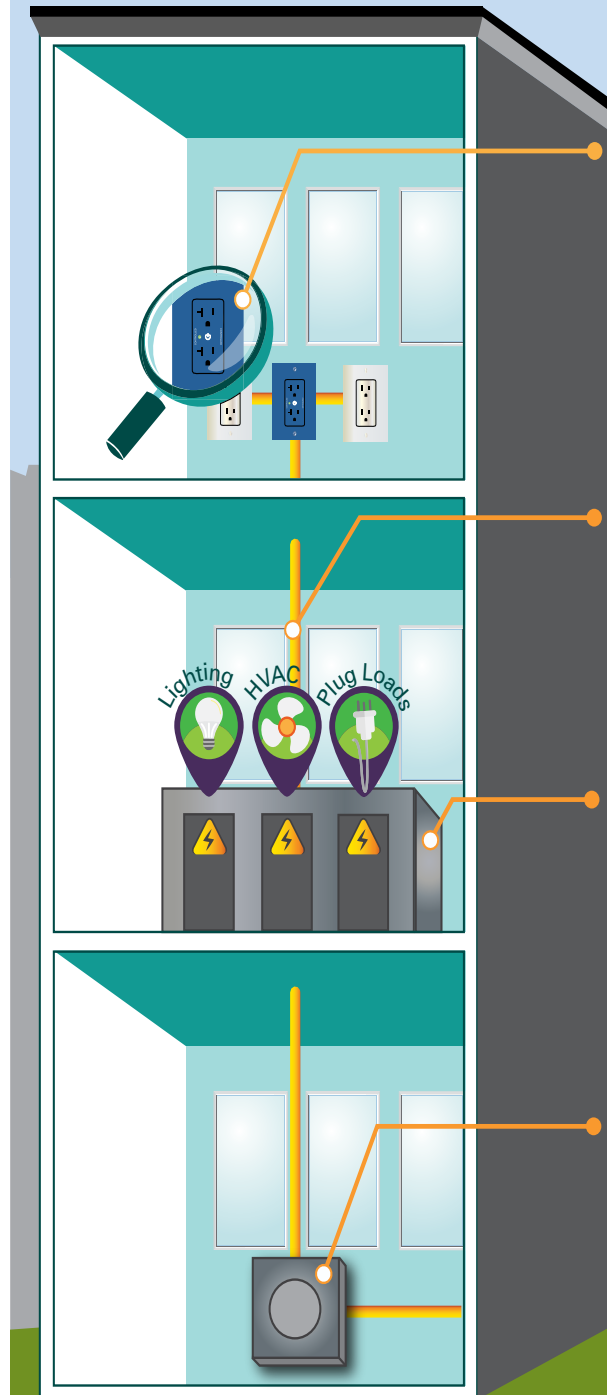


Watt's Happening Here? Electricity's Trip From the Ground Up



What is Electrical Power Distribution?

Electrical power distribution (EPD) systems encompass electrical systems and equipment not specific to lighting. All requirements in [Section 130.5](#) of California's 2019 Building Energy Efficiency Standards (Title 24, Part 6 or Energy Code) are Mandatory. These requirements apply to all New Construction, Additions and Alterations for nonresidential, high-rise residential and hotel/motel buildings.

Relevant Code Sections

2019 California Building Energy Efficiency Standards, Title 24, Part 6:

- [Section 110.12](#) – Mandatory Requirements for Demand Management
- [Section 130.5](#) – Electrical Power Distribution Systems

Relevant Compliance Forms

- [NRCC-ELC-E](#): Electrical Power Distribution
- [NRCI-ELC-01-E](#): Electrical Power Distribution
- [NRCI-LTI-02-E EMCS](#): Lighting Control System (if used to control 120-Volt receptacles)

Mandatory Requirements

Electrical Service Metering [Section 130.5\(a\)](#)

All newly installed electrical services (mechanism for electrical power from a utility company or on-site generation to enter a building) or feeders (device to conduct electrical power from one switchboard or panelboard to another) must have a permanently installed electrical meter.

Why? So service to every building can be metered, allowing the building owner to monitor energy use.

Requirements

- New or replacement electrical service equipment in existing buildings must meet the requirements of [Section 130.5\(a\)](#) applicable to the EPD system being altered
- The meter must be able to:
 - Show the instantaneous power in kilowatts (kW) being used by the building
 - Track energy use in kilowatt-hours (kWh) over a period set by the user
- Additional requirements must be met for larger services (see [Table 130.5-A](#)):
 - For electrical services >250 kilovolt-amperes (kVA), the meter must also record the historical peak demand in kW
 - For electrical services >1000 kVA, the meter must also be able to report the kWh for a fixed-rate period

A permanently installed metering system meeting the above requirements is not required if:

- The utility company provides a metering system, for the service or feeder, that indicates instantaneous kW demand and kWh for a utility-defined period OR
- The system is subject to California Electrical Code Article 517

In general, smart meters will meet the requirements.

If a building is not connected to the grid, a customer-owned meter must be in place to monitor energy use. Note that customer-owned meters can be less accurate than a typical utility company revenue-grade meter.

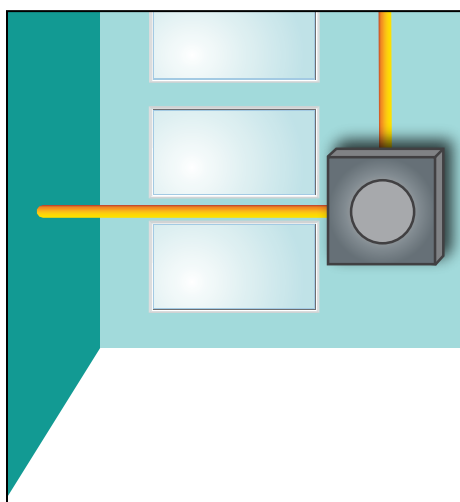
If a building has multiple services, only the service that provides regular electric power needs to meet the requirements. However, it is recommended that back-up power be metered as well.

Compliance Documentation: Complete Table F of [NRCC-ELC-E](#)

Separation of Electrical Circuits [Section 130.5\(b\)](#)

EPD systems should be designed for disaggregated measurement of electrical load energy uses downstream from the service meter according to load type and service power (kVA).

Why? To help building owners and managers get detailed end-use data to target specific operational improvements.



*The trip begins...
electricity arrives at a building and knocks to get in.*

Requirements:

- Separation is progressive and not required until the service is greater than 50 kVA, unless it pertains to renewable power sources or electric vehicle charging stations
 - This will not apply to most small buildings
- For services > 50 kVA - 250 kVA:
 - The requirements are applied to some load groups regardless of actual load, and to other load
 - Plug load including appliances rated < 25kVA are kept in aggregate, however groups of plug loads > 25kVA connected load in area < 5000ft² must be separated
- For services > 250 kVA:
 - Lighting and plug loads are required to be disaggregated “by floor, type or area”
 - All HVAC, DHW, elevator and charging station loads can be measured in aggregate, by load type
 - HVAC load ≥ 50 kVA must be separated
- See [Table 130.5-B](#) of the Energy Code for specific separation requirements
- For each separate load type, up to 10% of the connected load may be any type
- Entirely new or complete replacement of EPD systems in existing buildings must meet the applicable requirements of [Section 130.5\(b\)](#)

Compliance Documentation: Complete Table G of [NRCC-ELC-E](#)

Voltage Drop Section 130.5(c)

Voltage drop is the energy loss as heat in the electrical conductors. Following the limits in CA Electrical Code (Title 24, Part 3), the recommended voltage drop becomes Mandatory.

Why? Voltage drop is caused by resistance in the circuit and reduces the amount of useful work that can be done by the system. It can be reduced by using larger gauge wire and ensuring that all connections provide good conduction.

Requirements:

- The combined voltage drop on both feeders and branch circuit conductors to the furthest connected load may not exceed 5%
- Any addition, modification or replacement of both feeders and branch circuits in existing buildings must meet the requirements of [Section 130.5\(c\)](#) for the altered circuits

Exception:

- Voltage drops specifically permitted by Sections 647.4, 695.6 and 695.7 of the CA Electrical Code

Voltage drops can be calculated by hand or through an online or computer program calculator with a few inputs including feeder length and branch circuit lengths, wire gauge by type, and circuit amps. Since electrical loads vary, the calculations are based on design load.

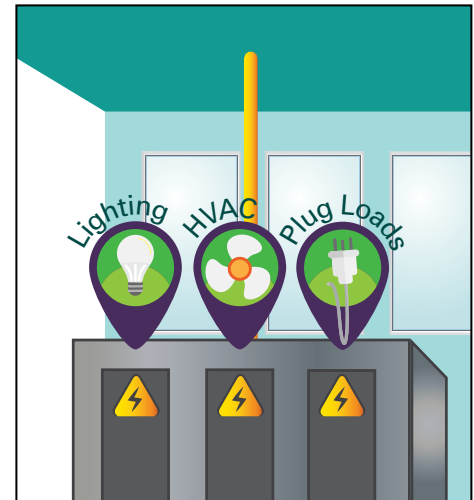
Compliance Documentation: Complete Table H of [NRCC-ELC-E](#). Attach voltage drop calculations to the [NRCC-ELC-E](#) form.

Circuit Controls for 120-Volt Receptacles Section 130.5(d)

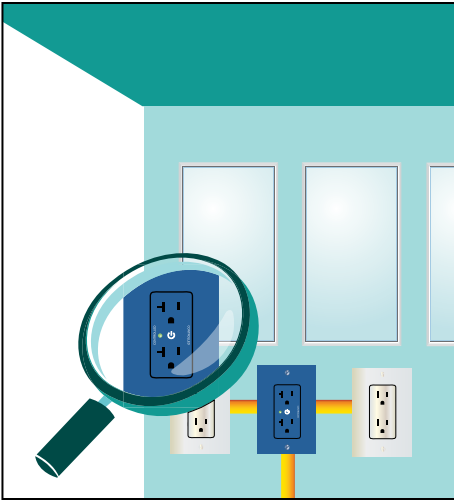
This requirement is designed to minimize plug loads in office areas and other similar space types. It requires that controlled and uncontrolled 120-volt receptacles be provided in each of the following locations: hotel/motel guest rooms, office areas, lobbies, conference rooms, kitchen areas in office spaces, and copy rooms.

Requirements:

- For entirely new or complete replacement of EPD systems, the entire system must meet the applicable requirements of [Section 130.5\(d\)](#)
- For each *uncontrolled* receptacle:
 - Provide a *controlled* receptacle within 6 feet OR
 - Use split-wired receptacles, with at least one uncontrolled and one controlled receptacle



Once in the building, electricity must make a choice on where to go (e.g., HVAC, lighting, plug loads). As electricity flows through the building's wires, voltage drops.



When the electricity arrives at its final destination, it may need to be controlled.

- Controlled receptacles must be permanently and durably marked to differentiate them from uncontrolled receptacles
- Circuit controls must be capable of automatically shutting OFF controlled receptacles when the space is typically unoccupied
 - The most common way to meet this requirement is to install a local motion sensor that can be connected to control both general lighting and receptacles, and use the occupancy (not vacancy) control method
 - Another common method is to employ automatic time switch controls with manual override switches
- Plug-in power strips cannot be used to meet this requirement
- For hotel/motel guest rooms:
 - At least 1/2 of the 120-volt receptacles in each room must be controlled receptacles, controlled by captive card controls, occupancy sensing controls, or automatic controls such that no longer than 30 minutes after the guest room has been vacated, power is switched off
- The requirements for controlled receptacles apply to additions and alterations only when the EPD system is entirely new or when the existing one is being completely replaced

Exceptions:

- Receptacles for refrigerators and water dispensers in kitchen areas
- Clock receptacles ≥ 6 feet above the floor
- Receptacles for network copiers, fax machines, A/V and data equipment in copy rooms
- Receptacles on circuits rated more than 20 amperes
- Receptacles connected to an uninterruptible power supply (UPS) that are intended to be in continuous use 24/365 and are marked to differentiate them from other uncontrolled receptacles

Compliance Documentation: Complete Table I of NRCC-ELC-E

Demand Responsive Controls & Equipment Sections 110.12 and 130.5(e)

Section 130.5(e) points to Section 110.12 in the 2019 Energy Code and adds specific requirements for Demand Response (DR) control functionality as well as when these controls are required for HVAC, lighting and Electronic Message Center (EMC) control. Healthcare facilities are exempt from these requirements.

Requirements:

- Nonresidential HVAC systems with Direct Digital Control (DDC) to the Zone level must be programmed to allow for centralized demand shed in non-critical zones to meet the applicable requirements of Section 110.12(b)
- Lighting controls in nonresidential buildings $>10,000$ ft² must be able to automatically reduce lighting power in response to a DR signal to meet requirements of Section 110.12c
 - Ambient lighting must maintain a uniform level of illumination per Table 130.1-A when being reduced
- EMC controls >15 kW must be able to reduce lighting power by a minimum of 30% when a DR signal is received

Exceptions:

- Spaces with a lighting power density (LPD) of 0.5 W/ft²
 - These areas do not count toward the 10,000 ft² threshold
- Spaces and EMCs where lighting cannot be reduced because of a health or life safety statute, ordinance or regulation
 - These areas do not count toward the 10,000 ft² threshold

Compliance Documentation: NRCC-MCH-E, NRCC-LTI-E and NRCC-LTS-E will indicate when DR controls are required.

For More Information

Primary Sources

- Energy Code Section 110.12 – Mandatory Requirements for Demand Management:
energycodeace.com/site/custom/public/reference-ace-2019/Documents/section11012mandatoryrequirementsfordemandmanagement.htm
- Energy Code Section 130.5 – Electrical Power Distribution Systems:
energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1305electricalpowerdistributionsystems.htm
- Energy Code Section 130.5(b) – Separation of Electrical Circuits
energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1305electricalpowerdistributionsystems.htm
- Energy Code Section 130.5(c) – Voltage Drop
energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1305electricalpowerdistributionsystems.htm
- Energy Code Section 130.5(d) – Circuit Controls for 120-Volt Receptacles
energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1305electricalpowerdistributionsystems.htm
- Energy Code Nonresidential Compliance Manual, Chapter 8 – Electrical Power Distribution
energycodeace.com/site/custom/public/reference-ace-2019/Documents/8electricalpowerdistribution.htm

Compliance Forms

- Nonresidential Compliance Forms
energycodeace.com/NonresidentialForms/2019

California Energy Commission Information & Services

- Energy Code Hotline: 1-800-772-3300 (Free) or Title24@energy.ca.gov
- Online Resource Center:
energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center
 - The Energy Commission’s main web portal for the Energy Code, including information, documents and historical information

Additional Resources

- Energy Code Ace:
EnergyCodeAce.com
 - An online “one-stop-shop” providing free resources and training to help appliance and building industry professionals decode and comply with Title 24, Part 6 and Title 20. The site is administered by California’s investor-owned utilities. Please register with the site and select an industry role for your profile in order to receive messages about all our free offerings!



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