

ARTICLE 110

General Requirements for Electrical Installations

Introduction to Article 110—General Requirements for Electrical Installations

Article 110 is the first article in the *NEC* that contains requirements, as opposed to overall scope, information, or definitions. It contains general rules that apply to all installations and is the foundation of the *Code*. This article is divided into five parts, but we only cover parts for systems under 1000V, nominal.

As you begin your journey to understanding the *NEC*, remember that many other *Code* rules are written assuming that you will first refer to Article 110 to determine the general requirements. By taking the time to read—and understand—each of these rules, you will set yourself up for success!

Part I. General Requirements

110.1 Scope

This article covers the general requirements for the examination, approval, installation, use, and access to spaces around electrical equipment. ▶Figure 110-1



▶Figure 110-1

110.3 Use of Equipment

(A) Examination. In judging equipment for approval, consideration must be given to the following:

- (1) Suitability for installation and use in accordance with the *NEC*

Note 2: Suitability of equipment use may be *identified* by a description marked on (or provided with) a product for a specific purpose, environment, or application. Suitability of equipment may be evidenced by *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 (both normal and abnormal)
- (6) Arcing effects
- (7) Classification by type, size, voltage, current capacity, and specific use
- (8) Cybersecurity for network-connected life safety equipment to address its ability to withstand unauthorized updates and malicious attacks, while maintaining its safety functionality
- (9) Practical safeguarding of persons using (or in contact with) the equipment

Author's Comment:

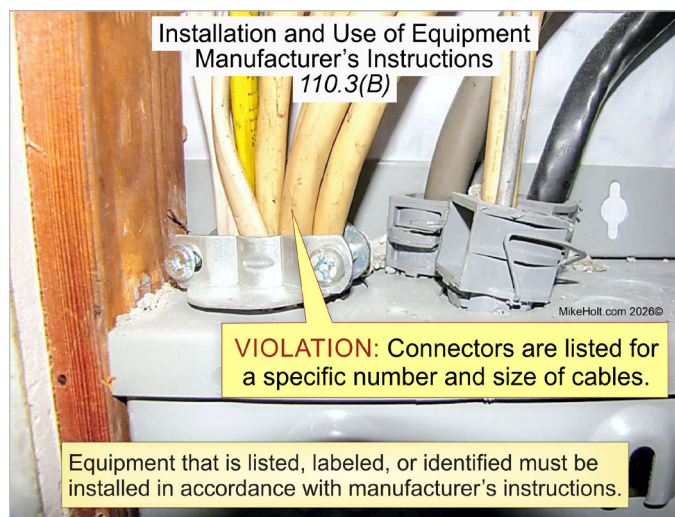
- ▶ Where equipment is not listed or labeled, the authority having jurisdiction (AHJ) may use the guidelines in 110.3(A) to establish suitability before approving the installation of equipment and conductors.



Manufacturer's instructions are not permitted to conflict with the NEC.

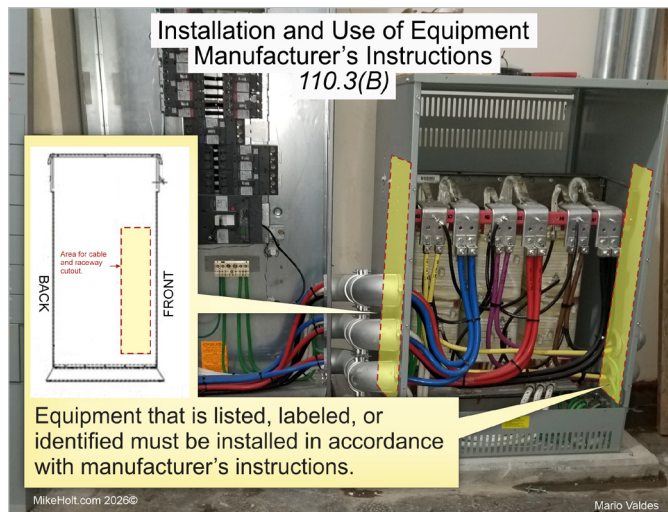
Analysis: A manufacturer's installation instructions cannot conflict with the *NEC* requirements. The instructions can exceed the *NEC* (where specified by the manufacturer), but you can never reduce the requirements of the *Code*.

(B) Installation and Use. Equipment that is *listed*, *labeled*, or *identified* must be installed in accordance with manufacturer's instructions. ▶Figure 110-2 and ▶Figure 110-3



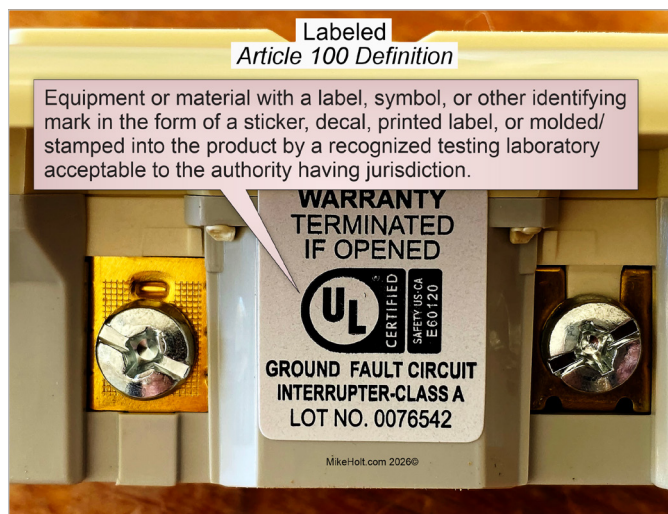
▶Figure 110-2

Listed. Equipment or materials included in a list published by a recognized testing laboratory acceptable to the authority having jurisdiction. The listing organization must periodically inspect the production of listed equipment or material to ensure they meet appropriate designated standards and suitable for a specified purpose.



▶Figure 110-3

Labeled. Equipment or material with a label, symbol, or other identifying mark in the form of a sticker, decal, printed label, or molded/stamped into the product by a recognized testing laboratory acceptable to the authority having jurisdiction. ▶Figure 110-4



▶Figure 110-4

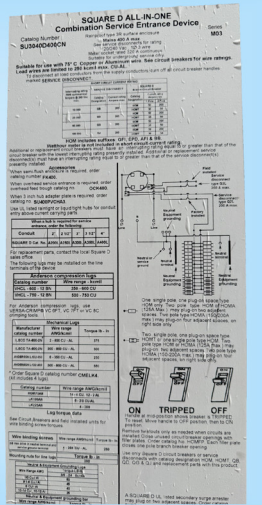
Identified. Recognized as being suitable for a specific purpose, function, use, environment, or application.

The manufacturer's installation and use instructions must comply with the *NEC* requirements. ▶Figure 110-5

Note: The manufacturer's installation instructions can be provided as printed material, quick response (QR) code, or web address to download. ▶Figure 110-6

Installation and Use of Equipment Manufacturer's Instructions 110.3(B)

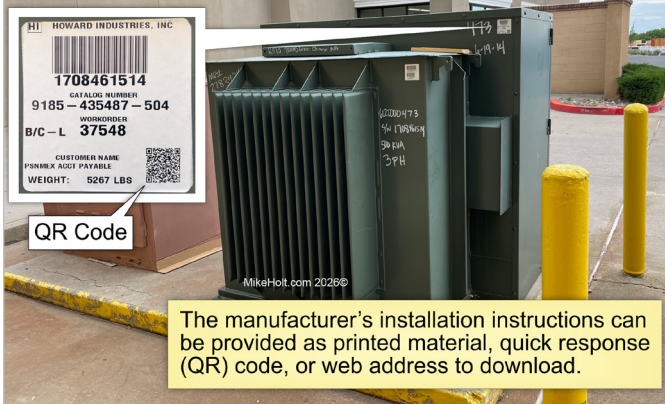
The manufacturer's installation and use instructions must comply with the *NEC* requirements.



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►Figure 110-5

Installation and Use of Equipment Manufacturer's Instructions, QR Codes 110.3(B) Note



The manufacturer's installation instructions can be provided as printed material, quick response (QR) code, or web address to download.

►Figure 110-6

Author's Comment:

- Many electricians throw away installation instructions, but this is no longer a viable reason for not having access to them. Because manufacturers now use QR codes on electrical equipment, the instructions are always readily available on their websites.

(C) Listing. Product testing, evaluation, and listing must be performed by a recognized, qualified electrical testing laboratory in accordance with standards that achieve adequate safety to comply with the *NEC*.

Note: OSHA recognizes qualified electrical testing laboratories that provide product certification that meet their electrical standards.

110.15 High-Leg Conductor Identification

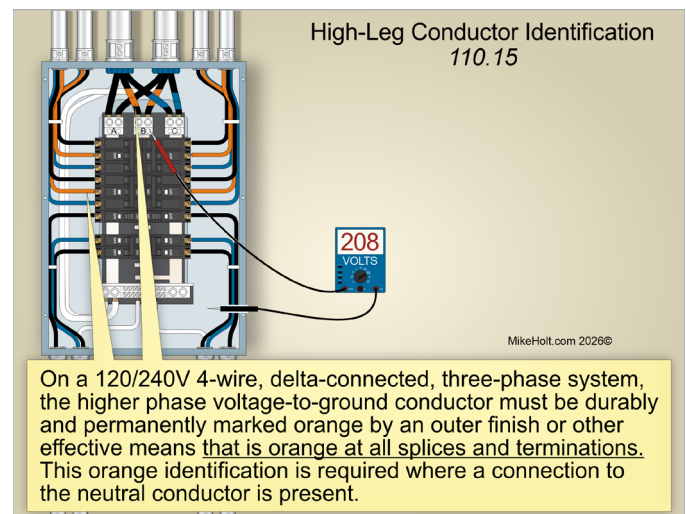


CLARIFIED

Revised text clarifies when the color orange is required for the high-leg conductor identification.

Analysis: The purpose of the high-leg marking is to distinguish the high-leg conductor from other phase conductors and neutral. Orange is required to identify the high-leg conductor to reduce potential misidentification risks at splices and terminations, but not in enclosures used for pulling.

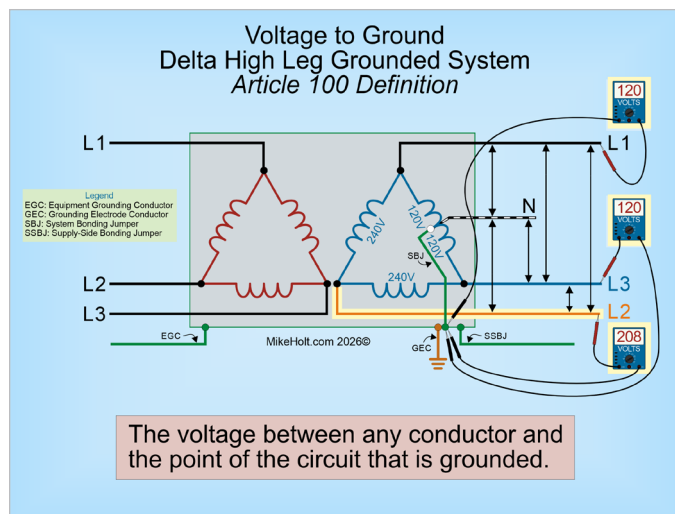
On a 120/240V 4-wire, delta-connected, three-phase system, the higher phase **voltage-to-ground** conductor must be durably and permanently marked orange by an outer finish or other effective means that is orange at all splices and terminations. This orange identification is required where a connection to the neutral conductor is present. ►Figure 110-7



On a 120/240V 4-wire, delta-connected, three-phase system, the higher phase voltage-to-ground conductor must be durably and permanently marked orange by an outer finish or other effective means that is orange at all splices and terminations. This orange identification is required where a connection to the neutral conductor is present.

►Figure 110-7

Voltage to Ground. For grounded systems, the voltage to ground is the voltage between any conductor and the point of the circuit that is grounded. ►Figure 110-8



►Figure 110-8

Author's Comment:

- The high-leg conductor is also called the “wild-leg” or “stinger-leg.” On three-phase, 4-wire, delta-connected system panelboards, the B phase busbar must be the high-leg [408.10(E)(1)]. The panelboard itself must be identified, “CAUTION B PHASE HAS 208V-TO-GROUND” [408.10(F)(1)].

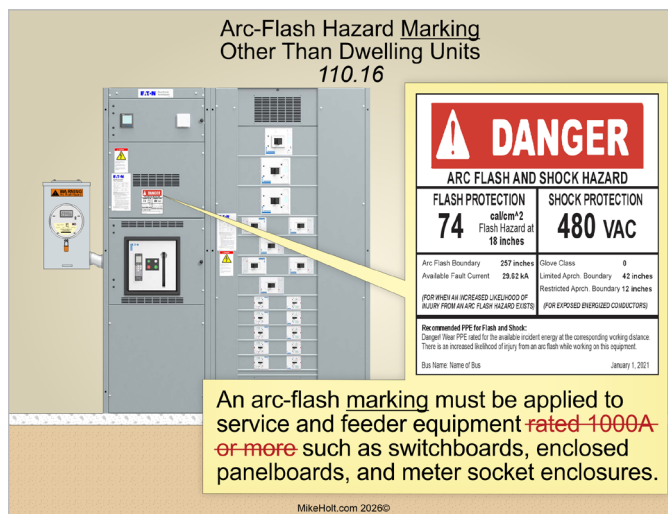
110.16 Arc-Flash Hazard Marking, Other Than Dwelling Units



Arc-flash warning labeling was significantly expanded by deleting a few words.

Analysis: Arc-flash warning label requirements for non-dwelling unit service and feeder equipment were expanded. The previous *Code* only required arc-flash warning labeling of service and feeder equipment of 1000A or more. Now it's required for all non-dwelling distribution equipment, and the arc-flash label must include specific information (such as the date the arc-flash assessment was completed).

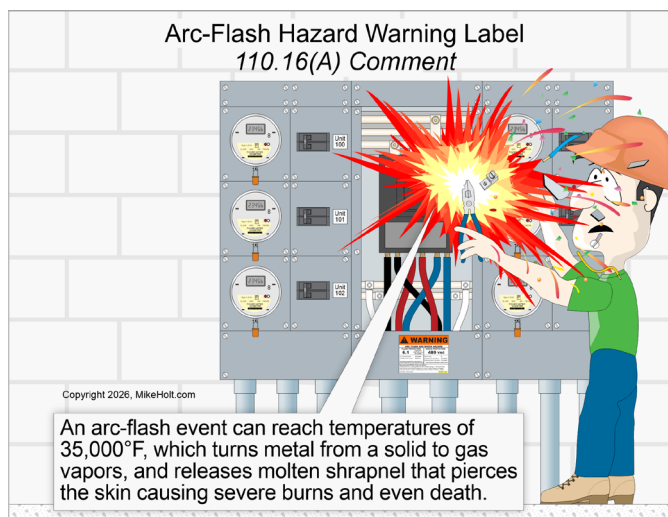
In other than dwelling units, a permanent arc-flash marking must be applied to service and feeder equipment ~~rated 1000A or more~~ such as switchboards, enclosed panelboards, and meter socket enclosures. ►Figure 110-9



►Figure 110-9

Author's Comment:

- An arc-flash event can reach temperatures of 35,000°F, which turns metal from a solid to gas vapors. This releases molten shrapnel that pierces the skin, causing severe burns—even death. The reason the arc-flash label is not required in dwelling units is the nominal voltage will be single-phase, 120V line-to-ground (240V line-to-line), so the arc fault will self-extinguish with every zero crossing of the sinusoidal waveform. A three-phase arc fault is sustainable in accordance with *IEEE-1584*. ►Figure 110-10



►Figure 110-10

The arc-flash hazard marking must be permanently affixed to the equipment and cannot be handwritten in accordance with 110.21(B), be clearly visible to qualified person, and installed in accordance with applicable industry practices containing the following information:

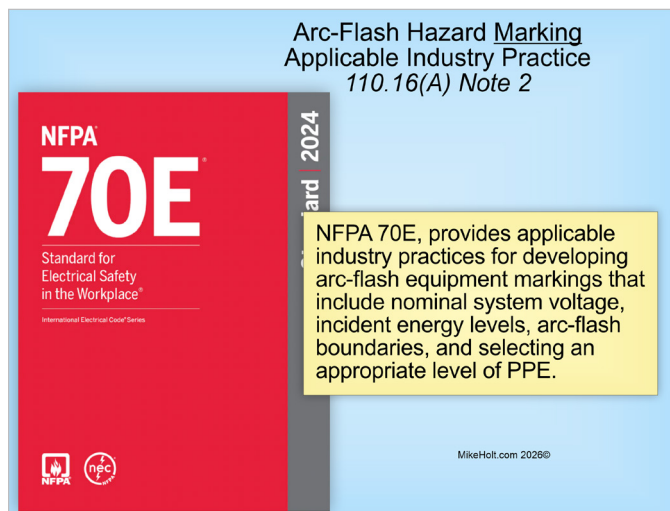
- (1) Nominal system voltage
- (2) Arc-flash boundary
- (3) Available incident energy or minimum required level of personal protective equipment (PPE)
- (4) Date the assessment was completed

►Figure 110-11



►Figure 110-11

Note 2: NFPA 70E, *Standard for Electrical Safety in the Workplace*, provides applicable industry practices for developing arc-flash equipment markings that include nominal system voltage, incident energy levels, arc-flash boundaries, and by selecting an appropriate level of personal protective equipment. ►Figure 110-12



►Figure 110-12

Part II. Not Over 1000V

110.26 Spaces About Electrical Equipment

Access to and egress from working space is required to permit safe operation and maintenance of equipment. ►Figure 110-13



►Figure 110-13



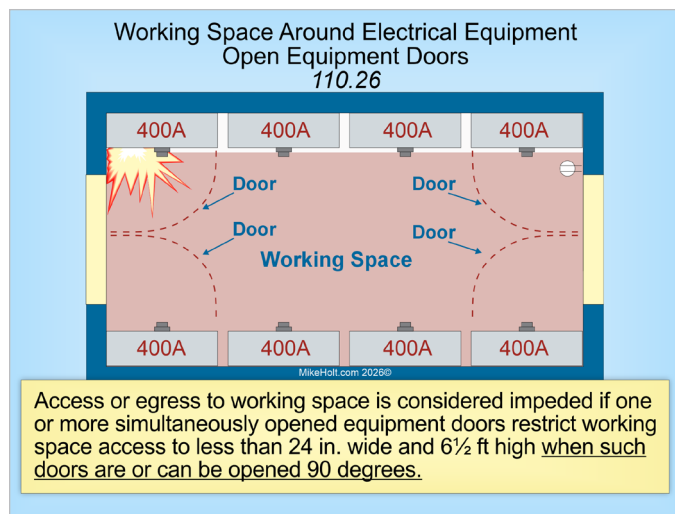
The egress dimension from the working space must be measured when the equipment doors are opened 90 degrees.

Analysis: Section 110.26 clarified that equipment doors that open 90 degrees cannot restrict egress from working spaces. Egress is considered impeded if one or more equipment doors are simultaneously opened 90 degrees, which could cause a scenario of entrapment within the working space.

Open equipment doors must not impede access to or egress from the working space. Access or egress to working space is considered impeded if one or more simultaneously opened equipment doors restrict working space access to less than 24 in. wide and 6½ ft high when such doors are or can be opened 90 degrees. ►Figure 110-14

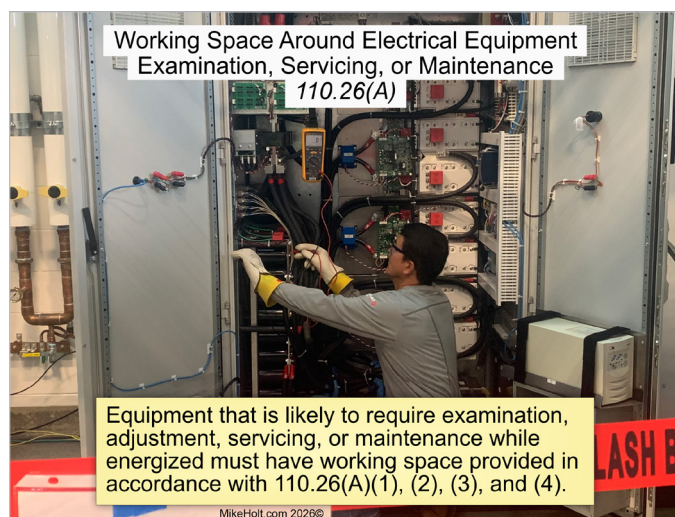
Author's Comment:

- This requirement is intended to prevent workers from being entrapped between equipment doors facing the installation. If an arc-flash incident occurs, there must be free egress so that workers can escape to a safe area.



►Figure 110-14

(A) Working Space. Equipment that is likely to require examination, adjustment, servicing, or maintenance while energized must have working space provided in accordance with 110.26(A)(1), (2), (3), and (4): ►Figure 110-15



►Figure 110-15

Author's Comment:

- Always check with the authority having jurisdiction (AHJ) to see what equipment needs to have a clear working space.

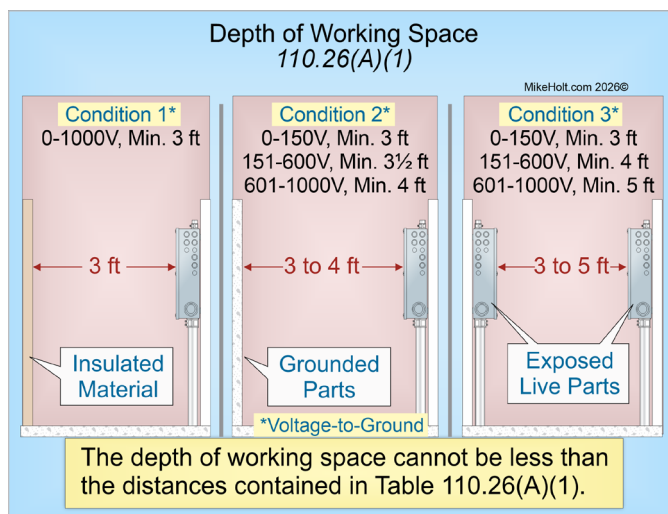
By special permission, smaller working spaces are permitted where exposed live parts operate at no greater than 30V rms, 42V peak, or 60V dc.



The working space distances measurement were clarified.

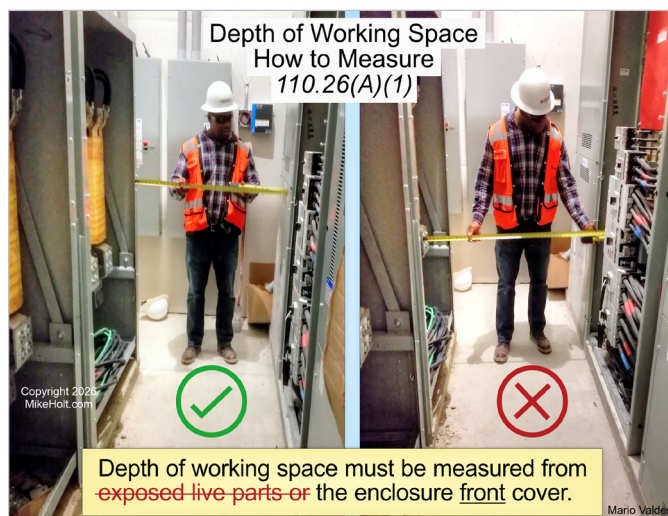
Analysis: The term “exposed live parts” was eliminated to clarify that working space measurements are made from the equipment enclosure front cover—not the live parts within the equipment.

(1) Depth of Working Space. The depth of working space cannot be less than the distances contained in Table 110.26(A)(1). ►Figure 110-16



►Figure 110-16

Depth of working space must be measured from **exposed live parts** or the enclosure **front cover**. ►Figure 110-17



►Figure 110-17



Working space rules apply to both ac or dc voltages.

Analysis: The ac or dc voltage ranges were added to Table 110.26(A)(1) to clarify that regardless of the type of voltage, the working space distances contained in Table 110.26(A)(1) apply.

Table 110.26(A)(1) Working Space

Voltage to Ground	Condition 1	Condition 2	Condition 3
0–150 Vac or Vdc	3 ft	3 ft	3 ft
151–600 Vac or Vdc	3 ft	3½ ft	4 ft
601–1000 Vac 601–1500 Vdc	3 ft	4 ft	5 ft

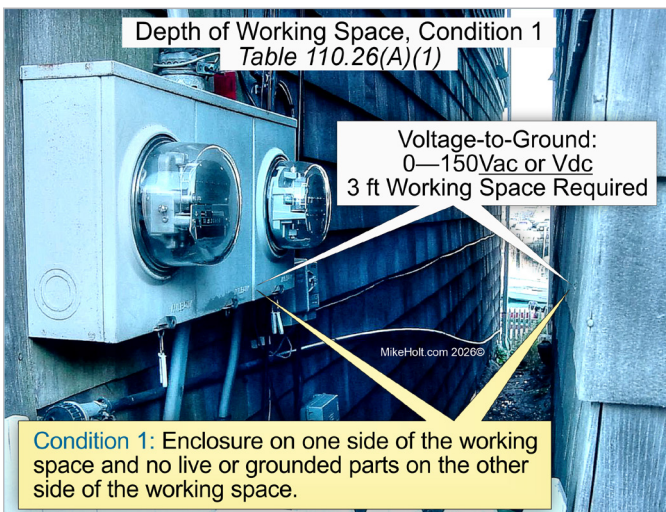
►Figure 110-18, ►Figure 110-19, and ►Figure 110-20

Table Notes:

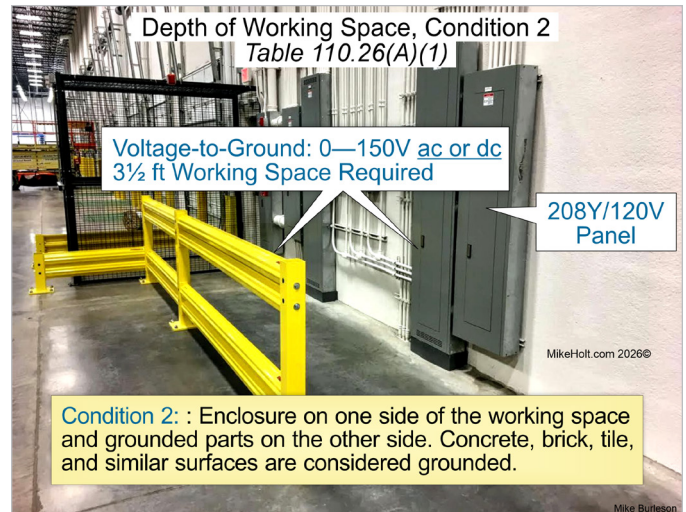
Condition 1: Enclosure (enclosed live parts) on one side of the working space and no live or grounded parts on the other side of the working space.

Condition 2: Enclosure (enclosed live parts) on one side of the working space and grounded parts on the other side. Concrete, brick, tile, and similar surfaces are considered grounded.

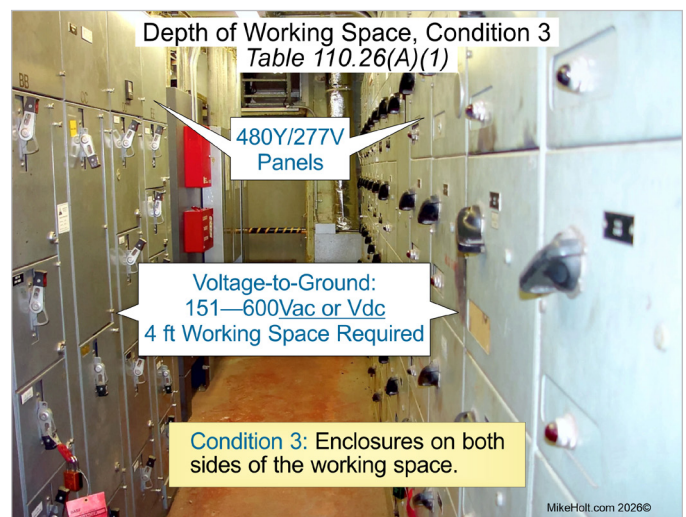
Condition 3: Enclosures (enclosed live parts) on both sides of the working space.



►Figure 110-18



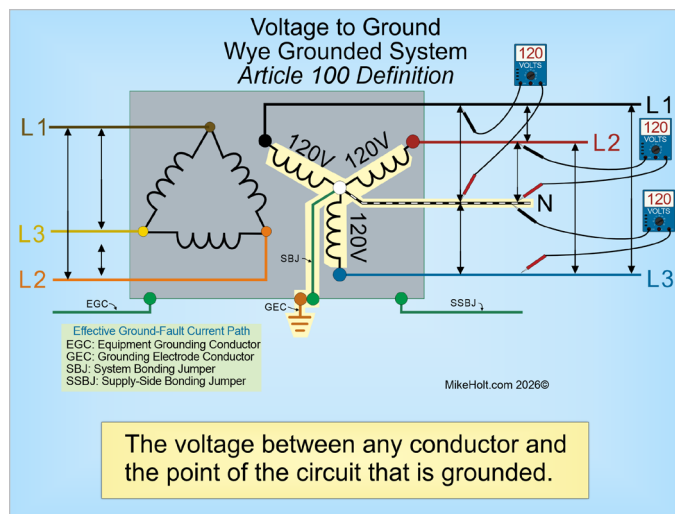
►Figure 110-19



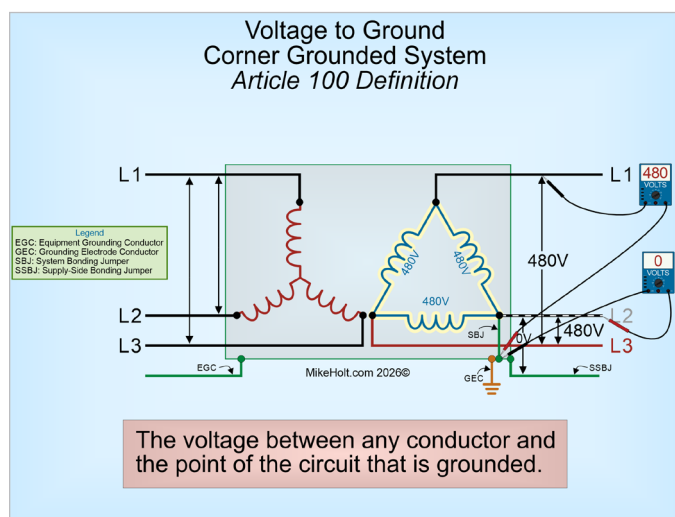
►Figure 110-20

Voltage to Ground. For grounded systems, the voltage to ground is the voltage between any conductor and the point of the circuit that is grounded. ►Figure 110-21, ►Figure 110-22, and ►Figure 110-23

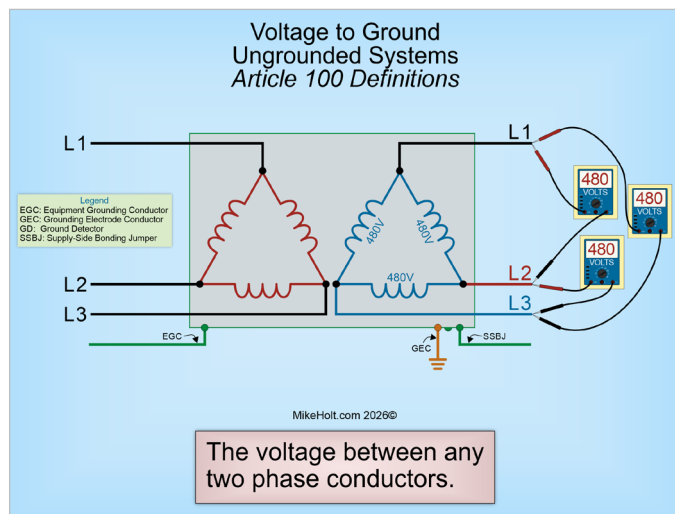
(a) Rear and Sides of Dead-Front Equipment. Working space is not required at the back or sides of equipment where all connections and renewable, adjustable, or serviceable parts are accessible from the front. ►Figure 110-24



►Figure 110-21



►Figure 110-22



►Figure 110-23



►Figure 110-24

Author's Comment:

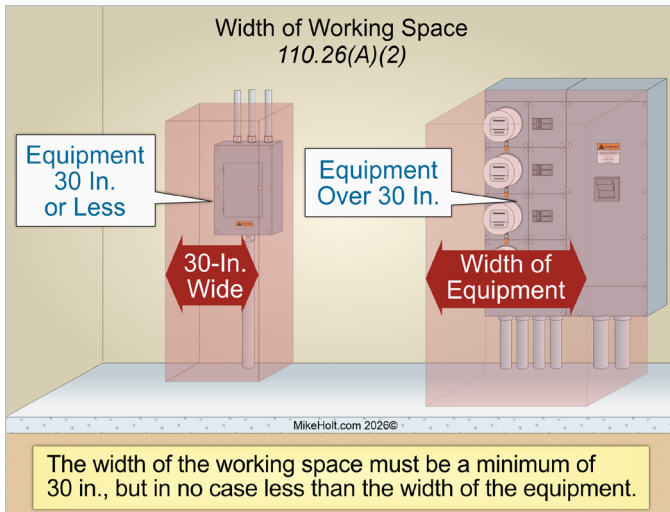
- Sections of equipment that require rear or side access to make field connections must be marked by the manufacturer on the front of the equipment. See 408.18(C).

(c) Existing Buildings. If electrical equipment is being replaced, Condition 2 working space dimensions are permitted instead of Condition 3 dimensions between dead-front switchboards or panelboards, only authorized or qualified persons will service the installation. These panelboards are 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.

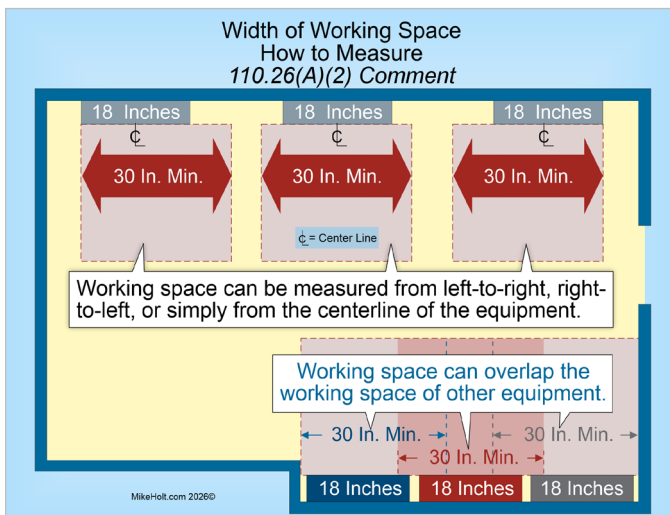
(2) Width of Working Space. The width of the working space must be a minimum of 30 in., but in no case less than the width of the equipment. ►Figure 110-25

Author's Comment:

- The width of the working space can be measured from left-to-right, right-to-left, or the centerline on the equipment. It can overlap the working space for other electrical equipment. ►Figure 110-26 and ►Figure 110-27



►Figure 110-25

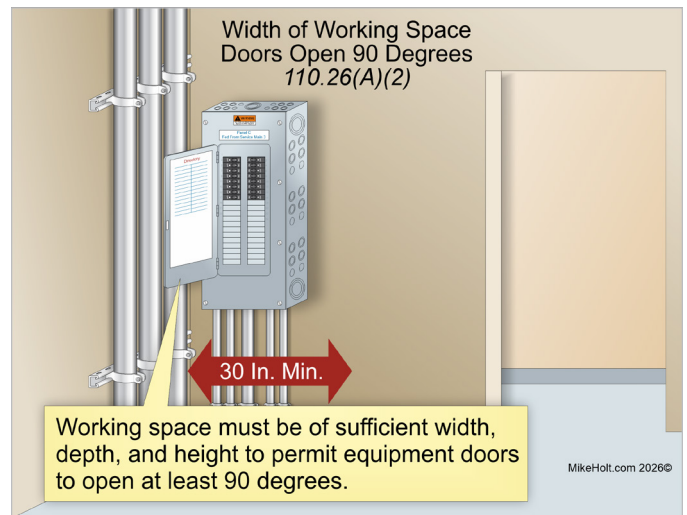


►Figure 110-26



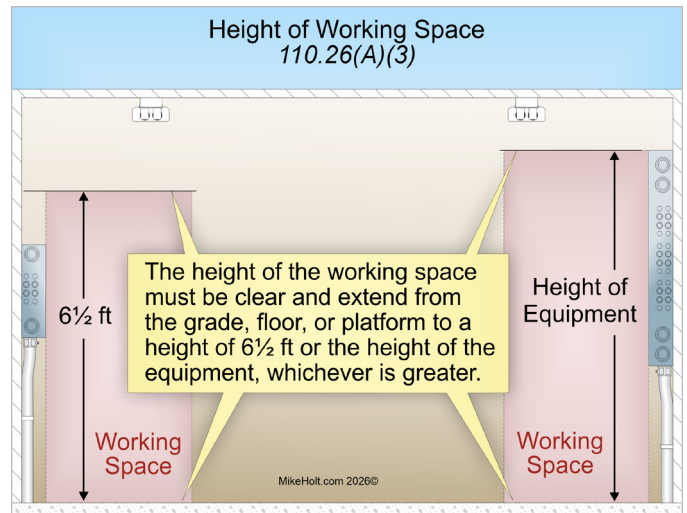
►Figure 110-27

The working space must be of sufficient width, depth, and height to permit equipment doors to open at least 90 degrees. ►Figure 110-28



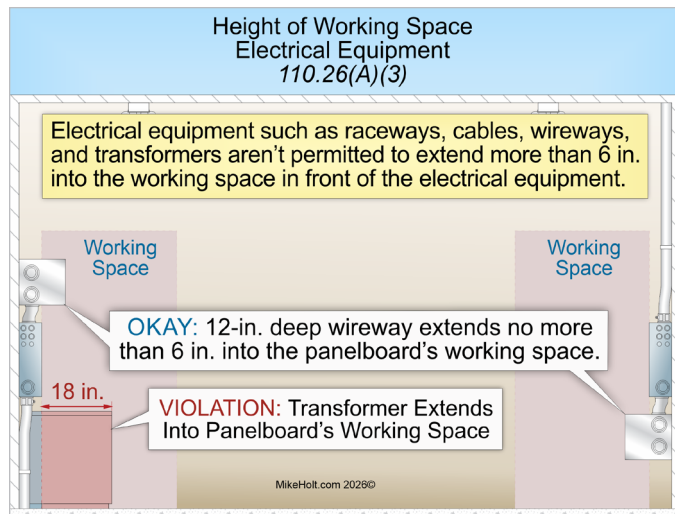
►Figure 110-28

(3) Height of Working Space. The height of the working space must be clear and extend from the grade, floor, or platform to a height of 6½ ft or the height of the equipment, whichever is greater. ►Figure 110-29



►Figure 110-29

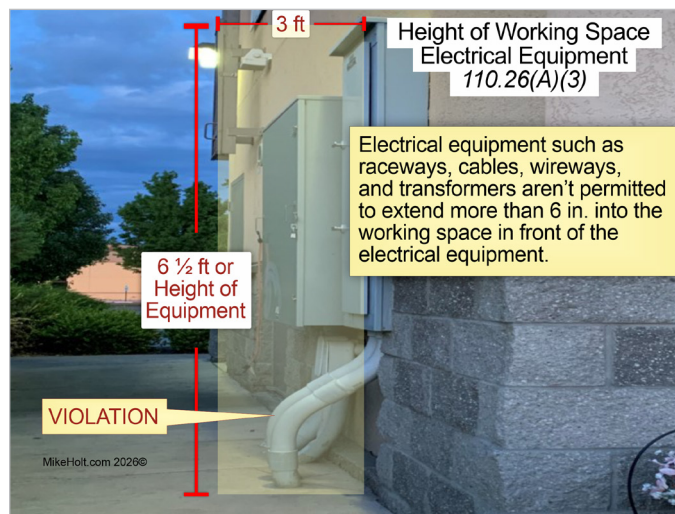
Electrical equipment such as raceways, cables, wireways, transformers, and support structures (including concrete pads) is not permitted to extend more than 6 in. into the working space in front of the electrical equipment. ►Figure 110-30, ►Figure 110-31, and ►Figure 110-32



►Figure 110-30



►Figure 110-31



►Figure 110-32

Ex 2: The minimum height of working space does not apply to a service disconnect or panelboards (rated 200A or less) in an existing dwelling unit where the height of the working space is less than 6½ ft.

Ex 3: Meters are permitted to be in the required working space but must also maintain the clearance requirements of this Code section.

(4) Limited Access. Where equipment is likely to require examination, adjustment, servicing, or maintenance while energized, and is located above a suspended ceiling or crawl space, all the following conditions apply:

(1) Suspended Ceiling and Crawl Space.

Suspended Ceiling. Equipment above a suspended ceiling must have an access opening not smaller than 22 in. × 22 in.

Crawl Space. Equipment installed in a crawl space must have an accessible opening not smaller than 22 in. × 30 in.

- (2) The width of the working space must be a minimum of 30 in., but in no case be less than the width of the equipment
- (3) The working space must permit equipment doors to open 90 degrees
- (4) The working space in front of equipment must comply with the depth requirements of Table 110.26(A)(1), and be unobstructed to the floor by fixed cabinets, walls, or partitions; horizontal ceiling structural members are permitted in this space, provided the location of weight-bearing structural members does not result in a side reach of more than 6 in. to work within the enclosure

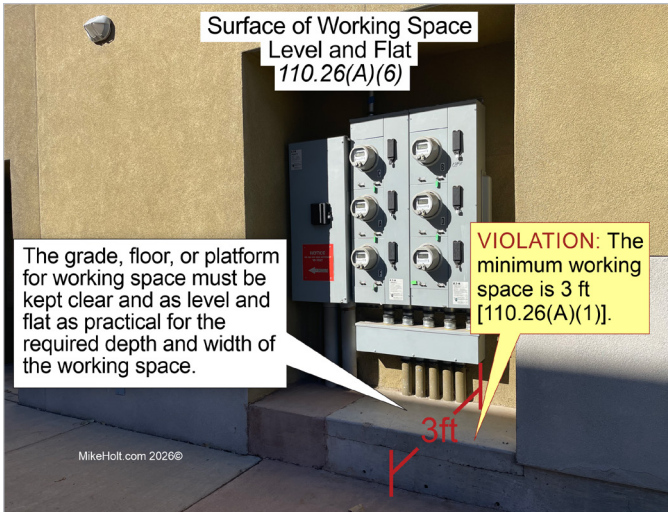
Author's Comment:

- The requirements of 110.26(A)(4) are applicable to installations (such as duct heaters and fan coil units) above the suspended ceiling where workers are using ladders and workspace is usually limited.

(6) Grade, Floor, or Working Platform. The grade, floor, or platform within the working space must be kept clear and as level and flat as practical for the required depth and width of the working space.

►Figure 110-33 and ►Figure 110-34

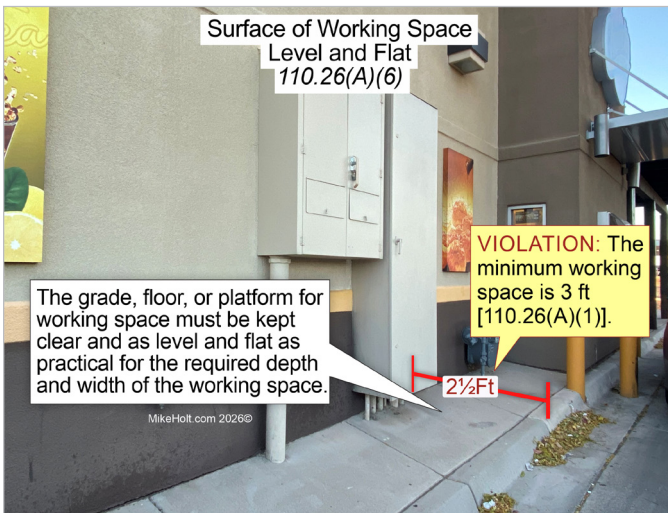
(B) Clear Working Space. The working space must be clear at all times and not used for storage. ►Figure 110-35 and ►Figure 110-36



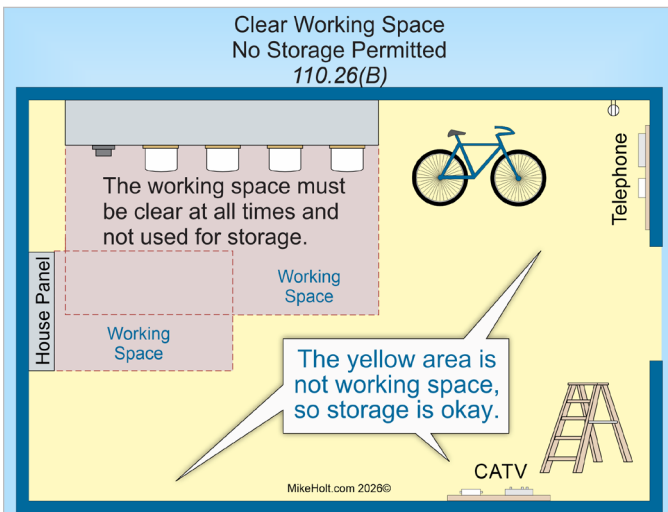
►Figure 110-33



►Figure 110-36



►Figure 110-34



►Figure 110-35

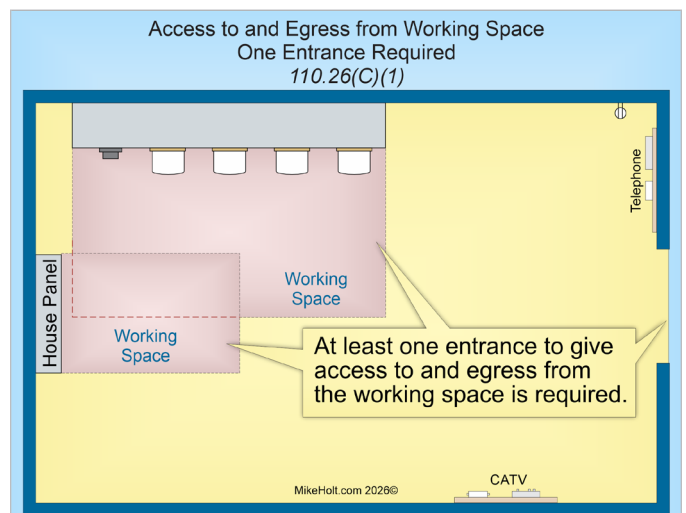
Caution



CAUTION: It is extremely dangerous to service energized parts in the first place, and unacceptable to subject oneself to additional dangers by working around bicycles, boxes, crates, appliances, and other impediments.

(C) Entrance to and Egress from Working Space.

(1) Minimum Required. At least one entrance to give access to and egress from the working space is required. ►Figure 110-37

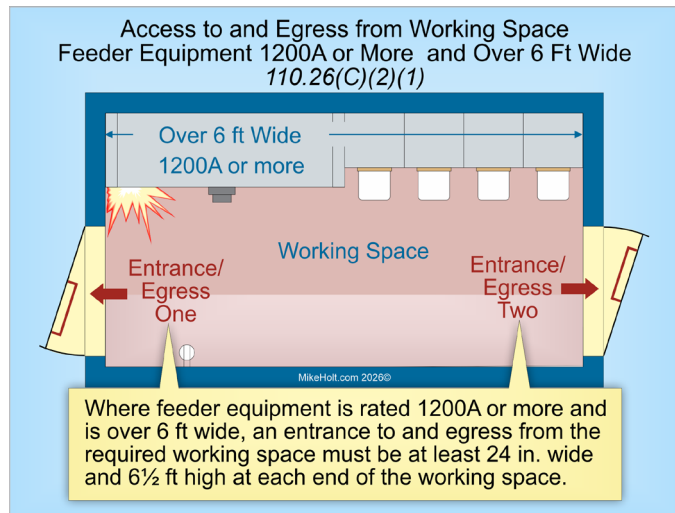


►Figure 110-37

(2) Large Equipment.

Two Egresses. For equipment containing overcurrent protection devices, switching devices, or control devices, an entrance to and egress from the required working space must be at least 24 in. wide and 6½ ft high at each end of the working space. This requirement applies to either of the following conditions:

- (1) Where feeder equipment is rated 1200A or more, and is over 6 ft wide ▶**Figure 110-38**

▶**Figure 110-38**

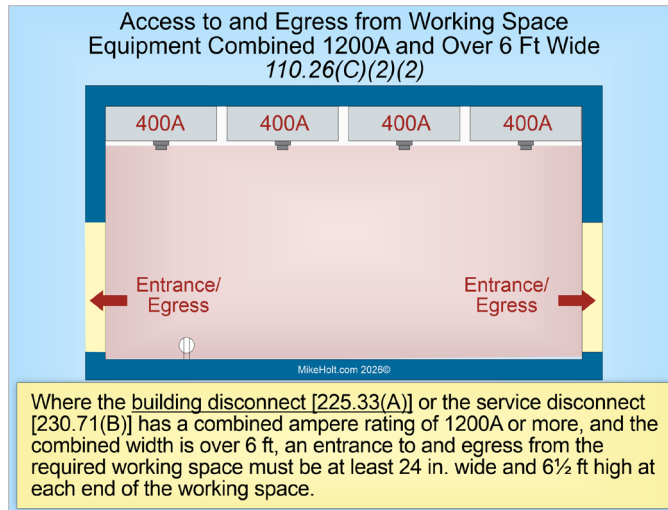
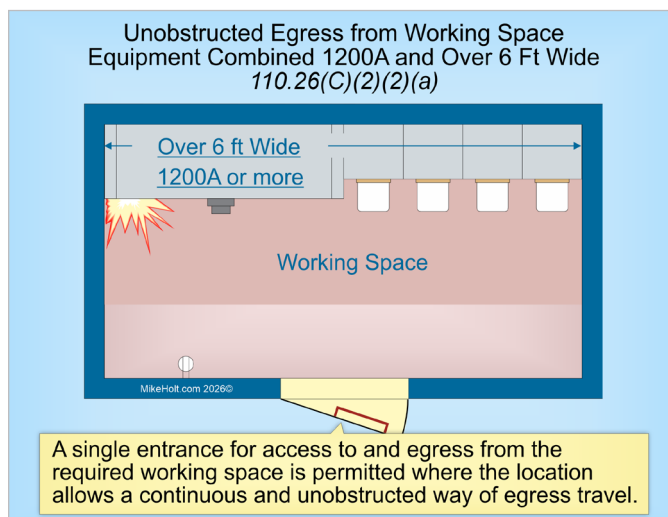
Working space requirements for outside feeder building disconnects were added.

Analysis: A reference to 225.33(A) was added for feeder disconnects supplying the building with a combined rating of 1200A or more and a combined width of 6 ft or more, requiring an entrance to and egress from each end of the working space. Without a second egress, a worker could become trapped between large pieces of equipment. This is a great change for safety!

- (2) Where the building disconnect [225.33(A)] or the service disconnect [230.71(B)] has a combined ampere rating of 1200A or more, and the combined width is over 6 ft ▶**Figure 110-39**

Single Egress. A single entrance for access to and egress from the required working space is permitted where either of the following conditions is met:

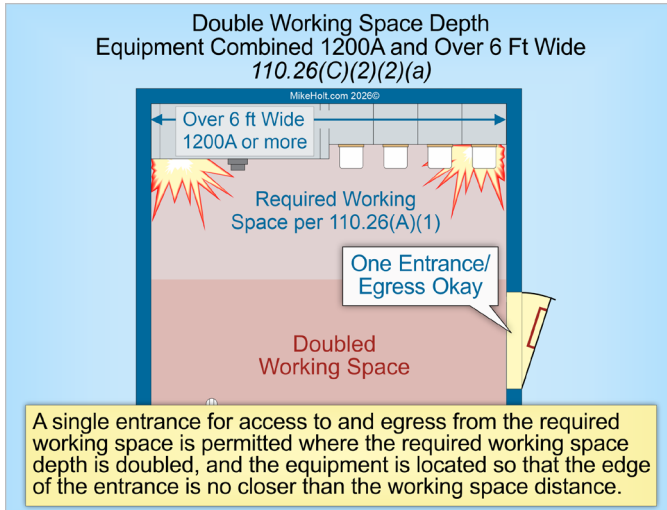
- (a) **Unobstructed Egress.** The location permits a continuous and unobstructed way of egress travel. ▶**Figure 110-40**

▶**Figure 110-39**▶**Figure 110-40**

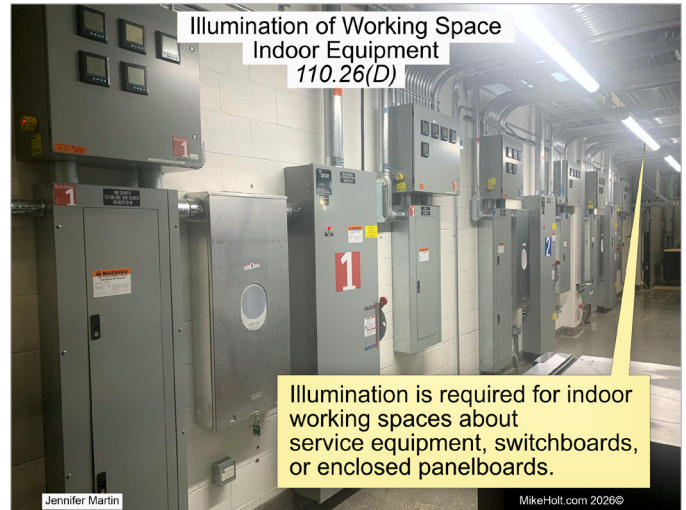
- (b) **Double Working Space.** The required working space depth is doubled, and the equipment is located so that the edge of the entrance is no closer than the minimum distance required by 110.26(A)(1).

▶**Figure 110-41**

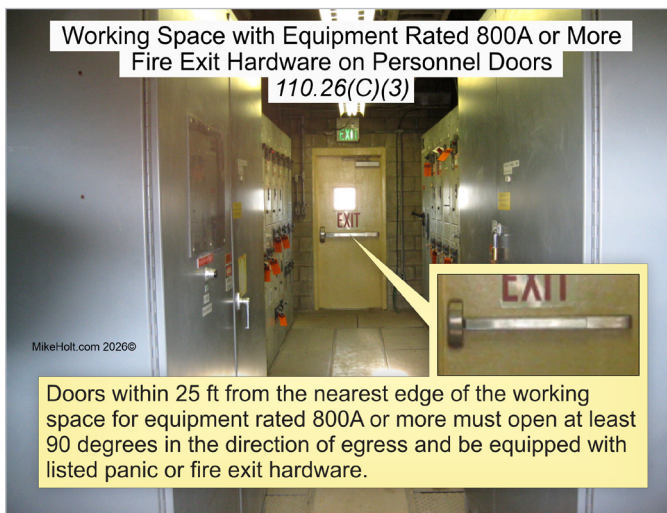
- (3) **Fire Exit Hardware on Personnel Doors.** Where equipment rated 800A or more contains overcurrent protection devices, switching devices, or control devices is installed, and there are personnel doors intended for entrance to and egress from the working space less than 25 ft from the nearest edge of the working space, the doors are required to open at least 90 degrees in the direction of egress and be equipped with listed panic or listed fire exit hardware. ▶**Figure 110-42**



►Figure 110-41



►Figure 110-43



►Figure 110-42

Author's Comment:

- Electricians who have suffered burns on their hands in arc-flash or arc-blast events often struggle to open doors equipped with knobs that must be turned or that must be pulled open. Because this requirement is in the *NEC*, electrical contractors are responsible for ensuring panic hardware or listed fire exit hardware is installed where required, allowing doors to be pressed and open outward toward egress.

(D) Illumination for Working Space.

Working Space Indoors. Illumination is required for indoor working spaces about service equipment, switchboards, or enclosed panelboards. ►Figure 110-43



It was clarified that automatic control of all “luminaires” for the working space illumination is not permitted.

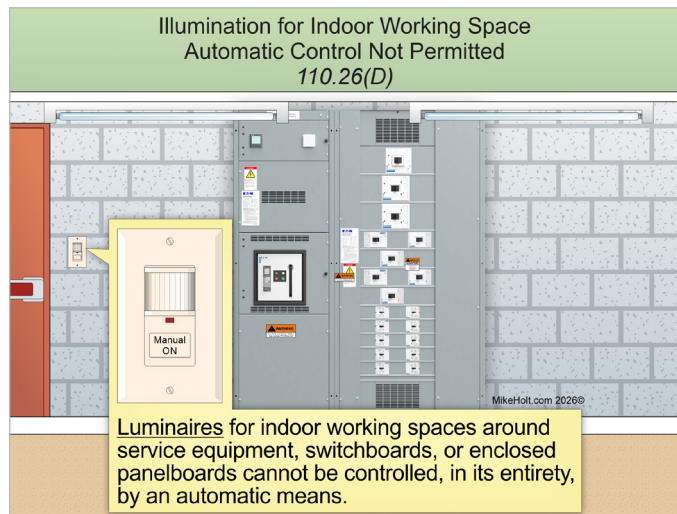
Analysis: The revised wording improves clarity by specifying that the required control applies to the luminaires themselves, rather than implying control over the illumination of the working space. This change ensures that the focus is on switching the luminaire on or off—not regulating the light level in the area it serves.

Automatic Means Not Permitted. Luminaires for indoor working spaces around service equipment, switchboards, or enclosed panelboards cannot be controlled, in its entirety, by an automatic means.

►Figure 110-44

Author's Comment:

- The *Code* does not identify the minimum foot-candles required to provide proper illumination. However, it is essential in electrical equipment rooms for the safety of those qualified to work on such equipment.



►Figure 110-44

110.29 In Sight From (Within Sight From, Within Sight)



Changes clarify how to apply the term, “Within Sight” for other than equipment.

Analysis: This section now includes “buildings or structures” to clarify that “within sight” can include references to buildings or structures—not just equipment. The 2023 *NEC* text only recognized equipment that was within sight of other equipment.

Where this *Code* specifies that equipment must be “in sight from,” “within sight from,” or “within sight of” a building or structure or other equipment, the specified equipment must be visible and not more than 50 ft from the building, structure, or other equipment.