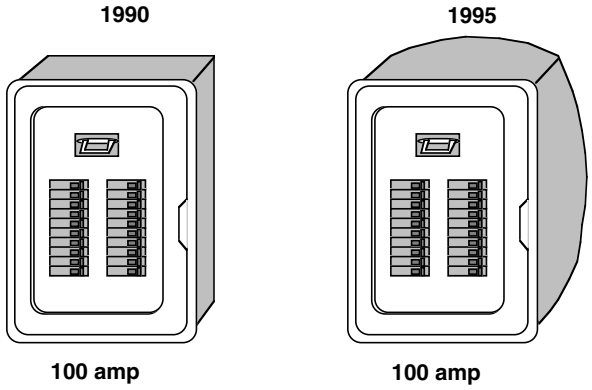
CONTENTS

ARTICLE 90 — INTRODUCTION

90.2. Purpose.

(A) This section states the purpose of the Code is the safeguarding of persons and property from the hazards of using electricity.

The Code is **not** intended as a design manual (textbook) for untrained persons. This is why so many students have trouble "studying" the Code.

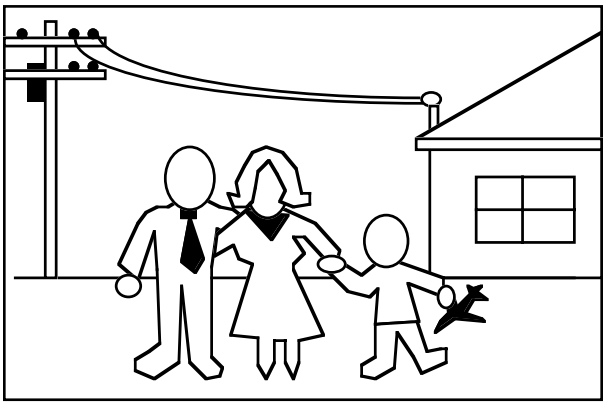


(B) Adequacy.

The Code contains provisions considered necessary for **safety**. But safety is not automatic by simply following the Code rules. Safety must be built into the system through proper designing.

Remember, the Code is the **minimum** permitted, it is not necessarily efficient, convenient, or adequate for good service or future expansion of electrical use.

Most electricians are working **above** Code rules. Example: (1) By using a larger size conductor than the Code minimum requires. This would lower voltage drop which is wasted electricity in itself. (2) By installing receptacles in hallways for convenience. (3) By installing a 200 amp service for a residence rather than the minimum calculated using the Code.



90.2. Scope

(C) Covered.

This Code covers the installation and removal of electrical conductors, equipment, and raceways; signaling and communications conductors, equipment, and raceways; and optical fiber cables for the following:

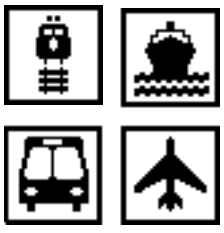
- Public and private premises, including buildings, structures, mobile homes, recreational vehicles, and floating buildings.
- Yards, lots, parking lots, carnivals, and industrial substations.
- Installations supplying shore power to ships and watercraft in marinas and boatyards.

(D) NOT Covered.

The Code **does not** cover:

(1) Ships & Watercraft (other than floating buildings), railway cars/rolling stock, aircraft and automotive vehicles (other than mobile homes) and recreational vehicles.

(2) The Code **does not** cover installations in **underground mines**.



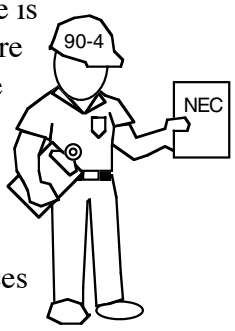
90.3 CODE ARRANGEMENT

1. The first four Chapters of the NEC apply to all installations.
2. Article 90 precedes Chapter One, and establishes the authority of the NEC.
3. Article 80 follows the body of the NEC; it exists as Annex H. It provides the requirements for administration.
4. Chapters 5, 6, and 7 are the "special" chapters, covering special: occupancies, equipment, and conditions (in that order).
5. Chapter 8 provides the requirements for communications systems.
6. Chapter 9 provides tables.
7. The annexes provide mostly reference information.
8. Annex D contains examples that every NEC user should study.

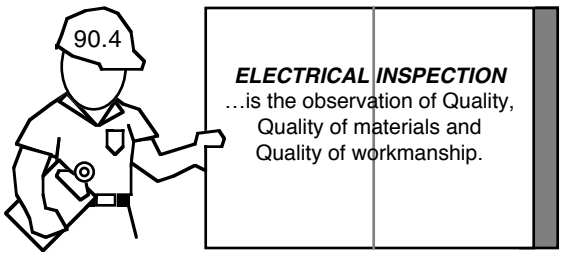
90.4 ENFORCEMENT.

The authority having jurisdiction.

The electrical inspector has the authority to enforce the Code by his individual interpretation of the Rule or by waiver of the Code Rule to satisfy a non-Code conforming method for the safety intent required by the Code. The permission given to the inspector to waiver the Code is only permitted under maintained and carefully controlled conditions that ensure constant safety. The inspector should be very concerned when waiving a Code Rule because of the responsibility the inspector is assuming.

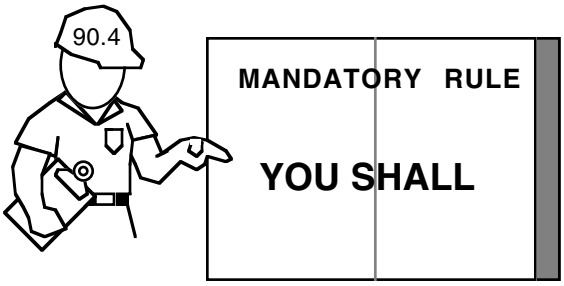


Remember, if in any inspection area certain Rules or Exceptions are more **stringent** than the N.E.C., they are adopted by local ordinance, the inspector must enforce these rules as well as those of the National Electrical Code. Unpredictable changes by inspectors could not be lawfully enforced, but ordinances can be. Always obtain a copy of the Local Area Code before starting a job.



90.5. Complying with the Code is satisfying all the conditions and requirements that state the word "shall". "Shall" indicates a mandatory rule and must be observed.

Explanatory material in the Code is in the form of Informational Notes (I.N.). Voltage drop is an example of explanatory material. The Code mentions voltage drop **two** places in the Code and all three are Informational Notes: 210.19 I.N., 215.2(A)(2) I.N. 2. Voltage drop is **not** a mandatory rule.



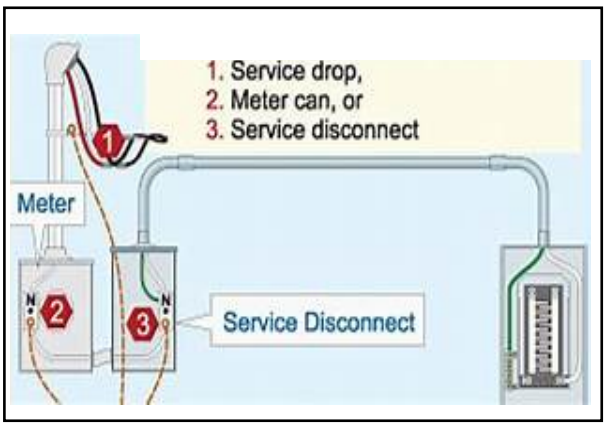
90.7. For specific items of equipment and materials referred to in the Code, examinations for safety made under standard conditions provide a basis for approval where the record is made generally available through promulgation by organizations properly equipped and qualified for experimental testing, inspections of the run of goods at factories, and service-value determination through field inspections.

90.8. The Code is the minimum so plans that provide space for additional circuits will allow for future expansion and convenience to the electrical system.

90.8(B). Limiting the number of circuits in a single enclosure will minimize the effects from a short circuit or ground fault.

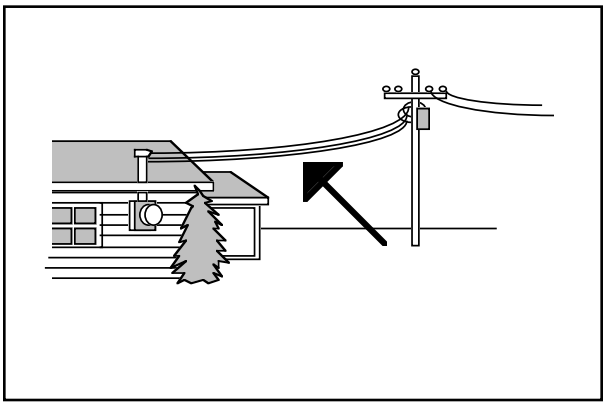
90.9(A). For the purpose of this Code, metric units of measurement are in accordance with the modernized metric system known as the International System of Units (SI).

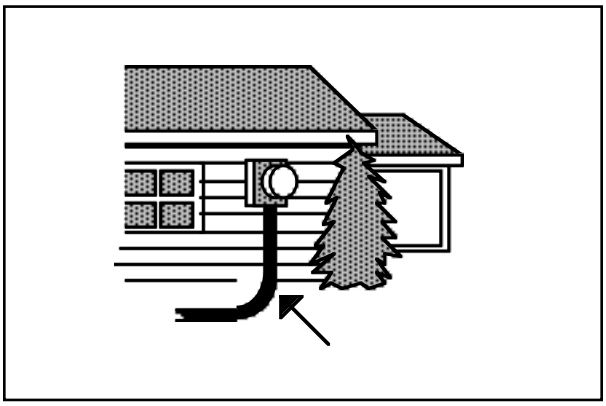
90.9(D) I.N. #1. Soft conversion is considered a direct mathematical conversion and involves a change in the description of an existing measurement but not in the actual dimension.



Service:
Service includes all the equipment and materials from distribution to the building being supplied.

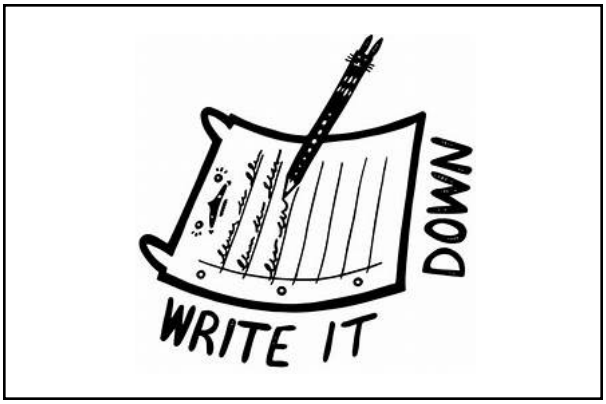
Service Drop:
The **overhead** conductors between the utility electric supply system and the service point.





Service Lateral:
The **underground** conductors between the utility electric supply system and the service point.

Special Permission:
The **written** consent of the inspector. Whenever the inspector gives "special permission" for a condition that is not fully covered by the Code, the authorization must be **written** and not verbal permission.



In the revised Article 100, there are no parts. Definitions are simply arranged alphabetically. Since some definitions appear in a form such as "service conductors, overhead," there will be a parenthetical form of the term that appears as "(Overhead service conductors)." Although this doesn't add value to the printed book, terms can be more easily searched for electronically.

Multiple definitions for the same term having different meanings are currently being addressed by the Code Making Panels. They've been asked to try and resolve the issue by "massaging" the wording to come up with a single definition. There are instances where this is not possible, including existing terms Accessible (as applied to equipment) and Accessible (as applied to wiring methods).

Similar or alternate terms are permitted to be added to a defined term. The term "Recreational Vehicle" now includes terms that were previously listed with separate definitions.

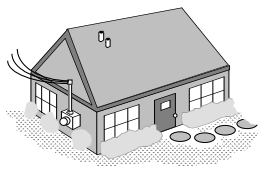
Having only one definition and including similar terms provide additional clarity an conciseness to the document [example, Recreational Vehicle (RV) (Camping Trailer) (Motor Home) (Travel Trailer) (Truck Camper)].

Moving all definitions into Article 100 was a huge task for the Code-Making Panels. The 2020 NEC has about 300 definitions in the three parts of Article 100. The **2023** NEC will have just short of 800 definitions.

An ignitible fiber/flying is essentially a combustible material that is larger than "combustible dust," as now defined in Article 100.

The 2020 Style Manual made some important changes that affect the arrangement and writing style for the **2023** NEC. The most notable is with the definitions. Previous editions of the NEC had definitions throughout the entire NEC. A definition could be found in a Code section, in an Article, and (if used in more than one Article) it would be found in Article 100 (Definitions).

Article 100 Quiz #3 - Open Book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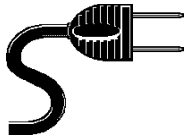
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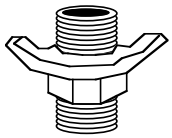
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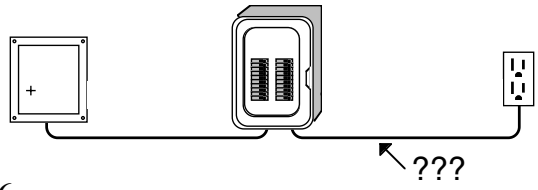

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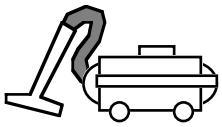
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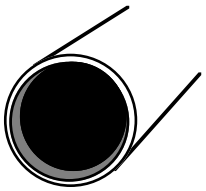
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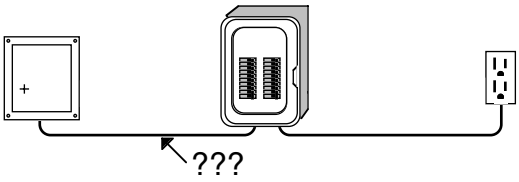

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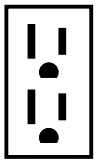

#10 _____

*Fill in the _____ beside the number with the correct **letter** beside the definition below:*

A. branch circuit

B. coupling

C. fixed appliance

D. raceway

E. receptacle

F. dwelling

G. feeder

H. multiple receptacle

I. service

J. labeled

K. identified

L. portable appliance

M. cube tap

N. attachment plug

O. conduit body

P. fitting

Q. wireway

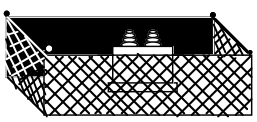
R. garage

S. header

T. multioutlet assembly

U. special permission

Article 100 Quiz #4 - Open Book



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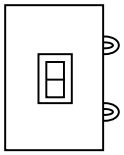

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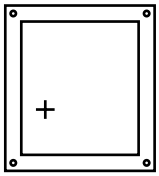

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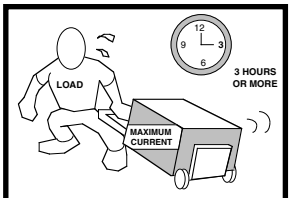

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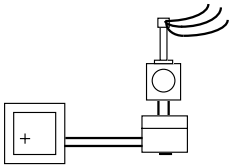

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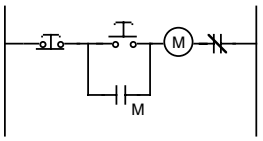

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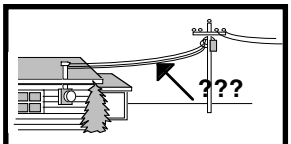

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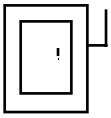

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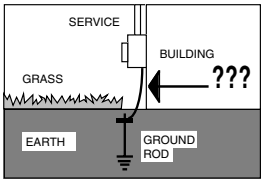

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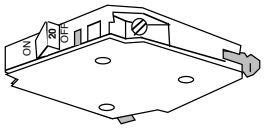


#12 _____

*Fill in the _____ beside the number with the correct **letter** beside the definition below:*

A. fuse

B. grounded conductor

C. cabinet

D. automatic

E. device

F. circuit breaker

G. continuous duty

H. grounding conductor

I. service lateral

J. garage

K. enclosed

L. feeder

M. service drop

N. qualified person

O. disconnecting means

P. bonding jumper

Q. control circuit

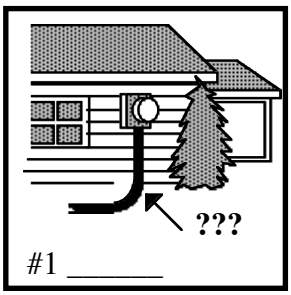
R. continuous load

S. multifamily dwelling

T. service

U. branch circuit

Article 100 Quiz #5 - Open Book



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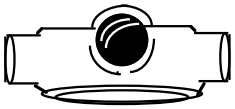
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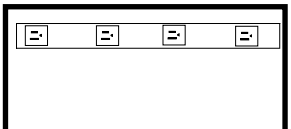
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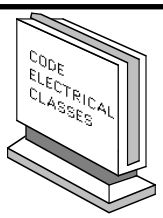

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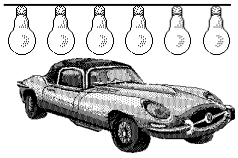

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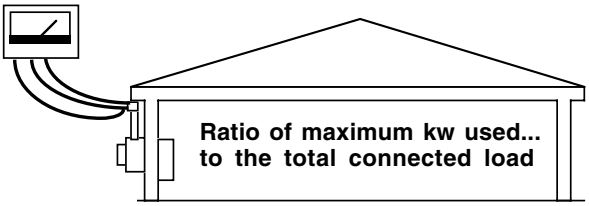

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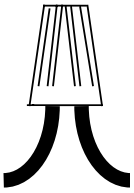
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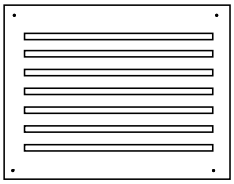
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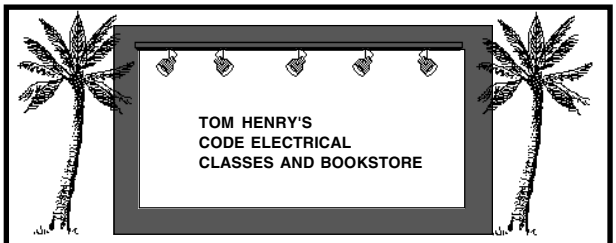

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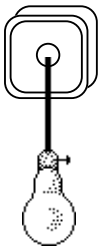

#10 _____

*Fill in the _____ beside the number with the correct **letter** beside the definition below:*

A. receptacle

B. appliance

C. outline lighting

D. temporary lighting

E. demand factor

F. continuous load

G. panelboard

H. ventilated

I. service drop

J. festoon lighting

K. sign

L. pressure connector

M. cooking unit

N. duty cycle load

O. LB fitting

P. lighting outlet

Q. multioutlet assembly

R. service lateral

S. cutout box

T. guarded

U. conduit body

110.4. The voltage considered shall be that at which the circuit operates. The highest voltage value is that of the service conductors, as voltage drop due to the resistance will cause the branch circuit voltages to be lower. The wattage or amperage rating of the nameplate of appliances is correct only when the appliance is supplied at the **nameplate voltage**. If the supplied voltage is less than the nameplate voltage the wattage and amperage will also be less.

An example is a 100 watt light bulb @ 120 volts. This means if you screw this bulb into a lamp that is supplied with a voltage of **exactly** 120 volts you will have 100 watts. If the voltage to the lamp is **less** than the rated 120v, you will have less than 100 watts. If the voltage is higher than the rated voltage of 120v, you will have more than 100 watts.

The light bulb was built with an internal fixed resistance so that when **exactly** 120 volts is applied, the output in watts will be 100.

The voltage rating of electrical equipment shall not be less than the circuit voltage to which it is connected.

110.5. Throughout the Code when the conductor material is **NOT SPECIFIED**, the sizes given shall apply to **COPPER** conductors.

110.6. Conductor sizes are given in the American Wire Gauge (AWG) or in circular mils (CM). The largest gauge is 4/0. Above 4/0 conductor sizes are expressed in circular mils (cma).
Example: A 250 kcmil is written: 250,000 cm. To find CM the diameter is squared.
$CM = D^2$ Example: What is the circular mil area of a wire having a diameter of 1"?
Solution: 1000 x 1000 = 1,000,000 cm.

110.7. All wiring shall be so installed that when the system is completed it will be free from short circuits, ground faults, or any connections to ground other than as required or permitted in the Code.

Measurements of insulation resistance can be made with a megger. The readings are in ohms or megohms. Insulation resistance usually increases in high-voltage conductors because of the increased thickness of insulation.

MEGGER

110.8. States that only wiring methods recognized as suitable are included in the Code. These methods recognized may be used in any type building or occupancy, except as otherwise provided in the Code. Code chapters 5, 6, 7 and 8 are wiring methods for special occupancies such as hazardous, communications, pools, mobile homes, motion picture studios, health care, etc.

110.9 and 110.10. These sections are companion rulings in which the interrupting capacity and the circuit impedance and related characteristics may govern the fault currents.

Equipment intended to clear fault currents must have an interrupting rating not less than the maximum fault current that the circuit is capable of delivering at the **line** terminals of the electrical equipment. Proper selection is not an easy task as each installation is different. Books are available from manufacturers that calculate the proper selection of overcurrent devices for the application.

110.11. This Code section requires that conductors and equipment shall not be exposed to any corrosive or deteriorating effects. Example: Do not install any non-weatherproof equipment in buildings under construction unless you thoroughly protect it from the weather. Do not use oil or grease or any unapproved wire pulling compound.

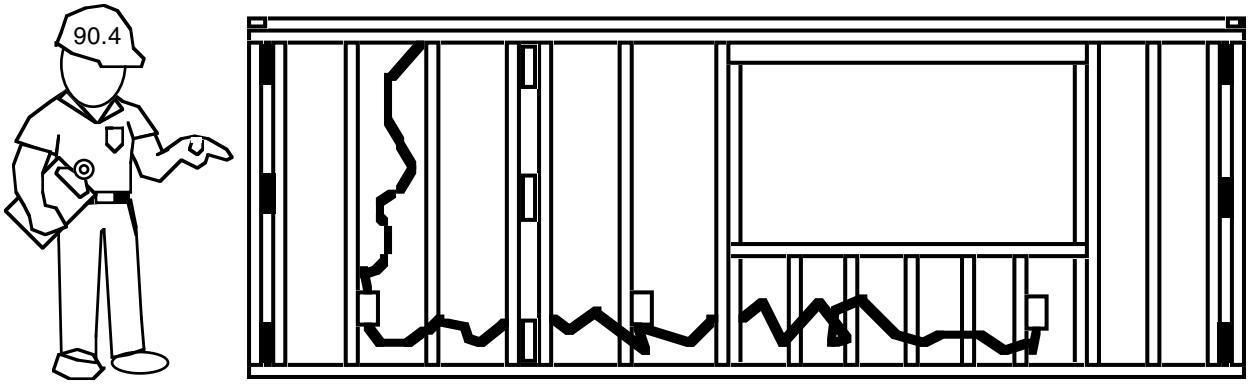
110.12. Electrical equipment **SHALL** be installed in a **PROFESSIONAL and SKILLFUL** manner.

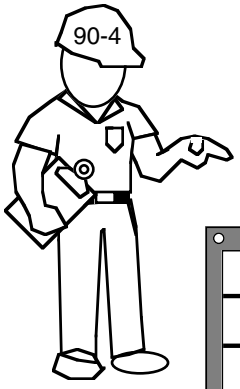
Poor workmanship is probably responsible for most electrical failures.

This Code rule has caused many conflicts as the responsibility for determining what is **professional and skillful** is left up to the inspector, and in some areas the enforcement of this rule is not applied in a uniform manner.

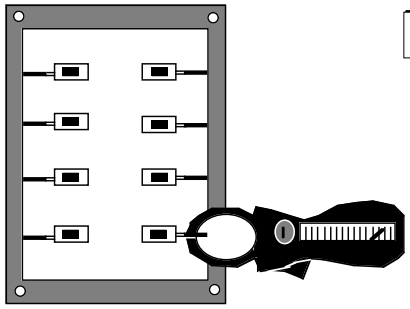
The following are examples of poor workmanship.

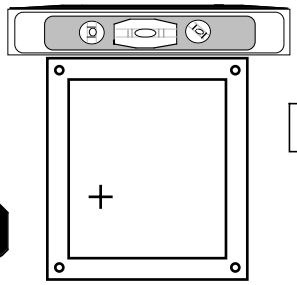
- Cables should not be kinked or twisted
- Cables should not have excessive slack
- Conduit bends should not have flat spots

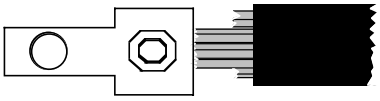




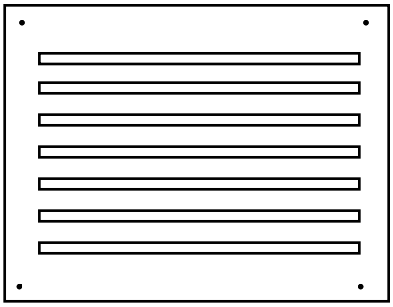
- Wiring should be formed in a panelboard so you can connect an ammeter
- Openings in boxes shall be plugged
- Excessive drilling of holes in studs and joists weaken the structure
- Electrical equipment should be plumb and level
- Conductor strands shall not be removed to fit a smaller lug







110.13. Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials shall **not** be used. Wood will rot, do not use any material that will deteriorate.



Equipment that has cooling vents must be firmly mounted in such position and location not to hinder the flow of cooling air. Make sure the ambient temperature will not prevent needed cooling air flow.

110.14. Due to the use of different metal alloys (copper and aluminum) of conductors and terminals, extreme care must be taken in joining the conductors by splicing or connecting at terminals. High compression tools, sleeves and lugs have been designed specifically for dissimilar metal connecting.

Many terminations and equipment are marked with a tightening torque.

Torque Screwdriver

Torque Wrench

Article 110 Quiz #1 - Open Book

•*Circle your answer choice either true or false and* ***write the Code section where it was found****.*

1. The Code is concerned only with fire prevention and safety; professional and skillful are, therefore, beyond the control of the electrical inspector.

(a) true (b) false

2. Disconnecting means are required to be legibly marked to indicate their purpose unless it is evident by arrangement or location.

(a) true (b) false

3. The Code requires a residence with a 150 amp panelboard to have adequate lighting for the panelboard.

(a) true (b) false

4. Parts of electrical equipment which in ordinary operation produce arcs, sparks, flames or molten metal must be enclosed, whether or not combustible material is present or not.

(a) true (b) false

5. Where the conductor material is not specified in the Code, the conductors are assumed to be made of copper.

(a) true (b) false

6. A minimum clearance of 24" must be provided and maintained around all electrical equipment to permit safe and ready operation and maintenance.

(a) true (b) false

7. Live parts (300v or less) need not be guarded against accidental contact if they are 8' or more above the floor or working surface.

(a) true (b) false

8. All splices and joints and free ends of conductors are required to be covered with an insulation equivalent to that of the conductors.

(a) true (b) false

Article 110 Quiz #2 - Open Book

•*Circle your answer choice either true or false and* ***write the Code section where it was found****.*

1. Free circulation of air for cooling must be insured, whether floor or wall mounted.

(a) true (b) false

2. Equipment intended to break current at fault levels shall have an interrupting rating sufficient for the system voltage and the current available at the line terminals of the equipment.

(a) true (b) false

3. No conductors may be installed in damp locations unless approved for the purpose.

(a) true (b) false

4. Without exception, copper conductors must be installed using copper lugs and connectors, and aluminum conductors must be installed using aluminum connectors and lugs.

(a) true (b) false

5. Protection of equipment against damage during construction is a responsibility of the contractor and is not covered by the Code.

(a) true (b) false

6. High-voltage (over 1000v) of Article 110 applies to equipment only on the load side of the service conductors.

(a) true (b) false

7. Working clearances in front of equipment apply not just directly in front of this equipment, but from the floor to the required height for headroom as well, or the height of equipment, whichever is greater.

(a) true (b) false

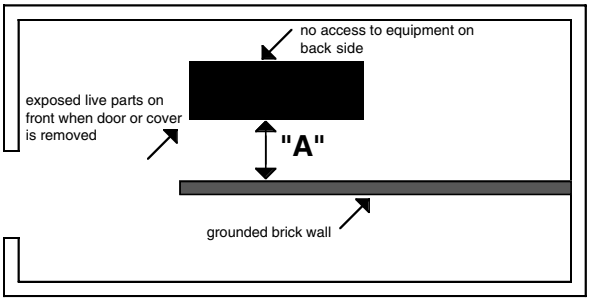
8. The minimum depth of clear working space required in front of high-voltage equipment increases with the magnitude of the voltage.

(a) true (b) false

Article 110 Quiz #3 - Open Book

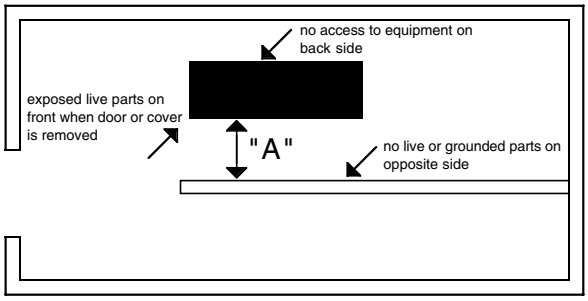
•*Circle your choice of answer and* ***write the Code section where it was found****.*

1. A 480v switchboard is shown below, ____ is the minimum clearance for dimension "A".



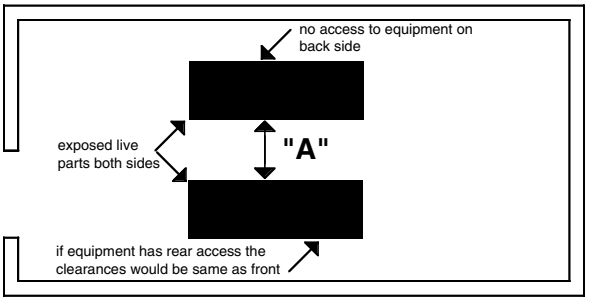
(a) 3' (b) 3 1/2' (c) 4' (d) 4 1/2'

2. A 480v switchboard is shown below, ____ is the minimum clearance for dimension "A".



(a) 3' (b) 3 1/2' (c) 4' (d) 4 1/2'

3. Two 480v switchboards are shown below, ____ is the minimum clearance for dimension "A".

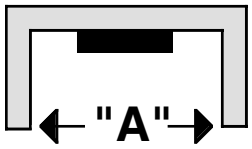


(a) 3' (b) 3 1/2' (c) 4' (d) 4 1/2'

Article 110 Quiz #4 - Open Book

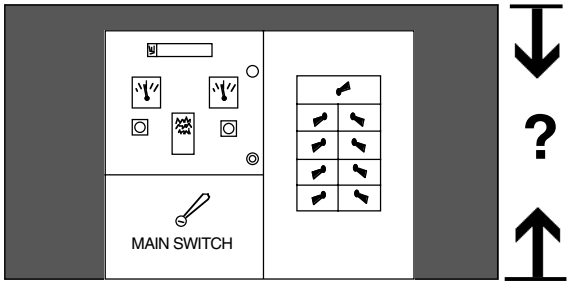
•*Circle your choice of answer and* ***write the Code section where it was found****.*

1. A 240/120v single-phase panelboard is shown below, ____ is the minimum clearance for dimension "A".



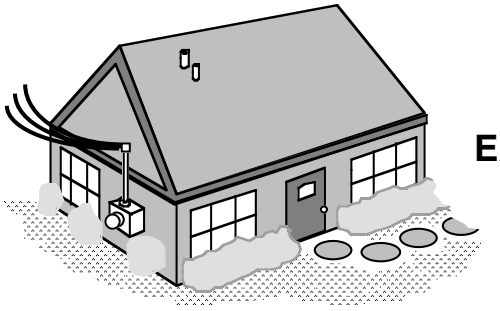
(a) 24" (b) 30" (c) 36" (d) 42"

2. The switchgear shown below is over 1000 volts, the minimum headroom required is ____.



(a) 6' (b) 6' 3" (c) 6' 6" (d) 6' 8"

3. The minimum headroom clearance of 6' 6" for equipment is not required in an **existing** dwelling where the service equipment or panelboards do not exceed ____ amps.



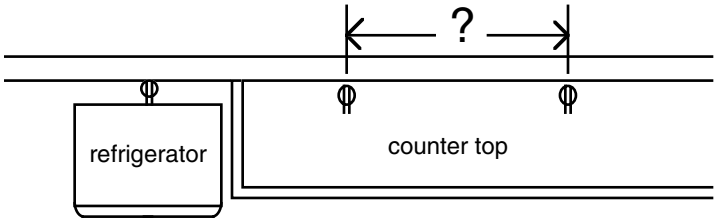
EXISTING DWELLING

(a) 100 (b) 150 (c) 175 (d) 200

FINAL EXAM #2 - OPEN BOOK

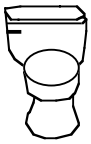
- *OPEN BOOK circle your choice of answer* ***and fill in Code section where found.***

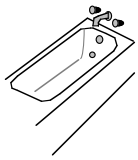
1. The maximum distance permitted between the counter top receptacles in the kitchen of a dwelling is ____.



(a) 12" (b) 24" (c) 36" (d) 48"
Code section _____.

2. Which of the following is the definition of a bathroom?

I. 

II. 

III. 

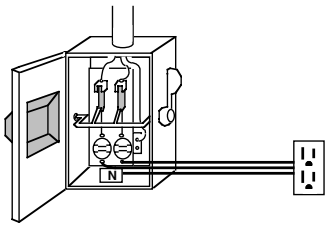
(a) I only (b) I and II (c) III only (d) I and III
Code section _____.

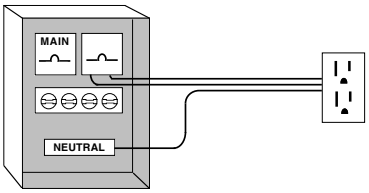
3. 

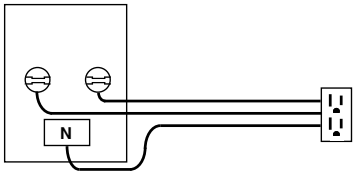
OKAY ☐ VIOLATION ☐

Code section _____.

4. Which of the following is a violation of 210.4 multiwire branch circuits?

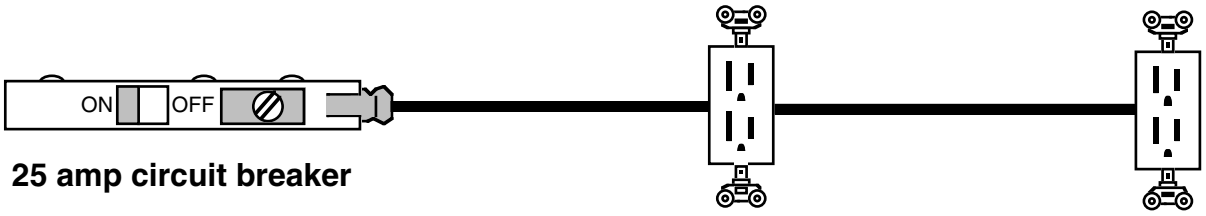
I. 

II. 

III. 

(a) I only (b) II only (c) III only (d) none of these
Code section _____.

5. The following duplex receptacles are connected to a 25 amp branch circuit.



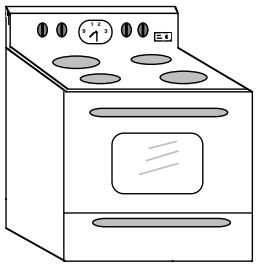
25 amp circuit breaker

☐ OKAY ☐ VIOLATION

Code section _____.

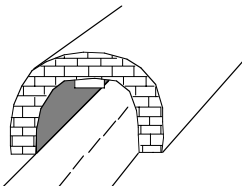
6. What is the minimum size neutral permitted for a branch circuit to a household range?

minimum neutral size ?



(a) #12 (b) #10 (c) #8 (d) #6
Code section _____.

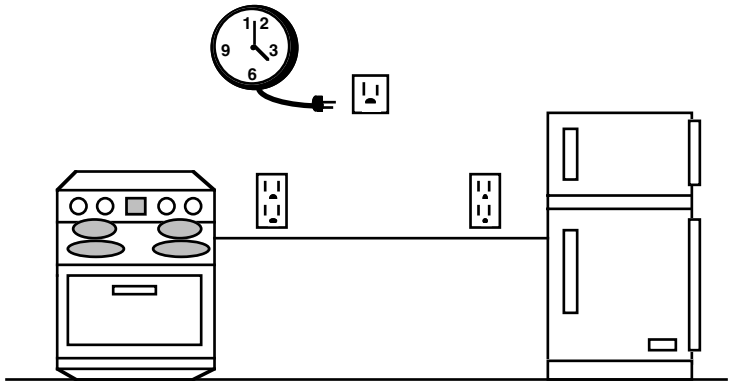
7. Branch circuits, 480 volts between conductors shall be permitted to supply auxiliary equipment of electric discharge lamps mounted in permanently installed fixtures not less than a height of ____ feet on a tunnel.



(a) 18 (b) 22 (c) 25 (d) 26

Code section _____.

8. The kitchen wall clock receptacle in a dwelling is connected to a 15 amp lighting circuit.



☐ OKAY ☐ VIOLATION

Code section _____.

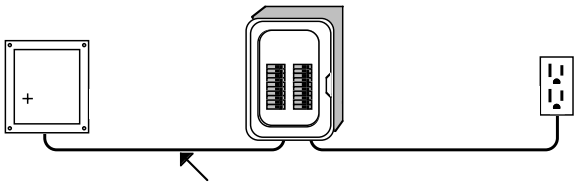
9. The water heater is connected to an individual 25 amp branch circuit.

25 amp circuit breaker

☐ OKAY ☐ VIOLATION

Code section _____.

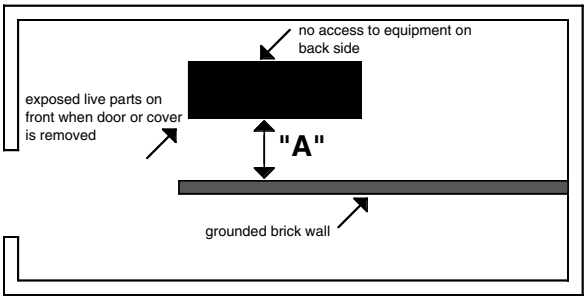
10. The conductors between the service equipment and the final branch circuit overcurrent device are called the _____ conductors.



(a) service lateral (b) feeder (c) branch circuit (d) tap

Code section _____.

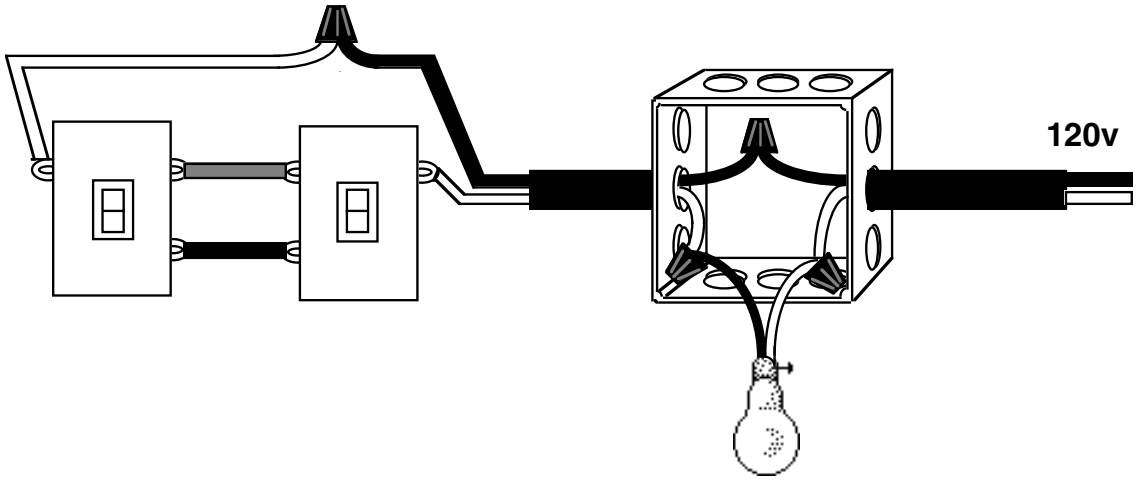
11. A 480v switchboard is shown below, ____ is the minimum clearance for dimension "A".



(a) 3' (b) 3 1/2' (c) 4' (d) 4 1/2'

Code section _____.

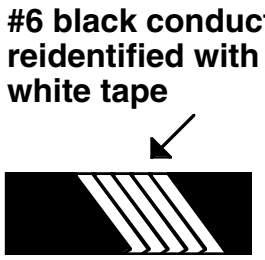
12.



OKAY ☐ VIOLATION ☐

Code section _____.

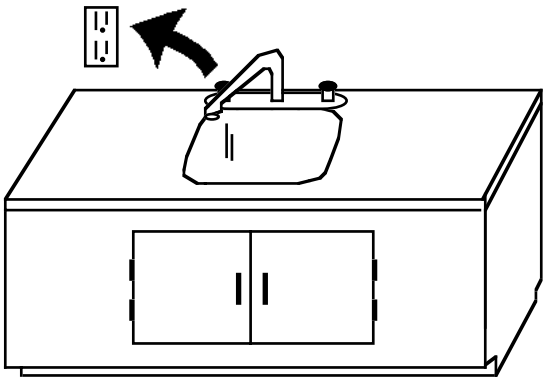
13.



OKAY ☐ VIOLATION ☐

Code section _____.

14. All 15 and 20 amp receptacles installed within ____ feet of a kitchen wet bar sink in a dwelling shall have GFCI protection for personnel.



(a) 2 (b) 3 (c) 4 (d) 6

Code section _____.

15.

OKAY ☐ VIOLATION ☐

Code section _____.