

Electrical Association

Overcurrent Protection Based on 2017 NEC Part 1



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This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying 2 hours of code credit toward Electrical Continuing Education requirements.

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- **Comments in green text are interpretations by MEA**
- **Please see the National Electrical Code 2017 (NFPA 70) for complete review of the code articles.**



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Part One

2 hours

Overcurrent Protection



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Art. 100 – Definitions

Overcurrent Protective Device, Branch-Circuit:

A device capable of providing protection for service, feeder, and branch circuits and equipment over the full range of overcurrents **between its rated current and its interrupting rating.**

Branch-circuit overcurrent protective devices are provided with interrupting ratings appropriate for the intended **use but no less than 5,000 amperes.**



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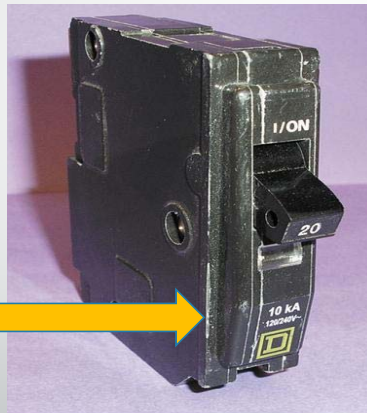
Art. 100 – Definitions

Interrupting Rating:

The highest current at rated voltage that a device is intended to interrupt under standard test conditions.



Interrupting rating



If possible:

- Show video of effects of non- current limiting and current limiting fuses on loose wire
- Show video of misapplied IC rating



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Art. 100 – Definitions

- **Circuit Breaker.** A device designed to open and close a circuit by nonautomatic means and to **open the circuit automatically on a predetermined overcurrent** without damage to itself when properly applied within its rating.
- **Circuit Breaker- Adjustable (as applied to CB).** A qualifying term indicating that the circuit breaker can be set to trip at **various values of current, time, or both**, within a predetermined range.
- **Instantaneous Trip (as applied to CB).** A qualifying term indicating that **no delay is purposely introduced in the tripping action** of the circuit breaker.

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Adjustable trip circuit breaker



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Art. 100 – Definitions

- **Inverse Time (as applied to circuit breakers).** A qualifying term indicating that there **is purposely introduced a delay in the tripping action** of the circuit breaker, which delay decreases as the magnitude of the current increases. **Higher current = shorter time to trip**
- **Nonadjustable (as applied to circuit breakers).** A qualifying term indicating that the circuit breaker **does not have any adjustment to alter the value of current at which it will trip or the time required** for its operation.
- **Setting (of circuit breakers).** The value of current, time, or both, at which an adjustable circuit breaker is set to trip. **Actual value of time and current to trip**



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100 – Definitions

Coordination (Selective):

Localization of an overcurrent condition to **restrict outages to the circuit or equipment affected**, accomplished by the choice of overcurrent protective devices and their ratings or settings.

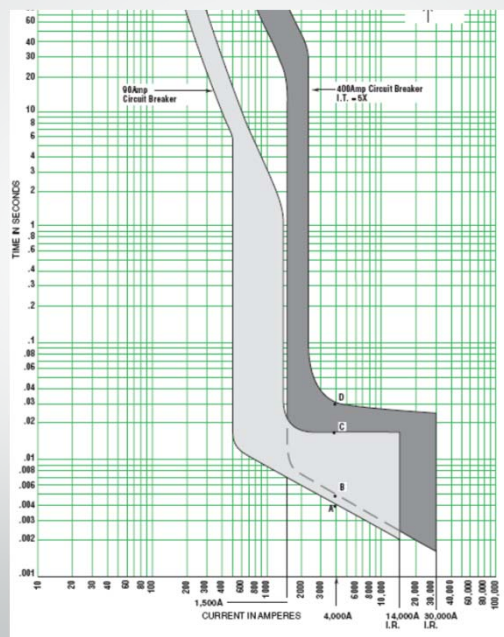
These apply to the full range of over currents from overload to full fault current, and the full range or opening times.



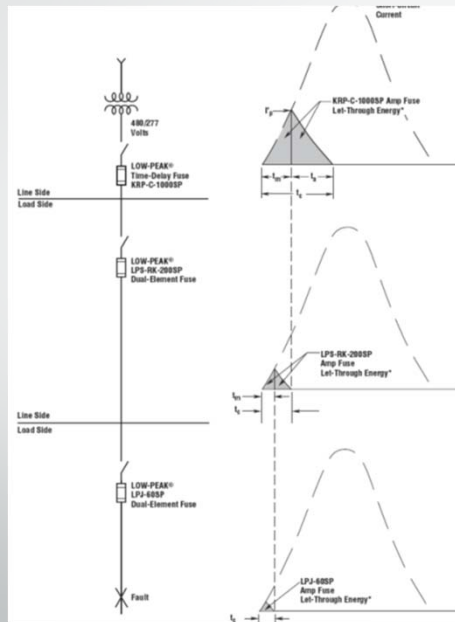
Selective Coordination

**90 Amp Breaker
downstream from a
400amp Breaker**

Point A – 90A starts to open
Point B – 400A starts to open
Point C – 90 a breaks the circuit
Point D – 400a breaks the circuit



Series Protection



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Art. 100 – Definitions

Ground-Fault Protection of Equipment (GFPE):

A system intended to provide protection (to)of equipment from damaging **line-to-ground fault currents by operating to cause a disconnecting means to open all ungrounded conductors** of the faulted circuit.

This protection **is provided at current levels less than those required to protect conductors from damage through the operation of a supply circuit overcurrent device**

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ICEA table

**Copper, 75° Thermoplastic Insulated Cable Damage Table
(Based on 60 HZ)**

Copper Wire Size 75°C Thermoplastic	Maximum Short-Circuit Withstand Current in Amperes					
	1/8	1/4	1/2	1	2	3
	Cycles*	Cycles*	Cycles*	Cycle	Cycles	Cycles
#14*	4,800	3,400	2,400	1,700	1,200	1,000
#12*	7,600	5,400	3,800	2,700	1,900	1,550
#10	12,000	8,500	6,020	4,300	3,000	2,450
#8	19,200	13,500	9,600	6,800	4,800	3,900
#6	30,400	21,500	16,200	10,800	7,600	6,200
#4	48,400	34,200	24,200	17,100	12,100	9,900

* Extrapolated data.

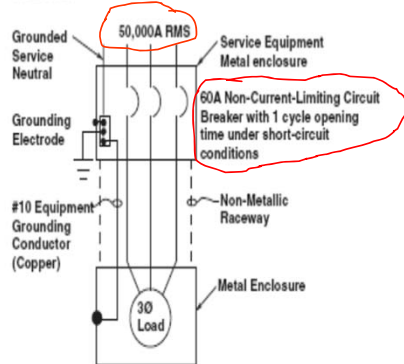


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Take the example below. The EGC must be protected from damage. It can withstand 4,300 amperes of current for 1 cycle. The 1 cycle opening time of the circuit breaker will cause damage to the #10 EGC. However, a current-limiting fuse will limit the cur-

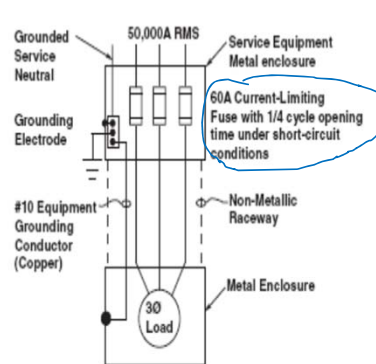
rent to within the withstand rating of the EGC. An LPS-RK60SP will limit the line to ground current to approximately 3300 amperes, providing protection.

VIOLATION



Would need to increase Equipment Grounding Conductor to 2/0, per ICEA Std. P-32-382.

COMPLIANCE



Conforms to Section 110-10 and 250-95.



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100 – Definitions

Overcurrent Protective Device, Supplementary:

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.



Over 1000 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.



Over 1000 Volts, Nominal

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



Part IX Over 1000 Volts, Nominal

- **Non-vented Power Fuse:**
A fuse without intentional provision for the escape of arc gases, liquids, or solid particles to the atmosphere during circuit interruption.
- **Vented Power Fuse:**
A fuse with provision for the escape of arc gases, liquids, or solid particles to the surrounding atmosphere during circuit interruption.



Power Fuse Unit:

A vented, non-vented, 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.



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Over 1000 Volts, Nominal

Multiple Fuse:

An assembly of two or more single-pole fuses.



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Wiring and Overcurrent Protection and the NEC

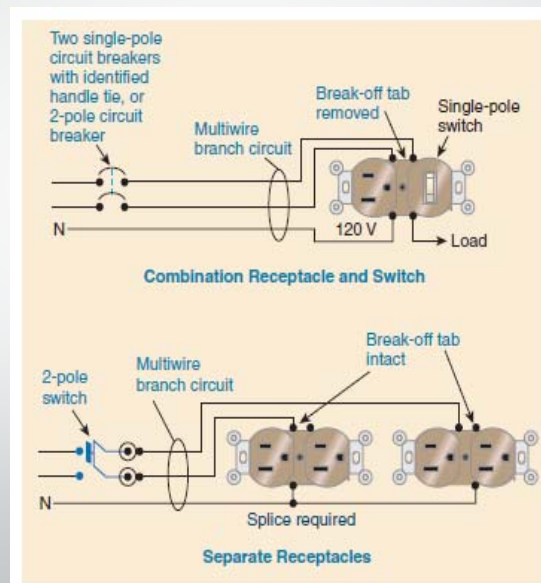


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210.4 Multiwire Branch circuit

(A) General. A multiwire circuit shall be permitted to be considered as multiple circuits. All conductors of a multiwire branch circuit shall originate from the same panelboard or similar distribution equipment.

(B) Disconnecting Means. Each multiwire branch circuit shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point where the branch circuit originates.



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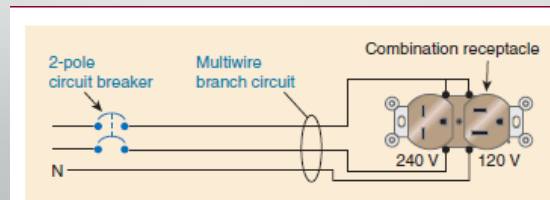


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210.4

(C) **Line-to-Neutral Loads.** Multiwire branch circuits shall supply only line-to-neutral loads.

The most commonly used multiwire branch circuit consists of two ungrounded conductors and one grounded conductor supplied from a 120/240-V, single-phase, 3-wire system. Such Multiwire circuits supply appliances that have both line-to-line and line-to-neutral connected loads, such as electric ranges and clothes dryers, or supply loads that are line-to-neutral connected only, such as the split-wired combination device shown in Exhibit 210.1 (bottom). A multiwire branch circuit is also permitted to supply a device with a 250-V receptacle (line-to-line) and a 125-V receptacle (line-to-neutral), as shown in Exhibit 210.2, provided the branch-circuit overcurrent device simultaneously opens both of the ungrounded conductors.



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210.4

(D) **Grouping.** The ungrounded and grounded circuit conductors of each multiwire branch circuit shall be grouped as per Art 200.4 (by cable ties or similar means in at least one location within an enclosure)

Exception: The requirement for grouping shall not apply if the circuit enters from a cable or raceway unique to the circuit that makes the grouping obvious

or if the conductors pass through a box or conduit body without a loop, or without a splice or termination.

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NEC Article 240



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240.2 Definitions

Supervised Industrial Installation. For the purposes of Part VIII, the industrial portions of a facility where all of the following conditions are met:

- (1) Conditions of maintenance and engineering supervision ensure that only qualified persons monitor and service the system.
- (2) The premises wiring system has 2500 kVA or greater of load used in industrial process(es), manufacturing activities, or both, as calculated in accordance with Article 220.
- (3) The premises has at least one service or feeder that is more than 150 volts to ground and more than 300 volts phase-to-phase.

This definition excludes installations in buildings used by the industrial facility for offices, warehouses, garages, machine shops, and recreational facilities that are not an integral part of the industrial plant, substation, or control center.



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240.4 (B) Overcurrent Devices Rated 800 Amperes or Less. (generally)

The next higher standard overcurrent device rating (above the ampacity of the conductors being protected) shall be permitted, **provided all of the following conditions are met:**

- (1) **(IF)** The conductors being protected are not part of a branch circuit supplying more than one receptacle for cord-and-plug-connected portable loads. **(Multi-receptacle branch circuits are not eligible for up sized OC protection)**

AND

- (2) **(IF)** The ampacity of the conductors does not correspond with the standard ampere rating of a fuse or a circuit breaker without overload trip adjustments above its rating. **See Table 240.6** (but that shall be permitted to have other trip or rating adjustments). **(lower trip adjustments)**

AND

- (3) The next higher standard rating selected does not exceed 800 amperes.



240.4 C

(C) Overcurrent Devices Rated over 800 Amperes.

Where the overcurrent device is rated **over 800 amperes**, the ampacity of the conductors it protects shall be equal to or greater than the rating of the overcurrent device defined in 240.6. **(conductor rated ampacity must meet or exceed the OC protection rating)**



240.4(D) Small Conductors

Unless specifically permitted in 240.4(E) (tap conductors) or (G) (See Specific conductors: table 240.4(G), the overcurrent protection shall not exceed that required by (D)(1) through (D)(7) (See NEC after any correction factors for ambient temperature and number of conductors have been applied. (Apply correction factors to the conductors, and then pick OC protection.)



240.4(D) Small Conductors

- (1) 18AWG 7 amperes with restrictions
- (2) 16AWG 10A with restrictions
- (3) 14 AWG Copper. 15 amperes
- (4) 12 AWG Aluminum and Copper-Clad Aluminum. 15 amperes
- (5) 12 AWG Copper. 20 amperes
- (6) 10 AWG Aluminum and Copper-Clad Aluminum. 25 amperes
- (7) 10 AWG Copper. 30 amperes



240.5 Protection of flexible cords and cables, and fixture wires

These wire shall be protected from overcurrent as in Art. 400.5 (A) or (B)

(A) Ampacities for **flexible cords and cables** as per table 400.4(1) and (A2)

Ampacities for fixture wire as per table 402.5

Supplemental protection as per 240.10

(B) Branch circuit overcurrent device - shall protect the branch circuit as in B1-B4

1. Listed appliance or luminaire: **use approved supply wires**
2. Fixture wire: **20A-#18 for 50 ft; #16 for 100 ft, etc.**
3. Extension cords: **as listed**
4. Field assembled extension cords: **20A -#16 or larger**



240.6 Standard Ampere Ratings for fuses and inverse time circuit breakers

Standard Ampere Ratings

15	20	25	30	35
40	45	50	60	70
80	90	100	110	125
150	175	200	225	250
300	350	400	450	500
600	700	800	1000	1200
1600	2000	2500	3000	4000
5000	6000	-	-	-



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240.6 Standard Ampere Ratings

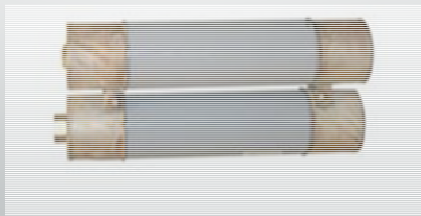
(B) Adjustable-Trip Circuit Breakers

The rating of adjustable trip circuit breakers having external means for adjusting the current setting (long-time pickup setting), not meeting the requirements of 240.6(C), shall be the maximum setting possible.



240.8 Fuses or Circuit Breakers in Parallel

Fuses and circuit breakers shall be permitted to be connected in parallel where they are factory assembled in parallel and listed as a unit. Individual fuses, circuit breakers, or combinations thereof shall not otherwise be connected in parallel.



240.9 Thermal Devices

Thermal relays and other **devices not designed to open short circuits or ground faults shall not be used for the protection of conductors against overcurrent due to short circuits** or ground faults, **but - the use of such devices shall be permitted to protect motor branch-circuit conductors from overload** if protected in accordance with 430.40. (motor overload relays)

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240.10 Supplementary Overcurrent Protection

Where supplementary overcurrent protection is used for luminaires, appliances, and other equipment or for internal circuits and components of equipment, **it shall not be used as a substitute for required branch-circuit overcurrent devices or in place of the required branch-circuit protection.** Supplementary overcurrent devices shall not be required to be readily accessible.



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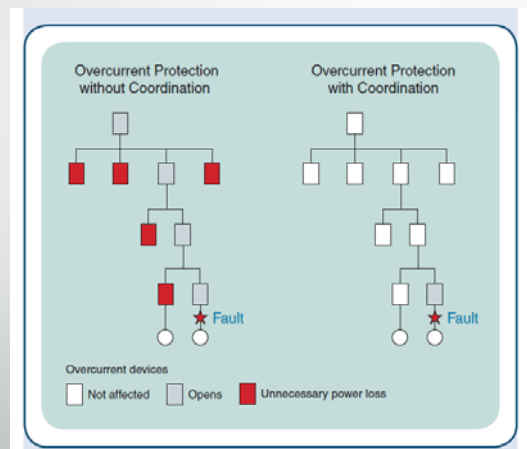
240.12 Electrical System Coordination

Where an orderly shutdown is required to minimize the hazard(s), a system of coordination based on the following two conditions shall be permitted:

- (1) Coordinated short-circuit protection
- (2) Overload indication based on monitoring systems or devices



Example of system without - and with coordinated protection



240.13 Ground-Fault Protection of Equipment

- Ground-fault **protection of equipment** (GFPE) shall be provided for solidly grounded wye systems of more than 150 V to ground but not exceeding 1000V phase-to-phase for each device used as a building disconnecting means rated 1000 amps or more.
- The provisions of this section **shall not apply to the disconnecting means** for:
 - (1) Continuous industrial processes where a non-orderly shutdown will introduce additional hazards
 - (2) Installations where GFP is provided by other requirements for services or feeders
 - (3) **Fire pumps**



240.15 Ungrounded Conductors

- (A) Overcurrent Device Required. A fuse or an overcurrent trip unit of a circuit breaker **shall be connected in series with each ungrounded conductor**. You may use a CT and an overcurrent trip relay in lieu of a fuse.
- (B) Circuit Breaker as Overcurrent Device. Circuit breakers **shall open all ungrounded conductors of the circuit both manually and automatically**. (See 1-4 following)



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240.15(B) Circuit Breaker as Overcurrent Device

(1) Multiwire Branch Circuit.

Individual single-pole circuit breakers, **with identified handle ties, shall be permitted as the protection for each ungrounded conductor** of multiwire branch circuits that serve only single-phase line-to-neutral loads. (Typically 120V loads)

(2) Grounded Single-Phase AC circuits.

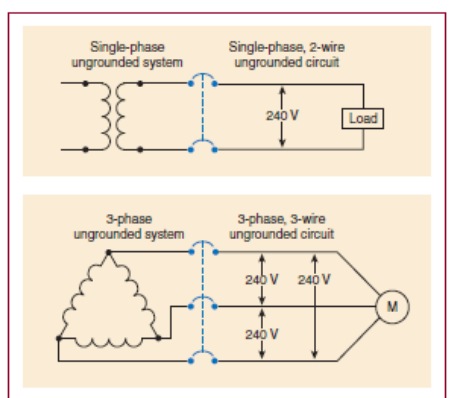
In grounded systems, individual single-pole circuit breakers rated 120/240 AC **with identified handle ties shall be permitted as the protection for each ungrounded conductor for line-to-line connected loads** for single-phase circuits. (Typically 240V loads)

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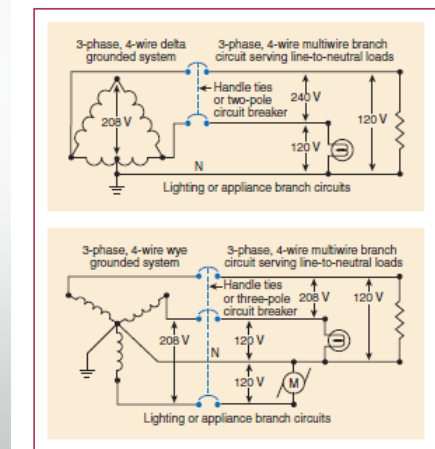


240.15 (B)

Multipole breakers required



Single pole breakers allowed



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- Handle ties required
- Multi-pole or handle ties permitted

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240.15 Ungrounded Conductors.

(3) 3-phase and 2-phase systems:

In 4-wire, 3 phase, and 5-wire 2 phase systems, individual breakers rated 120/240 with identified handle ties are permitted if the systems have a grounded neutral point and the voltage to ground does not exceed 120V. (Typically 120/208V systems)

(4) 3-wire DC circuits:

Individual circuit breakers rated 125/250VDC with identified handle ties are permitted for 3 wire circuits to protect the line to line connected loads if there is a grounded neutral and the voltage to ground does not exceed 125V

240.21 Location in Circuit

- Overcurrent protection shall be provided in each ungrounded circuit conductor and shall be located at the point where the conductors receive their supply conductors receive their supply **except as specified in 240.21(A) through (H)**.
- Conductors supplied under the provisions of 240.21(A) through (H) shall not supply another conductor except through an overcurrent protective device meeting the requirements of 240.4. **(Conductors protected by OC protection)**



Part II Location of OC protection 240.21(A)

- **Branch-Circuit Conductors.** Branch-circuit tap conductors meeting the requirements specified in 210.19-
(not less than maximum load after adjustment and correction factors are applied)
- shall be permitted to have overcurrent protection as specified in 210.20. **(125% for continuous loads)**



240.21(B) Feeder Taps

- Conductors are permitted to be tapped without O.C. protection at the tap if to a feeder as specified in B1 through B5. 240.4B
- (O.C. – next higher size- not over 800 A) rule are not permitted for tap conductors

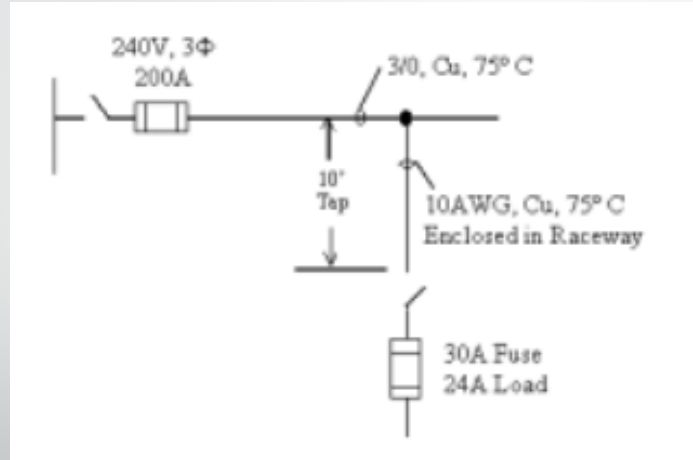


(B)(1) Taps Not Over 10 ft Long

- (1) Where the length of the tap conductors does not exceed (10 ft) and the tap conductors comply with all of the following:
 - (1) The ampacity of the tap conductors is:
 - a. Not less than the combined calculated loads on the circuits supplied by the tap conductors, and
 - b. Not less than the rating of the equipment containing an overcurrent device(s) supplied by the tap conductors, or not less than the rating of the overcurrent protective device at the termination of the tap conductors.



10-foot Tap Rule



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(1) Taps Not Over 10 ft Long

- (2) The tap conductors do not extend beyond the switchboard, panelboard, disconnecting means, or control devices they supply.
- (3) Except at the point of connection to the feeder, the tap conductors are enclosed in a raceway, which shall extend from the tap to the enclosure of an enclosed switchboard, panelboard, or control devices, or to the back of an open switchboard.
- (4) For field installations if the tap conductors leave the enclosure or vault in which the tap is made, the ampacity of the tap conductors is not less than 1/10 the rating of the OC device protecting the feeder.



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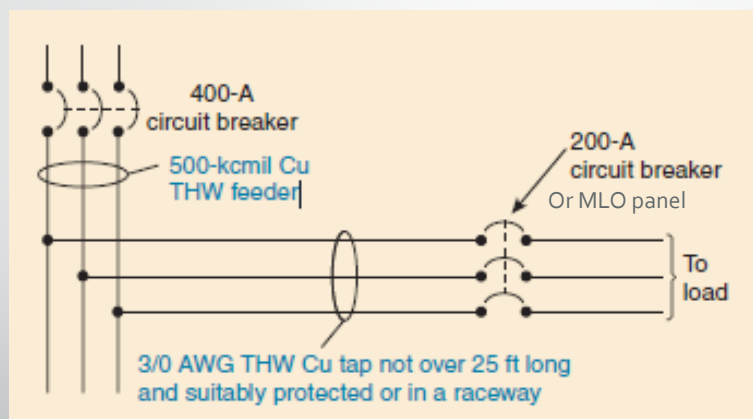
(B)(2) Taps Not over 25 ft Long.

Where the length of the tap conductors does not exceed (25 ft) and the tap conductors comply with all the following:

- (1) The ampacity of the tap conductors is not less than one-third of the rating of the overcurrent device protecting the feeder conductors.
- (2) The tap conductors terminate in a single circuit breaker or a single set of fuses that limit the load to the ampacity of the tap conductors. This device shall be permitted to supply any number of additional overcurrent devices on its load side.
- (3) The tap conductors are protected from physical damage by being enclosed in an approved raceway or by other approved means.



240.21(B) 25-ft Tap Rule



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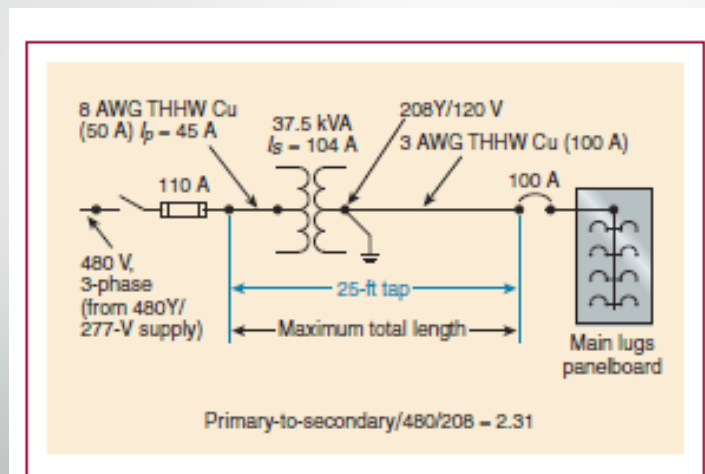
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240-21(B)(3) Taps supplying a transformer Pri + Sec not over 25 Feet long

- Taps that supply a transformer where the primary plus the secondary are not over 25ft.
- All of the conditions of 1-5 are met
 - (1) The tap for the primary is at least $\frac{1}{3}$ the ampacity of the feeder conductors
 - (2) The secondary conductor ampacity is at least $\frac{1}{3}$ of the feeder OC after the transformer ratio is used.
 - (3) The primary plus the secondary conductors are not over 25 feet in length
 - (4) Conductors are physically protected
 - (5) The secondary terminates in OC protection



Transformer Pri + Sec: not over 25 Foot




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240.21(B)(4) Taps over 25 feet long
240.21 (5) Outside taps unlimited length


- See code 240.21 (4) for **high bay** manufacturing buildings (over 35 feet high)
- See code 240.21 (5) for tap conductors that are **outdoors with unlimited length**

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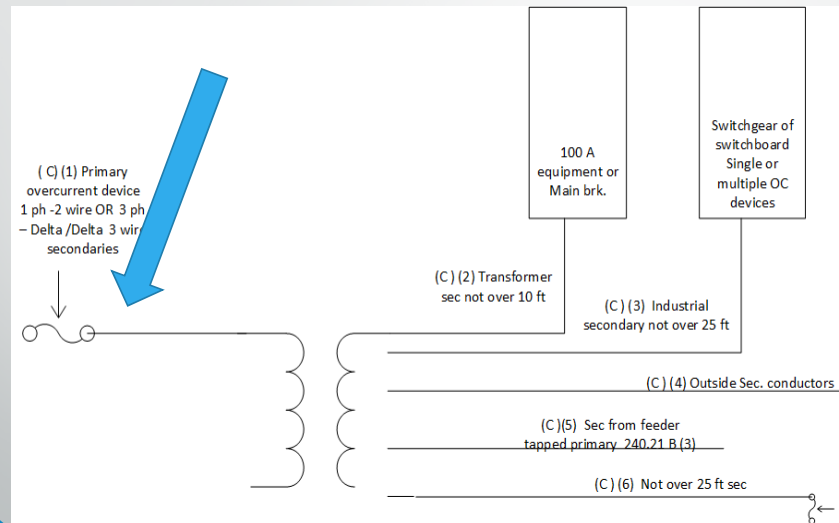
240.21 C Transformer secondary conductors

A set of conductors feeding a single load, or each set of conductors feeding separate loads, shall be permitted to be connected to a transformer secondary, **without overcurrent protection at the secondary, as specified in 240.21(C)(1) through (C)(6). The provisions of 240.4(B) shall not be permitted for transformer secondary conductors. (Cannot go to the next larger size of OC)**

Informational Note: For overcurrent protection requirements for transformers, see 450.3.

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C(1) Primary Overcurrent



240.21(C)(1) Transformer Secondary Conductors

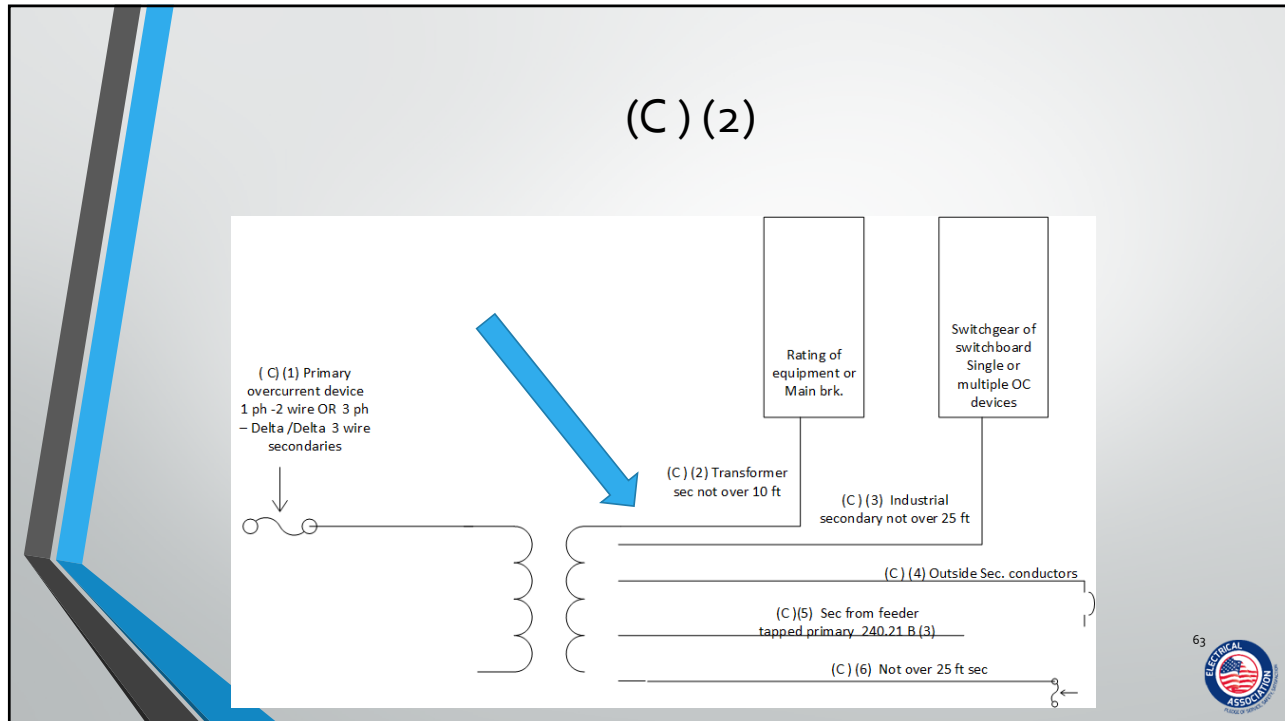
(1) Protection by Primary Overcurrent Device.

Conductors supplied by the secondary side of a **single-phase transformer having a 2-wire secondary**, ---

or a three-phase, delta-delta connected transformer having a 3-wire secondary, shall be permitted to be protected by OCP provided on the primary side of the transformer, *provided this 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.*

- *EG: 30A sec. conductor × 1 sec voltage :2 pri. voltage (1/2) = 15A Primary fuse*
- Single-phase (other than 2-wire) and multiphase (other than delta-delta, 3-wire) transformer secondary conductors are not considered to be protected by the primary overcurrent protective device. **Only these two configurations are protected by primary only protection**





240.21(C) (2) Transformer Secondary Conductors not over 10 feet long

Transformer Secondary Conductors Not over (10 ft) long.
Where the length of secondary conductor does not exceed
(10 ft) and complies with all of the following:

- (1) The ampacity of the secondary conductors is :
 - (a) Not less than the combined calculated loads on the circuits
supplied by the secondary conductors,
 - AND
 - (b) Not less than the rating of the equipment containing
overcurrent devices --- or not less than the rating of the OCP
device at the termination of the secondary conductors

240.21(C)(2)(2 and 3) 10 Ft Transformer Secondary Conductors

- (2) The secondary conductors do not extend beyond the switchboard, switchgear, panelboard, disconnecting means, or control devices they supply.
- (3) The secondary conductors are enclosed in a raceway, which shall extend from the transformer to the enclosure of an enclosed switchboard, panelboard, or control devices or to the back of an open switchboard.



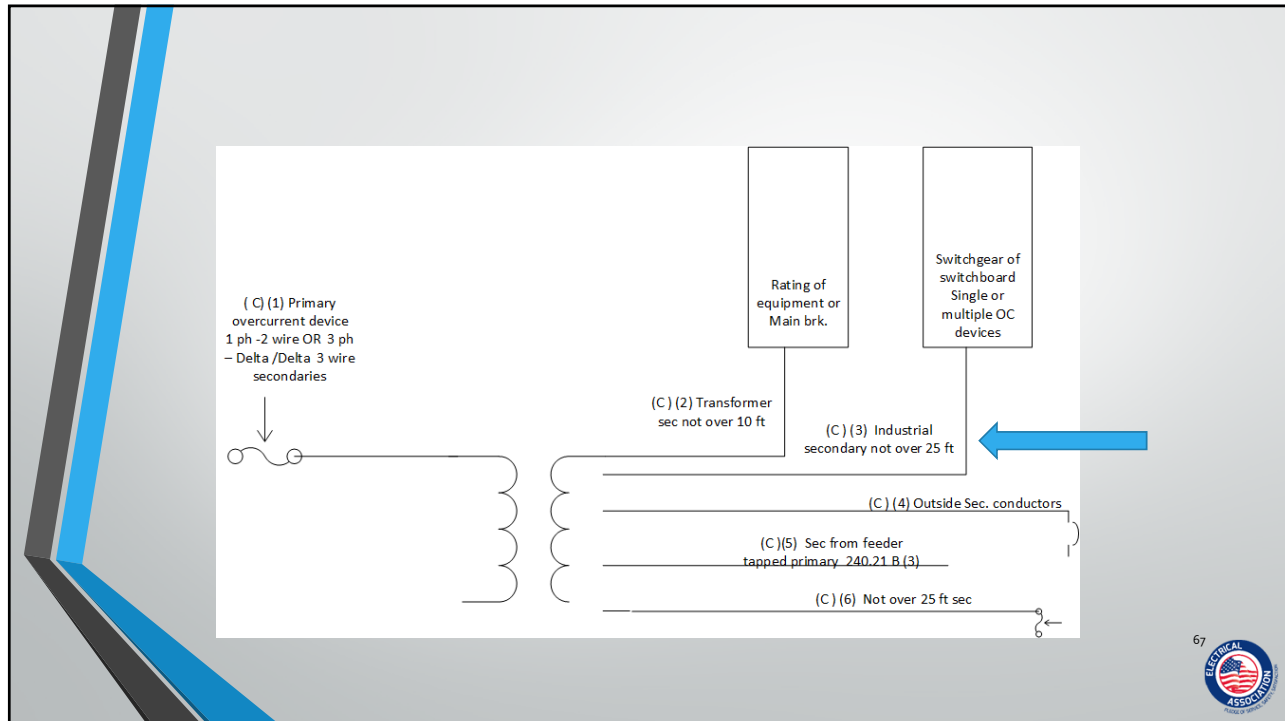
240.21(C)(2) (4) Transformer Secondary Conductors

- For field installations where the secondary conductors leave the enclosure or vault in which the supply connection is made, the rating of the overcurrent device protecting the primary of the transformer, multiplied by the primary to secondary transformer voltage ratio, shall not exceed 10 times the ampacity of the secondary conductor
- This requirement clearly applies to transformer secondary conductors that leave an enclosure or transformer vault.
- EG: 20A primary OC \times 2:1 voltage ratio = 40A \times 10: means the secondary conductors must be at least 1/10 of 400A- so the secondary ampacity is 40A or more.



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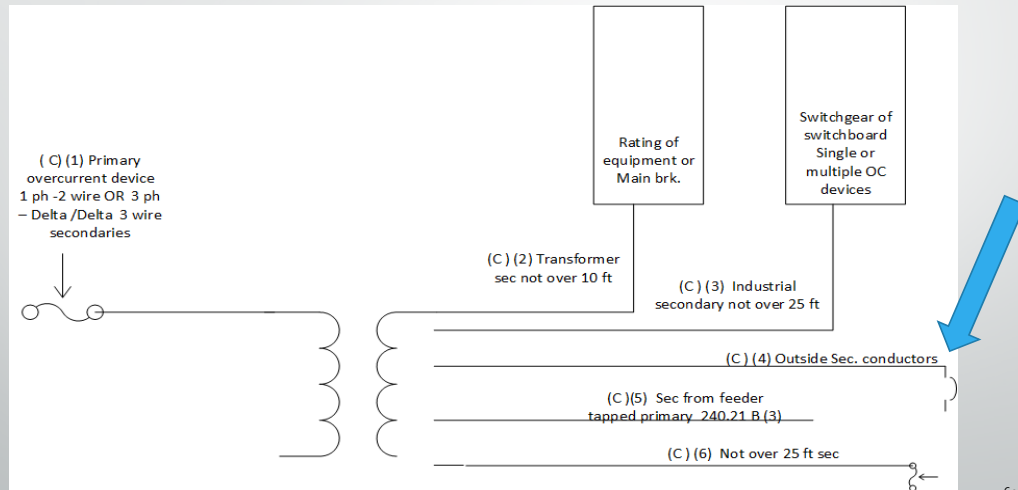
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240.21(C)(3) Industrial Transformer Secondary Conductors not over 25 ft

- 3) For the supply of switchboards or switchgear in Industrial Installation: Secondary Conductors Not over 25 ft Long. For **industrial installations only**, where the length of the secondary conductors does not exceed 25 ft and complies with all of the following:
- (1) Conditions of maintenance and supervision ensure that only qualified persons service the systems.
 - (2) The **ampacity of the secondary conductors is not less than the secondary current rating of the transformer, and the sum of the ratings of the overcurrent devices does not exceed the ampacity of the secondary conductors.**
 - (3) All overcurrent devices are grouped.
 - (4) The secondary conductors are protected from physical damage by being enclosed in an approved raceway or by other approved means.

(C)(4) Outside Secondary Conductors



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240.21(C)(4) Outside Secondary Conductors

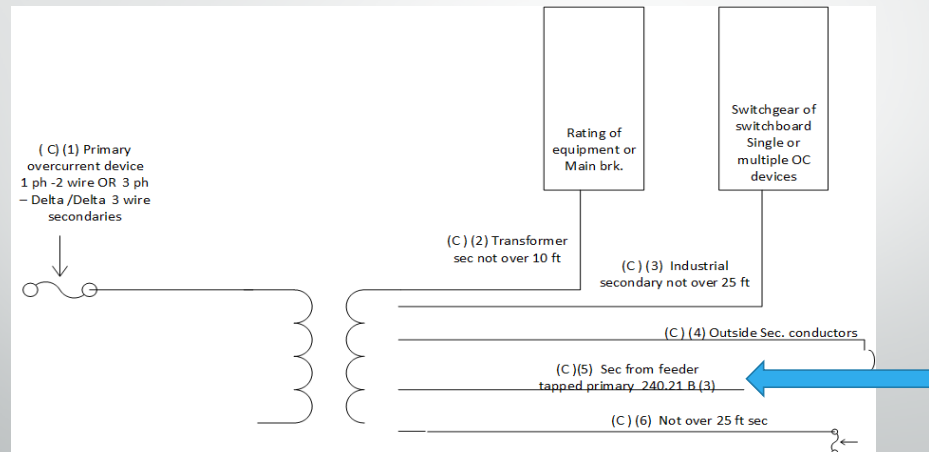
Outside Secondary Conductors. Where the conductors are located **outdoors** of a building or structure, **except at the point of load termination**, and comply with **all of the following conditions**:

- (1) The **conductors are protected** from physical damage in an approved manner.
- (2) The conductors terminate at **a single circuit breaker or a single set of fuses that limit the load to the ampacity of the conductors**. This single overcurrent device shall be permitted to supply any number of additional overcurrent devices on its load side.
- (3) The **overcurrent device for the conductors is an integral part of a disconnecting means** or shall be located immediately adjacent thereto.
- (4) The disconnecting means for the conductors is installed at a **readily accessible location** complying with one of the following:
 - a. Outside of a building or structure
 - b. Inside, nearest the point of entrance of the conductors
 - c. Where installed in accordance with 230.6, nearest the point of entrance of the conductors

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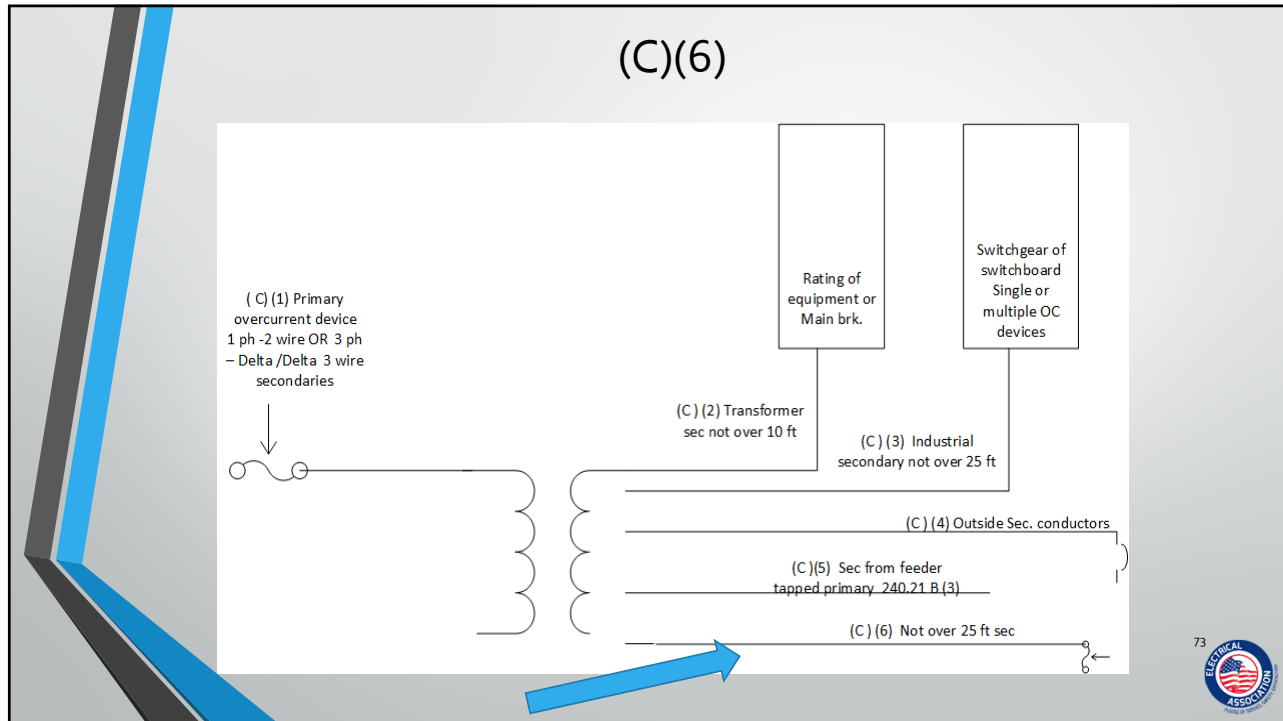
(C)(5) Secondary from Tapped Primary



240.21(C)(5) Secondary Conductors from a feeder tapped transformer

- Follow 240.21B -3 if the transformer is supplied by feeder taps
- Taps supplying a transformer within 25 feet or less.





240.21(C)(6) Transformer Secondary Conductors

Secondary Conductors Not over 25 ft Long. Where the length of secondary conductor does not exceed 25 ft **and complies with all of the following:**

- (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.

EG: 240:120 voltage ratio \times 1/3 the Pri OC 300A = $2 \times 100 = 200$ A sec ampacity

- (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.

240.21 D-E-F-G

- (D) Service conductors: Follow 230.91
- (E) Busway taps: Follow 368.17
- (F) Motor circuit taps: Follow 430.28 and 430.53
- (G) Conductors from Generator terminals: Follow 445.12 and 445.13



240.21(G) Generator Conductors



240.21(H) Battery Conductors

- 240.21(H) Battery Conductors.
- Overcurrent protection shall be permitted to be installed as close as practicable to the storage battery terminals in an **un-classified** location. **Art 480 for storage batteries**
- Installation of the overcurrent protection within a hazardous – classified- location shall also be permitted.



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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.

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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.
- Voltage drop may necessitate the need for increasing the size of the hot circuit conductors. This would also necessitate the need to increase the size of the Grounded conductor

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240.24(A) Location in or on Premises.

Accessibility. Switches containing fuses and circuit breakers shall be **readily accessible** and installed so the center of the operating handle of the switch or circuit breaker, when in its highest position, is **not more than 6 ft 7 in.** above the floor **unless one of the following applies:**

- (1) For busways, as provided in 368.17(C).
- (2) For supplementary OCP as 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.



240.24(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) (**below**).
- (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**



(B) Occupancy.

(2) Branch-Circuit Overcurrent Devices.

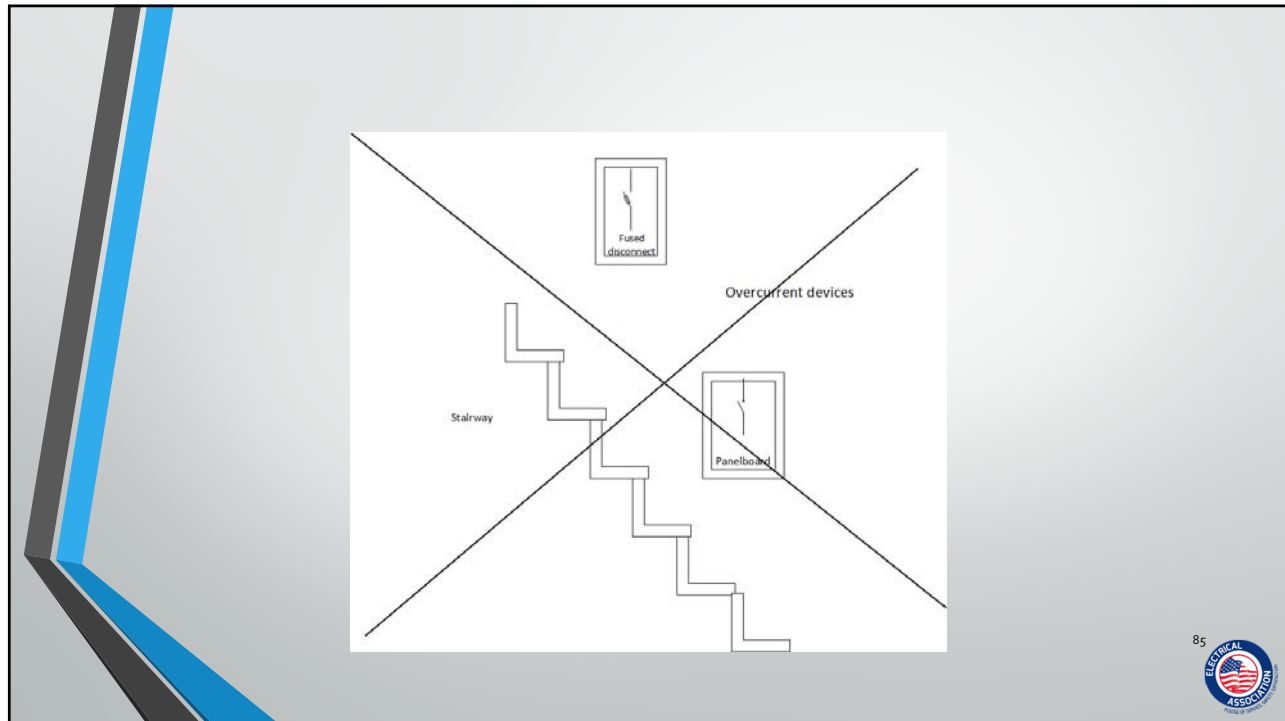
Where electric service and electrical maintenance are provided by the building management and where these are under continuous building management supervision, the branch-circuit overcurrent devices supplying any guest rooms or guest suites without permanent provisions for cooking shall be permitted to be accessible only to authorized management personnel.



Section 240.24

- (C) Not Exposed to Physical Damage. Overcurrent devices shall be located where they will not be exposed to physical damage.
- (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, dormitories, 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.





Part III Enclosures 240.30 General.

- (A) Protection from physical damage.
- (1) As when in cabinets or boxes
 - (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.

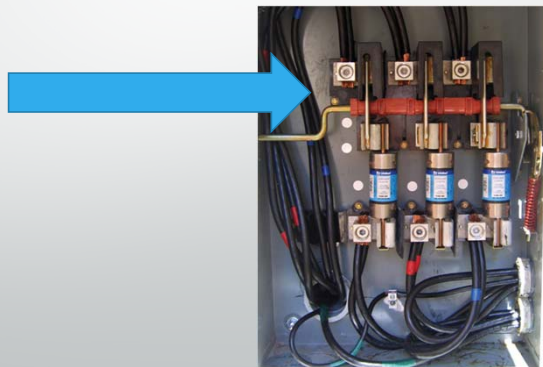
240.33 Vertical Position

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.



Part 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.



240.41(A-B) Arcing or suddenly moving parts

(A) Fuses and circuit breakers shall be located or shielded so that persons will not be burned or otherwise injured by their operation.

(B) Moving handles of ckt breakers must not cause injury when moved suddenly



The End of Part 1

Overcurrent protection

Based on 2017 NEC