply temporary lighting.

(E) Disconnecting Means. Suitable disconnecting switches or plug connectors shall be installed to permit the disconnection of all ungrounded conductors of each temporary circuit. Multiwire branch circuits shall be provided with a means to disconnect simultaneously all ungrounded conductors at the power outlet or panelboard where the branch circuit originated. Identified handle ties shall be permitted.

(F) Lamp Protection. All lamps for general illumination shall be protected from accidental contact or breakage by a suitable luminaire or lampholder with a guard.

Brass shell, paper-lined sockets, or other metal-cased sockets shall not be used unless the shell is grounded.

(G) Splices. On construction sites, a box shall not be required for splices or junction connections where the circuit conductors are multiconductor cord or cable assemblies, provided that the equipment grounding continuity is maintained with or without the box. See 110.14(B) and 400.9. A box, conduit body, or terminal fitting having a separately bushed hole for each conductor shall be used wherever a change is made to a conduit or tubing system or a metal-sheathed cable system.

(H) Protection from Accidental Damage. Flexible cords and cables shall be protected from accidental damage. Sharp corners and projections shall be avoided. Where passing through doorways or other pinch points, protection shall be provided to avoid damage.

(I) Termination(s) at Devices. Flexible cords and cables entering enclosures containing devices requiring termination shall be secured to the box with fittings designed for the purpose.

(J) Support. Cable assemblies and flexible cords and cables shall be supported in place at intervals that ensure that they will be protected from physical damage. Support shall be in the form of staples, cable ties, straps, or similar type fittings installed so as not to cause damage. Vegetation shall not be used for support of overhead spans of branch circuits or feeders.

Exception: For holiday lighting in accordance with 590.3(B), where the conductors or cables are arranged with proper strain relief devices, tension take-up devices, or other approved means to avoid damage from the movement of the live vegetation, trees shall be permitted to be used for support of overhead spans of branch-circuit conductors or cables.

590.5 Listing of Decorative Lighting. Decorative lighting used for holiday lighting and similar purposes, in accordance with 590.3(B), shall be listed.

590.6 Ground-Fault Protection for Personnel. Ground-fault protection for personnel for all temporary wiring installations shall be provided to comply with 590.6(A) and (B). This section shall apply only to temporary wiring installations used to supply temporary power to equipment used by personnel during construction, remodeling, maintenance, repair, or demolition of buildings, structures, equipment, or similar activities. This section shall apply to power derived from an electric utility company or from an on-site-generated power source.

(A) Receptacle Outlets. All 125-volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets that are not a part of the permanent wiring of the building or structure and that are in use by personnel shall have ground-fault circuit-interrupter protection for personnel. If a receptacle(s) is installed or exists as part of the permanent wiring of the building or structure and is used for temporary electric power, ground-fault circuit-interrupter protection for personnel shall be provided. For the purposes of this section, cord sets or devices incorporating listed ground-fault circuit-interrupter protection for personnel identified for portable use shall be permitted.

Exception: In industrial establishments only, where conditions of maintenance and supervision ensure that only qualified personnel are involved, an assured equipment grounding conductor program as specified in 590.6(B)(2)

shall be permitted for only those receptacle outlets used to supply equipment that would create a greater hazard if power were interrupted or having a design that is not compatible with GFCI protection.

(B) Use of Other Outlets. Receptacles other than 125-volt, single-phase, 15-, 20-, and 30-ampere receptacles shall have protection in accordance with (B)(1) or the assured equipment grounding conductor program in accordance with (B)(2).

(1) GFCI Protection. Ground-fault circuit-interrupter protection for personnel.

(2) Assured Equipment Grounding Conductor Program. A written assured equipment grounding conductor program continuously enforced at the site by one or more designated persons to ensure that equipment grounding conductors for all cord sets, receptacles that are not a part of the permanent wiring of the building or structure, and equipment connected by cord and plug are installed and maintained in accordance with the applicable requirements of 250.114, 250.138, 406.3(C), and 590.4(D).

(a) The following tests shall be performed on all cord sets, receptacles that are not part of the permanent wiring of the building or structure, and cord-and-plug-connected equipment required to be connected to an equipment grounding conductor:

- (1) All equipment grounding conductors shall be tested for continuity and shall be electrically continuous.
- (2) Each receptacle and attachment plug shall be tested for correct attachment of the equipment grounding conductor. The equipment grounding conductor shall be connected to its proper terminal.
- (3) All required tests shall be performed as follows:
 - a. Before first use on site
 - b. When there is evidence of damage
 - c. Before equipment is returned to service following any repairs
 - d. At intervals not exceeding 3 months

(b) The tests required in item (2)(a) shall be recorded and made available to the authority having jurisdiction.

590.7 Guarding. For wiring over 600 volts, nominal, suitable fencing, barriers, or other effective means shall be provided to limit access only to authorized and qualified personnel.

Chapter 6 Special Equipment

ARTICLE 600
Electric Signs and Outline Lighting

I. General

600.1 Scope. This article covers the installation of conductors and equipment for electric signs and outline lighting. All installations and equipment using neon tubing, such as signs, decorative elements, skeleton tubing, or art forms, are covered by this article.

FPN: WAC 296-46B-600.001, which addresses electric signs and outline lighting requirements is by this reference made part of the 2008 Seattle Electrical Code.

600.2 Definitions.

Electric-Discharge Lighting. Systems of illumination utilizing fluorescent lamps, high-intensity discharge (HID) lamps, or neon tubing.

Neon Tubing. Electric-discharge tubing manufactured into shapes that form letters, parts of letters, skeleton tubing, outline lighting, other decorative elements, or art forms, and filled with various inert gases.

Section Sign. A sign or outline lighting system, shipped as subassemblies, that requires field-installed wiring between the subassemblies to complete the overall sign. The subassemblies are either physically joined to form a single sign unit or are installed as separate remote parts of an overall sign.

Sign Body. A portion of a sign that may provide protection from the weather but is not an electrical enclosure.

Skeleton Tubing. Neon tubing that is itself the sign or outline lighting and not attached to an enclosure or sign body.

600.3 Listing. Electric signs, section signs, and outline lighting — fixed, mobile, or portable — shall be listed and installed in conformance with that listing, unless otherwise approved by special permission.

(A) Field-Installed Skeleton Tubing. Field-installed skeleton tubing shall not be required to be listed where installed in conformance with this Code.

(B) Outline Lighting. Outline lighting shall not be required to be listed as a system when it consists of listed luminaires wired in accordance with Chapter 3.

600.4 Markings.

(A) Signs and Outline Lighting Systems. Signs and outline lighting systems shall be marked with the manufacturer's

name, trademark, or other means of identification; and input voltage and current rating.

(B) Signs with Lampholders for Incandescent Lamps. Signs and outline lighting systems with lampholders for incandescent lamps shall be marked to indicate the maximum allowable lamp wattage per lampholder. The markings shall be permanently installed, in letters at least 6 mm (¼ in.) high, and shall be located where visible during relamping.

(C) Section Signs. Section signs shall be marked to indicate that field-wiring and installation instructions are required.

600.5 Branch Circuits.

(A) Required Branch Circuit. Each commercial building and each commercial occupancy accessible to pedestrians shall be provided with at least one outlet in an accessible location at each entrance to each tenant space for sign or outline lighting system use. The outlet(s) shall be supplied by a branch circuit rated at least 20 amperes that supplies no other load. Service hallways or corridors shall not be considered accessible to pedestrians.

(B) Rating. Branch circuits that supply signs shall be rated in accordance with 600.5(B)(1) or (B)(2).

(1) Incandescent and Fluorescent. Branch circuits that supply signs and outline lighting systems containing incandescent and fluorescent forms of illumination shall be rated not to exceed 20 amperes.

(2) Neon. Branch circuits that supply neon tubing installations shall not be rated in excess of 30 amperes.

(C) Wiring Methods. Wiring methods used to supply signs shall comply with 600.5(C)(1), (C)(2), and (C)(3).

(1) Supply. The wiring method used to supply signs and outline lighting systems shall terminate within a sign, an outline lighting system enclosure, a suitable box, or a conduit body.

(2) Enclosures as Pull Boxes. Signs and transformer enclosures shall be permitted to be used as pull or junction boxes for conductors supplying other adjacent signs, outline lighting systems, or floodlights that are part of a sign and shall be permitted to contain both branch and secondary circuit conductors.

(3) Metal or Nonmetallic Poles. Metal or nonmetallic poles used to support signs shall be permitted to enclose supply conductors, provided the poles and conductors are installed in accordance with 410.30(B).

600.6 Disconnects. Each sign and outline lighting system, or feeder circuit or branch circuit supplying a sign or outline lighting system, shall be controlled by an externally operable switch or circuit breaker that will open all ungrounded

conductors. Signs and outline lighting systems located within fountains shall have the disconnect located in accordance with 680.12.

Exception No. 1: A disconnecting means shall not be required for an exit directional sign located within a building.

Exception No. 2: A disconnecting means shall not be required for cord-connected signs with an attachment plug.

(A) Location.

(1) Within Sight of the Sign. The disconnecting means shall be within sight of the sign or outline lighting system that it controls. Where the disconnecting means is out of the line of sight from any section that is able to be energized, the disconnecting means shall be capable of being locked in the open position. The provision for locking or adding a lock to the disconnecting means must remain in place at the switch or circuit breaker whether the lock is installed or not. Portable means for adding a lock to the switch or circuit breaker shall not be permitted.

(2) Within Sight of the Controller. The following shall apply for signs or outline lighting systems operated by electronic or electromechanical controllers located external to the sign or outline lighting system:

- (1) The disconnecting means shall be permitted to be located within sight of the controller or in the same enclosure with the controller.
- (2) The disconnecting means shall disconnect the sign or outline lighting system and the controller from all ungrounded supply conductors.
- (3) The disconnecting means shall be designed such that no pole can be operated independently and shall be capable of being locked in the open position. The provisions for locking or adding a lock to the disconnecting means must remain in place at the switch or circuit breaker whether the lock is installed or not. Portable means for adding a lock to the switch or circuit breaker shall not be permitted.

(B) Control Switch Rating. Switches, flashers, and similar devices controlling transformers and electronic power supplies shall be rated for controlling inductive loads or have a current rating not less than twice the current rating of the transformer.

FPN: See 404.14 for rating of snap switches.

600.7 Grounding and Bonding.

(A) Grounding.

(1) Equipment Grounding. Signs and metal equipment of outline lighting systems shall be grounded by connection to the equipment grounding conductor of the supply branch circuit(s) or feeder using the types of equipment grounding conductors specified in 250.118.

Exception: Portable cord-connected signs shall not be required to be connected to the equipment grounding conductor where protected by a system of double insulation or its equivalent. Double insulated equipment shall be distinctively marked.

(2) Size of Equipment Grounding Conductor. The equipment grounding conductor size shall be in accordance with 250.122 based on the rating of the overcurrent device protecting the branch circuit or feeder conductors supplying the sign or equipment.

(3) Connections. Equipment grounding conductor connections shall be made in accordance with 250.130 and in a method specified in 250.8.

(4) Auxiliary Grounding Electrode. Auxiliary grounding electrode(s) shall be permitted for electric signs and outline lighting systems covered by this article and shall meet the requirements of 250.54.

(5) Metal Building Parts. Metal parts of a building shall not be permitted as a secondary return conductor or an equipment grounding conductor.

(B) Bonding.

(1) Bonding of Metal Parts. Metal parts and equipment of signs and outline lighting systems shall be bonded together and to the associated transformer or power-supply equipment grounding conductor of the branch circuit or feeder supplying the sign or outline lighting system and shall meet the requirements of 250.90.

(2) Bonding Connections. Bonding connections shall be made in accordance with 250.8.

(3) Metal Building Parts. Metal parts of a building shall not be permitted to be used as a means for bonding metal parts and equipment of signs or outline lighting systems together or to the transformer or power-supply equipment grounding conductor of the supply circuit.

(4) Flexible Metal Conduit Length. Listed flexible metal conduit or listed liquidtight flexible metal conduit that encloses the secondary circuit conductor from a transformer or power supply for use with neon tubing shall be permitted as a bonding means if the total accumulative length of the conduit in the secondary circuit does not exceed 30 m (100 ft).

(5) Small Metal Parts. Small metal parts not exceeding 50 mm (2 in.) in any dimension, not likely to be energized, and spaced at least 19 mm (¾ in.) from neon tubing, shall not require bonding.

(6) Nonmetallic Conduit. Where listed nonmetallic conduit is used to enclose the secondary circuit conductor from a transformer or power supply and a bonding conductor is required, the bonding conductor shall be installed separate and remote from the nonmetallic conduit and be spaced at least 38 mm (1½ in.) from the conduit when the circuit is operated at 100 Hz or less or 45 mm (1¾ in.) when the circuit is operated at over 100 Hz.

(7) Bonding Conductors. Bonding conductors shall comply with (a) and (b).

- (a) Bonding conductors shall be copper and not smaller than 14 AWG.
- (b) Bonding conductors installed externally of a sign or raceway shall be protected from physical damage.

(8) Signs in Fountains. Signs or outline lighting installed inside a fountain shall have all metal parts bonded to the equipment grounding conductor of the branch circuit for the fountain recirculating system. The bonding connection shall be as near as practicable to the fountain and shall be permitted to be made to metal piping systems that are bonded in accordance with 680.53.

FPN: Refer to 600.32(J) for restrictions on length of high-voltage secondary conductors.

600.8 Enclosures. Live parts, other than lamps, and neon tubing shall be enclosed. Transformers and power supplies provided with an integral enclosure, including a primary and secondary circuit splice enclosure, shall not require an additional enclosure.

- (A) Strength.** Enclosures shall have ample structural strength and rigidity.
- (B) Material.** Sign and outline lighting system enclosures shall be constructed of metal or shall be listed.
- (C) Minimum Thickness of Enclosure Metal.** Sheet copper or aluminum shall be at least 0.51 mm (0.020 in.) thick. Sheet steel shall be at least 0.41 mm (0.016 in.) thick.
- (D) Protection of Metal.** Metal parts of equipment shall be protected from corrosion.

600.9 Location.

- (A) Vehicles.** Sign or outline lighting system equipment shall be at least 4.3 m (14 ft) above areas accessible to vehicles unless protected from physical damage.
- (B) Pedestrians.** Neon tubing, other than dry-location portable signs, readily accessible to pedestrians shall be protected from physical damage.

FPN: See 600.41(D) for additional requirements.

(C) Adjacent to Combustible Materials. Signs and outline lighting systems shall be installed so that adjacent combustible materials are not subjected to temperatures in excess of 90°C (194°F).

The spacing between wood or other combustible materials and an incandescent or HID lamp or lampholder shall not be less than 50 mm (2 in.).

(D) Wet Location. Signs and outline lighting system equipment for wet location use, other than listed watertight type, shall be weatherproof and have drain holes, as necessary, in accordance with the following:

- (1) Drain holes shall not be larger than 13 mm (½ in.) or smaller than 6 mm (¼ in.).

- (2) Every low point or isolated section of the equipment shall have at least one drain hole.
- (3) Drain holes shall be positioned such that there will be no external obstructions.

(E) Clearance From High Voltage Power Lines. Signs and outline lighting shall have clearances from energized power lines in accordance with the following:

- (1) Proximity to Power Lines 750 Volts or Less. Signs and outline lighting shall be located no closer than 914 mm (3 ft) horizontally or 2.4 m (8 ft) vertically to overhead electrical conductors energized at 750 volts or less.
- (2) Proximity to Power Lines Over 750 Volts. Signs and outline lighting shall be located no closer than 3.0 m (10 ft) in any direction from overhead conductors energized at more than 750 volts.

FPN: In this section the term “overhead conductors” means any electrical conductor, either bare or insulated, installed above the ground except those conductors enclosed in iron pipe or other material covering of equal strength.

FPN: Also see Chapter 31 of the *Seattle Building Code* for regulation of signs.

600.10 Portable or Mobile Signs.

- (A) Support.** Portable or mobile signs shall be adequately supported and readily movable without the use of tools.
- (B) Attachment Plug.** An attachment plug shall be provided for each portable or mobile sign.
- (C) Wet or Damp Location.** Portable or mobile signs in wet or damp locations shall comply with 600.10(C)(1) and (C)(2).

(1) Cords. All cords shall be junior hard-service or hard-service types as designated in Table 400.4 and have an equipment grounding conductor.

(2) Ground-Fault Circuit Interrupter. Portable or mobile signs shall be provided with factory-installed ground-fault circuit-interrupter protection for personnel. The ground-fault circuit interrupter shall be an integral part of the attachment plug or shall be located in the power-supply cord within 300 mm (12 in.) of the attachment plug.

(D) Dry Location. Portable or mobile signs in dry locations shall meet the following:

- (1) Cords shall be SP-2, SPE-2, SPT-2, or heavier, as designated in Table 400.4.
- (2) The cord shall not exceed 4.5 m (15 ft) in length.

600.12 Field-Installed Secondary Wiring. Field-installed secondary circuit wiring for electric signs and outline lighting systems shall be in accordance with 600.12(A), (B), or (C).

(A) 1000 Volts or Less. Secondary circuit wiring of 1000 volts or less shall comply with 600.31.

including pendant controls, shall be bonded either by mechanical connections or bonding jumpers, where applicable, so that the entire crane or hoist is a ground-fault current path as required or permitted by Article 250, Parts V and VII.

Moving parts, other than removable accessories, or attachments that have metal-to-metal bearing surfaces, shall be considered to be electrically bonded to each other through bearing surfaces for grounding purposes. The trolley frame and bridge frame shall not be considered as electrically grounded through the bridge and trolley wheels and its respective tracks. A separate bonding conductor shall be provided.

ARTICLE 620
Elevators, Dumbwaiters, Escalators,
Moving Walks, Platform Lifts,
and Stairway Chairlifts

I. General

620.1 Scope. This article covers the installation of electrical equipment and wiring used in connection with elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts.

FPN No. 1: For further information, see ASME A17.1-2004, *Safety Code for Elevators and Escalators*.

FPN No. 2: For further information, see CSA B44.1-04/ASME-A17.5-2004, *Elevator and Escalator Electrical Equipment Certification Standard*.

FPN No. 3: The term *wheelchair lift* has been changed to platform lift. For further information, see ASME A18.1-2003, *Safety Standard for Platform Lifts and Stairway Lifts*.

FPN No. 4: See Chapter 7 of the *Seattle Building Code* for requirements to pressurize elevator hoistways and elevator lobbies.

FPN: No. 5: See Chapter 10 of the *Seattle Building Code* for requirements for elevators serving as an accessible means of egress component (in buildings that have a required accessible floor that is four or more stories above or below the level of exit discharge) and for pressurization of elevator lobbies used as an area of refuge.

FPN No. 6: See Chapter 30 of the *Seattle Building Code* for requirement that stretcher-sized elevator cars be supplied with power from a legally required standby or emergency system.

620.2 Definitions.

Control Room (for Elevator, Dumbwaiter). An enclosed control space outside the hoistway, intended for full bodily entry, that contains the elevator motor controller. The room could also contain electrical and/or mechanical equipment used directly in connection with the elevator or dumbwaiter but not the electric driving machine or the hydraulic machine.

Control Space (for Elevator, Dumbwaiter). A space inside or outside the hoistway, intended to be accessed with or without full bodily entry, that contains the elevator motor controller. This space could also contain electrical and/or mechanical equipment used directly in connection with the

elevator or dumbwaiter but not the electrical driving machine or the hydraulic machine.

Control System. The overall system governing the starting, stopping, direction of motion, acceleration, speed, and retardation of the moving member.

Controller, Motion. The electrical device(s) for that part of the control system that governs the acceleration, speed, retardation, and stopping of the moving member.

Controller, Motor. The operative units of the control system comprised of the starter device(s) and power conversion equipment used to drive an electric motor, or the pumping unit used to power hydraulic control equipment.

Controller, Operation. The electrical device(s) for that part of the control system that initiates the starting, stopping, and direction of motion in response to a signal from an operating device.

Machine Room (for Elevator, Dumbwaiter). An enclosed machinery space outside the hoistway, intended for full bodily entry, that contains the electrical driving machine or the hydraulic machine. The room could also contain electrical and/or mechanical equipment used directly in connection with the elevator or dumbwaiter.

Machinery Space (for Elevator, Dumbwaiter). A space inside or outside the hoistway, intended to be accessed with or without full bodily entry, that contains elevator or dumbwaiter mechanical equipment, and could also contain electrical equipment used directly in connection with the elevator or dumbwaiter. This space could also contain the electrical driving machine or the hydraulic machine.

Operating Device. The car switch, pushbuttons, key or toggle switch(s), or other devices used to activate the operation controller.

Remote Machine Room and Control Room (for Elevator, Dumbwaiter). A machine room or control room that is not attached to the outside perimeter or surface of the walls, ceiling, or floor of the hoistway.

Remote Machinery Space and Control Space (for Elevator, Dumbwaiter). A machinery space or control space that is not within the hoistway, machine room, or control room and that is not attached to the outside perimeter or surface of the walls, ceiling, or floor of the hoistway.

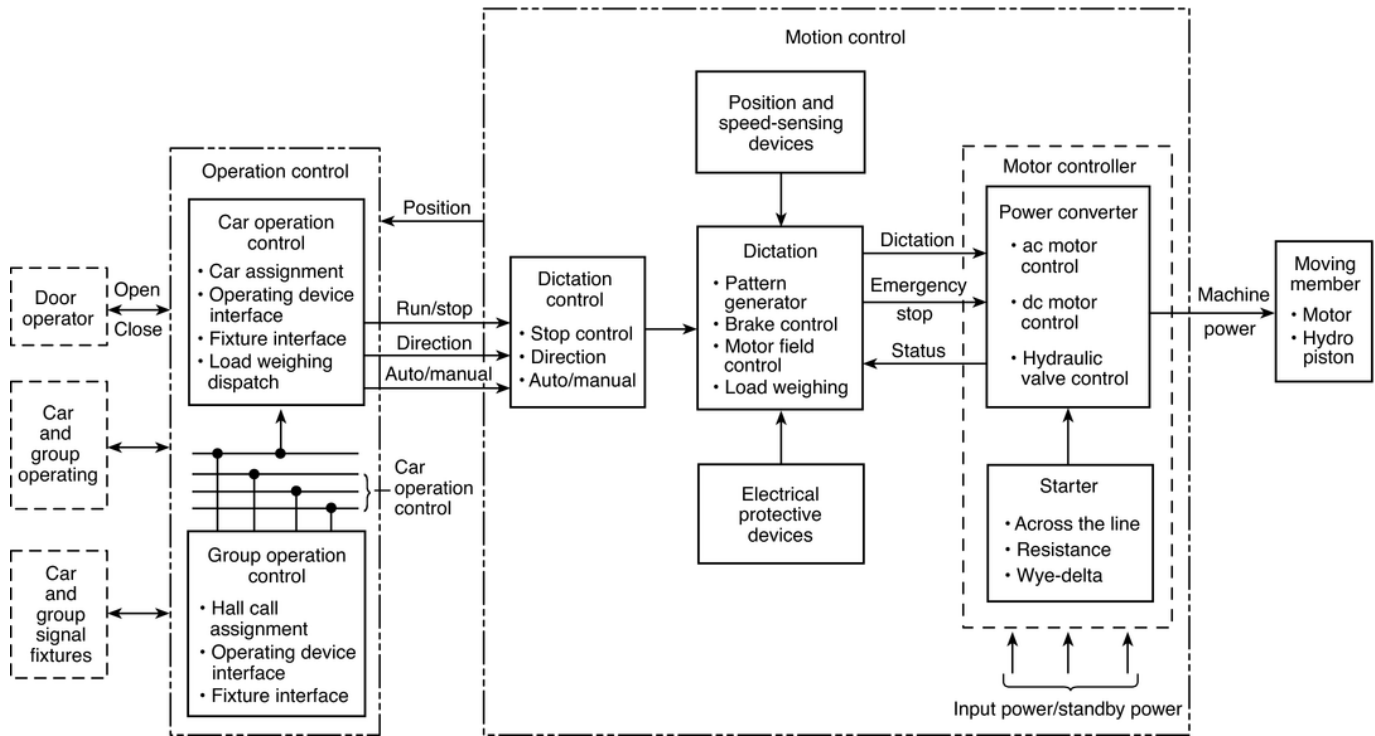
Signal Equipment. Includes audible and visual equipment such as chimes, gongs, lights, and displays that convey information to the user.

FPN No. 1: The motor controller, motion controller, and operation controller may be located in a single enclosure or a combination of enclosures.

FPN No. 2: FPN Figure 620.2 is for information only.

620.3 Voltage Limitations. The supply voltage shall not exceed 300 volts between conductors unless otherwise permitted in 620.3(A) through (C).

(A) Power Circuits. Branch circuits to door operator controllers and door motors and branch circuits and feeders to motor controllers, driving machine motors, machine



FPN Figure 620.2 Control System.

brakes, and motor-generator sets shall not have a circuit voltage in excess of 600 volts. Internal voltages of power conversion equipment and functionally associated equipment, and the operating voltages of wiring interconnecting the equipment, shall be permitted to be higher, provided that all such equipment and wiring shall be listed for the higher voltages. Where the voltage exceeds 600 volts, warning labels or signs that read “DANGER — HIGH VOLTAGE” shall be attached to the equipment and shall be plainly visible.

(B) Lighting Circuits. Lighting circuits shall comply with the requirements of Article 410.

(C) Heating and Air-Conditioning Circuits. Branch circuits for heating and air-conditioning equipment located on the elevator car shall not have a circuit voltage in excess of 600 volts.

620.4 Live Parts Enclosed. All live parts of electrical apparatus in the hoistways, at the landings, in or on the cars of elevators and dumbwaiters, in the wellways or the landings of escalators or moving walks, or in the runways and machinery spaces of platform lifts and stairway chairlifts shall be enclosed to protect against accidental contact.

FPN: See 110.27 for guarding of live parts (600 volts, nominal, or less).

620.5 Working Clearances. Working space shall be provided about controllers, disconnecting means, and other electrical equipment. The minimum working space shall be not less than that specified in ((110.26(A))) *Seattle Building Code Chapter 30*.

The clear working space in front of a disconnecting means shall be not less than 1220 mm (48 in.) in depth and 760 mm (30 in.) in width.

Elevator machine rooms are required to have not less than 2130 mm (84 in.) of headroom, per ASME A17.1, Rule 2.7.4.1.

~~((Where conditions of maintenance and supervision ensure that only qualified persons examine, adjust, service, and maintain the equipment, the clearance requirements of 110.26(A) shall be waived as permitted in 620.5(A) through (D)).~~

~~**(A) Flexible Connections to Equipment.** Electrical equipment in (A)(1) through (A)(4) shall be permitted to be provided with flexible leads to all external connections so that it can be repositioned to meet the clear working space requirements of 110.26(A):~~

- ~~(1) Controllers and disconnecting means for dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts installed in the same space with the driving machine~~
- ~~(2) Controllers and disconnecting means for elevators installed in the hoistway or on the car~~
- ~~(3) Controllers for door operators~~
- ~~(4) Other electrical equipment installed in the hoistway or on the car~~

~~**(B) Guards.** Live parts of the electrical equipment are suitably guarded, isolated, or insulated, and the equipment can be examined, adjusted, serviced, or maintained while energized without removal of this protection.~~

~~FPN: See definition of Exposed in Article 100.~~

~~(C) Examination, Adjusting, and Servicing.~~ Electrical equipment is not required to be examined, adjusted, serviced, or maintained while energized.

~~(D) Low Voltage.~~ Uninsulated parts are at a voltage not greater than 30 volts rms, 42 volts peak, or 60 volts dc.)

II. Conductors

620.11 Insulation of Conductors. The insulation of conductors shall comply with 620.11(A) through (D).

FPN: One method of determining that conductors are flame retardant is by testing the conductors to the VW-1 (Vertical-Wire) Flame Test in ANSI/UL 1581-2001, *Reference Standard for Electrical Wires, Cables, and Flexible Cords*.

(A) Hoistway Door Interlock Wiring. The conductors to the hoistway door interlocks from the hoistway riser shall be flame retardant and suitable for a temperature of not less than 200°C (392°F). Conductors shall be Type SF or equivalent.

(B) Traveling Cables. Traveling cables used as flexible connections between the elevator or dumbwaiter car or counterweight and the raceway shall be of the types of elevator cable listed in Table 400.4 or other approved types.

(C) Other Wiring. All conductors in raceways shall have flame-retardant insulation.

Conductors shall be Type MTW, TF, TFF, TFN, TFFN, THHN, THW, THWN, TW, XHHW, hoistway cable, or any other conductor with insulation designated as flame retardant. Shielded conductors shall be permitted if such conductors are insulated for the maximum nominal circuit voltage applied to any conductor within the cable or raceway system.

(D) Insulation. All conductors shall have an insulation voltage rating equal to at least the maximum nominal circuit voltage applied to any conductor within the enclosure, cable, or raceway. Insulations and outer coverings that are marked for limited smoke and are so listed shall be permitted.

620.12 Minimum Size of Conductors. The minimum size of conductors, other than conductors that form an integral part of control equipment, shall be in accordance with 620.12(A) and (B).

(A) Traveling Cables.

(1) Lighting Circuits. For lighting circuits, 14 AWG copper, 20 AWG copper or larger conductors shall be permitted in parallel, provided the ampacity is equivalent to at least that of 14 AWG copper.

(2) Other Circuits. For other circuits, 20 AWG copper.

(B) Other Wiring. 24 AWG copper. Smaller size listed conductors shall be permitted.

620.13 Feeder and Branch-Circuit Conductors. Conductors shall have an ampacity in accordance with 620.13(A) through (D). With generator field control, the conductor ampacity shall be based on the nameplate current

rating of the driving motor of the motor-generator set that supplies power to the elevator motor.

FPN No. 1: The heating of conductors depends on root-mean-square current values, which, with generator field control, are reflected by the nameplate current rating of the motor-generator driving motor rather than by the rating of the elevator motor, which represents actual but short-time and intermittent full-load current values.

FPN No. 2: See Figure 620.13.

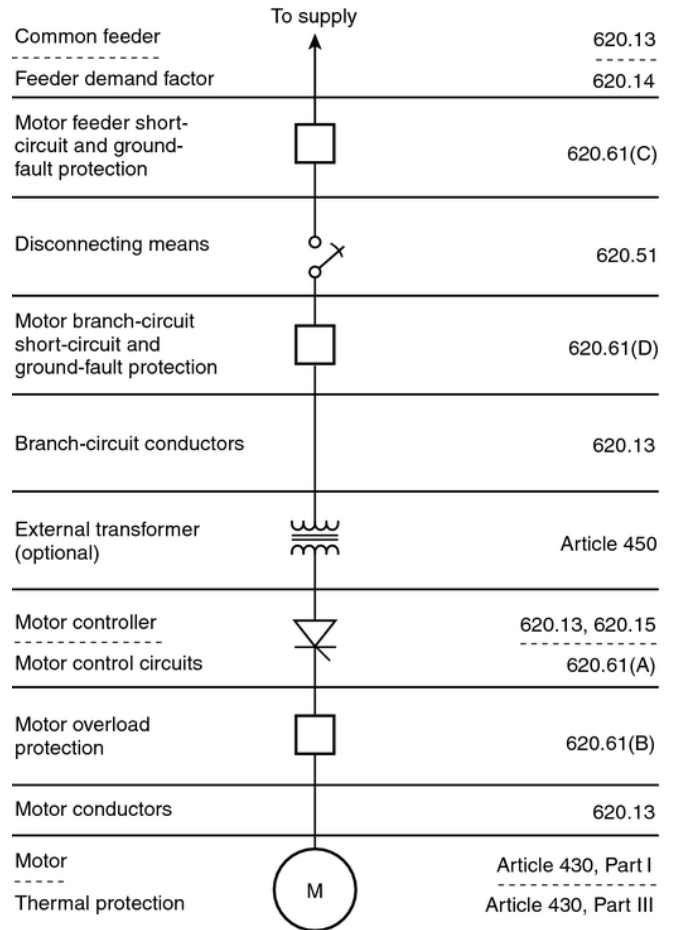


Figure 620.13 Single-Line Diagram.

(A) Conductors Supplying Single Motor. Conductors supplying a single motor shall have an ampacity not less than the percentage of motor nameplate current determined from 430.22(A) and (E).

FPN: Elevator motor currents, or those of similar functions, may exceed the nameplate value, but because they are inherently intermittent duty and the heating of the motor and conductors is dependent on the root-mean-square (rms) current value, conductors are sized for duty cycle service as shown in Table 430.22(E).

(B) Conductors Supplying a Single Motor Controller. Conductors supplying a single motor controller shall have an ampacity not less than the motor controller nameplate current rating, plus all other connected loads.

FPN: Motor controller nameplate current rating may be derived based on the rms value of the motor current using an intermittent duty cycle and other control system loads, if applicable.

(C) Conductors Supplying a Single Power Transformer. Conductors supplying a single power transformer shall have an ampacity not less than the nameplate current rating of the power transformer plus all other connected loads.

FPN No. 1: The nameplate current rating of a power transformer supplying a motor controller reflects the nameplate current rating of the motor controller at line voltage (transformer primary).

FPN No. 2: See Annex D, Example No. D10.

(D) Conductors Supplying More Than One Motor, Motor Controller, or Power Transformer. Conductors supplying more than one motor, motor controller, or power transformer shall have an ampacity not less than the sum of the nameplate current ratings of the equipment plus all other connected loads. The ampere ratings of motors to be used in the summation shall be determined from Table 430.22(E), 430.24 and 430.24, Exception No. 1.

FPN: See Annex D, Example Nos. D9 and D10.

620.14 Feeder Demand Factor. Feeder conductors of less ampacity than required by 620.13 shall be permitted, subject to the requirements of Table 620.14.

Table 620.14 Feeder Demand Factors for Elevators

Number of Elevators on a Single Feeder	Demand Factor
1	1.00
2	0.95
3	0.90
4	0.85
5	0.82
6	0.79
7	0.77
8	0.75
9	0.73
10 or more	0.72

FPN: Demand factors are based on 50 percent duty cycle (i.e., half time on and half time off).

620.15 Motor Controller Rating. The motor controller rating shall comply with 430.83. The rating shall be permitted to be less than the nominal rating of the elevator motor, when the controller inherently limits the available power to the motor and is marked as power limited.

FPN: For controller markings, see 430.8.

III. Wiring

620.21 Wiring Methods. Conductors and optical fibers located in hoistways, in escalator and moving walk wellways, in platform lifts, stairway chairlift runways, machinery spaces, control spaces, in or on cars, in machine rooms and control rooms, not including the traveling cables connecting the car or counterweight and hoistway wiring, shall be installed in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, rigid nonmetallic conduit, or wireways, ~~((or shall be Type MC, MI, or AC cable))~~

unless otherwise ~~((permitted))~~ specified in 620.21(A) through (C).

Type MC cable or Type MI cable may be permitted to be installed in elevator spaces only by special permission of the authority having jurisdiction.

(A) Elevators.

(1) Hoistways.

(a) Flexible metal conduit ~~((;))~~ or liquidtight flexible metal conduit ~~((; or liquidtight flexible nonmetallic conduit))~~ shall be permitted in hoistways between risers and limit switches, interlocks, operating buttons, and similar devices. Flexible conduit runs are limited to 1.8 m (6 ft) in length.

~~((Cables used in Class 2 power limited circuits shall be permitted to be installed between risers and signal equipment and operating devices, provided the cables are supported and protected from physical damage and are of a jacketed and flame retardant type.))~~ Feeders shall be permitted inside the hoistway for elevators with driving machine motors located in the hoistway or on the car or counterweight.

(c) Flexible cords and cables that are components of listed equipment and used in circuits operating at 30 volts rms or less or 42 volts dc or less shall be permitted in lengths not to exceed 1.8 m (6 ft), provided the cords and cables are supported and protected from physical damage and are of a jacketed and flame-retardant type.

(d) The following wiring methods shall be permitted in the hoistway in lengths not to exceed 1.8 m (6 ft):

- (1) Flexible metal conduit
- (2) Liquidtight flexible metal conduit
- ~~((3) Liquidtight flexible nonmetallic conduit))~~ Reserved
- ~~((4) Flexible cords and cables, or conductors grouped together and taped or corded, shall be permitted to be installed without a raceway. They shall be located to be protected from physical damage and shall be of a flame retardant type and shall be part of the following:~~
 - a. Listed equipment
 - b. A driving machine, or
 - c. A driving machine brake)) Reserved

(e) A sump pump or oil recovery pump located in the pit shall be permitted to be cord connected. The cord shall be a hard usage oil-resistant type, of a length not to exceed 1.8 m (6 ft), and shall be located to be protected from physical damage.

(f) Nonmetallic raceways and wireways shall not be installed in hoistways required to be of noncombustible fire-resistive construction.

(2) Cars.

(a) Flexible metal conduit, liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit of metric designator 12 (trade size 3/8), or larger, not exceeding ~~((1.8 m (6 ft))~~ 915 mm (3 ft) in length, shall be permitted on cars where so located as to be free from oil and if securely

fastened in place. Flexible conduit shall not be located where it can be walked on or damaged.

~~((Exception: Liquidtight flexible nonmetallic conduit of metric designator 12 (trade size 3/8), or larger, as defined by 356.2(2), shall be permitted in lengths in excess of 1.8 m (6 ft).))~~

(b) Hard-service cords and junior hard-service cords that conform to the requirements of Article 400 (Table 400.4) shall be permitted as flexible connections between the fixed wiring on the car and devices on the car doors or gates. Hard-service cords only shall be permitted as flexible connections for the portable-type top-of-car operating device or the car-top work lights. Devices or luminaires shall be grounded by means of an equipment grounding conductor run with the circuit conductors. Cables with smaller conductors and other types and thicknesses of insulation and jackets shall be permitted as flexible connections between the fixed wiring on the car and devices on the car doors or gates, if listed for this use.

~~(c) ((Flexible cords and cables that are components of listed equipment and used in circuits operating at 30 volts rms or less or 42 volts dc or less shall be permitted in lengths not to exceed 1.8 m (6 ft), provided the cords and cables are supported and protected from physical damage and are of a jacketed and flame retardant type.)) Nonmetallic raceways and wireways shall not be installed on cars located in hoistways required to be of noncombustible fire-resistive construction.~~

(d) The following wiring methods shall be permitted on the car assembly in lengths not to exceed ~~((1.8 m (6 ft)))~~ 915 mm (3 ft):

- (1) Flexible metal conduit
- (2) Liquidtight flexible metal conduit
- (3) Liquidtight flexible nonmetallic conduit
- (4) Flexible cords and cables, or conductors grouped together and taped or corded, shall be permitted to be installed without a raceway. They shall be located to be protected from physical damage and shall be of a flame-retardant type and shall be part of the following:
 - a. Listed equipment
 - b. A driving machine, or
 - c. A driving machine brake

(3) Within Machine Rooms, Control Rooms, and Machinery Spaces and Control Spaces.

(a) Flexible metal conduit, liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit of metric designator 12 (trade size 3/8), or larger, not exceeding 1.8 m (6 ft) in length, shall be permitted between control panels and machine motors, machine brakes, motor-generator sets, disconnecting means, and pumping unit motors and valves.

~~((Exception: Liquidtight flexible nonmetallic conduit metric designator 12 (trade size 3/8) or larger, as defined in 356.2(2), shall be permitted to be installed in lengths in excess of 1.8 m (6 ft).))~~

(b) Where motor-generators, machine motors, or pumping unit motors and valves are located adjacent to or

underneath control equipment and are provided with extra-length terminal leads not exceeding 1.8 m (6 ft) in length, such leads shall be permitted to be extended to connect directly to controller terminal studs without regard to the carrying-capacity requirements of Articles 430 and 445. Auxiliary gutters shall be permitted in machine and control rooms between controllers, starters, and similar apparatus.

(c) Flexible cords and cables that are components of listed equipment and used in circuits operating at 30 volts rms or less or 42 volts dc or less shall be permitted in lengths not to exceed 1.8 m (6 ft), provided the cords and cables are supported and protected from physical damage and are of a jacketed and flame-retardant type.

(d) On existing or listed equipment, conductors shall also be permitted to be grouped together and taped or corded without being installed in a raceway. Such cable groups shall be supported at intervals not over 900 mm (3 ft) and located so as to be protected from physical damage.

(e) Flexible cords and cables in lengths not to exceed 1.8 m (6 ft) that are of a flame-retardant type and located to be protected from physical damage shall be permitted in these rooms and spaces without being installed in a raceway. They shall be part of the following:

- (1) Listed equipment
- (2) A driving machine, or
- (3) A driving machine brake
- (4) **Counterweight.** The following wiring methods shall be permitted on the counterweight assembly in lengths not to exceed ~~((1.8 m (6 ft)))~~ 915 mm (3 ft):
 - (1) Flexible metal conduit
 - (2) Liquidtight flexible metal conduit
 - (3) Liquidtight flexible nonmetallic conduit
 - (4) Flexible cords and cables, or conductors grouped together and taped or corded, shall be permitted to be installed without a raceway. They shall be located to be protected from physical damage, shall be of a flame-retardant type, and shall be part of the following:
 - a. Listed equipment
 - b. A driving machine, or
 - c. A driving machine brake

(B) Escalators.

(1) Wiring Methods. Flexible metal conduit, liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit shall be permitted in escalator and moving walk wellways. Flexible metal conduit or liquidtight flexible conduit of metric designator 12 (trade size 3/8) shall be permitted in lengths not in excess of 1.8 m (6 ft).

Exception: Metric designator 12 (trade size 3/8), nominal, or larger liquidtight flexible nonmetallic conduit, as defined in 356.2(2), shall be permitted to be installed in lengths in excess of 1.8 m (6 ft).

~~**(2) ((Class 2 Circuit Cables. Cables used in Class 2 power-limited circuits shall be permitted to be installed within**~~

~~escalators and moving walkways, provided the cables are supported and protected from physical damage and are of a jacketed and flame-retardant type.)) Reserved.~~

(3) Flexible Cords. Hard-service cords that conform to the requirements of Article 400 (Table 400.4) shall be permitted as flexible connections on escalators and moving walk control panels and disconnecting means where the entire control panel and disconnecting means are arranged for removal from machine spaces as permitted in 620.5.

(C) Platform Lifts and Stairway Chairlift Raceways.

(1) Wiring Methods. Flexible metal conduit or liquidtight flexible metal conduit shall be permitted in platform lifts and stairway chairlift runways and machinery spaces. Flexible metal conduit or liquidtight flexible conduit of metric designator 12 (trade size $\frac{3}{8}$) shall be permitted in lengths not in excess of 1.8 m (6 ft).

Exception: Metric designator 12 (trade size $\frac{3}{8}$) or larger liquidtight flexible nonmetallic conduit, as defined in 356.2(2), shall be permitted to be installed in lengths in excess of 1.8 m (6 ft).

(2) Class 2 Circuit Cables. ~~((Cables))~~Traveling cables used in Class 2 power-limited circuits shall be permitted to be installed within platform lifts and stairway chairlift runways and machinery spaces, provided the cables are supported and protected from physical damage and are of a jacketed and flame-retardant type.

(3) Flexible Cords and Cables. Flexible cords and cables that are components of listed equipment and used in circuits operating at 30 volts rms or less or 42 volts dc or less shall be permitted in lengths not to exceed 1.8 m (6 ft), provided the cords and cables are supported and protected from physical damage and are of a jacketed and flame-retardant type.

620.22 Branch Circuits for Car Lighting, Receptacle(s), Ventilation, Heating, and Air-Conditioning.

(A) Car Light Source. A separate branch circuit shall supply the car lights, receptacle(s), auxiliary lighting power source, and ventilation on each elevator car. The overcurrent device protecting the branch circuit shall be located in the elevator machine room or control room/machinery space or control space.

Required lighting shall not be connected to the load side of a ground-fault circuit interrupter.

(B) Air-Conditioning and Heating Source. A dedicated branch circuit shall supply the air-conditioning and heating units on each elevator car. The overcurrent device protecting the branch circuit shall be located in the elevator machine room or control room/machinery space or control space.

620.23 Branch Circuits for Machine Room or Control Room/Machinery Space or Control Space Lighting and Receptacle(s).

(A) Separate Branch Circuit. A separate branch circuit shall supply the machine room or control room/machinery space or control space lighting and receptacle(s).

Required lighting shall not be connected to the load side of a ground-fault circuit interrupter.

(B) Lighting Switch. The machine room or control room/machinery space or control space lighting switch shall be located at the point of entry.

(C) Duplex Receptacle. At least one 125-volt, single-phase, 15- or 20-ampere duplex receptacle shall be provided in each machine room or control room and machinery space or control space.

FPN: See ASME A17.1-2004, *Safety Code for Elevators and Escalators*, for illumination levels.

620.24 Branch Circuit for Hoistway Pit Lighting and Receptacle(s).

(A) Separate Branch Circuit. A separate branch circuit shall supply the hoistway pit lighting and receptacle(s).

Required lighting shall not be connected to the load side of a ground-fault circuit interrupter.

(B) Lighting Switch. The lighting switch shall be so located as to be readily accessible from the pit access door.

(C) Duplex Receptacle. At least one 125-volt, single-phase, 15- or 20-ampere duplex receptacle shall be provided in the hoistway pit.

FPN: See ASME A17.1-2004, *Safety Code for Elevators and Escalators*, for illumination levels.

620.25 Branch Circuits for Other Utilization Equipment.

(A) Additional Branch Circuits. Additional branch circuit(s) shall supply utilization equipment not identified in 620.22, 620.23, and 620.24. Other utilization equipment shall be restricted to that equipment identified in 620.1.

(B) Overcurrent Devices. The overcurrent devices protecting the branch circuit(s) shall be located in the elevator machinery room or control room/machinery space or control space.

IV. Installation of Conductors

620.32 Metal Wireways and Nonmetallic Wireways. The sum of the cross-sectional area of the individual conductors in a wireway shall not be more than 50 percent of the interior cross-sectional area of the wireway.

Vertical runs of wireways shall be securely supported at intervals not exceeding 4.5 m (15 ft) and shall have not more than one joint between supports. Adjoining wireway sections shall be securely fastened together to provide a rigid joint.

620.33 Number of Conductors in Raceways. The sum of the cross-sectional area of the individual conductors in raceways shall not exceed 40 percent of the interior cross-sectional area of the raceway, except as permitted in 620.32 for wireways.

620.34 Supports. Supports for cables or raceways in a hoistway or in an escalator or moving walk wellway or platform lift and stairway chairlift runway shall be securely fastened to the guide rail; escalator or moving walk truss; or to the hoistway, wellway, or runway construction.

620.35 Auxiliary Gutters. Auxiliary gutters shall not be subject to the restrictions of 366.12(2) covering length or of 366.22 covering number of conductors.

620.36 Different Systems in One Raceway or Traveling Cable. Optical fiber cables and conductors for operating devices, operation and motion control, power, signaling, fire alarm, lighting, heating, and air-conditioning circuits of 600 volts or less shall be permitted to be run in the same traveling cable or raceway system if all conductors are insulated for the maximum voltage applied to any conductor within the cables or raceway system and if all live parts of the equipment are insulated from ground for this maximum voltage. Such a traveling cable or raceway shall also be permitted to include shielded conductors and/or one or more coaxial cables if such conductors are insulated for the maximum voltage applied to any conductor within the cable or raceway system. Conductors shall be permitted to be covered with suitable shielding for telephone, audio, video, or higher frequency communications circuits.

620.37 Wiring in Hoistways, Machine Rooms, Control Rooms, Machinery Spaces, and Control Spaces.

(A) Uses Permitted. Only such electrical wiring, raceways, and cables used directly in connection with the elevator or dumbwaiter, including wiring for signals, for communication with the car, for lighting, heating, air conditioning, and ventilating the elevator car, for fire detecting systems, for pit sump pumps, and for heating, lighting, and ventilating the hoistway, shall be permitted inside the hoistway, machine rooms, control rooms, machinery spaces, and control spaces.

(B) Lightning Protection. Bonding of elevator rails (car and/or counterweight) to a lightning protection system grounding down conductor(s) shall be permitted. The lightning protection system grounding down conductor(s) shall not be located within the hoistway. Elevator rails or other hoistway equipment shall not be used as the grounding down conductor for lightning protection systems.

FPN: See 250.106 for bonding requirements. For further information, see NFPA 780-2008, *Standard for the Installation of Lightning Protection Systems*.

(C) Main Feeders. Main feeders for supplying power to elevators and dumbwaiters shall be installed outside the hoistway unless as follows:

(1) By special permission, feeders for elevators shall be permitted within an existing hoistway if no conductors are spliced within the hoistway.

(2) Feeders shall be permitted inside the hoistway for elevators with driving machine motors located in the hoistway or on the car or counterweight.

620.38 Electrical Equipment in Garages and Similar Occupancies. Electrical equipment and wiring used for elevators, dumbwaiters, escalators, moving walks, and platform lifts and stairway chairlifts in garages shall comply with the requirements of Article 511.

FPN: Garages used for parking or storage and where no repair work is done in accordance with 511.3 are not classified.

V. Traveling Cables

620.41 Suspension of Traveling Cables. Traveling cables shall be suspended at the car and hoistways' ends, or counterweight end where applicable, so as to reduce the strain on the individual copper conductors to a minimum.

Traveling cables shall be supported by one of the following means:

- (1) By their steel supporting member(s)
- (2) By looping the cables around supports for unsupported lengths less than 30 m (100 ft)
- (3) By suspending from the supports by a means that automatically tightens around the cable when tension is increased for unsupported lengths up to 60 m (200 ft)

FPN: Unsupported length for the hoistway suspension means is that length of cable as measured from the point of suspension in the hoistway to the bottom of the loop, with the elevator car located at the bottom landing. Unsupported length for the car suspension means is that length of cable as measured from the point of suspension on the car to the bottom of the loop, with the elevator car located at the top landing.

620.42 Hazardous (Classified) Locations. In hazardous (classified) locations, traveling cables shall be of a type approved for hazardous (classified) locations and shall comply with 501.140, 502.140, or 503.140, as applicable.

620.43 Location of and Protection for Cables. Traveling cable supports shall be located so as to reduce to a minimum the possibility of damage due to the cables coming in contact with the hoistway construction or equipment in the hoistway. Where necessary, suitable guards shall be provided to protect the cables against damage.

620.44 Installation of Traveling Cables. Traveling cables that are suitably supported and protected from physical damage shall be permitted to be run without the use of a raceway in either or both of the following:

(a) When used inside the hoistway, on the elevator car, hoistway wall, counterweight, or controllers and machinery that are located inside the hoistway, provided the cables are in the original sheath.

(b) From inside the hoistway, to elevator controller enclosures and to elevator car and machine room, control room, machinery space, and control space connections that are located outside the hoistway for a distance not exceeding 1.8 m (6 ft) in length as measured from the first point of

support on the elevator car or hoistway wall, or counterweight where applicable, provided the conductors are ~~((grouped together and taped or corded, or))~~ in the original sheath. These traveling cables shall be permitted to be continued to this equipment.

VI. Disconnecting Means and Control

620.51 Disconnecting Means. A single means for disconnecting all ungrounded main power supply conductors for each unit shall be provided and be designed so that no pole can be operated independently. Where multiple driving machines are connected to a single elevator, escalator, moving walk, or pumping unit, there shall be one disconnecting means to disconnect the motor(s) and control valve operating magnets.

The disconnecting means for the main power supply conductors shall not disconnect the branch circuit required in 620.22, 620.23, and 620.24.

(A) Type. The disconnecting means shall be an enclosed externally operable fused motor circuit switch or circuit breaker capable of being locked in the open position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed. Portable means for adding a lock to the switch or circuit breaker shall not be permitted as the means required to be installed at and remain with the equipment.

The disconnecting means shall be a listed device.

FPN: For additional information, see ASME A17.1-2004, *Safety Code for Elevators and Escalators*.

Exception No. 1: Where an individual branch circuit supplies a platform lift, the disconnecting means required by 620.51(C)(4) shall be permitted to comply with 430.109(C). This disconnecting means shall be listed and shall be capable of being locked in the open position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed. Portable means for adding a lock to the switch or circuit breaker shall not be permitted as the means required to be installed at and remain with the equipment.

Exception No. 2: Where an individual branch circuit supplies a stairway chairlift, the stairway chairlift shall be permitted to be cord-and-plug-connected, provided it complies with 422.16(A) and the cord does not exceed 1.8 m (6 ft) in length.

(B) Operation. No provision shall be made to open or close this disconnecting means from any other part of the premises. If sprinklers are installed in hoistways, machine rooms, control rooms, machinery spaces, or control spaces, the disconnecting means shall be permitted to ~~((automatically))~~ open the power supply to the affected elevator(s) prior to the

application of water. No provision shall be made to automatically close this disconnecting means. Power shall only be restored by manual means.

FPN: To reduce hazards associated with water on live elevator electrical equipment.

(C) Location. The disconnecting means shall be located where it is readily accessible to qualified persons.

(1) On Elevators Without Generator Field Control. On elevators without generator field control, the disconnecting means shall be located within sight of the motor controller. Where the motor controller is located in the elevator hoistway, the disconnecting means required by 620.51(A) shall be located in a machinery space, machine room, control space or control room outside the hoistway; and an additional, non-fused enclosed externally operable motor circuit switch capable of being locked in the open position to disconnect all ungrounded main power-supply conductors shall be located within sight of the motor controller. The additional switch shall be a listed device and shall comply with 620.91(C).

The provision for locking or adding a lock to the disconnecting means, required by this section, shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed. Portable means for adding a lock to the switch or circuit breaker shall not be permitted.

Driving machines or motion and operation controllers not within sight of the disconnecting means shall be provided with a manually operated switch installed in the control circuit to prevent starting. The manually operated switch(es) shall be installed adjacent to this equipment.

Where the driving machine of an electric elevator or the hydraulic machine of a hydraulic elevator is located in a remote machine room or remote machinery space, a single means for disconnecting all ungrounded main power-supply conductors shall be provided and be capable of being locked in the open position.

(2) On Elevators with Generator Field Control. On elevators with generator field control, the disconnecting means shall be located within sight of the motor controller for the driving motor of the motor-generator set. Driving machines, motor-generator sets, or motion and operation controllers not within sight of the disconnecting means shall be provided with a manually operated switch installed in the control circuit to prevent starting. The manually operated switch(es) shall be installed adjacent to this equipment.

Where the driving machine or the motor-generator set is located in a remote machine room or remote machinery space, a single means for disconnecting all ungrounded main power-supply conductors shall be provided and be capable of being locked in the open position.

(3) On Escalators and Moving Walks. On escalators and moving walks, the disconnecting means shall be installed in the space where the controller is located.

(4) On Platform Lifts and Stairway Chairlifts. On platform lifts and stairway chairlifts, the disconnecting means shall be located within sight of the motor controller.

(D) Identification and Signs. Where there is more than one driving machine in a machine room, the disconnecting means shall be numbered to correspond to the identifying number of the driving machine that they control.

The disconnecting means shall be provided with a sign to identify the location of the supply side overcurrent protective device.

(E) Automatic Power Disconnect Device Control Circuit. The control circuit for a required automatic power disconnect device or shunt trip shall be derived either from:

(1) Within the disconnecting means enclosure when the shunt trip circuit equipment is a part of the listed assembly and the control-circuit controls only the disconnect(s) within the listed equipment; or

(2) A dedicated circuit from an appropriate panelboard located in the machine room.

620.52 Power from More Than One Source.

(A) Single-Car and Multicar Installations. On single-car and multicar installations, equipment receiving electrical power from more than one source shall be provided with a disconnecting means for each source of electrical power. The disconnecting means shall be within sight of the equipment served.

(B) Warning Sign for Multiple Disconnecting Means. Where multiple disconnecting means are used and parts of the controllers remain energized from a source other than the one disconnected, a warning sign shall be mounted on or next to the disconnecting means. The sign shall be clearly legible and shall read as follows:

WARNING
PARTS OF THE CONTROLLER ARE NOT
DE-ENERGIZED BY THIS SWITCH.

(C) Interconnection Multicar Controllers. Where interconnections between controllers are necessary for the operation of the system on multicar installations that remain energized from a source other than the one disconnected, a warning sign in accordance with 620.52(B) shall be mounted on or next to the disconnecting means.

620.53 Car Light, Receptacle(s), and Ventilation Disconnecting Means. Elevators shall have a single means for disconnecting all ungrounded car light, receptacle(s), and ventilation power-supply conductors for that elevator car.

The disconnecting means shall be an enclosed externally operable fused motor circuit switch or circuit breaker capable of being locked in the open position and shall be located in the machine room or control room for that elevator car. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place

with or without the lock installed. Portable means for adding a lock to the switch or circuit breaker shall not be permitted as the means required to be installed at and remain with the equipment. Where there is no machine room or control room, the disconnecting means shall be located in a machinery space or control space outside the hoistway that is readily accessible to only qualified persons.

Disconnecting means shall be numbered to correspond to the identifying number of the elevator car whose light source they control.

The disconnecting means shall be provided with a sign to identify the location of the supply side overcurrent protective device.

620.54 Heating and Air-Conditioning Disconnecting Means. Elevators shall have a single means for disconnecting all ungrounded car heating and air-conditioning power-supply conductors for that elevator car.

The disconnecting means shall be an enclosed externally operable fused motor circuit switch or circuit breaker capable of being locked in the open position and shall be located in the machine room or control room for that elevator car. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed. Portable means for adding a lock to the switch or circuit breaker shall not be permitted as the means required to be installed at and remain with the equipment. Where there is no machine room or control room, the disconnecting means shall be located in a machinery space or control space outside the hoistway that is readily accessible to only qualified persons.

Where there is equipment for more than one elevator car in the machine room, the disconnecting means shall be numbered to correspond to the identifying number of the elevator car whose heating and air-conditioning source they control.

The disconnecting means shall be provided with a sign to identify the location of the supply side overcurrent protective device.

620.55 Utilization Equipment Disconnecting Means. Each branch circuit for other utilization equipment shall have a single means for disconnecting all ungrounded conductors. The disconnecting means shall be capable of being locked in the open position and shall be located in the machine room or control room/machine space or control space. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed. Portable means for adding a lock to the switch or circuit breaker shall not be permitted as the means required to be installed at and remain with the equipment.

Where there is more than one branch circuit for other utilization equipment, the disconnecting means shall be numbered to correspond to the identifying number of the equipment served. The disconnecting means shall be

provided with a sign to identify the location of the supply side overcurrent protective device.

VII. Overcurrent Protection

620.61 Overcurrent Protection. Overcurrent protection shall be provided in accordance with 620.61(A) through (D)

(A) Operating Devices and Control and Signaling Circuits. Operating devices and control and signaling circuits shall be protected against overcurrent in accordance with the requirements of 725.43 and 725.45.

Class 2 power-limited circuits shall be protected against overcurrent in accordance with the requirements of Chapter 9, Notes to Tables 11(A) and 11(B).

(B) Overload Protection for Motors. Motor and branch-circuit overload protection shall conform to Article 430, Part III, and (B)(1) through (B)(4).

(1) Duty Rating on Elevator, Dumbwaiter, and Motor-Generator Sets Driving Motors. Duty on elevator and dumbwaiter driving machine motors and driving motors of motor-generators used with generator field control shall be rated as intermittent. Such motors shall be permitted to be protected against overload in accordance with 430.33.

(2) Duty Rating on Escalator Motors. Duty on escalator and moving walk driving machine motors shall be rated as continuous. Such motors shall be protected against overload in accordance with 430.32.

(3) Overload Protection. Escalator and moving walk driving machine motors and driving motors of motor-generator sets shall be protected against running overload as provided in Table 430.37.

(4) Duty Rating and Overload Protection on Platform Lift and Stairway Chairlift Motors. Duty on platform lift and stairway chairlift driving machine motors shall be rated as intermittent. Such motors shall be permitted to be protected against overload in accordance with 430.33.

FPN: For further information, see 430.44 for orderly shutdown.

(C) Motor Feeder Short-Circuit and Ground-Fault Protection. Motor feeder short-circuit and ground-fault protection shall be as required in Article 430, Part V.

(D) Motor Branch-Circuit Short-Circuit and Ground-Fault Protection. Motor branch-circuit short-circuit and ground-fault protection shall be as required in Article 430, Part IV.

620.62 Selective Coordination. Where more than one driving machine disconnecting means is supplied by a single feeder, the overcurrent protective devices in each disconnecting means shall be selectively coordinated with any other supply side overcurrent protective devices.

Exception: When an electrical engineer provides stamped fault current calculations, the overcurrent protective devices in each disconnecting means may be selectively coordinated

with any other supply side overcurrent protective devices for faults with a duration of 0.1 seconds and longer.

VIII. Machine Rooms, Control Rooms, Machinery Spaces, and Control Spaces

620.71 ((Guarding)) Securing Equipment. Elevator, dumbwaiter, escalator, and moving walk driving machines; motor-generator sets; motor controllers; and disconnecting means shall be installed in a room or space set aside for that purpose unless otherwise permitted in 620.71(A) or (B). The room or space shall be secured against unauthorized access.

Exception: Elevator motor controllers may be installed, with permission of the authority having jurisdiction, in a hoistway.

FPN: Non-elevator equipment, wiring, pipes, and other materials are prohibited in elevator hoistways, pits, machine rooms and spaces. Only such equipment and wiring that pertain to the elevator and its operation are permitted in these elevator spaces. See Chapter 30 of the Seattle Building Code.

(A) Motor Controllers. Motor controllers shall be permitted outside the spaces herein specified, provided they are in enclosures with doors or removable panels that are capable of being locked in the closed position and the disconnecting means is located adjacent to or is an integral part of the motor controller. Motor controller enclosures for escalator or moving walks shall be permitted in the balustrade on the side located away from the moving steps or moving treadway. If the disconnecting means is an integral part of the motor controller, it shall be operable without opening the enclosure.

(B) Driving Machines. Elevators with driving machines located on the car, on the counterweight, or in the hoistway, and driving machines for dumbwaiters, platform lifts, and stairway lifts, shall be permitted outside the spaces herein specified.

IX. Grounding

620.81 Metal Raceways Attached to Cars. Metal raceways, Type MC cable, Type MI cable, or Type AC cable attached to elevator cars shall be bonded to metal parts of the car that are bonded to the equipment grounding conductor.

620.82 Electric Elevators. For electric elevators, the frames of all motors, elevator machines, controllers, and the metal enclosures for all electrical equipment in or on the car or in the hoistway shall be bonded in accordance with Article 250, Parts V and VII.

620.83 Nonelectric Elevators. For elevators other than electric having any electrical conductors attached to the car, the metal frame of the car, where normally accessible to persons, shall be bonded in accordance with Article 250, Parts V and VII.

620.84 Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts. Escalators, moving walks, platform lifts, and stairway chairlifts shall comply with Article 250.

620.85 Ground-Fault Circuit-Interrupter Protection for Personnel. Each 125-volt, single-phase, 15- and 20-ampere receptacle installed in pits, in hoistways, on elevator car tops, and in escalator and moving walk wellways shall be of the ground-fault circuit-interrupter type.

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in machine rooms and machinery spaces shall have ground-fault circuit-interrupter protection for personnel.

A single receptacle supplying a permanently installed sump pump shall not require ground-fault circuit-interrupter protection.

X. Emergency and Standby Power Systems

620.91 Emergency and Standby Power Systems. ~~((An-e)) Elevator power system requirements are determined by the Seattle Building Code. (s) shall be permitted to be powered by an emergency or standby power system.~~

FPN No. 1: See ASME A17.1-2004, *Safety Code for Elevators and Escalators*, and CSA B44-04, *Elevator and Escalator Electrical Equipment Certification Standard 2.27.2*, for additional information.

FPN No. 2: See Chapter 7 of the *Seattle Building Code* for the requirements to pressurize elevator hoistways and elevator lobbies.

FPN No. 3: See Chapter 10 of the *Seattle Building Code* for requirements for elevators serving as an accessible means of egress component (in buildings that have a required accessible floor that is four or more stories above or below the level of exit discharge) and for pressurization of elevator lobbies used as an area of refuge.

FPN No. 4: See Chapter 30 of the *Seattle Building Code* for requirement that stretcher-sized elevator cars be supplied with power from a legally required standby or emergency system.

(A) Regenerative Power. For elevator systems that regenerate power back into the power source that is unable to absorb the regenerative power under overhauling elevator load conditions, a means shall be provided to absorb this power.

(B) Other Building Loads. Other building loads, such as power and lighting, shall be permitted as the energy absorption means required in 620.91(A), provided that such loads are automatically connected to the emergency or standby power system operating the elevators and are large enough to absorb the elevator regenerative power.

(C) Disconnecting Means. The disconnecting means required by 620.51 shall disconnect the elevator from both the emergency or standby power system and the normal power system.

Where an additional power source is connected to the load side of the disconnecting means, the disconnecting means required in 620.51 shall be provided with an auxiliary contact that is positively opened mechanically, and the opening shall not be solely dependent on springs. This contact shall cause the additional power source to be

disconnected from its load when the disconnecting means is in the open position.

ARTICLE 625 Electric Vehicle Charging System

I. General

625.1 Scope. The provisions of this article cover the electrical conductors and equipment external to an electric vehicle that connect an electric vehicle to a supply of electricity by conductive or inductive means, and the installation of equipment and devices related to electric vehicle charging.

FPN: For industrial trucks, see NFPA 505-2006, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operation*.

625.2 Definitions.

Electric Vehicle. An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electric current. For the purpose of this article, electric motorcycles and similar type vehicles and off-road, self-propelled electric vehicles, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats, and the like, are not included.

Electric Vehicle Connector. A device that, by insertion into an electric vehicle inlet, establishes an electrical connection to the electric vehicle for the purpose of charging and information exchange. This device is part of the electric vehicle coupler.

Electric Vehicle Coupler. A mating electric vehicle inlet and electric vehicle connector set.

Electric Vehicle Inlet. The device on the electric vehicle into which the electric vehicle connector is inserted for charging and information exchange. This device is part of the electric vehicle coupler. For the purposes of this Code, the electric vehicle inlet is considered to be part of the electric vehicle and not part of the electric vehicle supply equipment.

Electric Vehicle Nonvented Storage Battery. A hermetically sealed battery, comprised of one or more rechargeable electrochemical cells, that has no provision for the release of excessive gas pressure, or for the addition of water or electrolyte, or for external measurements of electrolyte specific gravity.

Electric Vehicle Supply Equipment. The conductors, including the ungrounded, grounded, and equipment grounding conductors and the electric vehicle connectors, attachment plugs, and all other fittings, devices, power

outlets, or apparatus installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle.

Personnel Protection System. A system of personnel protection devices and constructional features that when used together provide protection against electric shock of personnel.

625.3 Other Articles. Wherever the requirements of other articles of this Code and Article 625 differ, the requirements of Article 625 shall apply.

625.4 Voltages. Unless other voltages are specified, the nominal ac system voltages of 120, 120/240, 208Y/120, 240, 480Y/277, 480, 600Y/347, and 600 volts shall be used to supply equipment covered by this article.

625.5 Listed or Labeled. All electrical materials, devices, fittings, and associated equipment shall be listed or labeled.

II. Wiring Methods

625.9 Electric Vehicle Coupler. The electric vehicle coupler shall comply with 625.9(A) through (F).

(A) Polarization. The electric vehicle coupler shall be polarized unless part of a system identified and listed as suitable for the purpose.

(B) Noninterchangeability. The electric vehicle coupler shall have a configuration that is noninterchangeable with wiring devices in other electrical systems. Nongrounding-type electric vehicle couplers shall not be interchangeable with grounding-type electric vehicle couplers.

(C) Construction and Installation. The electric vehicle coupler shall be constructed and installed so as to guard against inadvertent contact by persons with parts made live from the electric vehicle supply equipment or the electric vehicle battery.

(D) Unintentional Disconnection. The electric vehicle coupler shall be provided with a positive means to prevent unintentional disconnection.

(E) Grounding Pole. The electric vehicle coupler shall be provided with a grounding pole, unless part of a system identified and listed as suitable for the purpose in accordance with Article 250.

(F) Grounding Pole Requirements. If a grounding pole is provided, the electric vehicle coupler shall be so designed that the grounding pole connection is the first to make and the last to break contact.

III. Equipment Construction

625.13 Electric Vehicle Supply Equipment. Electric vehicle supply equipment rated at 125 volts, single phase, 15 or 20 amperes or part of a system identified and listed as suitable for the purpose and meeting the requirements of

625.18, 625.19, and 625.29 shall be permitted to be cord-and-plug-connected. All other electric vehicle supply equipment shall be permanently connected and fastened in place. This equipment shall have no exposed live parts.

625.14 Rating. Electric vehicle supply equipment shall have sufficient rating to supply the load served. For the purposes of this article, electric vehicle charging loads shall be considered to be continuous loads.

625.15 Markings. The electric vehicle supply equipment shall comply with 625.15(A) through (C).

(A) General. All electric vehicle supply equipment shall be marked by the manufacturer as follows:

FOR USE WITH ELECTRIC VEHICLES

(B) Ventilation Not Required. Where marking is required by 625.29(C), the electric vehicle supply equipment shall be clearly marked by the manufacturer as follows:

VENTILATION NOT REQUIRED

The marking shall be located so as to be clearly visible after installation.

(C) Ventilation Required. Where marking is required by 625.29(D), the electric vehicle supply equipment shall be clearly marked by the manufacturer, "Ventilation Required." The marking shall be located so as to be clearly visible after installation.

625.16 Means of Coupling. The means of coupling to the electric vehicle shall be either conductive or inductive. Attachment plugs, electric vehicle connectors, and electric vehicle inlets shall be listed or labeled for the purpose.

625.17 Cable. The electric vehicle supply equipment cable shall be Type EV, EVJ, EVE, EVJE, EVT, or EVJT flexible cable as specified in Article 400 and Table 400.4. Ampacities shall be as specified in Table 400.5(A) for 10 AWG and smaller, and in Table 400.5(B) for 8 AWG and larger. The overall length of the cable shall not exceed 7.5 m (25 ft) unless equipped with a cable management system that is listed as suitable for the purpose. Other cable types and assemblies listed as being suitable for the purpose, including optional hybrid communications, signal, and optical fiber cables, shall be permitted.

625.18 Interlock. Electric vehicle supply equipment shall be provided with an interlock that de-energizes the electric vehicle connector and its cable whenever the electrical connector is uncoupled from the electric vehicle. An interlock shall not be required for portable cord-and-plug-connected electric vehicle supply equipment intended for connection to receptacle outlets rated at 125 volts, single phase, 15 and 20 amperes.

625.19 Automatic De-Energization of Cable. The electric vehicle supply equipment or the cable-connector combination

of the equipment shall be provided with an automatic means to de-energize the cable conductors and electric vehicle connector upon exposure to strain that could result in either cable rupture or separation of the cable from the electric connector and exposure of live parts. Automatic means to de-energize the cable conductors and electric vehicle connector shall not be required for portable cord-and-plug-connected electric vehicle supply equipment intended for connection to receptacle outlets rated at 125 volts, single phase, 15 and 20 amperes.

IV. Control and Protection

625.21 Overcurrent Protection. Overcurrent protection for feeders and branch circuits supplying electric vehicle supply equipment shall be sized for continuous duty and shall have a rating of not less than 125 percent of the maximum load of the electric vehicle supply equipment. Where noncontinuous loads are supplied from the same feeder or branch circuit, the overcurrent device shall have a rating of not less than the sum of the noncontinuous loads plus 125 percent of the continuous loads.

625.22 Personnel Protection System. The electric vehicle supply equipment shall have a listed system of protection against electric shock of personnel. The personnel protection system shall be composed of listed personnel protection devices and constructional features. Where cord-and-plug-connected electric vehicle supply equipment is used, the interrupting device of a listed personnel protection system shall be provided and shall be an integral part of the attachment plug or shall be located in the power supply cable not more than 300 mm (12 in.) from the attachment plug.

625.23 Disconnecting Means. For electric vehicle supply equipment rated more than 60 amperes or more than 150 volts to ground, the disconnecting means shall be provided and installed in a readily accessible location. The disconnecting means shall be capable of being locked in the open position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed. Portable means for adding a lock to the switch or circuit breaker shall not be permitted.

625.25 Loss of Primary Source. Means shall be provided such that, upon loss of voltage from the utility or other electrical system(s), energy cannot be back fed through the electric vehicle and the supply equipment to the premises wiring system unless permitted by 625.26.

625.26 Interactive Systems. Electric vehicle supply equipment and other parts of a system, either on-board or off-board the vehicle, that are identified for and intended to be interconnected to a vehicle and also serve as an optional standby system or an electric power production source or provide for bi-directional power feed shall be listed as

suitable for that purpose. When used as an optional standby system, the requirements of Article 702 shall apply, and when used as an electric power production source, the requirements of Article 705 shall apply.

V. Electric Vehicle Supply Equipment Locations

625.27 Requirements for Future Installation of Outlets. To facilitate future installation of electric vehicle outlets in residential occupancies, the following shall be provided:

(1) Space shall be reserved in the electrical service equipment for installation of an overcurrent protective device to serve electric vehicle charging system branch circuits.

(2) A location shall be designated, together with the required working clearances, for the electric vehicle charging system panelboard.

FPN No. 1: See also 220.57, Electrical Vehicle Outlets, for calculating demand loads.

FPN No. 2: Consideration of the location of the future electric vehicle outlets is recommended when designating a location for the electric vehicle outlet panelboard.

FPN No 3: Residential occupancies are defined in Chapter 3 of the Seattle Building Code.

625.28 Hazardous (Classified) Locations. Where electric vehicle supply equipment or wiring is installed in a hazardous (classified) location, the requirements of Articles 500 through 516 shall apply.

625.29 Indoor Sites. Indoor sites shall include, but not be limited to, integral, attached, and detached residential garages; enclosed and underground parking structures; repair and nonrepair commercial garages; and agricultural buildings.

(A) Location. The electric vehicle supply equipment shall be located to permit direct connection to the electric vehicle.

(B) Height. Unless specifically listed for the purpose and location, the coupling means of the electric vehicle supply equipment shall be stored or located at a height of not less than 450 mm (18 in.) and not more than 1.2 m (4 ft) above the floor level.

(C) Ventilation Not Required. Where electric vehicle nonvented storage batteries are used or where the electric vehicle supply equipment is listed or labeled as suitable for charging electric vehicles indoors without ventilation and marked in accordance with 625.15(B), mechanical ventilation shall not be required.

(D) Ventilation Required. Where the electric vehicle supply equipment is listed or labeled as suitable for charging electric vehicles that require ventilation for indoor charging, and is marked in accordance with 625.15(C), mechanical ventilation, such as a fan, shall be provided. The ventilation shall include both supply and exhaust equipment and shall be

permanently installed and located to intake from, and vent directly to, the outdoors. Positive pressure ventilation systems shall be permitted only in buildings or areas that have been specifically designed and approved for that application. Mechanical ventilation requirements shall be determined by one of the methods specified in 625.29(D)(1) through (D)(4).

(1) Table Values. For supply voltages and currents specified in Table 625.29(D)(1) or Table 625.29(D)(2), the minimum ventilation requirements shall be as specified in Table 625.29(D)(1) or Table 625.29(D)(2) for each of the total number of electric vehicles that can be charged at one time.

(2) Other Values. For supply voltages and currents other than specified in Table 625.29(D)(1) or Table 625.29(D)(2), the minimum ventilation requirements shall be calculated by means of the following general formulas as applicable:

(1) Single phase: Ventilation_{single phase} in cubic meters per minute (m³/min) =

$$\frac{(\text{volts})(\text{amperes})}{1718}$$

Ventilation_{single phase} in cubic feet per minute (cfm) =

$$\frac{(\text{volts})(\text{amperes})}{48.7}$$

(2) Three phase: Ventilation_{three phase} in cubic meters per minute (m³/min) =

$$\frac{1.732(\text{volts})(\text{amperes})}{1718}$$

Ventilation_{three phase} in cubic feet per minute (cfm) =

$$\frac{1.732(\text{volts})(\text{amperes})}{48.7}$$

(3) Engineered Systems. For an electric vehicle supply equipment ventilation system designed by a person qualified to perform such calculations as an integral part of a building's total ventilation system, the minimum ventilation requirements shall be permitted to be determined per calculations specified in the engineering study.

(4) Supply Circuits. The supply circuit to the mechanical ventilation equipment shall be electrically interlocked with the electric vehicle supply equipment and shall remain

Table 625.29(D)(1) Minimum Ventilation Required in Cubic Meters per Minute (m³/min) for Each of the Total Number of Electric Vehicles That Can Be Charged at One Time

Branch-Circuit Ampere Rating	Branch-Circuit Voltage						
	Single Phase			3 Phase			
	120 V	208 V	240 V or 120/240 V	208 V or 208Y/120 V	240 V	480 V or 480Y/277 V	600 V or 600Y-347 V
15	1.1	1.8	2.1	--	--	--	--
20	1.4	2.4	2.8	4.2	4.8	9.7	12
30	2.1	3.6	4.2	6.3	7.2	15	18
40	2.8	4.8	5.6	8.4	9.7	19	24
50	3.5	6.1	7.0	10	12	24	30
30	4.2	7.3	8.4	13	15	29	36
100	7	12	14	21	24	48	60
150	--	--	--	31	36	73	91
200	--	--	--	42	48	97	120
150	--	--	--	52	60	120	150
300	--	--	--	63	73	145	180
350	--	--	--	73	85	170	210
400	--	--	--	84	97	195	240

have inherent intermittent duty, the determinations of equivalent current ratings in 675.7(A) and (B) shall be used.

(A) Continuous-Current Rating. The equivalent continuous-current rating for the selection of branch-circuit conductors and overcurrent protection shall be equal to 125 percent of the motor nameplate full-load current rating of the largest motor, plus a quantity equal to the sum of each of the motor nameplate full-load current ratings of all remaining motors on the circuit, multiplied by the maximum percent duty cycle at which they can continuously operate.

(B) Locked-Rotor Current. The equivalent locked-rotor current rating shall be equal to the numerical sum of the locked-rotor current of the two largest motors plus 100 percent of the sum of the motor nameplate full-load current ratings of all the remaining motors on the circuit.

675.8 Disconnecting Means.

(A) Main Controller. A controller that is used to start and stop the complete machine shall meet all of the following requirements:

- (1) An equivalent continuous current rating not less than specified in 675.7(A) or 675.22(A)
- (2) A horsepower rating not less than the value from Table 430.251(A) and Table 430.251(B), based on the equivalent locked-rotor current specified in 675.7(B) or 675.22(B)

Exception: A listed molded case switch shall not require a horsepower rating.

(B) Main Disconnecting Means. The main disconnecting means for the machine shall provide overcurrent protection, shall be at the point of connection of electric power to the machine, or shall be visible and not more than 15 m (50 ft) from the machine, and shall be readily accessible and capable of being locked in the open position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed. This disconnecting means shall have a horsepower and current rating not less than required for the main controller.

Exception No. 1: Circuit breakers without marked horsepower ratings shall be permitted in accordance with 430.109.

Exception No. 2: A listed molded case switch without marked horsepower ratings shall be permitted.

(C) Disconnecting Means for Individual Motors and Controllers. A disconnecting means shall be provided to simultaneously disconnect all ungrounded conductors for each motor and controller and shall be located as required by Article 430, Part IX. The disconnecting means shall not be required to be readily accessible.

675.9 Branch-Circuit Conductors. The branch-circuit conductors shall have an ampacity not less than specified in 675.7(A) or 675.22(A).

675.10 Several Motors on One Branch Circuit.

(A) Protection Required. Several motors, each not exceeding 2 hp rating, shall be permitted to be used on an irrigation machine circuit protected at not more than 30 amperes at 600 volts, nominal, or less, provided all of the following conditions are met:

- (1) The full-load rating of any motor in the circuit shall not exceed 6 amperes.
- (2) Each motor in the circuit shall have individual overload protection in accordance with 430.32.
- (3) Taps to individual motors shall not be smaller than 14 AWG copper and not more than 7.5 m (25 ft) in length.

(B) Individual Protection Not Required. Individual branch-circuit short-circuit protection for motors and motor controllers shall not be required where the requirements of 675.10(A) are met.

675.11 Collector Rings.

(A) Transmitting Current for Power Purposes. Collector rings shall have a current rating not less than 125 percent of the full-load current of the largest device served plus the full-load current of all other devices served, or as determined from 675.7(A) or 675.22(A).

(B) Control and Signal Purposes. Collector rings for control and signal purposes shall have a current rating not less than 125 percent of the full-load current of the largest device served plus the full-load current of all other devices served.

(C) Grounding. The collector ring used for grounding shall have a current rating not less than that sized in accordance with 675.11(A).

(D) Protection. Collector rings shall be protected from the expected environment and from accidental contact by means of a suitable enclosure.

675.12 Grounding.

The following equipment shall be grounded:

- (1) All electrical equipment on the irrigation machine
- (2) All electrical equipment associated with the irrigation machine
- (3) Metal junction boxes and enclosures
- (4) Control panels or control equipment that supplies or controls electrical equipment to the irrigation machine

Exception: Grounding shall not be required on machines where all of the following provisions are met:

(a) *The machine is electrically controlled but not electrically driven.*

(b) *The control voltage is 30 volts or less.*

(c) *The control or signal circuits are current limited as specified in Chapter 9, Tables 11(A) and 11(B).*

675.13 Methods of Grounding. Machines that require grounding shall have a non-current-carrying equipment grounding conductor provided as an integral part of each cord, cable, or raceway. This grounding conductor shall be sized not less than the largest supply conductor in each cord, cable, or raceway. Feeder circuits supplying power to irrigation machines shall have an equipment grounding conductor sized according to Table 250.122.

675.14 Bonding. Where electrical grounding is required on an irrigation machine, the metallic structure of the machine, metallic conduit, or metallic sheath of cable shall be **connected** to the grounding conductor. Metal-to-metal contact with a part that is **connected** to the grounding conductor and the non-current-carrying parts of the machine shall be considered as an acceptable bonding path.

675.15 Lightning Protection. If an irrigation machine has a stationary point, a grounding electrode system in accordance with Article 250, Part III, shall be connected to the machine at the stationary point for lightning protection.

675.16 Energy from More Than One Source. Equipment within an enclosure receiving electric energy from more than one source shall not be required to have a disconnecting means for the additional source, provided that its voltage is 30 volts or less and it meets the requirements of Part III of Article 725.

675.17 Connectors. External plugs and connectors on the equipment shall be of the weatherproof type.

Unless provided solely for the connection of circuits meeting the requirements of Part III of Article 725, external plugs and connectors shall be constructed as specified in 250.124(A).

II. Center Pivot Irrigation Machines

675.21 General. The provisions of Part II are intended to cover additional special requirements that are peculiar to center pivot irrigation machines. See 675.2 for the definition of *Center Pivot Irrigation Machine*.

675.22 Equivalent Current Ratings. To establish ratings of controllers, disconnecting means, conductors, and the like, for the inherent intermittent duty of center pivot irrigation machines, the determinations in 675.22(A) and (B) shall be used.

(A) Continuous-Current Rating. The equivalent continuous-current rating for the selection of branch-circuit conductors and branch-circuit devices shall be equal to 125

percent of the motor nameplate full-load current rating of the largest motor plus 60 percent of the sum of the motor nameplate full-load current ratings of all remaining motors on the circuit.

(B) Locked-Rotor Current. The equivalent locked-rotor current rating shall be equal to the numerical sum of two times the locked-rotor current of the largest motor plus 80 percent of the sum of the motor nameplate full-load current ratings of all the remaining motors on the circuit.

ARTICLE 680 Swimming Pools, Fountains, and Similar Installations

I. General

680.1 Scope. The provisions of this article apply to the construction and installation of electrical wiring for, and equipment in or adjacent to, all swimming, wading, therapeutic, and decorative pools; fountains; hot tubs; spas; and hydromassage bathtubs, whether permanently installed or storable, and to metallic auxiliary equipment, such as pumps, filters, and similar equipment. The term *body of water* used throughout Part I applies to all bodies of water covered in this scope unless otherwise amended.

FPN: WAC 296-46B-680.001, which addresses requirements for listing or field tests of equipment, is by this reference made part of the 2008 Seattle Electrical Code.

680.2 Definitions.

Cord-and-Plug-Connected Lighting Assembly. A lighting assembly consisting of a luminaire intended for installation in the wall of a spa, hot tub, or storable pool, and a cord-and-plug-connected transformer.

Dry-Niche Luminaire. A luminaire intended for installation in the wall of a pool or fountain in a niche that is sealed against the entry of pool water.

Equipment, Fixed. Equipment that is fastened or otherwise secured at a specific location.

Equipment, Portable. Equipment that is actually moved or can easily be moved from one place to another in normal use.

Equipment, Stationary. Equipment that is not easily moved from one place to another in normal use.

Forming Shell. A structure designed to support a wet-niche luminaire assembly and intended for mounting in a pool or fountain structure.

- (3) The other conductors are supply conductors to a feed-through-type ground-fault circuit interrupter.
- (4) Ground-fault circuit interrupters shall be permitted in a panelboard that contains circuits protected by other than ground-fault circuit interrupters.

680.24 Junction Boxes and Electrical Enclosures for Transformers or Ground-Fault Circuit Interrupters.

(A) Junction Boxes. A junction box connected to a conduit that extends directly to a forming shell or mounting bracket of a no-niche luminaire shall meet the requirements of this section.

(1) Construction. The junction box shall be listed as a swimming pool junction box and shall comply with the following conditions:

- (1) Be equipped with threaded entries or hubs or a nonmetallic hub
- (2) Be comprised of copper, brass, suitable plastic, or other approved corrosion-resistant material
- (3) Be provided with electrical continuity between every connected metal conduit and the grounding terminals by means of copper, brass, or other approved corrosion-resistant metal that is integral with the box

(2) Installation. Where the luminaire operates over 15 volts, the junction box location shall comply with (A)(2)(a) and (A)(2)(b). Where the luminaire operates at 15 volts or less, the junction box location shall be permitted to comply with (A)(2)(c).

(a) *Vertical Spacing.* The junction box shall be located not less than 100 mm (4 in.), measured from the inside of the bottom of the box, above the ground level, or pool deck, or not less than 200 mm (8 in.) above the maximum pool water level, whichever provides the greater elevation.

(b) *Horizontal Spacing.* The junction box shall be located not less than 1.2 m (4 ft) from the inside wall of the pool, unless separated from the pool by a solid fence, wall, or other permanent barrier.

(c) *Flush Deck Box.* If used on a lighting system operating at 15 volts or less, a flush deck box shall be permitted if both of the following apply:

- (1) An approved potting compound is used to fill the box to prevent the entrance of moisture.
- (2) The flush deck box is located not less than 1.2 m (4 ft) from the inside wall of the pool.

(B) Other Enclosures. An enclosure for a transformer, ground-fault circuit interrupter, or a similar device connected to a conduit that extends directly to a forming shell or mounting bracket of a no-niche luminaire shall meet the requirements of this section.

(1) Construction. The enclosure shall be listed and labeled for the purpose and meet the following requirements:

- (1) Equipped with threaded entries or hubs or a nonmetallic hub
- (2) Comprised of copper, brass, suitable plastic, or other approved corrosion-resistant material
- (3) Provided with an approved seal, such as duct seal at the conduit connection, that prevents circulation of air between the conduit and the enclosures
- (4) Provided with electrical continuity between every connected metal conduit and the grounding terminals by means of copper, brass, or other approved corrosion-resistant metal that is integral with the box

(2) Installation.

(a) *Vertical Spacing.* The enclosure shall be located not less than 100 mm (4 in.), measured from the inside of the bottom of the box, above the ground level, or pool deck, or not less than 200 mm (8 in.) above the maximum pool water level, whichever provides the greater elevation.

(b) *Horizontal Spacing.* The enclosure shall be located not less than 1.2 m (4 ft) from the inside wall of the pool, unless separated from the pool by a solid fence, wall, or other permanent barrier.

(C) Protection. Junction boxes and enclosures mounted above the grade of the finished walkway around the pool shall not be located in the walkway unless afforded additional protection, such as by location under diving boards, adjacent to fixed structures, and the like.

(D) Grounding Terminals. Junction boxes, transformer enclosures, and ground-fault circuit-interrupter enclosures connected to a conduit that extends directly to a forming shell or mounting bracket of a no-niche luminaire shall be provided with a number of grounding terminals that shall be no fewer than one more than the number of conduit entries.

(E) Strain Relief. The termination of a flexible cord of an underwater luminaire within a junction box, transformer enclosure, ground-fault circuit interrupter, or other enclosure shall be provided with a strain relief.

(F) Grounding. The equipment grounding conductor terminals of a junction box, transformer enclosure, or other enclosure in the supply circuit to a wet-niche or no-niche luminaire and the field-wiring chamber of a dry-niche luminaire shall be connected to the equipment grounding terminal of the panelboard. This terminal shall be directly connected to the panelboard enclosure.

680.25 Feeders. These provisions shall apply to any feeder on the supply side of panelboards supplying branch circuits for pool equipment covered in Part II of this article and on the load side of the service equipment or the source of a separately derived system.

(A) Wiring Methods. ~~(Feeders shall be installed in rigid metal conduit, intermediate metal conduit, liquidtight flexible~~

~~nonmetallic conduit, rigid polyvinyl chloride conduit, or reinforced thermosetting resin conduit. Electrical metallic tubing shall be permitted where installed on or within a building, and electrical nonmetallic tubing shall be permitted where installed within a building. Aluminum conduits shall not be permitted in the pool area where subject to corrosion.~~) A feeder between the service equipment and the remote panelboard is permitted to be housed in the following:

- (1) flexible metal conduit
- (2) an approved cable assembly that includes an equipment grounding conductor within its outer sheath and the grounding conductor complies with Section 250.24(A)(5) of this Code.
- (3) rigid metal conduit
- (4) intermediate metal conduit
- (5) liquidtight flexible nonmetallic conduit
- (6) rigid polyvinyl chloride conduit
- (7) reinforced thermosetting resin conduit
- (8) electrical metallic tubing when installed on or within a building or crawl space
- (9) electrical nonmetallic tubing when installed within a building or crawl space

Aluminum conduit is not permitted.

~~(Exception: An existing feeder between an existing remote panelboard and service equipment shall be permitted to run in flexible metal conduit or an approved cable assembly that includes an equipment grounding conductor within its outer sheath. The equipment grounding conductor shall comply with 250.24(A)(5).)~~

(B) Grounding. An equipment grounding conductor shall be installed with the feeder conductors between the grounding terminal of the pool equipment panelboard and the grounding terminal of the applicable service equipment or source of a separately derived system. For other than ~~((1) existing feeders covered in 680.25(A), Exception, or (2))~~ feeders to separate buildings that do not utilize an insulated equipment grounding conductor in accordance with 680.25(B)(2), this equipment grounding conductor shall be insulated.

(1) Size. This conductor shall be sized in accordance with 250.122 but not smaller than 12 AWG. On separately derived systems, this conductor shall be sized in accordance with Table 250.66 but not smaller than 8 AWG.

(2) Separate Buildings. A feeder to a separate building or structure shall be permitted to supply swimming pool equipment branch circuits, or feeders supplying swimming pool equipment branch circuits, if the grounding arrangements in the separate building meet the requirements in 250.32(B). ~~((Where installed in other than existing feeders covered in 680.25(A), Exception, a))~~ A separate equipment grounding conductor shall be an insulated conductor.

680.26 Equipotential Bonding.

(A) Performance. The equipotential bonding required by this section shall be installed to reduce voltage gradients in the pool area.

(B) Bonded Parts. The parts specified in 680.26(B)(1) through (B)(7) shall be bonded together using solid copper conductors, insulated covered, or bare, not smaller than 8 AWG or with rigid metal conduit of brass or other identified corrosion-resistant metal. Connections to bonded parts shall be made in accordance with 250.8. An 8 AWG or larger solid copper bonding conductor provided to reduce voltage gradients in the pool area shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes.

(1) Conductive Pool Shells. Bonding to conductive pool shells shall be provided as specified in 680.26(B)(1)(a) or (B)(1)(b). Poured concrete, pneumatically applied or sprayed concrete, and concrete block with painted or plastered coatings shall all be considered conductive materials due to water permeability and porosity. Vinyl liners and fiberglass composite shells shall be considered to be nonconductive materials.

(a) *Structural Reinforcing Steel.* Unencapsulated structural reinforcing steel shall be bonded together by steel tie wires or the equivalent. Where structural reinforcing steel is encapsulated in a nonconductive compound, a copper conductor grid shall be installed in accordance with 680.26(B)(1)(b).

(b) *Copper Conductor Grid.* A copper conductor grid shall be provided and shall comply with (b)(1) through (b)(4).

- (1) Be constructed of minimum 8 AWG bare solid copper conductors bonded to each other at all points of crossing
- (2) Conform to the contour of the pool and the pool deck
- (3) Be arranged in a 300-mm (12-in.) by 300-mm (12-in.) network of conductors in a uniformly spaced perpendicular grid pattern with a tolerance of 100 mm (4 in.)
- (4) Be secured within or under the pool no more than 150 mm (6 in.) from the outer contour of the pool shell

(2) Perimeter Surfaces. The perimeter surface shall extend for 1 m (3 ft) horizontally beyond the inside walls of the pool and shall include unpaved surfaces as well as poured concrete and other types of paving. Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a) or (2)(b) and shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four (4) points uniformly spaced around the perimeter of the pool. For nonconductive pool shells, bonding at four points shall not be required.

(a) *Structural Reinforcing Steel.* Structural reinforcing steel shall be bonded in accordance with 680.26(B)(1)(a).

(b) *Alternate Means.* Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, a copper conductor(s) shall be utilized where the following requirements are met:

- (1) At least one minimum 8 AWG bare solid copper conductor shall be provided.

(2) The conductors shall follow the contour of the perimeter surface.

(3) Only listed splices shall be permitted.

(4) The required conductor shall be 450 to 600 mm (18 to 24 in.) from the inside walls of the pool.

(5) The required conductor shall be secured within or under the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below the subgrade.

(3) Metallic Components. All metallic parts of the pool structure, including reinforcing metal not addressed in 680.26(B)(1)(a), shall be bonded. Where reinforcing steel is encapsulated with a nonconductive compound, the reinforcing steel shall not be required to be bonded.

(4) Underwater Lighting. All metal forming shells and mounting brackets of no-niche luminaires shall be bonded.

Exception: Listed low-voltage lighting systems with nonmetallic forming shells shall not require bonding.

(5) Metal Fittings. All metal fittings within or attached to the pool structure shall be bonded. Isolated parts that are not over 100 mm (4 in.) in any dimension and do not penetrate into the pool structure more than 25 mm (1 in.) shall not require bonding.

(6) Electrical Equipment. Metal parts of electrical equipment associated with the pool water circulating system, including pump motors and metal parts of equipment associated with pool covers, including electric motors, shall be bonded.

Exception: Metal parts of listed equipment incorporating an approved system of double insulation shall not be bonded.

(a) **Double-Insulated Water Pump Motors.** Where a double-insulated water pump motor is installed under the provisions of this rule, a solid 8 AWG copper conductor of sufficient length to make a bonding connection to a replacement motor shall be extended from the bonding grid to an accessible point in the vicinity of the pool pump motor. Where there is no connection between the swimming pool bonding grid and the equipment grounding system for the premises, this bonding conductor shall be connected to the equipment grounding conductor of the motor circuit.

(b) **Pool Water Heaters.** For pool water heaters rated at more than 50 amperes and having specific instructions regarding bonding and grounding, only those parts designated to be bonded shall be bonded and only those parts designated to be grounded shall be grounded.

(7) Metal Wiring Methods and Equipment. Metal-sheathed cables and raceways, metal piping, and all fixed metal parts shall be bonded.

Exception No. 1: Those separated from the pool by a permanent barrier shall not be required to be bonded.

Exception No. 2: Those greater than 1.5 m (5 ft) horizontally of the inside walls of the pool shall not be required to be bonded.

Exception No. 3: Those greater than 3.7 m (12 ft) measured vertically above the maximum water level of the pool, or as measured vertically above any observation stands, towers, or platforms, or any diving structures, shall not be required to be bonded.

(C) Pool Water. An intentional bond of a minimum conductive surface area of 5806 mm² (9 in.²) shall be installed in contact with the pool water. This bond shall be permitted to consist of parts that are required to be bonded in 680.26(B).

680.27 Specialized Pool Equipment.

(A) Underwater Audio Equipment. All underwater audio equipment shall be identified for the purpose.

(1) Speakers. Each speaker shall be mounted in an approved metal forming shell, the front of which is enclosed by a captive metal screen, or equivalent, that is bonded to, and secured to, the forming shell by a positive locking device that ensures a low-resistance contact and requires a tool to open for installation or servicing of the speaker. The forming shell shall be installed in a recess in the wall or floor of the pool.

(2) Wiring Methods. Rigid metal conduit of brass or other identified corrosion-resistant metal, liquidtight flexible nonmetallic conduit (LFNC-B), rigid polyvinyl chloride conduit, or reinforced thermosetting resin conduit shall extend from the forming shell to a listed junction box or other enclosure as provided in 680.24. Where rigid polyvinyl chloride conduit, reinforced thermosetting resin conduit, or liquidtight flexible nonmetallic conduit is used, an 8 AWG insulated solid or stranded copper bonding jumper shall be installed in this conduit. The bonding jumper shall be terminated in the forming shell and the junction box. The termination of the 8 AWG bonding jumper in the forming shell shall be covered with, or encapsulated in, a listed potting compound to protect such connection from the possible deteriorating effect of pool water.

(3) Forming Shell and Metal Screen. The forming shell and metal screen shall be of brass or other approved corrosion-resistant metal. All forming shells shall include provisions for terminating an 8 AWG copper conductor.

(B) Electrically Operated Pool Covers.

(1) Motors and Controllers. The electric motors, controllers, and wiring shall be located not less than 1.5 m (5 ft) from the inside wall of the pool unless separated from the pool by a wall, cover, or other permanent barrier. Electric motors installed below grade level shall be of the totally enclosed type. The device that controls the operation of the motor for an electrically operated pool cover shall be located such that the operator has full view of the pool.

FPN No. 1: For cabinets installed in damp and wet locations, see 312.2.

FPN No. 2: For switches or circuit breakers installed in wet locations, see 404.4.

FPN No. 3: For protection against liquids, see 430.11.

(2) Protection. The electric motor and controller shall be connected to a circuit protected by a ground-fault circuit interrupter.

(C) Deck Area Heating. The provisions of this section shall apply to all pool deck areas, including a covered pool, where electrically operated comfort heating units are installed within 6.0 m (20 ft) of the inside wall of the pool.

(1) Unit Heaters. Unit heaters shall be rigidly mounted to the structure and shall be of the totally enclosed or guarded type. Unit heaters shall not be mounted over the pool or within the area extending 1.5 m (5 ft) horizontally from the inside walls of a pool.

(2) Permanently Wired Radiant Heaters. Radiant electric heaters shall be suitably guarded and securely fastened to their mounting device(s). Heaters shall not be installed over a pool or within the area extending 1.5 m (5 ft) horizontally from the inside walls of the pool and shall be mounted at least 3.7 m (12 ft) vertically above the pool deck unless otherwise approved.

(3) Radiant Heating Cables Not Permitted. Radiant heating cables embedded in or below the deck shall not be permitted.

III. Storable Pools

680.30 General. Electrical installations at storable pools shall comply with the provisions of Part I and Part III of this article.

680.31 Pumps. A cord-connected pool filter pump shall incorporate an approved system of double insulation or its equivalent and shall be provided with means for grounding only the internal and nonaccessible non-current-carrying metal parts of the appliance.

The means for grounding shall be an equipment grounding conductor run with the power-supply conductors in the flexible cord that is properly terminated in a grounding-type attachment plug having a fixed grounding contact member.

Cord-connected pool filter pumps shall be provided with a ground-fault circuit interrupter that is an integral part of the attachment plug or located in the power supply cord within 300 mm (12 in.) of the attachment plug.

680.32 Ground-Fault Circuit Interrupters Required. All electrical equipment, including power-supply cords, used with storable pools shall be protected by ground-fault circuit interrupters.

All 125-volt receptacles located within 6.0 m (20 ft) of the inside walls of a storable pool shall be protected by a ground-fault circuit interrupter. In determining these dimensions, the distance to be measured shall be the shortest path the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall,

ceiling, doorway with hinged or sliding door, window opening, or other effective permanent barrier.

FPN: For flexible cord usage, see 400.4.

680.33 Luminaires. An underwater luminaire, if installed, shall be installed in or on the wall of the storable pool. It shall comply with either 680.33(A) or (B).

(A) 15 Volts or Less. A luminaire shall be part of a cord-and-plug-connected lighting assembly. This assembly shall be listed as an assembly for the purpose and have the following construction features:

- (1) No exposed metal parts
- (2) A luminaire lamp that operates at 15 volts or less
- (3) An impact-resistant polymeric lens, luminaire body, and transformer enclosure
- (4) A transformer meeting the requirements of 680.23(A)(2) with a primary rating not over 150 volts

(B) Over 15 Volts But Not over 150 Volts. A lighting assembly without a transformer and with the luminaire lamp(s) operating at not over 150 volts shall be permitted to be cord-and-plug-connected where the assembly is listed as an assembly for the purpose. The installation shall comply with 680.23(A)(5), and the assembly shall have the following construction features:

- (1) No exposed metal parts
- (2) An impact-resistant polymeric lens and luminaire body
- (3) A ground-fault circuit interrupter with open neutral conductor protection as an integral part of the assembly
- (4) The luminaire lamp permanently connected to the ground-fault circuit interrupter with open-neutral protection
- (5) Compliance with the requirements of 680.23(A)

680.34 Receptacle Locations. Receptacles shall not be located less than 1.83 m (6 ft) from the inside walls of a pool. In determining these dimensions, the distance to be measured shall be the shortest path the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, doorway with hinged or sliding door, window opening, or other effective permanent barrier.

IV. Spas and Hot Tubs

680.40 General. Electrical installations at spas and hot tubs shall comply with the provisions of Part I and Part IV of this article.

FPN: WAC 296-46B-680.001 which addresses requirements for listing or field tests of equipment regulated by this section is by this reference made part of the 2008 *Seattle Electrical Code*.

680.41 Emergency Switch for Spas and Hot Tubs. A clearly labeled emergency shutoff or control switch for the purpose of stopping the motor(s) that provide power to the

The voltage at the motor terminals shall not drop more than 5 percent below the voltage rating of the motor when the motor is operating at 115 percent of the full-load current rating of the motor.

Exception: This limitation shall not apply for emergency run mechanical starting. [20:9.4.2]

695.10 Listed Equipment. Diesel engine fire pump controllers, electric fire pump controllers, electric motors, fire pump power transfer switches, foam pump controllers, and limited service controllers shall be listed for fire pump service. [20:9.5.1.1, 10.1.2.1, 12.1.3.1]

695.12 Equipment Location.

(A) Controllers and Transfer Switches. Electric motor-driven fire pump controllers and power transfer switches shall be located as close as practicable to, and within sight of, the motors that they control.

(B) Engine-Drive Controllers. Engine-drive fire pump controllers shall be located as close as is practical to, and within sight of, the engines that they control.

(C) Storage Batteries. Storage batteries for fire pump engine drives shall be supported above the floor, secured against displacement, and located where they are not subject to physical damage, flooding with water, excessive temperature, or excessive vibration.

(D) Energized Equipment. All energized equipment parts shall be located at least 300 mm (12 in.) above the floor level.

(E) Protection Against Pump Water. Fire pump controller and power transfer switches shall be located or protected so that they are not damaged by water escaping from pumps or pump connections.

(F) Mounting. All fire pump control equipment shall be mounted in a substantial manner on noncombustible supporting structures.

695.14 Control Wiring.

(A) Control Circuit Failures. External control circuits that extend outside the fire pump room shall be arranged so that failure of any external circuit (open or short circuit) shall not prevent the operation of a pump(s) from all other internal or

external means. Breakage, disconnecting, shorting of the wires, or loss of power to these circuits could cause continuous running of the fire pump but shall not prevent the controller(s) from starting the fire pump(s) due to causes other than these external control circuits. All control conductors within the fire pump room that are not fault tolerant shall be protected against physical damage. [20:10.5.2.6, 12.5.2.5]

(B) Sensor Functioning. No undervoltage, phase-loss, frequency-sensitive, or other sensor(s) shall be installed that automatically or manually prohibits actuation of the motor contactor. [20:10.4.5.6]

Exception: A phase loss sensor(s) shall be permitted only as a part of a listed fire pump controller.

(C) Remote Device(s). No remote device(s) shall be installed that will prevent automatic operation of the transfer switch. [20:10.8.1.3]

(D) Engine-Drive Control Wiring. All wiring between the controller and the diesel engine shall be stranded and sized to continuously carry the charging or control currents as required by the controller manufacturer. Such wiring shall be protected against physical damage. Controller manufacturer's specifications for distance and wire size shall be followed. [20:12.3.5.1]

(E) Electric Fire Pump Control Wiring Methods. All electric motor-driven fire pump control wiring shall be in rigid metal conduit, intermediate metal conduit, liquidtight flexible metal conduit, liquidtight flexible nonmetallic conduit Type B (LFNC-B), listed Type MC cable with an impervious covering, or Type MI cable.

(F) Generator Control Wiring Methods. Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. They shall be protected to resist potential damage by fire or structural failure. They shall be permitted to be routed through a building(s) encased in 50 mm (2 in.) of concrete or within enclosed construction dedicated to the fire pump circuits and having a minimum 1-hour fire resistance rating, or circuit protective systems with a minimum of 1-hour fire resistance. The installation shall comply with any restrictions provided in the listing of the electrical circuit protective system used.

Chapter 700 Special Conditions

ARTICLE 700 Emergency Systems

I. General

700.1 Scope. The provisions of this article apply to the electrical safety of the installation, operation, and maintenance of emergency systems consisting of circuits and equipment intended to supply, distribute, and control electricity for illumination, power, or both, to required facilities when the normal electrical supply or system is interrupted.

Emergency systems are those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. These systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life.

FPN No. 1: For further information regarding wiring and installation of emergency systems in health care facilities, see Article 517.

FPN No. 2: For further information regarding performance and maintenance of emergency systems in health care facilities, see NFPA 99-2005, *Standard for Health Care Facilities*.

FPN No. 3: Emergency systems are generally installed in places of assembly where artificial illumination is required for safe exiting and for panic control in buildings subject to occupancy by large numbers of persons, such as hotels, theaters, sports arenas, health care facilities, and similar institutions. Emergency systems may also provide power for such functions as ventilation where essential to maintain life, fire detection and alarm systems, elevators, fire pumps, public safety communications systems, industrial processes where current interruption would produce serious life safety or health hazards, and similar functions.

FPN No. 4: For specification of locations where emergency lighting is considered essential to life safety, see NFPA 101[®]-2006, *Life Safety Code*[®].

FPN No. 5: For further information regarding performance of emergency and standby power systems, see NFPA 110-2005, *Standard for Emergency and Standby Power Systems*.

FPN No. 6: See Chapter 10 of the *Seattle Building Code* for means of egress illumination and identification requirements.

FPN No. 7: See DPD Client Assistance Memo (CAM 339), *Emergency and Standby Power Systems*, for additional information.

700.2 Application of Other Articles. Except as modified by this article, all applicable articles of this *Code* shall apply.

700.3 Equipment Approval. All equipment shall be approved for use on emergency systems.

700.4 Tests and Maintenance.

(A) Conduct or Witness Test. The authority having jurisdiction shall conduct or witness a test of the complete system upon installation and periodically afterward under the control of the Seattle Fire Department.

(B) Tested Periodically. Systems shall be tested periodically by the building owner or manager on a schedule acceptable to the authority having jurisdiction to ensure the systems are maintained in proper operating condition.

(C) Battery Systems Maintenance. Where battery systems or unit equipments are involved, including batteries used for starting, control, or ignition in auxiliary engines, the authority having jurisdiction shall require periodic maintenance by the building owner or manager.

(D) Written Record. A written record shall be kept of such tests and maintenance.

(E) Testing Under Load. Means for testing all emergency lighting and power systems during maximum anticipated load conditions shall be provided.

FPN: For testing and maintenance procedures of emergency power supply systems (EPSSs), see NFPA 110-2005, *Standard for Emergency and Standby Power Systems*.

700.5 Capacity.

(A) Capacity and Rating. An emergency system shall have adequate capacity and rating for all loads to be operated simultaneously. The emergency system equipment shall be suitable for the maximum available fault current at its terminals.

(B) Selective Load Pickup, Load Shedding, and Peak Load Shaving. The alternate power source shall be permitted to supply emergency, legally required standby, and optional standby system loads where the source has adequate capacity or where automatic selective load pickup and load shedding is provided as needed to ensure adequate power to (1) the emergency circuits, (2) the legally required standby circuits, and (3) the optional standby circuits, in that order of priority. The alternate power source shall be permitted to be used for peak load shaving, provided these conditions are met.

Peak load shaving operation shall be permitted for satisfying the test requirement of 700.4(B), provided all other conditions of 700.4 are met.

A portable or temporary alternate source shall be available whenever the emergency generator is out of service for major maintenance or repair.

700.6 Transfer Equipment.

(A) General. Transfer equipment, including automatic transfer switches, shall be automatic, identified for emergency use, and approved by the authority having jurisdiction. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and emergency sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705.

(B) Bypass Isolation Switches. Means shall be permitted to bypass and isolate the transfer equipment. Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

(C) Automatic Transfer Switches. Automatic transfer switches shall be electrically operated and mechanically held. Automatic transfer switches, rated 600 VAC and below, shall be listed for emergency system use.

(D) Use. Transfer equipment shall supply only emergency loads.

700.7 Signals. Audible and visual signal devices shall be provided, where practicable, for the purpose described in 700.7(A) through (D).

(A) Derangement. To indicate derangement of the emergency source.

(B) Carrying Load. To indicate that the battery is carrying load.

(C) Not Functioning. To indicate that the battery charger is not functioning.

(D) Ground Fault. To indicate a ground fault in solidly grounded wye emergency systems of more than 150 volts to ground and circuit-protective devices rated 1000 amperes or more. The sensor for the ground-fault signal devices shall be located at, or ahead of, the main system disconnecting means for the emergency source, and the maximum setting of the signal devices shall be for a ground-fault current of 1200 amperes. Instructions on the course of action to be taken in event of indicated ground fault shall be located at or near the sensor location.

FPN: For signals for generator sets, see NFPA 110-2005, *Standard for Emergency and Standby Power Systems*.

700.8 Signs.

(A) Emergency Sources. A sign shall be placed at the service-entrance equipment, indicating type and location of on-site emergency power sources.

Exception: A sign shall not be required for individual unit equipment as specified in 700.12(F).

FPN: WAC 296-46B-700.008(2) contains sight requirements; this WAC provision is by this reference made part of the 2008 Seattle Electrical Code.

(B) Grounding. Where the grounded circuit conductor connected to the emergency source is connected to a grounding electrode conductor at a location remote from the emergency source, there shall be a sign at the grounding location that identifies all emergency and normal sources connected at that location.

II. Circuit Wiring**700.9 Wiring, Emergency System.**

FPN: WAC 296-46B-700.009(3) & (4) contains requirements for emergency and exit lights, and identification plates; these WAC subsections are by this reference made part of the 2008 Seattle Electrical Code.

(A) Identification. All boxes and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system.

(B) Wiring. Wiring of two or more emergency circuits supplied from the same source shall be permitted in the same raceway, cable, box, or cabinet. Wiring from an emergency source or emergency source distribution overcurrent protection to emergency loads shall be kept entirely independent of all other wiring and equipment, unless otherwise permitted in (1) through (5):

- (1) Wiring from the normal power source located in transfer equipment enclosures
- (2) Wiring supplied from two sources in exit or emergency luminaires
- (3) Wiring from two sources in a common junction box, attached to exit or emergency luminaires
- (4) Wiring within a common junction box attached to unit equipment, containing only the branch circuit supplying the unit equipment and the emergency circuit supplied by the unit equipment
- (5) Wiring from an emergency source to supply any combination of emergency, legally required, or optional loads in accordance with (a), (b), and (c):

a. From separate vertical switchboard sections, with or without a common bus, or from individual disconnects mounted in separate enclosures.

b. The common bus or separate sections of the switchboard or the individual enclosures shall be permitted to be supplied by single or multiple feeders without overcurrent protection at the source.

Exception to (5)(b): Overcurrent protection shall be permitted at the source or for the equipment, provided the overcurrent protection is selectively coordinated with the downstream overcurrent protection

c. Legally required and optional standby circuits shall not originate from the same vertical switchboard section, panelboard enclosure, or individual disconnect enclosure as emergency circuits.

(C) Wiring Design and Location. Emergency wiring circuits shall be designed and located so as to minimize the hazards that might cause failure due to flooding, fire, icing, vandalism, and other adverse conditions.

(D) Fire Protection. Emergency systems shall meet the additional requirements in 700.9(D)(1) and (D)(2) in assembly occupancies for not less than 1000 persons or in buildings above 23 m (75 ft) in height with any of the following occupancy classes: assembly, educational, residential, detention and correctional, business, and mercantile.

FPN: For the definition of Occupancy Classification, see ((Section 6.1 of NFPA 101-2006, Life Safety Code)) Chapter 3 of the Seattle Building Code.

(1) Feeder-Circuit Wiring. Feeder-circuit wiring shall meet one of the following conditions:

- (1) Be installed in spaces or areas that are fully protected by an approved automatic fire suppression system

FPN: In buildings having Seattle Building Code Type I or II construction, wiring located above sprinkler heads, including wiring separated from sprinkler heads by a drop-ceiling system, is considered fully protected as required by this section.

- (2) Be a listed electrical circuit protective system with a minimum 1-hour fire rating

FPN: UL guide information for electrical circuit protection systems (FHIT) contains information on proper installation requirements to maintain the fire rating.

- (3) Be protected by a listed thermal barrier system for electrical system components

- (4) Be protected by a listed fire-rated assembly that has a minimum fire rating of 1-hour and contains only emergency wiring circuits.

- (5) Be embedded in not less than 50 mm (2 in.) of concrete

- (6) Be a cable listed to maintain circuit integrity for not less than 1 hour when installed in accordance with the listing requirements

(2) Feeder-Circuit Equipment. Equipment for feeder circuits (including transfer switches, transformers, and panelboards) shall be located either in spaces fully protected by approved automatic fire suppression systems (including sprinklers, carbon dioxide systems) or in spaces with a 1-hour fire resistance rating.

(FPN: For the definition of Occupancy Classification, see Section 6.1 of NFPA 101-2006, Life Safety Code.)

(3) Generator Control Wiring. Control conductors installed between the transfer equipment and the emergency generator shall be kept entirely independent of all other wiring and shall meet the conditions of 700.9(D)(1).

III. Sources of Power

700.12 General Requirements. Current supply shall be such that, in the event of failure of the normal supply to, or within, the building or group of buildings concerned, emergency lighting, emergency power, or both shall be available within the time required for the application but not to exceed 10 seconds. The supply system for emergency purposes, in addition to the normal services to the building and meeting the general requirements of this section, shall be one or more of the types of systems described in 700.12(A) through (E). Unit equipment in accordance with 700.12(F) shall satisfy the applicable requirements of this article.

In selecting an emergency source of power, consideration shall be given to the occupancy and the type of service to be rendered, whether of minimum duration, as for evacuation of a theater, or longer duration, as for supplying emergency power and lighting due to an indefinite period of current failure from trouble either inside or outside the building.

Equipment shall be designed and located so as to minimize the hazards that might cause complete failure due to flooding, fires, icing, and vandalism.

Equipment for sources of power as described in 700.12(A) through (E) where located within assembly occupancies for greater than 1000 persons or in buildings above 23 m (75 ft) in height with any of the following occupancy classes — assembly, educational, residential, detention and correctional, business, and mercantile — shall be installed either in spaces fully protected by approved automatic fire suppression systems (sprinklers, carbon dioxide systems, and so forth) or in spaces with a 1-hour fire rating.

FPN: For the definition of Occupancy Classification, see ((Section 6.1 of NFPA 101-2006, Life Safety Code)) Chapter 3 of the Seattle Building Code.

FPN No. 2: Assignment of degree of reliability of the recognized emergency supply system depends on the careful evaluation of the variables at each particular installation.

(A) Storage Battery. Storage batteries used as a source of power for emergency systems shall be of suitable rating and capacity to supply and maintain the total load for a minimum period of 1½ hours, without the voltage applied to the load falling below 87½ percent of normal.

Batteries, whether of the acid or alkali type, shall be designed and constructed to meet the requirements of emergency service and shall be compatible with the charger for that particular installation.

For a sealed battery, the container shall not be required to be transparent. However, for the lead acid battery that requires water additions, transparent or translucent jars shall be furnished. Automotive-type batteries shall not be used.

An automatic battery charging means shall be provided.

(B) Generator Set.

(1) Prime Mover-Driven. For a generator set driven by a prime mover acceptable to the authority having jurisdiction and sized in accordance with 700.5, means shall be provided for automatically starting the prime mover on failure of the normal service and for automatic transfer and operation of all

required electrical circuits. A time-delay feature permitting a 15-minute setting shall be provided to avoid retransfer in case of short-time reestablishment of the normal source.

(2) Internal Combustion as Prime Movers. Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premise fuel supply sufficient for not less than 2 hours' full-demand operation of the system. Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, this pump shall be connected to the emergency power system.

(3) Dual Supplies. Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems. Means shall be provided for automatically transferring from one fuel supply to another where dual fuel supplies are used.

(Exception: Where acceptable to the authority having jurisdiction, the use of other than on site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off site fuel delivery system and power from the outside electrical utility company.)

(4) Battery Power and Dampers. Where a storage battery is used for control or signal power or as the means of starting the prime mover, it shall be suitable for the purpose and shall be equipped with an automatic charging means independent of the generator set. Where the battery charger is required for the operation of the generator set, it shall be connected to the emergency system. Where power is required for the operation of dampers used to ventilate the generator set, the dampers shall be connected to the emergency system.

(5) Auxiliary Power Supply. Generator sets that require more than 10 seconds to develop power shall be permitted if an auxiliary power supply energizes the emergency system until the generator can pick up the load.

(6) Outdoor Generator Sets. Where an outdoor housed generator set is equipped with a readily accessible disconnecting means located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. The disconnecting means shall meet the requirements of 225.36.

(C) Uninterruptible Power Supplies. Uninterruptible power supplies used to provide power for emergency systems shall comply with the applicable provisions of 700.12(A) and (B) and shall be listed for emergency use.

FPN: UL 924 Emergency Lighting and Power Equipment is the appropriate standard for emergency equipment.

(D) Separate Service. Where approved by the authority having jurisdiction as suitable for use as an emergency source of power, an additional service shall be permitted. This service shall be in accordance with the applicable provisions of Article 230 and the following additional requirements:

- (1) Separate service drop or service lateral

(2) Service conductors sufficiently remote electrically and physically from any other service conductors to minimize the possibility of simultaneous interruption of supply

(E) Fuel Cell System. Fuel cell systems used as a source of power for emergency systems shall be of suitable rating and capacity to supply and maintain the total load for not less than 2 hours of full-demand operation.

Installation of a fuel cell system shall meet the requirements of Parts II through VIII of Article 692.

Where a single fuel cell system serves as the normal supply for the building or group of buildings concerned, it shall not serve as the sole source of power for the emergency standby system.

(F) Unit Equipment. Individual unit equipment for emergency illumination shall consist of the following:

- (1) A rechargeable battery
- (2) A battery charging means
- (3) Provisions for one or more lamps mounted on the equipment, or shall be permitted to have terminals for remote lamps, or both
- (4) A relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment

The batteries shall be of suitable rating and capacity to supply and maintain at not less than 87½ percent of the nominal battery voltage for the total lamp load associated with the unit for a period of at least 1½ hours, or the unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1½ hours. Storage batteries, whether of the acid or alkali type, shall be designed and constructed to meet the requirements of emergency service.

Unit equipment shall be permanently fixed in place (i.e., not portable) and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. Flexible cord-and-plug connection shall be permitted, provided that the cord does not exceed 900 mm (3 ft) in length. The branch circuit feeding the unit equipment shall be the same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches. The branch circuit that feeds unit equipment shall be clearly identified at the distribution panel. Emergency luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by 700.9 and by one of the wiring methods of Chapter 3.

Exception: In a separate and uninterrupted area supplied by a minimum of three normal lighting circuits, a separate branch circuit for unit equipment shall be permitted if it originates from the same panelboard as that of the normal lighting circuits and is provided with a lock-on feature.

IV. Emergency System Circuits for Lighting and Power

700.15 Loads on Emergency Branch Circuits. No appliances and no lamps, other than those specified as required for emergency use, shall be supplied by emergency lighting circuits.

700.16 Emergency Illumination. Emergency illumination shall include all required means of egress lighting, illuminated exit signs, and all other lights specified as necessary to provide required illumination.

Emergency lighting systems shall be designed and installed so that the failure of any individual lighting element, such as the burning out of a lamp, cannot leave in total darkness any space that requires emergency illumination.

Where high-intensity discharge lighting such as high- and low-pressure sodium, mercury vapor, and metal halide is used as the sole source of normal illumination, the emergency lighting system shall be required to operate until normal illumination has been restored.

Exit signs with open bottom lighting shall not be used in lieu of a required pathway light unless specifically approved for the purpose.

Exit illumination (pathway lighting) and emergency area lighting shall comply with Chapter 10 of the Seattle Building Code.

Exception: Alternative means that ensure emergency lighting illumination level is maintained shall be permitted.

700.17 Circuits for Emergency Lighting. Branch circuits that supply emergency lighting shall be installed to provide service from a source complying with 700.12 when the normal supply for lighting is interrupted. Such installations shall provide either of the following:

- (1) An emergency lighting supply, independent of the general lighting supply, with provisions for automatically transferring the emergency lights upon the event of failure of the general lighting system supply
- (2) Two or more separate and complete systems with independent power supply, each system providing sufficient current for emergency lighting purposes

Unless both systems are used for regular lighting purposes and are both kept lighted, means shall be provided for automatically energizing either system upon failure of the other. Either or both systems shall be permitted to be a part of the general lighting system of the protected occupancy if circuits supplying lights for emergency illumination are installed in accordance with other sections of this article.

700.18 Circuits for Emergency Power. For branch circuits that supply equipment classed as emergency, there shall be an emergency supply source to which the load will be transferred automatically upon the failure of the normal supply.

V. Control — Emergency Lighting Circuits

700.20 Switch Requirements. The switch or switches installed in emergency lighting circuits shall be arranged so that only authorized persons have control of emergency lighting.

Exception No. 1: Where two or more single-throw switches are connected in parallel to control a single circuit, at least one of these switches shall be accessible only to authorized persons.

Exception No. 2: Additional switches that act only to put emergency lights into operation but not disconnect them shall be permissible.

Switches connected in series or 3- and 4-way switches shall not be used.

700.21 Switch Location. All manual switches for controlling emergency circuits shall be in locations convenient to authorized persons responsible for their actuation. In facilities covered by Articles 518 and 520, a switch for controlling emergency lighting systems shall be located in the lobby or at a place conveniently accessible thereto.

In no case shall a control switch for emergency lighting be placed in a motion-picture projection booth or on a stage or platform.

Exception: Where multiple switches are provided, one such switch shall be permitted in such locations where arranged so that it can only energize the circuit but cannot de-energize the circuit.

700.22 Exterior Lights. Those lights on the exterior of a building that are not required for illumination when there is sufficient daylight shall be permitted to be controlled by an automatic light-actuated device.

700.23 Dimmer Systems. A dimmer system containing more than one dimmer and listed for use in emergency systems shall be permitted to be used as a control device for energizing emergency lighting circuits. Upon failure of normal power, the dimmer system shall be permitted to selectively energize only those branch circuits required to provide minimum emergency illumination. All branch circuits supplied by the dimmer system cabinet shall comply with the wiring methods of Article 700.

VI. Overcurrent Protection

700.25 Accessibility. The branch-circuit overcurrent devices in emergency circuits shall be accessible to authorized persons only.

700.26 Ground-Fault Protection of Equipment. The alternate source for emergency systems shall not be required to have ground-fault protection of equipment with automatic disconnecting means. Ground-fault indication of the emergency source shall be provided per 700.7(D).

700.27 Coordination. Emergency system(s) overcurrent devices shall be selectively coordinated with all supply side overcurrent protective devices.

Exception No. 1: Selective coordination shall not be required in (1) or (2):

(1) Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary,

(2) Between overcurrent protective devices of the same size (ampere rating) in series.

Exception No. 2: When an electrical engineer provides stamped fault current calculations, the emergency system(s) overcurrent protective devices may be selectively coordinated with emergency system supply side overcurrent protective devices for faults with a duration of 0.1 seconds and longer.

ARTICLE 701

Legally Required Standby Systems

I. General

701.1 Scope. The provisions of this article apply to the electrical safety of the installation, operation, and maintenance of legally required standby systems consisting of circuits and equipment intended to supply, distribute, and control electricity to required facilities for illumination or power, or both, when the normal electrical supply or system is interrupted.

The systems covered by this article consist only of those that are permanently installed in their entirety, including the power source.

FPN No. 1: For additional information, see NFPA 99-2005, *Standard for Health Care Facilities*.

FPN No. 2: For further information regarding performance of emergency and standby power systems, see NFPA 110-2005, *Standard for Emergency and Standby Power Systems*.

FPN No. 3: For further information, see ANSI/IEEE 446-1995, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications*.

701.2 Definition.

Legally Required Standby Systems. Those systems required and so classed as legally required standby by municipal, state, federal, or other codes or by any governmental agency having jurisdiction. These systems are intended to automatically supply power to selected loads (other than those classed as emergency systems) in the event of failure of the normal source.

FPN: Legally required standby systems are typically installed to serve loads, such as heating and refrigeration systems, communications systems, ventilation and smoke removal systems, sewage disposal, lighting systems, and industrial processes, that, when stopped during any interruption of the normal electrical supply, could create hazards or hamper rescue or fire-fighting operations.

701.3 Application of Other Articles. Except as modified by this article, all applicable articles of this *Code* shall apply.

701.4 Equipment Approval. All equipment shall be approved for the intended use.

701.5 Tests and Maintenance for Legally Required Standby Systems.

(A) Conduct or Witness Test. The authority having jurisdiction shall conduct or witness a test of the complete system upon installation.

(B) Tested Periodically. Systems shall be tested periodically on a schedule and in a manner acceptable to the authority having jurisdiction to ensure the systems are maintained in proper operating condition.

(C) Battery Systems Maintenance. Where batteries are used for control, starting, or ignition of prime movers, the authority having jurisdiction shall require periodic maintenance.

(D) Written Record. A written record shall be kept on such tests and maintenance.

(E) Testing Under Load. Means for testing legally required standby systems under load shall be provided.

FPN: For testing and maintenance procedures of emergency power supply systems (EPSs), see NFPA 110-2005, *Standard for Emergency and Standby Power Systems*.

701.6 Capacity and Rating. A legally required standby system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. Legally required standby system equipment shall be suitable for the maximum available fault current at its terminals.

The legally required standby alternate power source shall be permitted to supply both legally required standby and optional standby system loads under either of the following conditions:

- (1) Where the alternate source has adequate capacity to handle all connected loads
- (2) Where automatic selective load pickup and load shedding is provided that will ensure adequate power to the legally required standby circuits

701.7 Transfer Equipment.

(A) General. Transfer equipment, including automatic transfer switches, shall be automatic and identified for standby use and approved by the authority having jurisdiction. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and alternate sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705.

(B) Bypass Isolation Switches. Means to bypass and isolate the transfer switch equipment shall be permitted. Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

(C) Automatic Transfer Switches. Automatic transfer switches shall be electrically operated and mechanically held. Automatic transfer switches, rated 600 VAC and below, shall be listed for legally required standby system use.

701.8 Signals. Audible and visual signal devices shall be provided, where practicable, for the purposes described in 701.8(A), (B), and (C).

(A) Derangement. To indicate derangement of the standby source.

(B) Carrying Load. To indicate that the standby source is carrying load.

(C) Not Functioning. To indicate that the battery charger is not functioning.

FPN: For signals for generator sets, see NFPA 110-2005, *Standard for Emergency and Standby Power Systems*.

FPN: WAC 296-46B-70.008(1) sets forth in-sight requirements; This WAC provision is by this reference made part of the 2008 Seattle Electrical Code.

701.9 Signs.

(A) Mandated Standby. A sign shall be placed at the service entrance indicating type and location of on-site legally required standby power sources.

Exception: A sign shall not be required for individual unit equipment as specified in 701.11(G).

(B) Grounding. Where the grounded circuit conductor connected to the legally required standby power source is connected to a grounding electrode conductor at a location remote from the legally required standby power source, there shall be a sign at the grounding location that shall identify all legally required standby power and normal sources connected at that location.

II. Circuit Wiring

701.10 Wiring Legally Required Standby Systems. The legally required standby system wiring shall be kept entirely independent of all other wiring and equipment and shall not enter the same raceway, cable, box, or cabinet with other wiring for the following systems:

- (1) Shaft pressurization systems installed according to Chapter 9 of the Seattle Building Code, and
- (2) Elevators serving as an accessible means of egress according to Chapter 10 of the Seattle Building Code.

Other legally required standby system wiring shall be permitted to occupy the same raceways, cables, boxes, and cabinets with other general wiring.

FPN: Stretcher-sized elevator cars are required by Seattle Building Code Chapter 30 to be supplied with power from a legally required standby or emergency system.

III. Sources of Power

701.11 Legally Required Standby Systems. Current supply shall be such that, in the event of failure of the normal supply to, or within, the building or group of buildings concerned, legally required standby power will be available within the time required for the application but not to exceed 60 seconds. The supply system for legally required standby purposes, in addition to the normal services to the building, shall be permitted to comprise one or more of the types of systems described in 701.11(A) through (F). Unit equipment in accordance with 701.11(G) shall satisfy the applicable requirements of this article.

In selecting a legally required standby source of power, consideration shall be given to the type of service to be rendered, whether of short-time duration or long duration.

Consideration shall be given to the location or design, or both, of all equipment to minimize the hazards that might cause complete failure due to floods, fires, icing, and vandalism.

FPN: Assignment of degree of reliability of the recognized legally required standby supply system depends on the careful evaluation of the variables at each particular installation.

(A) Storage Battery. A storage battery shall be of suitable rating and capacity to supply and maintain at not less than 87½ percent of system voltage the total load of the circuits supplying legally required standby power for a period of at least 1½ hours.

Batteries, whether of the acid or alkali type, shall be designed and constructed to meet the service requirements of emergency service and shall be compatible with the charger for that particular installation.

For a sealed battery, the container shall not be required to be transparent. However, for the lead acid battery that requires water additions, transparent or translucent jars shall be furnished. Automotive-type batteries shall not be used.

An automatic battery charging means shall be provided.

(B) Generator Set.

(1) Prime Mover-Driven. For a generator set driven by a prime mover acceptable to the authority having jurisdiction and sized in accordance with 701.6, means shall be provided for automatically starting the prime mover upon failure of the normal service and for automatic transfer and operation of all required electrical circuits. A time-delay feature permitting a 15-minute setting shall be provided to avoid retransfer in case of short-time re-establishment of the normal source.

(2) Internal Combustion Engines as Prime Mover. Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours' full-demand operation of the system.

(3) Dual Fuel Supplies. Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or on a municipal water supply for their cooling systems.

Means shall be provided for automatically transferring one fuel supply to another where dual fuel supplies are used.

~~Exception: Where acceptable to the authority having jurisdiction, the use of other than on site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off site fuel delivery system and power from the outside electrical utility company.~~

(4) Battery Power. Where a storage battery is used for control or signal power or as the means of starting the prime mover, it shall be suitable for the purpose and shall be equipped with an automatic charging means independent of the generator set.

(5) Outdoor Generator Sets. Where an outdoor housed generator set is equipped with a readily accessible disconnecting means located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. The disconnecting means shall meet the requirements of 225.36.

(C) Uninterruptible Power Supplies. Uninterruptible power supplies used to provide power for legally required standby systems shall comply with the applicable provisions of 701.11(A) and (B).

(D) Separate Service. Where approved, a separate service shall be permitted as a legally required source of standby power. This service shall be in accordance with the applicable provisions of Article 230, with separate service drop or lateral sufficiently remote electrically and physically from any other service to minimize the possibility of simultaneous interruption of supply from an occurrence in another service.

(E) Connection Ahead of Service Disconnecting Means. Where acceptable to the authority having jurisdiction, connections located ahead of and not within the same cabinet, enclosure, or vertical switchboard section as the service disconnecting means shall be permitted. The legally required standby service shall be sufficiently separated from the normal main service disconnecting means to prevent simultaneous interruption of supply through an occurrence within the building or groups of buildings served.

FPN: See 230.82 for equipment permitted on the supply side of a service disconnecting means.

(F) Fuel Cell System. Fuel cell systems used as a source of power for legally required standby systems shall be of suitable rating and capacity to supply and maintain the total load for not less than 2 hours of full-demand operation.

Installation of a fuel cell system shall meet the requirements of Parts II through VIII of Article 692.

Where a single fuel cell system serves as the normal supply for the building or group of buildings concerned, it shall not serve as the sole source of power for the legally required standby system.

(G) Unit Equipment. Individual unit equipment for legally required standby illumination shall consist of the following:

- (1) A rechargeable battery
- (2) A battery charging means
- (3) Provisions for one or more lamps mounted on the equipment and shall be permitted to have terminals for remote lamps
- (4) A relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment

The batteries shall be of suitable rating and capacity to supply and maintain at not less than 87½ percent of the nominal battery voltage for the total lamp load associated with the unit for a period of at least 1½ hours, or the unit equipment shall supply and maintain not less than 60 percent of the initial legally required standby illumination for a period of at least 1½ hours. Storage batteries, whether of the acid or alkali type, shall be designed and constructed to meet the requirements of emergency service.

Unit equipment shall be permanently fixed in place (i.e., not portable) and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. Flexible cord-and-plug connection shall be permitted, provided that the cord does not exceed 0.9 m (3 ft) in length. The branch circuit feeding the unit equipment shall be the same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches. Legally required standby luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment by one of the wiring methods of Chapter 3.

Exception: In a separate and uninterrupted area supplied by a minimum of three normal lighting circuits, a separate branch circuit for unit equipment shall be permitted if it originates from the same panelboard as that of the normal lighting circuits and is provided with a lock-on feature.

IV. Overcurrent Protection

701.15 Accessibility. The branch-circuit overcurrent devices in legally required standby circuits shall be accessible to authorized persons only.

701.17 Ground-Fault Protection of Equipment. The alternate source for legally required standby systems shall not be required to have ground-fault protection of equipment.

701.18 Coordination. Legally required standby system(s) overcurrent devices shall be selectively coordinated with all supply side overcurrent protective devices.

Exception No. 1: Selective coordination shall not be required in (1) or (2):

- (1) *Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary,*
- (2) *Between overcurrent protective devices of the same size (ampere rating) in series.*

Exception No. 2: When an electrical engineer provides stamped fault current calculations, the overcurrent protective devices of each legally required standby system may be selectively coordinated with legally required standby system supply side overcurrent protective devices for faults with a duration of 0.1 seconds and longer.

ARTICLE 702 Optional Standby Systems

I. General

702.1 Scope. The provisions of this article apply to the installation and operation of optional standby systems.

The systems covered by this article consist of those that are permanently installed in their entirety, including prime movers, and those that are arranged for a connection to a premises wiring system from a portable alternate power supply.

702.2 Definition.

Optional Standby Systems. Those systems intended to supply power to public or private facilities or property where life safety does not depend on the performance of the system. Optional standby systems are intended to supply on-site generated power to selected loads either automatically or manually.

FPN: Optional standby systems are typically installed to provide an alternate source of electric power for such facilities as industrial and commercial buildings, farms, and residences and to serve loads such as heating and refrigeration systems, data processing and communications systems, and industrial processes that, when stopped during any power outage, could cause discomfort, serious interruption of the process, damage to the product or process, or the like.

702.3 Application of Other Articles. Except as modified by this article, all applicable articles of this Code shall apply.

702.4 Equipment Approval. All equipment shall be approved for the intended use.

702.5 Capacity and Rating.

(A) Available Short-Circuit Current. Optional standby system equipment shall be suitable for the maximum available short-circuit current at its terminals.

(B) System Capacity. The calculations of load on the standby source shall be made in accordance with Article 220 or by another approved method.

(1) Manual Transfer Equipment. Where manual transfer equipment is used, an optional standby system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. The user of the optional standby system shall be permitted to select the load connected to the system.

(2) Automatic Transfer Equipment. Where automatic transfer equipment is used, an optional standby system shall comply with (2)(a) or (2)(b).

(a) Full Load. The standby source shall be capable of supplying the full load that is transferred by the automatic transfer equipment.

(b) Load Management. Where a system is employed that will automatically manage the connected load, the standby source shall have a capacity sufficient to supply the maximum load that will be connected by the load management system.

702.6 Transfer Equipment. Transfer equipment shall be suitable for the intended use and designed and installed so as to prevent the inadvertent interconnection of normal and alternate sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705.

Transfer equipment, located on the load side of branch circuit protection, shall be permitted to contain supplemental overcurrent protection having an interrupting rating sufficient for the available fault current that the generator can deliver. The supplementary overcurrent protection devices shall be part of a listed transfer equipment.

Transfer equipment shall be required for all standby systems subject to the provisions of this article and for which an electric utility supply is either the normal or standby source.

Exception: Temporary connection of a portable generator without transfer equipment shall be permitted where conditions of maintenance and supervision ensure that only qualified persons service the installation and where the normal supply is physically isolated by a lockable disconnecting means or by disconnection of the normal supply conductors.

702.7 Signals. Audible and visual signal devices shall be provided, where practicable, for the following purposes.

(B) Selective Load Pickup, Load Shedding, and Peak Load Sharing. The alternate power source shall be permitted to supply COPS emergency, legally required standby and optional loads where the source has adequate capacity or where automatic selective load pickup and load shedding is provided as needed to ensure adequate power to (1) the COPS and emergency circuits, (2) the legally required standby circuits, and (3) the optional standby circuits, in that order of priority. The alternate power source shall be permitted to be used for peak load shaving, provided these conditions are met.

Peak load-shaving operation shall be permitted for satisfying the test requirement of 708.6(B), provided all other conditions of 708.6 are met.

(C) Duration of COPS Operation. The alternate power source shall be capable of operating the COPS for a minimum of 72 hours at full load of DCOA with a steady-state voltage within ± 10 percent of nominal utilization voltage.

(D) Ventilation. Adequate ventilation shall be provided for the alternate power source for continued operation under maximum anticipated ambient temperatures.

FPN: NFPA 110-2005, *Standard for Emergency and Standby Power Systems*, and NFPA 111-2005, *Standard for Stored Energy Emergency and Standby Power Systems*, include additional information on ventilation air for combustion and cooling.

708.24 Transfer Equipment.

(A) General. Transfer equipment, including automatic transfer switches, shall be automatic and identified for emergency use. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and critical operations sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of Article 705.

(B) Bypass Isolation Switches. Means shall be permitted to bypass and isolate the transfer equipment. Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

(C) Automatic Transfer Switches. Where used with sources that are not inherently synchronized, automatic transfer switches shall comply with (C)(1) and (C)(2).

- (1) Automatic transfer switches shall be listed for emergency use.
- (2) Automatic transfer switches shall be electrically operated and mechanically held.

(D) Use. Transfer equipment shall supply only COPS loads.

708.30 Branch Circuits Supplied by COPS. Branch circuits supplied by the COPS shall only supply equipment specified as required for critical operations use.

IV. Overcurrent Protection

708.50 Accessibility. The feeder- and branch-circuit overcurrent devices shall be accessible to authorized persons only.

708.52 Ground-Fault Protection of Equipment.

(A) Applicability. The requirements of 708.52 shall apply to critical operations (including multiple occupancy buildings) with critical operation areas.

(B) Feeders. Where ground-fault protection is provided for operation of the service disconnecting means or feeder disconnecting means as specified by 230.95 or 215.10, an additional step of ground-fault protection shall be provided in all next level feeder disconnecting means downstream toward the load. Such protection shall consist of overcurrent devices and current transformers or other equivalent protective equipment that causes the feeder disconnecting means to open.

The additional levels of ground-fault protection shall not be installed on electrical systems that are not solidly grounded wye systems with greater than 150 volts to ground but not exceeding 600 volts phase-to-phase.

(C) Testing. When equipment ground-fault protection is first installed, each level shall be tested to ensure that ground-fault protection is operational.

FPN: Testing is intended to verify the ground-fault function is operational. The performance test is not intended to verify selectivity in 708.52(D), as this is often coordinated similarly to circuit breakers by reviewing tie and current curves and properly setting the equipment. (Selectivity of fuses and circuit breakers is not performance tested for overload and short circuit.)

(D) Selectivity. Ground-fault protection for operation of the service and feeder disconnecting means shall be fully selective such that the feeder device, but not the service device, shall open on ground faults on the load side of the feeder device. A six-cycle minimum separation between the service and feeder ground-fault tripping bands shall be provided. Operating time of the disconnecting devices shall be considered in selecting the time spread between these two bands to achieve 100 percent selectivity.

FPN: See 230.95, FPN No. 4, for transfer of alternate source where ground-fault protection is applied.

708.54 Coordination. Critical operations power system(s) overcurrent devices shall be selectively coordinated with all supply side overcurrent protective devices.

Exception: When an electrical engineer provides stamped fault current calculations, the critical operations power system(s) overcurrent protective devices may be selectively

coordinated with all critical operations power supply side overcurrent protective devices for faults with a duration of 0.1 seconds and longer.

V. System Performance and Analysis

708.64 Emergency Operations Plan. A facility with a COPS shall have documented an emergency operations plan. The plan shall consider emergency operations and response, recovery, and continuity of operations.

FPN: NFPA 1600-2007, *Standard on Disaster/Emergency Management and Business Continuity Programs*, Section 5.7, provides guidance for the development and implementation of emergency plans.

ARTICLE 720 Circuits and Equipment Operating at Less Than 50 Volts

720.1 Scope. This article covers installations operating at less than 50 volts, direct current or alternating current.

720.2 Other Articles. Direct current or alternating-current installations operating at less than 50 volts, as covered in 411.1 through 411.7; Part VI of Article 517; Part II of Article 551; Parts II and III and 552.60(B) of Article 552; 650.1 through 650.8; 669.1 through 669.9; Parts I and VIII of Article 690; Parts I and III of Article 725; or Parts I and III of Article 760 shall not be required to comply with this article.

720.3 Hazardous (Classified) Locations. Installations within the scope of this article and installed in hazardous (classified) locations shall also comply with the appropriate provisions for hazardous (classified) locations in other applicable articles of this *Code*.

720.4 Conductors. Conductors shall not be smaller than 12 AWG copper or equivalent. Conductors for appliance branch circuits supplying more than one appliance or appliance receptacle shall not be smaller than 10 AWG copper or equivalent.

720.5 Lampholders. Standard lampholders that have a rating of not less than 660 watts shall be used.

720.6 Receptacle Rating. Receptacles shall have a rating of not less than 15 amperes.

720.7 Receptacles Required. Receptacles of not less than 20-ampere rating shall be provided in kitchens, laundries, and other locations where portable appliances are likely to be used.

720.9 Batteries. Installations of storage batteries shall comply with 480.1 through 480.4 and 480.8 through 480.10.

720.11 Mechanical Execution of Work. Circuits operating at less than 50 volts shall be installed in a neat and workmanlike manner. Cables shall be supported by the building structure in such a manner that the cable will not be damaged by normal building use.

ARTICLE 725 Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power-Limited Circuits

I. General

725.1 Scope. This article covers remote-control, signaling, and power-limited circuits that are not an integral part of a device or appliance.

FPN: The circuits described herein are characterized by usage and electrical power limitations that differentiate them from electric light and power circuits; therefore, alternative requirements to those of Chapters 1 through 4 are given with regard to minimum wire sizes, derating factors, overcurrent protection, insulation requirements, and wiring methods and materials.

725.2 Definitions.

Abandoned Class 2, Class 3, and PLTC Cable. Installed Class 2, Class 3, and PLTC cable that is not terminated at equipment and not identified for future use with a tag.

Circuit Integrity (CI) Cable. Cable(s) used for remote-control, signaling, or power-limited systems that supply critical circuits to ensure survivability for continued circuit operation for a specified time under fire conditions.

Class 1 Circuit. The portion of the wiring system between the load side of the overcurrent device or power-limited supply and the connected equipment.

FPN: See 725.41 for voltage and power limitations of Class 1 circuits.

Class 2 Circuit. The portion of the wiring system between the load side of a Class 2 power source and the connected equipment. Due to its power limitations, a Class 2 circuit considers safety from a fire initiation standpoint and provides acceptable protection from electric shock.

Class 3 Circuit. The portion of the wiring system between the load side of a Class 3 power source and the connected equipment. Due to its power limitations, a Class 3 circuit considers safety from a fire initiation standpoint. Since higher levels of voltage and current than for Class 2 are permitted, additional safeguards are specified to provide protection from an electric shock hazard that could be encountered.

1685-2000, *Standard for Safety for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*. The smoke measurements in the test method are not applicable.

Another method of defining *resistant to the spread of fire* is for the damage (char length) not to exceed 1.5 m (4 ft 11 in.) when performing the CSA “Vertical Flame Test — Cables in Cable Trays,” as described in CSA C22.2 No. 0.3-M-2001, *Test Methods for Electrical Wires and Cables*.

727.7 Marking. The cable shall be marked in accordance with 310.11(A)(2), (A)(3), (A)(4), and (A)(5). Voltage ratings shall not be marked on the cable.

727.8 Allowable Ampacity. The allowable ampacity of the conductors shall be 5 amperes, except for 22 AWG conductors, which shall have an allowable ampacity of 3 amperes.

727.9 Overcurrent Protection. Overcurrent protection shall not exceed 5 amperes for 20 AWG and larger conductors, and 3 amperes for 22 AWG conductors.

727.10 Bends. Bends in Type ITC cables shall be made so as not to damage the cable.

ARTICLE 760 Fire Alarm Systems

I. General

760.1 Scope. This article covers the installation of wiring and equipment of fire alarm systems including all circuits controlled and powered by the fire alarm system.

FPN No. 1: Fire alarm systems include fire detection and alarm notification, guard’s tour, sprinkler waterflow, and sprinkler supervisory systems. Circuits controlled and powered by the fire alarm system include circuits for the control of building systems safety functions, elevator capture, elevator shutdown, door release, smoke doors and damper control, fire doors and damper control and fan shutdown, but only where these circuits are powered by and controlled by the fire alarm system. For further information on the installation and monitoring for integrity requirements for fire alarm systems, refer to the NFPA 72®-2007, National Fire Alarm Code®.

FPN No. 2: Class 1, 2, and 3 circuits are defined in Article 725.

760.2 Definitions.

Abandoned Fire Alarm Cable. Installed fire alarm cable that is not terminated at equipment other than a connector and not identified for future use with a tag.

Fire Alarm Circuit. The portion of the wiring system between the load side of the overcurrent device or the power-limited supply and the connected equipment of all circuits powered and controlled by the fire alarm system. Fire alarm

circuits are classified as either non-power-limited or power-limited.

Fire Alarm Circuit Integrity (CI) Cable. Cable used in fire alarm systems to ensure continued operation of critical circuits during a specified time under fire conditions.

Non-Power-Limited Fire Alarm Circuit (NPLFA). A fire alarm circuit powered by a source that complies with 760.41 and 760.43.

Power-Limited Fire Alarm Circuit (PLFA). A fire alarm circuit powered by a source that complies with 760.121.

760.3 Other Articles. Circuits and equipment shall comply with 760.3(A) through (G). Only those sections of Article 300 referenced in this article shall apply to fire alarm systems.

(A) Spread of Fire or Products of Combustion. Section 300.21. The accessible portion of abandoned fire alarm cables shall be removed.

(B) Ducts, Plenums, and Other Air-Handling Spaces. Section 300.22, where installed in ducts or plenums or other spaces used for environmental air.

Exception: As permitted in 760.53(B)(1) and (B)(2) and 760.154(A).

(C) Hazardous (Classified) Locations. Articles 500 through 516 and Article 517, Part IV, where installed in hazardous (classified) locations.

(D) Corrosive, Damp, or Wet Locations. Sections 110.11, 300.6, and 310.9, where installed in corrosive, damp, or wet locations.

(E) Building Control Circuits. Article 725, where building control circuits (e.g., elevator capture, fan shutdown) are associated with the fire alarm system.

(F) Optical Fiber Cables. Where optical fiber cables are utilized for fire alarm circuits, the cables shall be installed in accordance with Article 770.

(G) Installation of Conductors with Other Systems. Installations shall comply with 300.8.

760.21 Access to Electrical Equipment Behind Panels Designed to Allow Access. Access to electrical equipment shall not be denied by an accumulation of conductors and cables that prevents removal of panels, including suspended ceiling panels.

760.24 Mechanical Execution of Work. Fire alarm circuits shall be installed in a neat workmanlike manner. Cables and conductors installed exposed on the surface of ceilings and sidewalls shall be supported by the building structure in such a manner that the cable will not be damaged by normal

building use. Such cables shall be supported by straps, staples, cable ties, hangers, or similar fittings designed and installed so as not to damage the cable. The installation shall also comply with 300.4(D).

760.25 Abandoned Cables. The accessible portion of abandoned fire alarm cables shall be removed. Where cables are identified for future use with a tag, the tag shall be of sufficient durability to withstand the environment involved.

760.30 Fire Alarm Circuit Identification. Fire alarm circuits shall be identified at terminal and junction locations in a manner that helps to prevent unintentional signals on fire alarm system circuit(s) during testing and servicing of other systems.

FPN: WAC 296-46B-760, which involves device and junction box identification requirements is by this reference made part of the 2008 Seattle Electrical Code.

760.32 Fire Alarm Circuits Extending Beyond One Building. Power-limited fire alarm circuits that extend beyond one building and run outdoors either shall meet the installation requirements of Parts II, III, and IV of Article 800 or shall meet the installation requirements of Part I of Article 300. Non-power-limited fire alarm circuits that extend beyond one building and run outdoors shall meet the installation requirements of Part I of Article 300 and the applicable sections of Part I of Article 225.

760.35 Fire Alarm Circuit Requirements. Fire alarm circuits shall comply with 760.35(A) and (B).

(A) Non-Power-Limited Fire Alarm (NPLFA) Circuits. See Parts I and II.

(B) Power-Limited Fire Alarm (PLFA) Circuits. See Parts I and III.

II. Non-Power-Limited Fire Alarm (NPLFA) Circuits

760.41 NPLFA Circuit Power Source Requirements.

(A) Power Source. The power source of non-power-limited fire alarm circuits shall comply with Chapters 1 through 4, and the output voltage shall be not more than 600 volts, nominal.

(B) Branch Circuit. An individual branch circuit shall be required for the supply of the power source. This branch circuit shall not be supplied through ground-fault circuit interrupters or arc-fault circuit interrupters.

FPN: See 210.8(A)(5), Exception, for receptacles in dwelling-unit unfinished basements that supply power for fire alarm systems.

760.43 NPLFA Circuit Overcurrent Protection. Overcurrent protection for conductors 14 AWG and larger shall be

provided in accordance with the conductor ampacity without applying the derating factors of 310.15 to the ampacity calculation. Overcurrent protection shall not exceed 7 amperes for 18 AWG conductors and 10 amperes for 16 AWG conductors.

Exception: Where other articles of this Code permit or require other overcurrent protection.

760.45 NPLFA Circuit Overcurrent Device Location. Overcurrent devices shall be located at the point where the conductor to be protected receives its supply.

Exception No. 1: Where the overcurrent device protecting the larger conductor also protects the smaller conductor.

Exception No. 2: Transformer secondary conductors. Non-power-limited fire alarm circuit conductors supplied by the secondary of a single-phase transformer that has only a 2-wire (single-voltage) secondary shall be permitted to be protected by overcurrent protection provided by the primary (supply) side of the transformer, provided the protection is in accordance with 450.3 and does not exceed the value determined by multiplying the secondary conductor ampacity by the secondary-to-primary transformer voltage ratio. Transformer secondary conductors other than 2-wire shall not be considered to be protected by the primary overcurrent protection.

Exception No. 3: Electronic power source output conductors. Non-power-limited circuit conductors supplied by the output of a single-phase, listed electronic power source, other than a transformer, having only a 2-wire (single-voltage) output for connection to non-power-limited circuits shall be permitted to be protected by overcurrent protection provided on the input side of the electronic power source, provided this protection does not exceed the value determined by multiplying the non-power-limited circuit conductor ampacity by the output-to-input voltage ratio. Electronic power source outputs, other than 2-wire (single voltage), connected to non-power-limited circuits shall not be considered to be protected by overcurrent protection on the input of the electronic power source.

FPN: A single-phase, listed electronic power supply whose output supplies a 2-wire (single-voltage) circuit is an example of a non-power-limited power source that meets the requirements of 760.41.

760.46 NPLFA Circuit Wiring. Installation of non-power-limited fire alarm circuits shall be in accordance with 110.3(B), 300.7, 300.11, 300.15, 300.17, and other appropriate articles of Chapter 3.

Exception No. 1: As provided in 760.48 through 760.53.

Exception No. 2: Where other articles of this Code require other methods.

**SECTION 1006
MEANS OF EGRESS ILLUMINATION**

1006.1 Illumination required. The means of egress, including the exit discharge, shall be illuminated at all times the building space served by the means of egress is occupied.

Exceptions:

1. Occupancies in Group U.
2. Aisle accessways in Group A.
3. Dwelling units and sleeping units in Groups R-1, R-2 and R-3.
4. Sleeping units of Group I occupancies.

1006.2 Illumination level. Illumination shall be provided at every point in ((⌘))the means of egress. The illumination level shall not be less than 1 foot-candle (11 lux) at the walking surface level. Luminaires shall be installed whenever exit signs are required as specified in Section 1011.

Exception: For auditoriums, theaters, concert or opera halls and similar assembly occupancies, the illumination at the walking surface level is permitted to be reduced during performances to not less than 0.2 foot-candle (2.15 lux), provided that the required illumination is automatically restored upon activation of a premises' fire alarm system where such system is provided.

Code Alternate CA1006.2: Compliance with the following paragraphs will be deemed to satisfy the requirement for means of egress illumination at every point in the means of egress. Means of egress illumination systems that comply with this Code Alternate shall also comply with Section 1006.3.

1. Location and Fixture Placement. Means of egress illumination shall be located in stairways, corridors, halls, passenger elevator cars, lobbies, rooms with an occupant load of 100 or more, and other areas required to provide safe egress from the premises and immediately outside of the building exit when required by the building official. Fixtures shall be installed to not less than the following schedule:

- | | |
|---|--|
| <u>1.1 Interior and exterior stairways and landings and outside building exit</u> | <u>At least one per landing</u> |
| <u>1.2 Corridors and halls and designated means of egress paths in parking garages</u> | <u>At least one for each 40 lineal feet</u> |
| <u>1.3 Lobbies, vestibules, foyers, elevator cars and other similar areas as required</u> | <u>At least one for each 250 square feet</u> |
| <u>1.4 Warehouses</u> | <u>See Item 2 below.</u> |

These fixtures are permitted to be included in the watts per square foot calculation for means of egress illumination.

2. Amount of Illumination. Where means of egress illumination is required, illumination shall be provided at the rate of 0.1 watt of fluorescent illumination per square foot of area. Installations using incandescent lamps shall have a minimum wattage of at least 3 times the fluorescent requirements. Use of other light sources is subject to the approval of the building official.

Exceptions:

1. In warehouses, the allowable minimum illumination is permitted to be 0.1 watt per square foot (0.03 watts for fluorescent) provided fixtures are placed either:
 - 1.1 Where means of egress pathways are not designated, fixtures shall be placed to cover an area not larger than 1,600 square feet, or
 - 1.2 Where means of egress pathways are designated, fixtures shall be placed at least one for every 40 lineal feet.
2. In theaters, auditoriums or other places of assembly where motion pictures or other projections are made by means of directed light, the minimum allowable illumination is permitted to be reduced to 0.05 watts per square foot of floor area (0.02 watts for fluorescent). The higher level of required illumination shall be automatically restored upon activation of a premises fire alarm system where such system is provided.
3. In Groups B, F-1, M and S-1 occupancies, when approved by the building official, the minimum allowable illumination is permitted to be reduced to 0.05 watts per square foot (0.02 watts for fluorescent) of floor area.
4. In Group B occupancies and open parking garages, when approved by the building official, the illumination is permitted to be eliminated when within 50 feet of a window wall or open side and where light is not totally obscured.

Means of egress illumination fixtures shall be spaced and designed to give adequate distribution of light for safe egress and so that the failure of any individual lighting element, such as the burning out of a light bulb, will not leave any space in total darkness. Illumination from battery operated fixtures shall provide the same level of illumination required for hard-wired fixtures.

1006.3 Illumination ((emergency)) power supply. The power supply for means of egress illumination shall normally be provided by the premises' electrical supply.

In the event of power supply failure, an emergency electrical system shall automatically illuminate the following areas:

1. Aisles and unenclosed egress stairways in rooms and spaces that require two or more means of egress.
2. Corridors, exit enclosures and exit passageways in buildings required to have two or more exits.
3. Exterior egress components at other than the level of exit discharge until exit discharge is accomplished for buildings required to have two or more exits.
4. Interior exit discharge elements, as permitted in Section 1024.1, in buildings required to have two or more exits.
5. Exterior landings, as required by Section 1008.1.5, for exit discharge doorways in buildings required to have two or more exits.

SECTION 1011 EXIT SIGNS

1011.1 Where required. Exits and exit access doors shall be marked by an approved exit sign readily visible from any direction of egress travel. Access to exits shall be marked by readily visible exit signs in cases where the exit or the path of egress travel is not immediately visible to the occupants. Exit sign placement shall be such that no point in a corridor is more than 100 feet (30 480 mm) or the listed viewing distance for the sign, whichever is less, from the nearest visible exit sign. Either exit signs or exit placards shall be located at any other location determined by the building official to be necessary to clearly indicate the direction of egress.

Exceptions:

1. Exit signs are not required in rooms or areas that require only one exit or exit access other than in buildings designed with a single exit stairway according to Section 1019.2 exception 4.
2. Main exterior exit doors or gates that are obviously and clearly identifiable as exits need not have exit signs where approved by the building official.
3. Exit signs are not required in occupancies in Group U and individual sleeping units or dwelling units in Group R-1, R-2 or R-3.
4. Exit signs are not required in sleeping areas in occupancies in Group I-3.
5. In occupancies in Groups A-4 and A-5, exit signs are not required on the seating side of vomitories or openings into seating areas where exit signs are provided in the concourse that are readily apparent from the vomitories. Egress lighting is provided to

The emergency power system shall provide power for a duration of not less than 90 minutes and shall consist of storage batteries, unit equipment or an on-site generator. The installation of the emergency power system shall be in accordance with Section 2702.

1006.4 Performance of system. Emergency lighting facilities shall be arranged to provide initial illumination that is at least an average of 1 foot-candle (11 lux) and a minimum at any point of 0.1 foot-candle (1 lux) measured along the path of egress at floor level. Illumination levels shall be permitted to decline to 0.6 foot-candle (6 lux) average and a minimum at any point of 0.06 foot-candle (0.6 lux) at the end of the emergency lighting time duration. A maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.

identify each vomitory or opening within the seating area in an emergency.

6. Exit signs are not required on exterior stairways serving exterior exit balconies.

Interpretation I1011.1: Exit placards are permitted to be used to identify exits in occupancies where exit signs are not required.

1011.2 Illumination. Exit signs shall be internally or externally illuminated.

Exception: Tactile signs required by Section 1011.3 need not be provided with illumination.

1011.3 Tactile exit signs. A tactile sign stating EXIT and complying with ICC A117.1 shall be provided adjacent to each door to an egress stairway, an exit passageway and the exit discharge.

1011.4 Internally illuminated exit signs. Internally illuminated exit signs shall be listed and labeled and shall be installed in accordance with the manufacturer's instructions and Section 2702. Exit signs shall be illuminated at all times.

1011.5 Externally illuminated exit signs. Externally illuminated exit signs shall comply with Sections 1011.5.1 through 1011.5.3.

1011.5.1 Graphics. Every exit sign, exit placard and directional exit sign shall have plainly legible green letters not less than 6 inches (152 mm) high with the principal strokes of the letters not less than 0.75 inch (19.1 mm) wide. The word "EXIT" shall have letters having a width not less than 2 inches (51 mm) wide, except the letter "I," and the minimum spacing between letters shall not be less than 0.375 inch (9.5 mm). Signs and placards larger than the minimum established in this section

shall have letter widths, strokes and spacing in proportion to their height.

The word "EXIT" shall be in high contrast with the background and shall be clearly discernible when the means of exit sign illumination is or is not energized. If a chevron directional indicator is provided as part of the exit sign or placard, the construction shall be such that the direction of the chevron directional indicator cannot be readily changed.

Exception: Existing exit signs or placards with letters at least 5 inches (127 mm) in height are permitted to be reused.

1011.5.2 Exit sign illumination. The face of an exit sign illuminated from an external source shall have an intensity of not less than 5 foot-candles (54 lux).

1011.5.3 Power source. Exit signs shall be illuminated at all times. To ensure continued illumination for a duration of not less than 90 minutes in case of primary power loss, the sign

illumination means shall be connected to an emergency power system provided from storage batteries, unit equipment or an on-site generator. The installation of the emergency power system shall be in accordance with Section 2702.

Exception: Approved exit sign illumination means that provide continuous illumination independent of external power sources for a duration of not less than 90 minutes, in case of primary power loss, are not required to be connected to an emergency electrical system.

1011.6 Not-an-exit warnings. Placards reading "NOT AN EXIT" shall be installed at all doorways, passageways or stairways which are not exits, exit accesses or exit discharges, and which may be mistaken for an exit. A sign indicating the use of the doorway, passageway or stairway, such as "TO BASEMENT", "STORE ROOM", "LINEN CLOSET", is permitted in lieu of the "NOT AN EXIT" sign.