

# The *Electrical* CONTACTOR

THE OFFICIAL PUBLICATION OF THE FLORIDA  
ASSOCIATION OF ELECTRICAL CONTRACTORS

Volume 6  
Number 3

Summer 2010



## Tools for Tomorrow's Technology

**September 29 - October 2, 2010**  
**Renaissance Hotel, World of Golf Village**  
**St. Augustine, FL**

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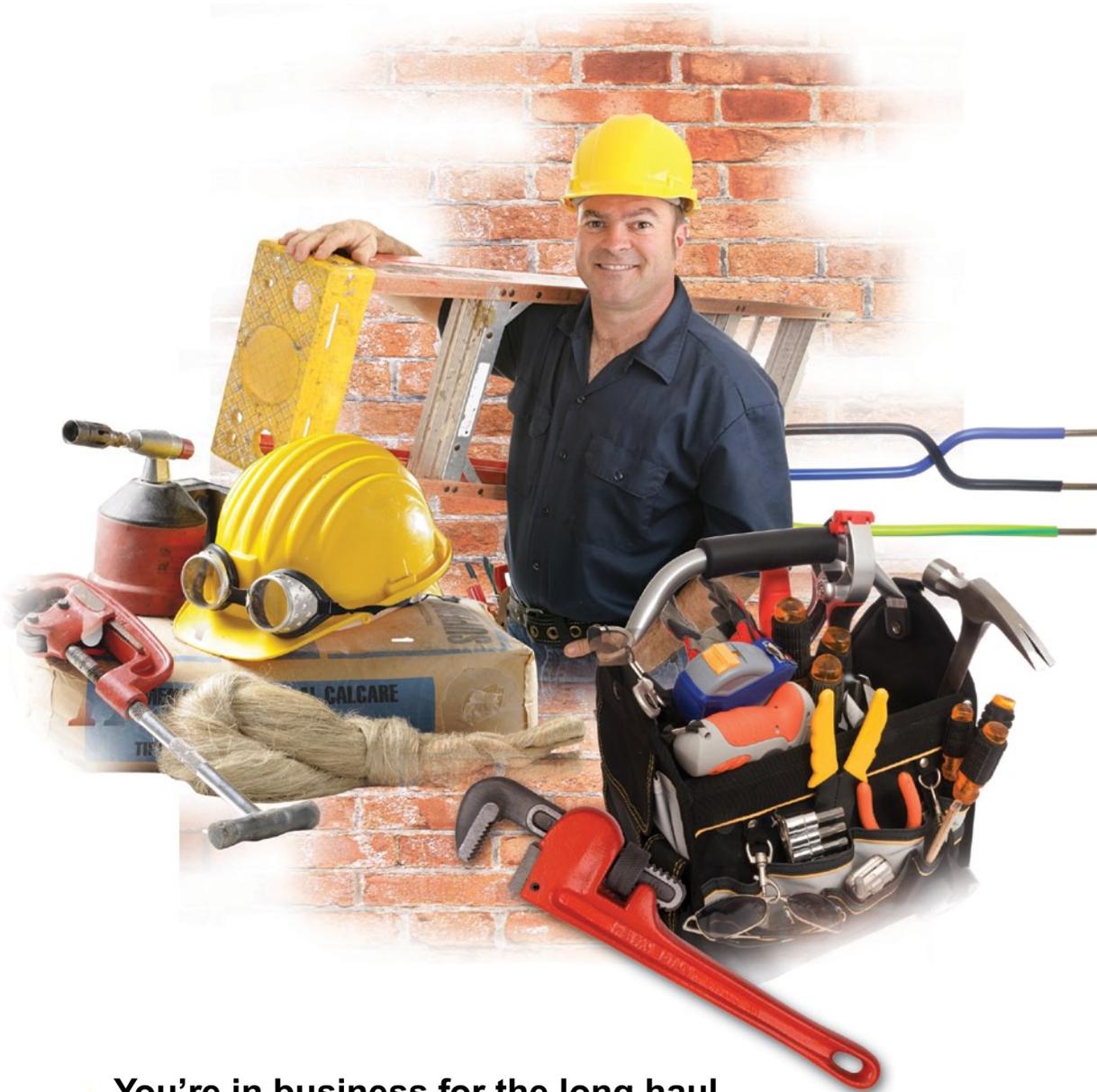
Executive Vice  
Presidents Report

FAEC President's Report

Article 110 - Requirements  
For Electrical Installations

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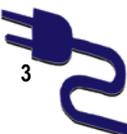


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# EXECUTIVE VICE PRESIDENT'S REPORT

## Janice Ficarrotto

Each day, I come to work wondering how many more of our friends and colleagues will be closing their businesses in the weeks to come? I've been in this business for almost 30 years now, longer than I care to remember, and never, in that time, have I seen anything like this – last so long! There just doesn't seem to be any end in sight. I've spoken to contractors – statewide, manufacturers, distributors, at various levels of management and everyone has had the same question – when will this end?

Hopefully, with the upcoming mid-term elections, we will see a change in Washington that might get the country moving again. I don't want to get into politics – someone once told me that politics, along with sex, are not topics for general discussion. I've learned over the years why.

Within the next two weeks, we will be holding our annual conference in St. Augustine, Fl. at the beautiful Renaissance Hotel at the World of Golf Village. We've secured a great room rate in the oldest city in our Nation. There is a line-up of speakers second to none – from all over the country! So – where is everyone??? While I know I still have several registrations pending, I am totally disappointed at the poor response to such great educational programming. While I know many, many companies have implemented major cut-backs, education of yourself and your employees should not be one of them. If you hope to stay on the cutting-edge of today's ever-changing technology, then you need to be in St. Augustine on September 29th. All the programs are geared to ways to help you change the manner in which you do business – opportunities for you to find new business – think outside the box sort of speak. With the bid market as slim as it is, I would think many of you would be looking for new, innovative ideas to help keep your organizations afloat.

As we wind down this year, we will probably be offering one additional seminar on E-Verification and the use of illegal immigration in construction. This will be a

vital program that everyone should attend. FAEC will be providing our members with the most up-to-date information on the ramifications of utilizing illegal immigration in our construction market. While I'm certain there are very few of our members who utilize illegals for their electrical workforce, it has been brought to our attention that it is getting harder and harder for legitimate contractors to compete in an already "slim" climate with those who do.

We will be publishing one additional "Contactor" before the end of the year with a line-up of 2011 programs along with two additional Technical Bulletins. I hope you've found the Bulletins helpful – short and to the point regarding safety, management and technical articles. We are always looking for code questions/problems and any question that you wish to pose to FAEC, will be forwarded on to our industry specialist for an answer.

I hope to see many of you in St. Augustine on September 29th and if you have any questions or need anything, please don't hesitate to contact me at the Association's office.

~ Janice

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- The opportunity to interact with fellow contractors to share industry concerns and discuss industry news.

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## **By Kimberly DeBerry Kim's Electric Jacksonville, Florida**

As summer comes to an end and with Fall near I am excited about our Annual Fall Convention at the beautiful Renaissance Hotel at the World of Golf Village located in St. Augustine, Florida on September 29th - October 2nd, 2010.

Once again you will have the opportunity to obtain continuing education, network and have some fun! The agenda outlined for this convention has a lot of new information on important topics that is viable for the success of your business. You will have the opportunity to learn new technology. After you retain all of the knowledge from attending the classes you will have the opportunity to play golf and enjoy the fellowship among family, friends and fellow contractors.

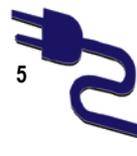
If you were not able to join us at the last conference you really missed out on some great topics. We had Mr. Tim Moorhead, Attorney, with Wright, Fulford, Moorhead & Brown, Orlando, FL, who spoke to the group

on the topic of reviewing contracts. (I know if you are like us we have not seen them in a while but once we do we will have the tools to better assist us in being aware of language that can really impact our business). Tim will return for the fall convention to discuss "The Hiring Act of 2010". We were also pleased to have Mr. Marcus "Bo" Orr from Federated Insurance (our FAEC insurance partner) educating us on insurance language and that is a big deal!

There is just so much that you can learn attending these events. Plus the opportunity to network with other professionals. So submit your registration and get involved!

See you at the Fall Convention....

*~ Kim*



# How do you know if a Training Certificate is a Fake?



“Trust, but verify,” was President Ronald Reagan’s signature phrase, and this is a circumstance where both trust and verification are essential. Seeing a card is NOT a verification or a guarantee of safe practice.

If we see practices or workmanship that do not meet designated safety standards, it’s up to us to demand accountability. Pencil-whipping a form or printing out a training card may meet regulatory or contractual requirements, but that does not send a serious message or change behavior.

We as construction professionals have not only the moral and legal obligation - but also the leverage to hold our crews and trades on site accountable to our established construction safety standards and policies. It is up to us to get out there and evaluate the competence of our trade people and to enforce the set standards.

It’s not enough to just meet regulatory and contractual requirements by filling binders full of paperwork.

Yes, we still have to keep those binders, but we also

The issue of fake safety training cards is a serious one for our industry, and we need to get a grip on the problem. What can contractors do to ensure that the people holding the safety training cards are actually safe workers?

A training card is simply a piece of paper. It’s the responsibility of project owners and contractors to get out in the field and prove to their own satisfaction that individuals holding safety training cards are truly competent. How? Observe, ask questions and monitor work practices and examine processes.

A safety training card, whether legitimate or fake, gives the controlling employer no assurance that the worker will follow safety requirements set by regulation or by the contractor’s policies. Even knowing that the worker took a safety training class is not a guarantee of competence.

need to verify and validate the competence of workers on sites.

Even if a project engineer can't yet classify soil types, s/he can ask a competent person how that person knows whether a trench is safe. By asking questions and observing practices, s/he will likely be able to sniff out a "not-so-competent person" and direct a superintendent or safety person to investigate.

Engaging people and using basic critical thinking skills goes a long way on a construction site.

It is the responsibility of all construction professionals, including executives, superintendents, project managers, trades people and every other professional on the job to ensure that safety happens.

We can argue the semantics of terms such as "company safety culture" and "company culture of safety" until the cows come home.

But the real question is: how can we become a safer industry? Because even an extraordinarily safe company with a strong culture of safety can have a "competent person" with a fake training card on site and never know it.



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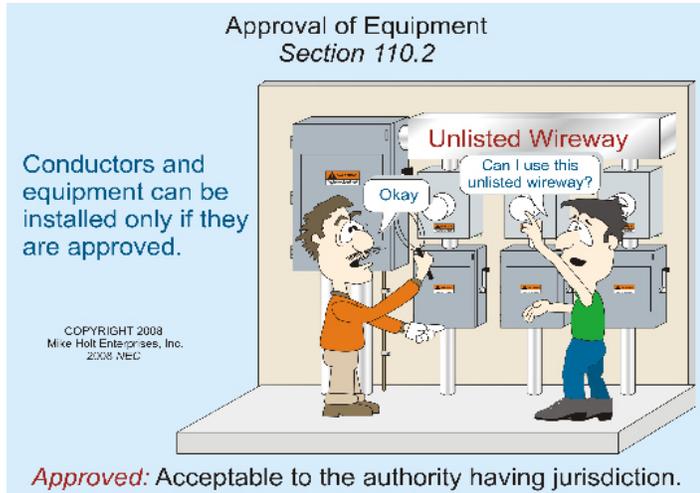
By Mike Holt, NEC Expert

## Introduction to Article 110

### Requirements for Electrical Installations

Part 2 of 6:  
Mike Holt's Illustrated Guide to Understanding the National Electrical Code

110.2 Approval of Conductors and Equipment. The authority having jurisdiction must approve all electrical conductors and equipment. Figure 110-1



Author's Comments:

- See the definitions of "Labeling" and "Listing" in Article 100.
- Failure to follow product listing instructions, such as torquing of terminals and sizing of conductors, is a violation of this Code rule. Figure 110-3
- When an air conditioner nameplate specifies "Maximum Fuse Size," one-



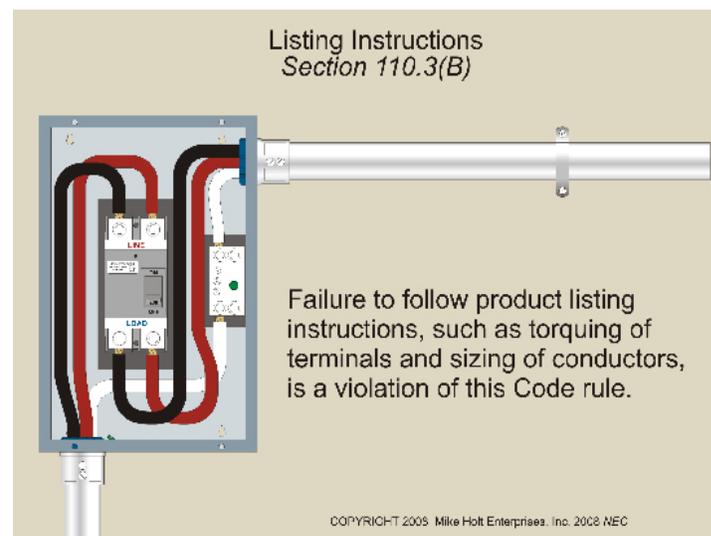
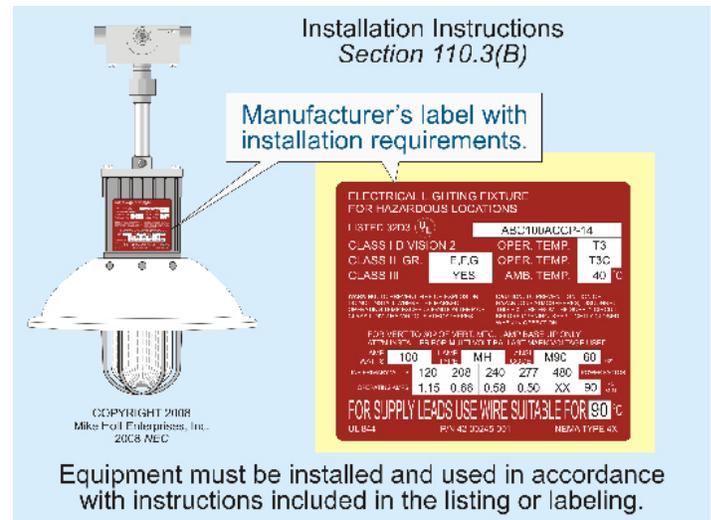
Author's Comment: For a better understanding of product approval, review 90.4, 90.7, 110.3 and the definitions for "Approved," "Identified," "Labeled," and "Listed" in Article 100.

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

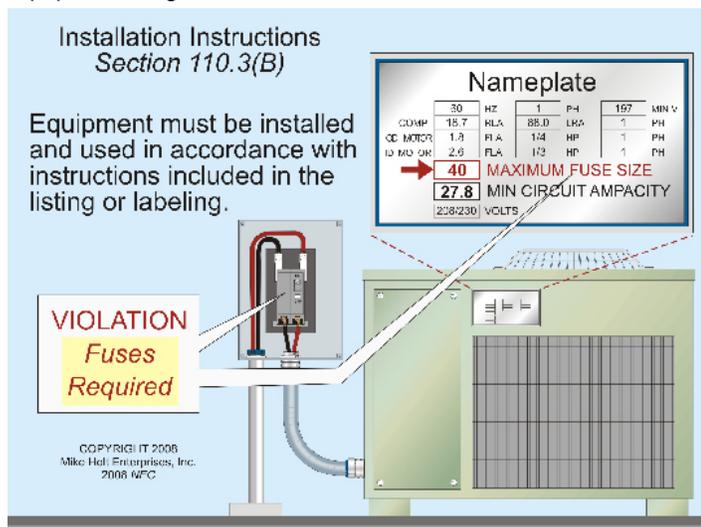
(A) Guidelines for Approval. The authority having jurisdiction must approve equipment, and consideration must be given to the following:

- (1) Listing or labeling
- (2) Mechanical strength and durability
- (3) Wire-bending and connection space
- (4) Electrical insulation
- (5) Heating effects under all conditions of use
- (6) Arcing effects
- (7) Classification by type, size, voltage, current capacity, and specific use
- (8) Other factors contributing to the practical safeguarding of persons using or in contact with the equipment

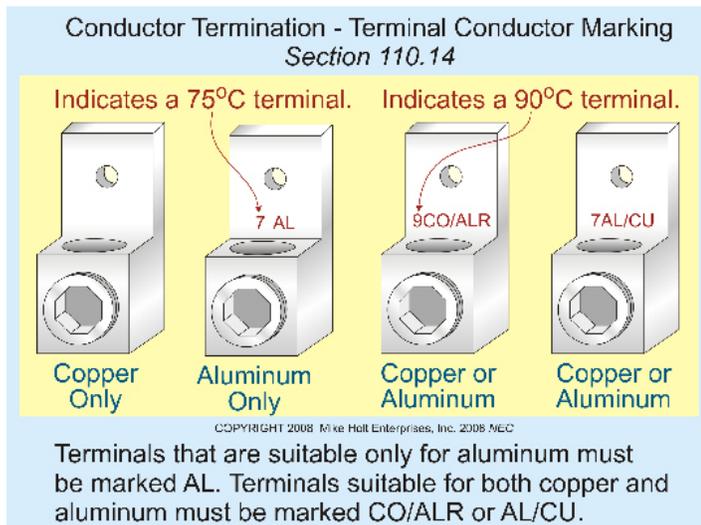
(B) Installation and Use. Equipment must be installed and used in accordance with any instructions included in the listing or labeling requirements. Figure 110-2



time or dual-element fuses must be used to protect the equipment. Figure 110-4



110.14 Conductor Termination and Splicing. Conductor terminal and splicing devices must be identified for the conductor material and they must be properly installed and used. Figure 110-5



Caution: When the insulation is stripped from an aluminum conductor and the conductor is exposed to air, an insulating film (aluminum oxide) immediately forms on the conductor. This film can create a poor connection and overheating at terminations. Unless the terminal or the device is manufactured with the right contacts designed to break through the film and ensure a good connection, overheating may occur.

Switches and receptacles marked CO/ALR are designed to ensure a good connection through the use of the larger contact area and compatible materials. The terminal screws are plated with the element Indium. Indium is an extremely soft metal that forms a gas-sealed connection with the aluminum conductor.

Author's Comments:

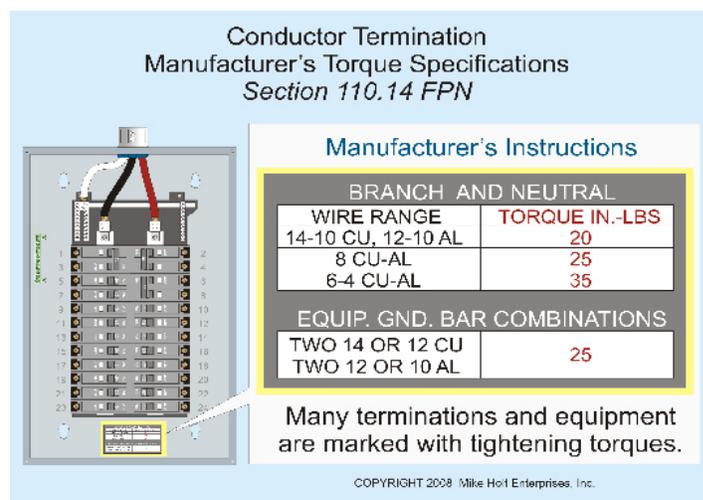
- See the definition of "Identified" in Article 100.
- Conductor terminations must comply with the manufacturer's instructions as required by 110.3(B). For example, if the instructions for the device state "Suitable for 18-12 AWG Stranded," then only stranded conductors can be used with the terminating device. If the instructions state "Suitable for 18-12 AWG Solid," then only solid conductors are permitted, and if the instructions state "Suitable for 18-12 AWG," then either solid or stranded conductors can be used with the terminating device.

Copper and Aluminum Mixed. Copper and aluminum conductors must not make contact with each other in a device unless the device is listed and identified for this purpose.

Author's Comment: Few terminations are listed for the mixing of aluminum and copper conductors, but if they are, they will be marked on the product package or terminal device. The reason copper and aluminum should not be in contact with each other is because corrosion develops between the two different metals due to galvanic action, resulting in increased contact resistance at the splicing device. This increased resistance can cause over-heating of the splice and cause a fire.

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

Author's Comment: Conductors must terminate in devices that have been properly tightened in accordance with the manufacturer's torque specifications included with equipment instructions. Failure to torque terminals can result in excessive heating of terminals or splicing devices (due to a loose connection), which can result in a fire because of a short circuit or ground fault. In addition, this is a violation of 110.3(B), which requires all equipment to be installed in accordance with listing or labeling instructions. Figure 110-6



# SERIES PART 2 REPORT

**Question:** What do you do if the torque value isn't provided with the device?

**Answer:** Call the manufacturer, visit the manufacturer's Website, or have the supplier make a copy of the installation instructions.

**Author's Comment:** Terminating conductors without a torque tool can result in an improper and unsafe installation. If a torque screwdriver is not used, there's a good chance the conductors are not properly terminated.

**(A) Terminations.** Conductor terminals must ensure a good connection without damaging the conductors and must be made by pressure connectors (including set screw type) or splices to flexible leads.

**Author's Comments:**

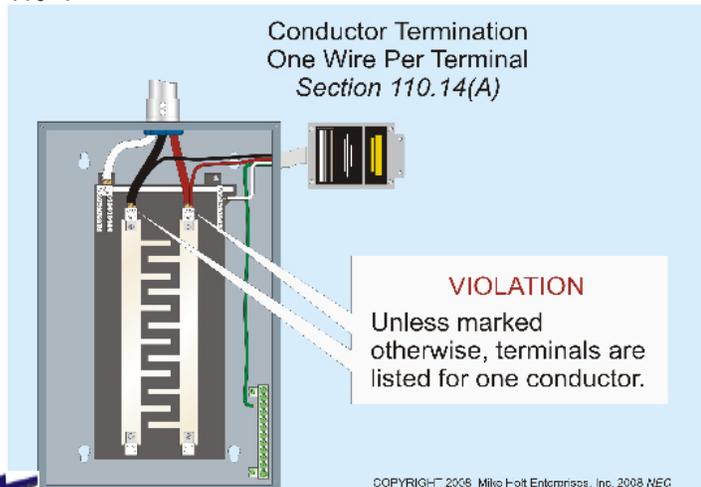
- See the definition of "Connector, Pressure" in Article 100.
- Grounding conductors and bonding jumpers must be connected by listed pressure connectors, terminal bars, exothermic welding, or other listed means [250.8(A)].

**Question:** What if the conductor is larger than the terminal device?

**Answer:** This condition needs to be anticipated in advance, and the equipment should be ordered with terminals that will accommodate the larger conductor. However, if you're in the field, you should:

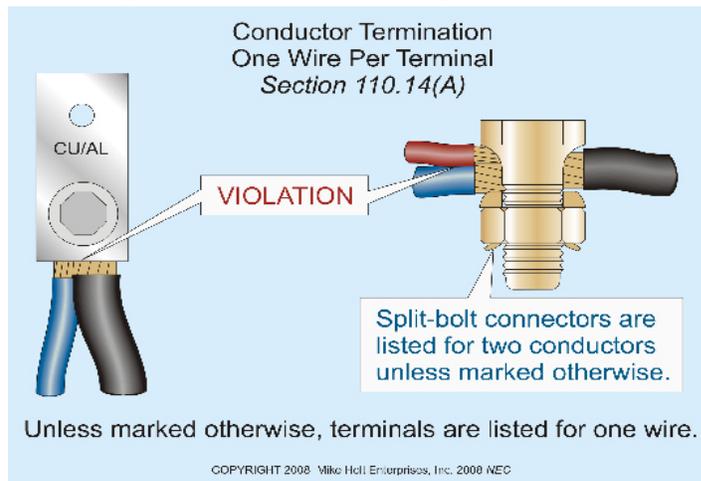
- Contact the manufacturer and have them express deliver you the proper terminals, bolts, washers, and nuts, or
- Order a terminal device that crimps on the end of the larger conductor and reduces the termination size.

**One Wire Per Terminal.** Terminals for more than one conductor must be identified for this purpose, either within the equipment instructions or on the terminal itself. Figure 110-7



**Author's Comments:**

- Split-bolt connectors are commonly listed for only two conductors, although some are listed for three conductors. However, it's a common industry practice to terminate as many conductors as possible within a split-bolt connector, even though this violates the NEC. Figure 110-8

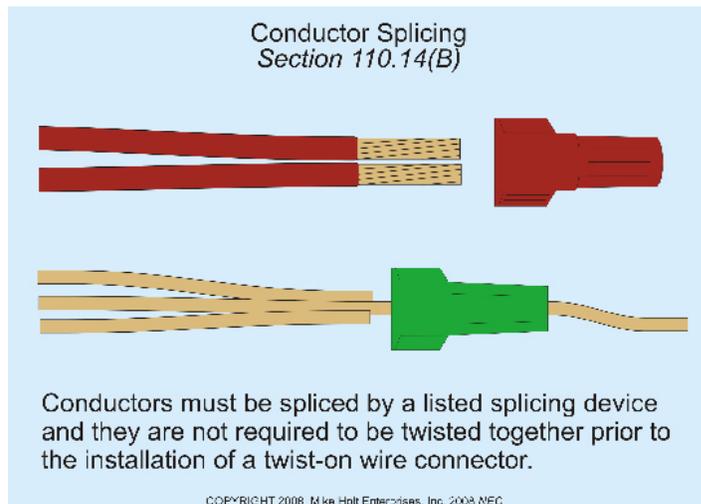


- Many devices are listed for more than one conductor per terminal. For example, some circuit breakers rated 30A or less can have two conductors under each lug. Grounding and bonding terminals are also listed for more than one conductor under the terminal.

Split-bolt connectors for aluminum-to-aluminum or aluminum-to-copper conductors must be identified as suitable for the application.

**(B) Conductor Splices.** Conductors must be spliced by a splicing device identified for the purpose or by exothermic welding.

**Author's Comment:** Conductors are not required to be twisted together prior to the installation of a twist-on wire connector. Figure 110-9



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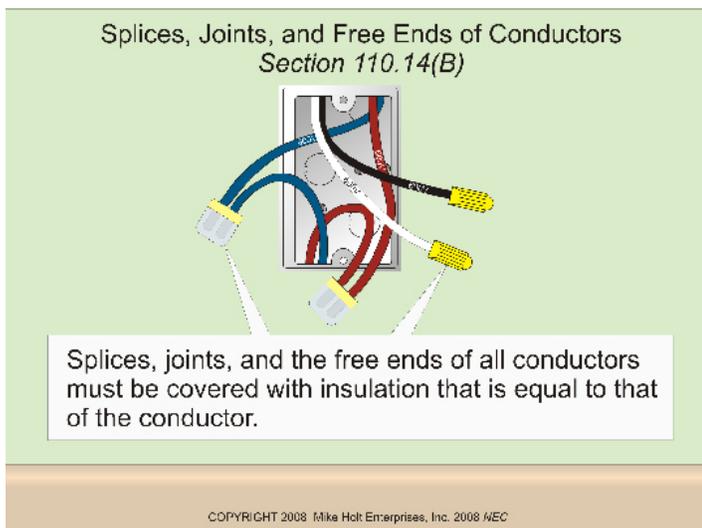


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“but as for me and my house, we will serve the Lord” [Joshua 24:15]

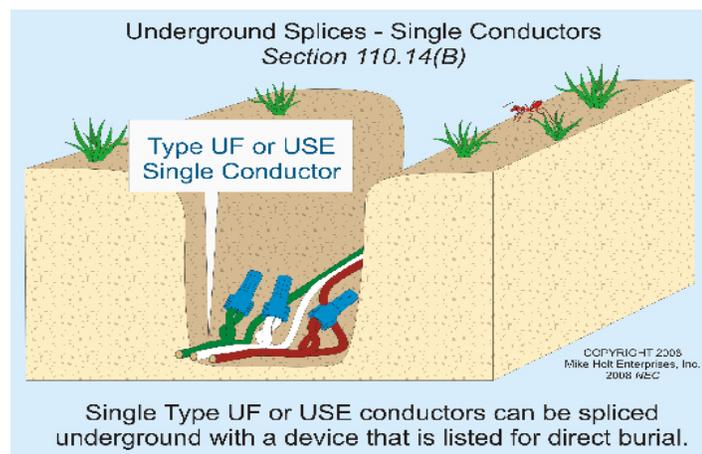
Unused circuit conductors are not required to be removed. However, to prevent an electrical hazard, the free ends of the conductors must be insulated to prevent the exposed end of the conductor from touching energized parts. This requirement can be met by the use of an insulated twist-on or push-on wire connector. Figure 110-10



Author's Comment: See the definition of "Energized" in Article 100.

Underground Splices:

Single Conductors. Single direct burial conductors of types UF or USE can be spliced underground without a junction box, but the conductors must be spliced with a device listed for direct burial [300.5(E) and 300.15(G)]. Figure 110-11



Multiconductor Cable. Multiconductor UF or USE cable can have the individual conductors spliced underground without a junction box, if a listed splice kit that encapsulates the conductors and the cable jacket is used.

(C) Temperature Limitations (Conductor Size). Conductors

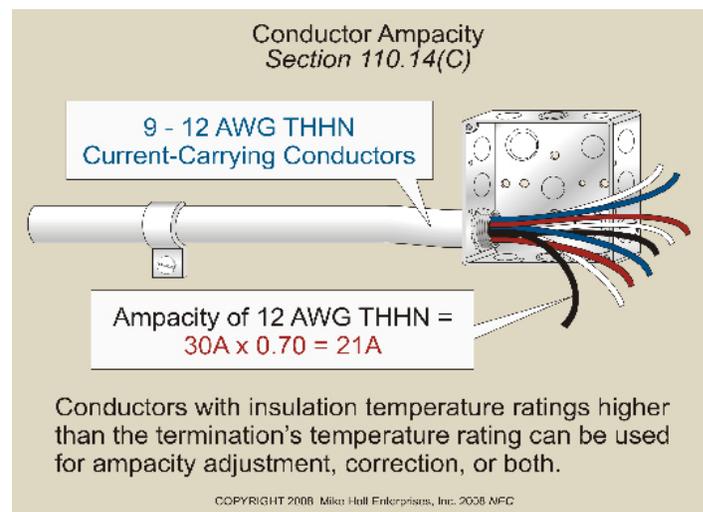
are to be sized to the lowest temperature rating of any terminal, device, or conductor of the circuit, in accordance with the equipment terminal temperature rating .

Conductor Ampacity. Conductors with insulation temperature ratings higher than the termination's temperature rating can be used for conductor ampacity adjustment, correction, or both.

Author's Comments:

- See the definition of "Ampacity" in Article 100.
- This means conductor ampacity must be based on the conductor's insulation temperature rating listed in Table 310.16, as adjusted for ambient temperature correction factors, conductor bundling adjustment factors, or both.
- The location of conductors can influence their ampacity as well. For example, THHW is a 90°C conductor in a dry location, but it's a 75°C conductor in a wet location. THHN/THWN-2 is a 90°C conductor, in wet, dry, or damp locations [Table 310.13(A)].

Example: The ampacity of each 12 THHW conductor in a dry location is 30A, based on the values listed in the 90°C column of Table 310.16. If we bundle nine current-carrying 12 THHN conductors, the ampacity for each conductor (30A at 90°C, Table 310.16) needs to be adjusted by a 70 percent adjustment factor [Table 310.15(B)(2)(a)]. Figure 110-12



Adjusted Conductor Ampacity =  $30A \times 0.70$

Adjusted Conductor Ampacity = 21A

If the conductors are installed in a wet location, the ampacity of 12 THHW conductors is 25A according to the 75°C column of Table 310.16 [Table 310.13(A)].

Adjusted Conductor Ampacity =  $25A \times 0.70$

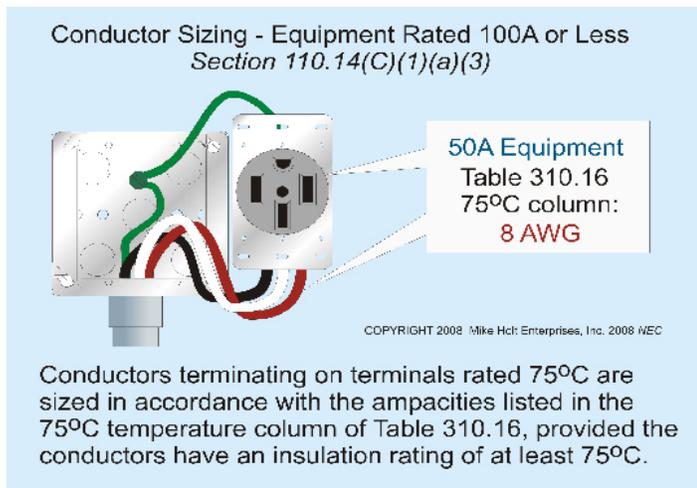
Adjusted Conductor Ampacity = 17.50A, 18A [220.5(B)]

(1) Equipment Temperature Rating Provisions. Unless the equipment is listed and marked otherwise, conductor sizing for equipment terminations must be based on Table 310.16 in accordance with (a) or (b):

(a) Equipment Rated 100A or Less.

(3)

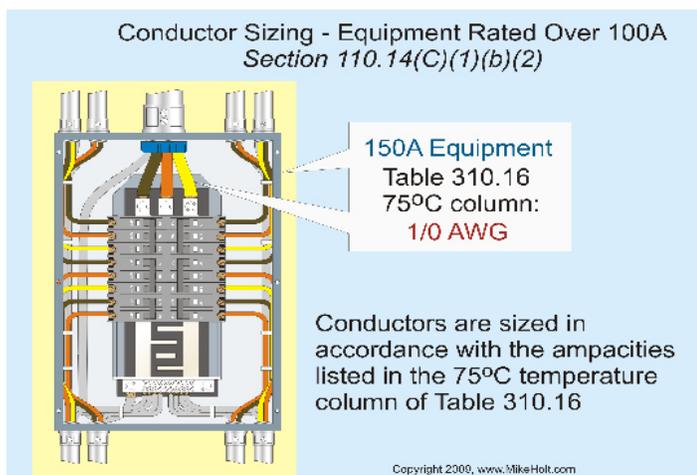
Conductors terminating on terminals rated 75°C are sized in accordance with the ampacities listed in the 75°C temperature column of Table 310.16, provided the conductors have an insulation rating of at least 75°C. Figure 110–13



(b) Equipment Rated Over 100A

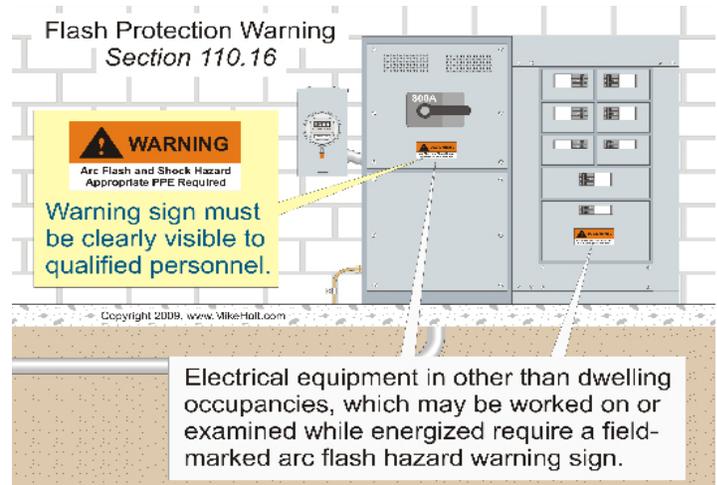
(2)

Conductors are sized in accordance with the ampacities listed in the 75°C temperature column of Table 310.16. Figure 110–14



110.16 Flash Protection Warning. Electrical equipment such

as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers in other than dwelling units that are likely to require examination, adjustment, servicing, or maintenance while energized must be field-marked to warn qualified persons of the danger associated with an arc flash from line-to-line or ground faults. The field-marking must be clearly visible to qualified persons before they examine, adjust, service, or perform maintenance on the equipment. Figure 110–15



Author's Comments:

- See the definition of “Qualified Person” in Article 100.
- This rule is meant to warn qualified persons who work on energized electrical systems that an arc flash hazard exists so they will select proper personal protective equipment (PPE) in accordance with industry accepted safe work practice standards.

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

110.26 Spaces About Electrical Equipment. For the purpose of safe operation and maintenance of equipment, sufficient access and working space must be provided.

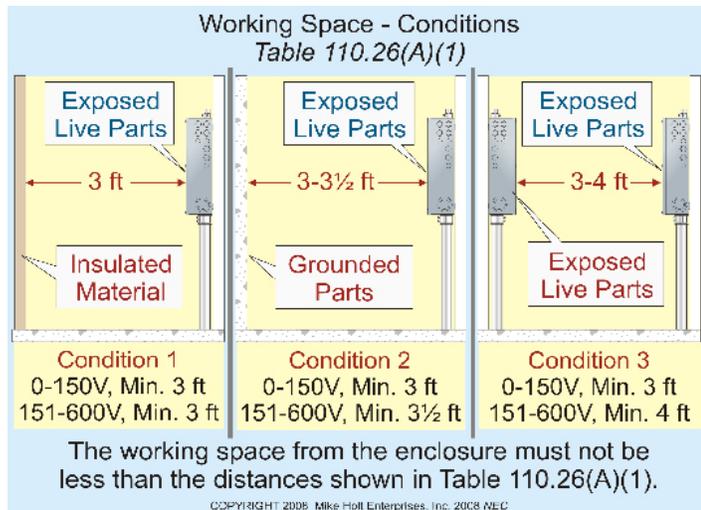
(A) Working Space. Equipment that may need examination, adjustment, servicing, or maintenance while energized must have sufficient working space in accordance with (1), (2), and (3):

Author's Comment: The phrase “while energized” is the root of many debates. As always, check with the AHJ to see what equipment he/she believes needs a clear working space.

(1) Depth of Working Space. The working space, which is measured from the enclosure front, must not be less

than the distances contained in Table 110.26(A)(1). Figure 110-16

Table 110.26(A)(1) Working Space



Voltage-to-Ground	Condition 1	Condition 2	Condition 3
0-150V	3 ft	3 ft	3 ft
151-600V	3 ft	3 1/2 ft	4 ft

- *Condition 1*—Exposed live parts on one side of the working space and no live or grounded parts, including concrete, brick, or tile walls are on the other side of the working space.
- *Condition 2*—Exposed live parts on one side of the working space and grounded parts, including concrete, brick, or tile walls are on the other side of the working space.
- *Condition 3*—Exposed live parts on both sides of the working space.

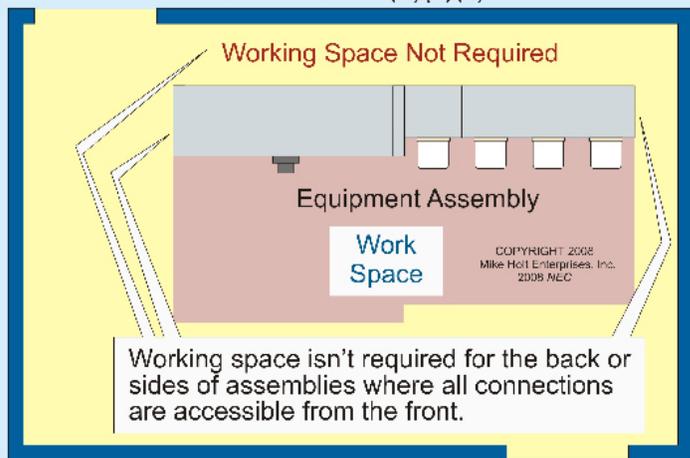
(a) Rear and Sides. Working space isn't required for the back or sides of assemblies where all connections and all renewable or adjustable parts are accessible from the front. Figure 110-17

(b) Low Voltage. Where special permission is granted in accordance with 90.4, working space for equipment that operates at not more than 30V ac or 60V dc can be less than the distance in Table 110.26(A)(1). Figure 110-18

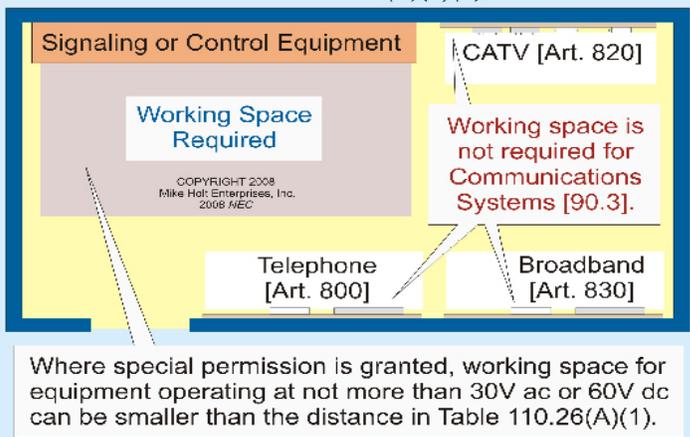
Author's Comment: See the definition of "Special Permission" in Article 100.

(c) Existing Buildings. Where electrical equipment is being replaced, Condition 2 working space is permitted between dead-front switchboards, panelboards, or motor control

Working Space - Sides and Back of Equipment Section 110.26(A)(1)(a)



Working Space - Low-Voltage Systems Section 110.26(A)(1)(b)



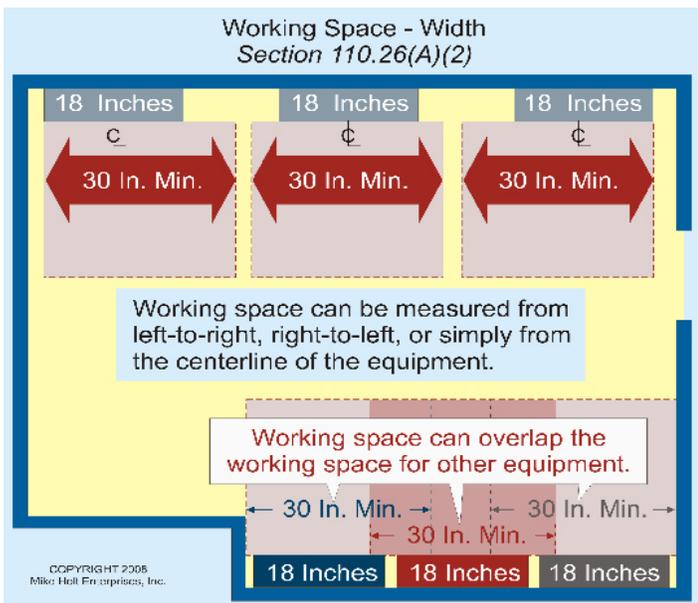
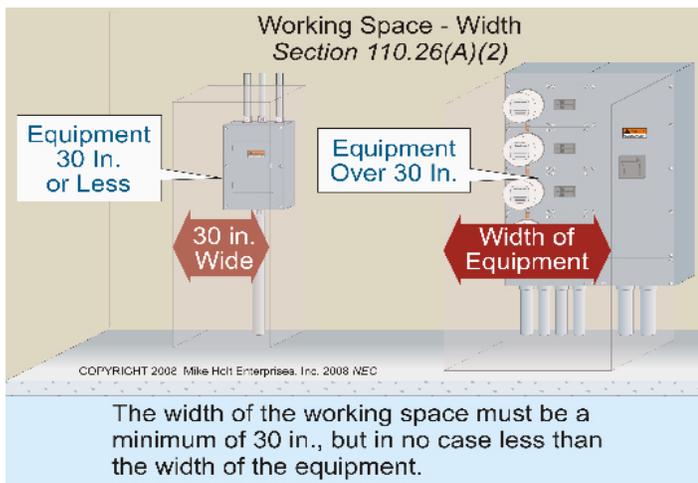
Where special permission is granted, working space for equipment operating at not more than 30V ac or 60V dc can be smaller than the distance in Table 110.26(A)(1).

centers located across the aisle from each other where conditions of maintenance and supervision ensure that written procedures have been adopted to prohibit equipment on both sides of the aisle from being open at the same time, and only authorized, qualified persons will service the installation.

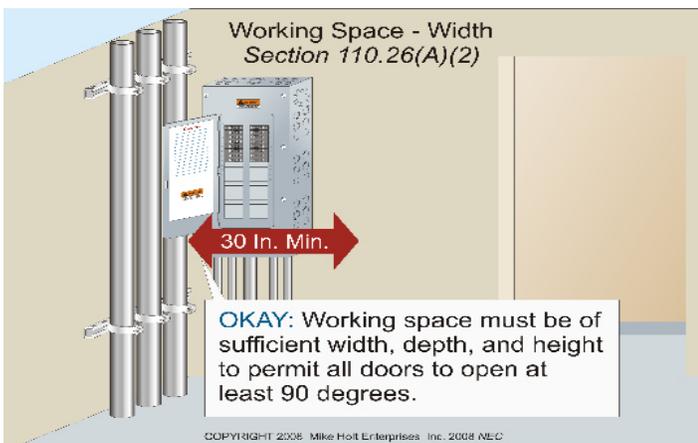
Author's Comment: The working space requirements of 110.26 don't apply to equipment included in Chapter 8—Communications Circuits [90.3].

(2) Width of Working Space. The width of the working space must be a minimum of 30 in., but in no case less than the width of the equipment. Figure 110-19

Author's Comment: The width of the working space can be measured from left-to-right, from right-to-left, or simply centered on the equipment, and the working space can overlap the working space for other electrical equipment. Figure 110-20

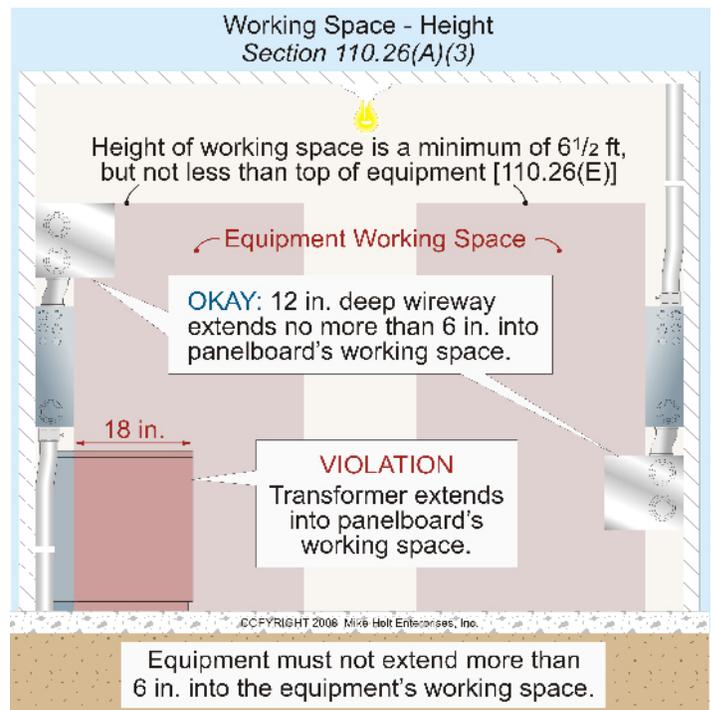


In all cases, the working space must be of sufficient width, depth, and height to permit all equipment doors to open 90 degrees. Figure 110-21



(3) Height of Working Space (Headroom). For service equipment, switchboards, panelboards, and motor control equipment, the height of the working space in front of equipment must not be less than 6½ ft, measured from the grade, floor, or platform [110.26(E)].

Equipment such as raceways, cables, wireways, cabinets, panels, etc., can be located above or below electrical equipment, but must not extend more than 6 in. into the equipment's working space. Figure 110-22

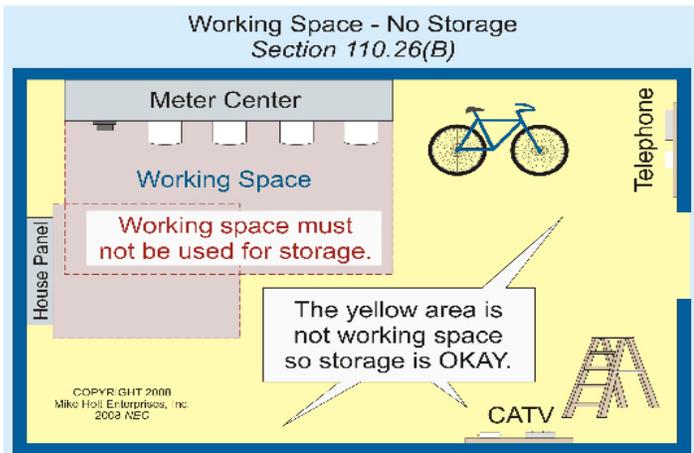


(B) Clear Working Space. The working space required by this section must be clear at all times. Therefore, this space is not permitted for storage. When normally enclosed live parts are exposed for inspection or servicing, the working space, if in a passageway or general open space, must be suitably guarded.

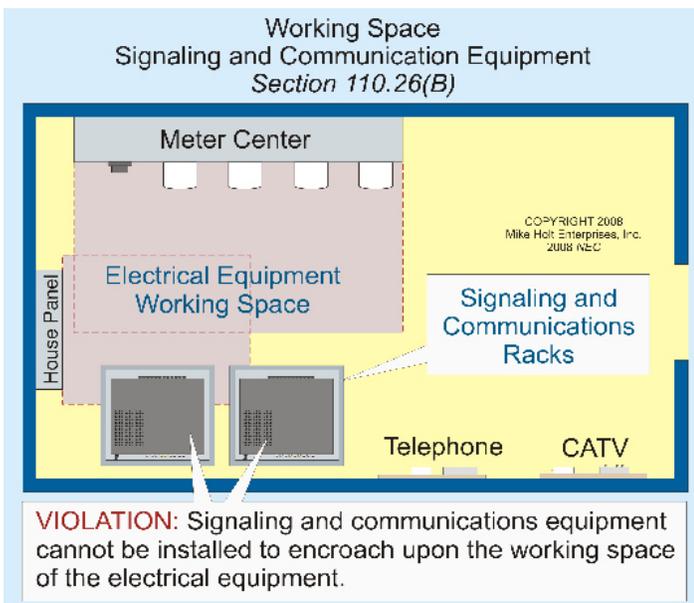
Author's Comment: When working in a passageway, the working space should be guarded from occupants using the passageway. When working on electrical equipment in a passageway one must be mindful of a fire alarm evacuation with numerous occupants congregated and moving through the passageway.

*Caution: It's very dangerous to service energized parts in the first place, and it's unacceptable to be subjected to additional dangers by working around bicycles, boxes, crates, appliances, and other impediments. Figure 110-23*

Author's Comment: Signaling and communications equipment must not be installed in a manner that



encroaches on the working space of the electrical equipment. Figure 110-24



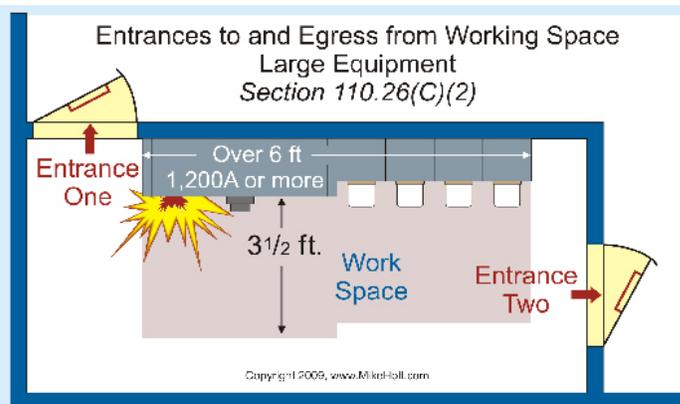
### (C) Entrance to and Egress from Working Space.

(1) Minimum Required. At least one entrance of sufficient area must provide access to and egress from the working space.

Author's Comment: Check to see what the authority having jurisdiction considers "Sufficient Area." Building codes contain minimum dimensions for doors and openings for personnel travel.

(2) Large Equipment. An entrance to and egress from each end of the working space of electrical equipment rated 1,200A or more that is over 6 ft wide is required. The opening must be not less than 24 in. wide and 6½ ft high. A single entrance to and egress from the required working

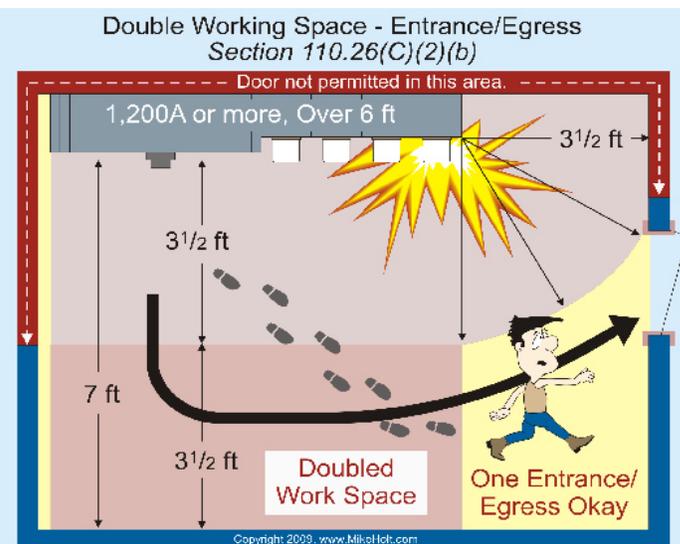
space is permitted where either of the following conditions is met. Figure 110-25



For equipment rated 1,200A or more, and over 6 ft wide, an entrance to and egress from (2 ft x 6 ½ ft) is required at each end of the working space.

(a) Unobstructed Egress. Only one entrance is required where the location permits a continuous and unobstructed way of egress travel.

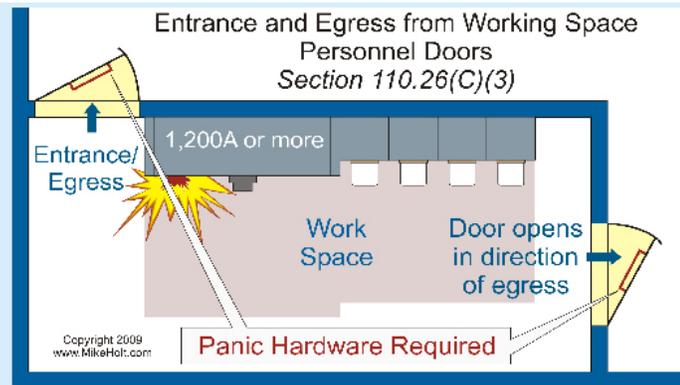
(b) Double Workspace. Only one entrance is required where the required working space depth is doubled, and the equipment is located so the edge of the entrance is no closer than the required working space distance. Figure 110-26



One entrance/egress is permitted where the required working space is doubled, and equipment is located so the edge of the entrance is no closer than the required working space distance.

(3) Personnel Doors. Where equipment with overcurrent or switching devices rated 1,200A or more is installed, personnel door(s) for entrance to and egress from the

working space located less than 25 ft from the nearest edge of the working space must have the door(s) open in the direction of egress and be equipped with panic hardware or other devices that open under simple pressure. Figure 110–27



For equipment rated 1,200A or more, personnel door(s) located less than 25 ft from the nearest edge of working space must open in the direction of egress and have panic hardware or devices that open under simple pressure.

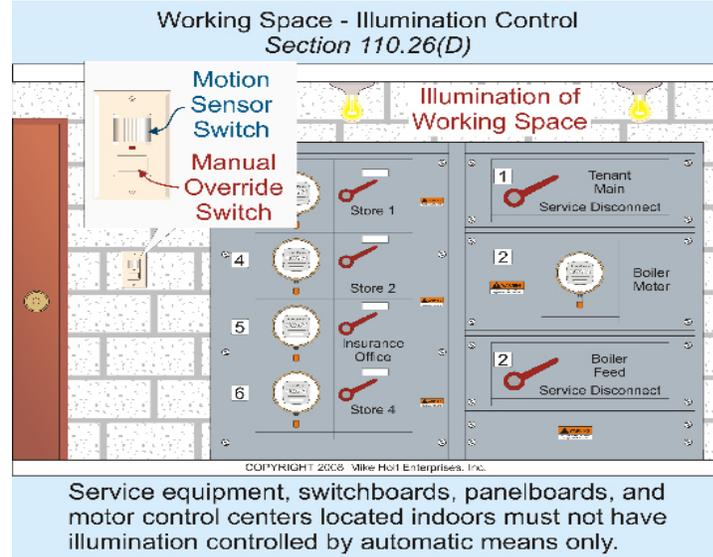
## Author's Comments:

- History has shown that electricians who suffer burns on their hands in electrical arc flash or arc blast events often can't open doors equipped with knobs that must be turned.
- Since this requirement is in the NEC, the electrical contractor is responsible for ensuring that panic hardware is installed where required. Some electrical contractors are offended at being held liable for nonelectrical responsibilities, but this rule is designed to save the lives of electricians. For this and other reasons, many construction professionals routinely hold "pre-construction" or "pre-con" meetings to review potential opportunities for miscommunication—before the work begins.

(D) Illumination. Service equipment, switchboards, panelboards, as well as motor control centers located indoors must have illumination located in or next to the working space. Illumination must not be controlled by automatic means only. Figure 110–28

Author's Comment: The NEC does not provide the minimum foot-candles required to provide proper illumination. Proper illumination of electrical equipment rooms is essential for the safety of those qualified to work on such equipment.

(E) Headroom. For service equipment, panelboards, switchboards, or motor control centers, the minimum working space headroom must not be less than 6½ ft. When the height of the equipment exceeds 6½ ft, the



minimum headroom must not be less than the height of the equipment.

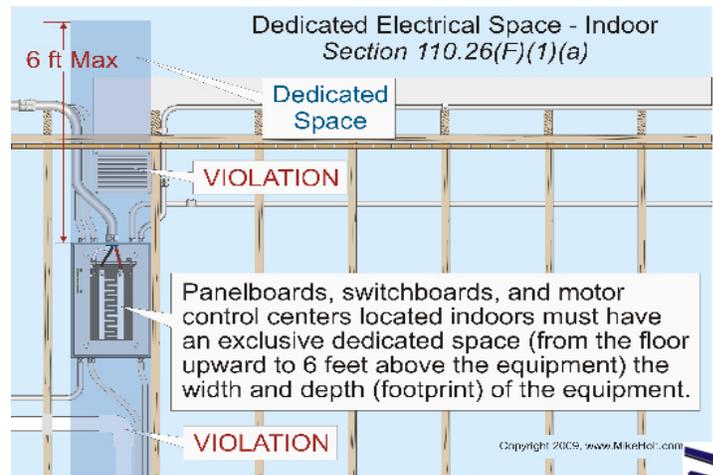
Exception: The minimum headroom requirement doesn't apply to service equipment or panelboards rated 200A or less located in an existing dwelling unit.

Author's Comment: See the definition of "Dwelling Unit" in Article 100.

(F) Dedicated Equipment Space. Switchboards, panelboards, and motor control centers must have dedicated equipment space as follows:

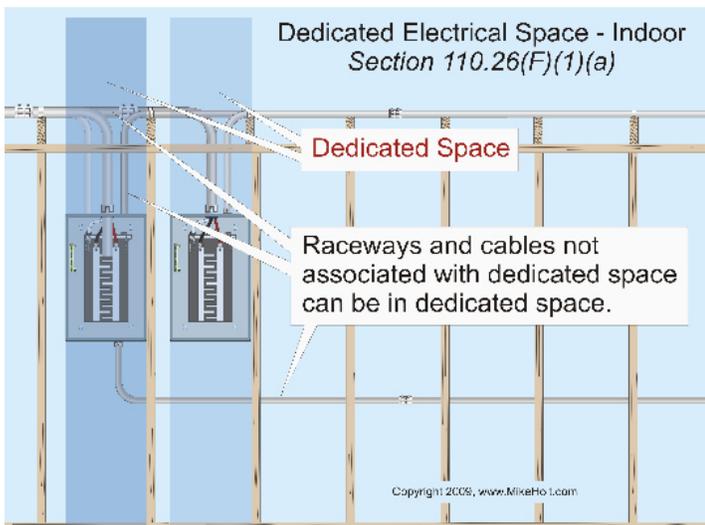
(1) Indoors.

(a) Dedicated Electrical Space. The footprint space (width and depth of the equipment) extending from the floor to a height of 6 ft above the equipment or to the structural ceiling, whichever is lower, must be dedicated for the electrical installation. No piping, ducts, or other equipment foreign to the electrical installation can be installed in this dedicated footprint space. Figure 110–29

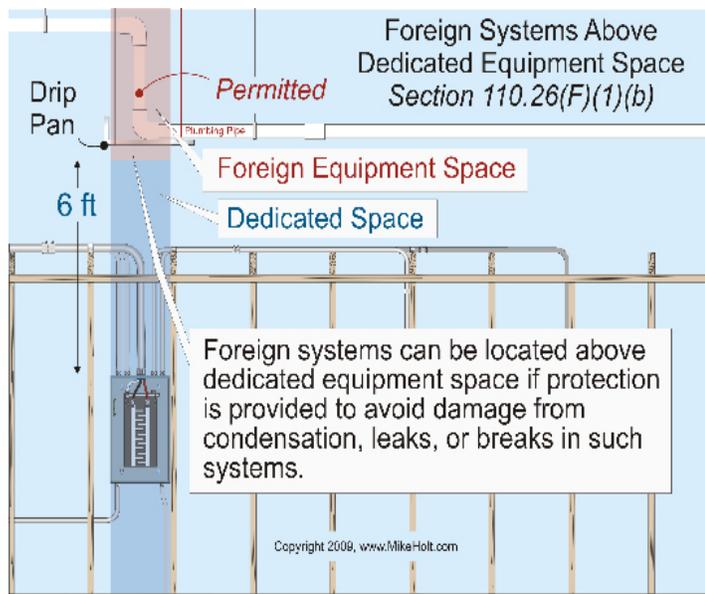


Exception: Suspended ceilings with removable panels can be within the dedicated footprint space [110.26(G)].

Author's Comment: Electrical raceways and cables not associated with the dedicated space can be within the dedicated space. These aren't considered "equipment foreign to the electrical installation." Figure 110-30



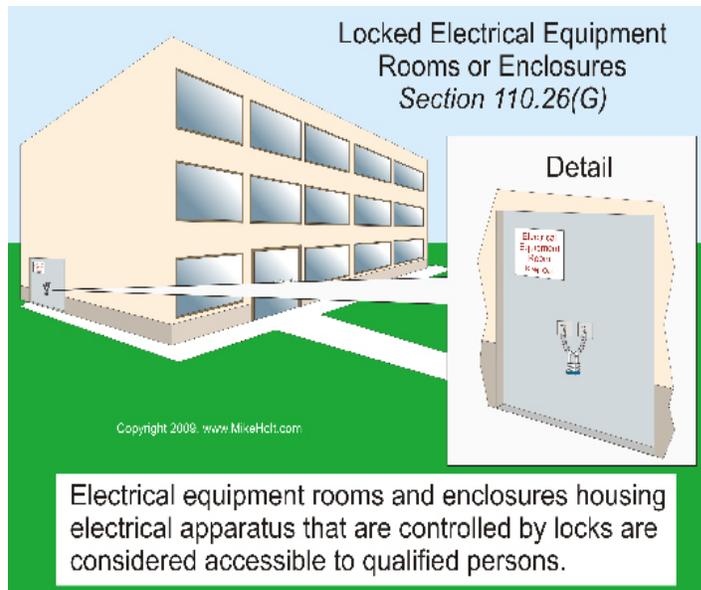
(b) Foreign Systems. Foreign systems can be located above the dedicated space if protection is installed to prevent damage to the electrical equipment from condensation, leaks, or breaks in the foreign systems. Figure 110-31



(c) Sprinkler Protection. Sprinkler protection piping isn't permitted in the dedicated space, but the NEC doesn't prohibit sprinklers from spraying water on electrical equipment.

(d) Suspended Ceilings. A dropped, suspended, or similar ceiling isn't considered a structural ceiling.

(G) Locked Electrical Equipment Rooms or Enclosures. Electrical equipment rooms and enclosures housing electrical equipment or apparatus controlled by locks are considered accessible to qualified persons who require access. Figure 110-32



Author's Comment: See the definition of "Accessible as it applies to equipment" in Article 100.



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