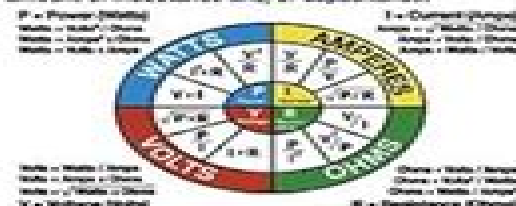


NEUTRAL & GROUNDED CONDUCTORS (NEC Article 90; Article 200; Article 300)

OHM'S LAW & POWER FORMULAS

Ohm's law and the power formula are limited to circuits in which electrical resistance is the only significant opposition to current flow, including all DC circuits and AC circuits that do not contain a significant amount of inductance and/or capacitance.



OHM'S LAW DIAGRAM & FORMULAS

Voltage = Current x Resistance

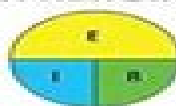
$$E = I \times R$$

Current = Voltage ÷ Resistance

$$I = E \div R$$

Resistance = Voltage ÷ Current

$$R = E \div I$$



OHM'S LAW & IMPEDANCE

Voltage = Current x Impedance

$$E = I \times Z$$

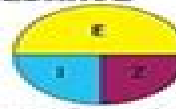
Current = Voltage ÷ Impedance

$$I = E \div Z$$

Impedance = Voltage ÷ Current

$$Z = E \div I$$

E = Voltage (in volts) **I** = Current (in amps)
Z = Impedance (in Ohms)



POWER DIAGRAM & FORMULAS

Power = Current x Voltage

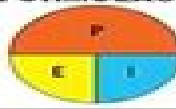
$$P = I \times E$$

Voltage = Power ÷ Current

$$E = P \div I$$

Current = Power ÷ Voltage

$$I = P \div E$$



NUMBER OF CONDUCTORS — BOX FILL CALCULATIONS (Based on 314.16)

- Boxes and conduit bodies must be of an approved size to provide free space for all enclosed conductors.
- In no case must the volume of the box, as calculated in 314.16(A), be less than the fill calculation.
- Each conductor that originates outside the box and terminates or is spliced within the box must be counted once.
- Each conductor that passes through the box without splice or termination must be counted as one.
- Each loop or coil of unbroken conductor not less than twice the minimum length required for free conductors in 300.34 must be counted as twice.

NEUTRAL CONDUCTORS (Based on 200.4(A)(3))

Neutral conductors must be installed in accordance to:

- Neutral conductors must not be used for more than one branch circuit, for more than one multiwire branch circuit, or for more than one set of ungrounded feeder conductors.
- Where more than one neutral conductor associated with different circuits is in an enclosure, grounded circuit conductors of each circuit must be identified or grouped to correspond with the ungrounded circuit conductor(s) by wire markers, cable ties or similar means in at least one location within the enclosure.

GROUNDED CONDUCTOR IDENTIFICATION (Based on 200.6(A)-(3))

Grounded Conductors Size 6 AWG or Smaller must be identified by their insulation through one of the following means:

- A continuous white outer finish
- A continuous gray outer finish
- 3 continuous white or gray stripes along its whole length on other than green insulation
- Insulated conductors with their outer covering showing a white or gray color but with colored tracer threads in the braid to identify the source are acceptable for identification
- The grounded conductor of a mineral insulated, metal-sheathed cable (Type MI) must be identified at the time of installation by distinctive marking at its terminations
- A single-conductor, sunlight-resistant, outdoor rated cable used as a grounded conductor in photovoltaic power systems, identified as indicated above at all terminations
- Fixture wire must comply with the requirements for grounded conductor identification as specified in 402.8
- For aerial cable, the identification must be as above, or by means of a ridge located on the exterior of the cable so as to identify it.

Grounded Conductors Size 4 AWG or Larger must be identified in one of the following ways:

- A continuous white outer finish
- A continuous gray outer finish
- 3 continuous white or gray stripes along the entire length of the conductor on any but green insulation
- At installation, by a distinctive white or gray marking at its terminations. Marking must encircle the conductor or insulation.



200 AMP	200 AMPS	Service Entrance - From Utility Pole to Energy Meter
150 AMP	150 AMPS	Service Entrance & Feeder Wire - to Panel Box
100 AMP	100 AMPS	Service Entrance & Feeder Wire - to Panel Box
55 AMP	55 AMPS	Feeder & Large Appliance Wire
40 AMP	40 AMPS	Feeder & Large Appliance Wire
30 AMP	30 AMPS	Appliances such as Dryer, Air Conditioning, Water Heater
20 AMP	20 AMPS	Appliances such as Laundry, Bathroom & Kitchen Circuits
15 AMP	15 AMPS	General Lighting, Fans & Outlet / Receptacle Circuits

VOLUME ALLOWANCE REQUIRED PER CONDUCTOR (Based on NEC Table 314.16(B)(1))

SIZE OF CONDUCTOR (AWG)	FREE SPACE WITHIN BOX FOR EACH CONDUCTOR	
	cm ³	in. ³
18	24.6	1.50
16	28.7	1.75
14	32.8	2.00
12	36.9	2.25
10	41.0	2.50
8	49.2	3.00
6	81.9	5.00

TERMINAL IDENTIFICATION (Based on 200.10(B)(3))

Receptacles, polarized attachment plugs, and cord connectors for plugs and polarized plugs must have the terminal intended for connection to the grounded conductor identified as:

- Identification must be by a metal or metal coating that is substantially white or silver in color or by the word white or the letter W located adjacent to the identified terminal.
- If the terminal is not visible, the conductor entrance hole for the connection shall be colored white or marked with the word white or the letter W.

SINGLE-PHASE DWELLING SERVICES & FEEDERS (Based on 210.10)

- For a service rated 100 through 400 amperes, the service conductors supplying the entire load associated with a one-family dwelling, or the service conductors supplying the entire load associated with an individual dwelling unit in a two-family or multifamily dwelling, must be permitted to have an ampacity not less than 83% of the service rating. **Note:** This also applies to feeders.
- In no case must a feeder for an individual-dwelling unit be required to have an ampacity greater than that specified above.
- Grounded conductors must be permitted to be sized smaller than the ungrounded conductors, if the requirements of 220.61 and 220.42 for service conductors or the requirements of 215.2 and 220.61 for feeder conductors are met.

GROUNDED CONDUCTORS OF DIFFERENT SYSTEMS — IDENTIFICATION (Based on 200.6(D))

- Where grounded conductors of different nominal voltage systems are installed in the same raceway, cable, box or auxiliary gutter or other type of enclosure, each grounded conductor must be identified by nominal voltage system.
- Identification that distinguishes each system grounded conductor must be permitted by one of the following means:
 - One nominal voltage system grounded conductor must have an outer covering conforming to 200.6 (A) or (B).
 - The grounded conductor of other systems must have different outer coverings conforming to 200.6 (A) or 200.6 (B) or by an outer covering of white or gray with a readily distinguishable colored stripe other than green running along the insulation.

ALTERNATING-CURRENT SYSTEMS (Based on NEC 250.26)

TYPE OF SYSTEM	CONDUCTOR TO BE GROUNDED
Single Phase, 2 Wire	one conductor
Single Phase, 3 Wire	the neutral conductor
Multiphase systems having a common wire to all phases	the neutral conductor
Multiphase system where one phase is grounded	that phase conductor
Multiphase systems in which one phase is used as a single phase, 3-wire	the neutral conductor

National Electric Code Residential Wiring

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