

TechTopics No. 79

Working space required around electrical equipment

This issue of TechTopics discusses the depth of working space (or clearance) required around electrical equipment as specified in the National Electrical Code® (NEC®), NFPA 70® for purposes of maintenance and examination. The information in this issue is based on the 2011 edition of the NEC.

The requirements for working space are primarily contained in NEC Articles 110.26 (for low voltage) and 110.34 (for high voltage). Since the two sections are mostly similar, we will consolidate our discussion.

The NEC uses the expression “clear distance,” which means that the working space cannot be used for other purposes, such as storage. When a person needs to work on the equipment, the person must not be impeded by extraneous items in the working space area. Often there are auxiliary devices or systems around the switchgear (for example, panelboards, battery systems, tool cabinets), and such items must be moved away from the NEC clear working space, or the working space must be increased to allow for the required clear working space between the switchgear and the auxiliary devices or systems.

Table 1 is a composite of the essential information in NEC tables 110.26(A)(1) and 110.34(A). The table shows required minimum clear distances. These distances are measured from the (potentially) exposed live parts (if not enclosed), or from the opening of the enclosure when the parts are inside an enclosure.

Thus, even though the live parts might be some significant distance back from the enclosure opening, this distance is ignored when determining the required clear distance. In the case of metal-enclosed or metal-clad switchgear, the distance is measured from the front of the switchgear or from the rear of the switchgear, as applicable.

There is often confusion about which “condition” shown in the table applies.

Condition one covers installations in which the wall or other equipment located directly across from the equipment being considered is insulated, with no grounded or live parts exposed. This condition is pretty rare, so is seldom applicable.

Condition two is the condition in which the wall or other equipment directly across from the equipment being considered is grounded (as with equipment in a power equipment center outdoor enclosure, or with an ordinary wall across from the equipment front) or does not have exposed live parts. Concrete or masonry walls are considered as grounded surfaces. Condition two is probably the most common condition.

Condition three covers installations with electrical equipment located on both sides of the working space. Condition three is applicable for “common-aisle” installations, where two groups of equipment face each other. It would also apply in a situation where the front of one group of equipment faces the rear of a second group of equipment.

Condition three requires more distance than condition two, at least in part due to the reduced working space when doors of the facing groups are open. If two groups of equipment face each other, and each has hinged doors that can open 135°, then these doors can reduce the working space available.

For example, assume 13.8 kV switchgear, with 36” (0.9 m) wide doors opened to their full open position, approximately 135°. The open door extends slightly over 25” (0.635 m) into the working space. If the required clear distance from Table 1 is 72” (1.8 m), and over 25” (0.635 m) is occupied by an open door, then the “real” working space is less than 47” (1.2 m) (72”-25”) (1.8 m-0.635 m), which is less than the distance required for condition two (60”) (1.5 m) that is presumably a less severe condition. Thus, a user considering use of condition three may also wish to increase the working space above that required by the NEC to compensate for working space that may be impeded by open doors.

Table 1: Working spaces

Nominal voltage phase-ground	Common system voltages phase-phase ⁴	Minimum clear distance ²		
		Condition one ¹	Condition two ¹	Condition three ¹
0 - 150	120 ³ , 120/240 ³ , 208Y; 240Δ	36" (0.9 m)	36" (0.9 m)	36" (0.9 m)
151 - 600	480 (Δ or Y) 600 (Δ or Y)	36" (0.9 m)	42" (1.07 m)	48" (1.22 m)
601 - 2,500	2,400 (Δ or Y) 4,160 (Δ or Y)	36" (0.9 m)	48" (1.2 m)	60" (1.5 m)
2,501 - 9,000	4,800Δ 6,900 (Δ or Y) 7,200 (Δ or Y) 12,000Δ 12,470Y 13,200 (Δ or Y) 13,800 (Δ or Y)	48" (1.2 m)	60" (1.5 m)	72" (1.8 m)
9,001 - 25,000	24,000Δ 26,400Δ 34,500Δ or Y	60" (1.5 m)	72" (1.8 m)	108" (2.8 m)

Footnotes:

¹ Description of conditions:

- Condition one: exposed live parts on one side of the working space; parts on other side are not live or grounded, or are guarded by insulating materials.
- Condition two: exposed live parts on one side of the working space; grounded parts on the other side.
- Condition three: exposed live parts on both sides of working space.

² Distances are measured from exposed live parts, or from the enclosure or from the opening if the parts are enclosed.

³ Single phase.

⁴ Assumes normally balanced system voltages with phase-phase voltage essentially equal to phase-ground voltage times 1.73.

Alternatively, the user may wish to implement procedures that prohibit opening doors or compartments on one side of the working space when doors or compartments on the other side of the working space are also open.

In earlier days, users often were concerned only with working space in front of equipment. However, with changes in regulations and the NEC, working space requirements also apply to the rear of the equipment when there is need to maintain or examine live parts at the rear of the equipment. In the earlier days, it was considered that the equipment should not be opened for maintenance or examination unless the equipment was de-energized.

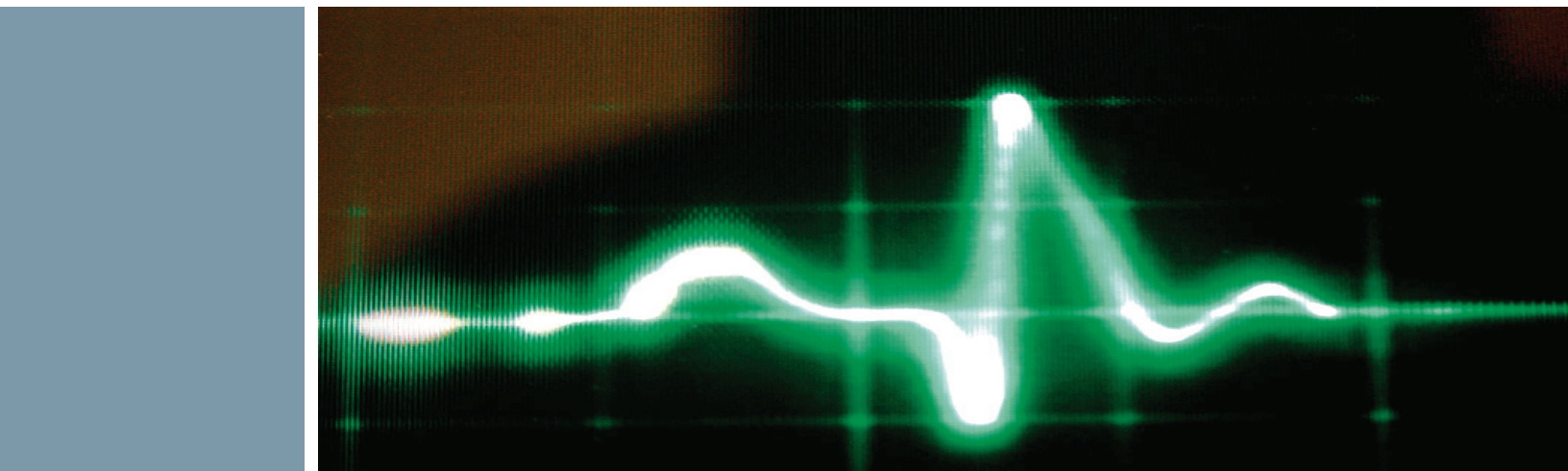
However, Occupational Safety and Health Administration and NPFA 70E® (Standard for Electrical Safety in the Workplace) now are premised on the concept that parts must be considered as being energized until it is proven that they are not energized.

NFPA 70E Article 120 provides the steps to achieving an "electrically safe work condition" as (in brief):

1. Determine all possible sources of electrical energy
2. Switch "off" each source using a disconnect device
3. Visually verify disconnects are fully open, or that drawout type devices are in the fully withdrawn position
4. Test for the presence of voltage
5. Ground the phase conductors with grounding equipment rated for the available fault duty.

These steps make it clear that conductors must be treated as if they are live parts (energized parts) until they are proven otherwise.

The NEC is enforced by the Authority Having Jurisdiction (AHJ), defined in NEC Article 90 as the organization responsible for enforcing the requirements of the NEC. This is usually the local or state electrical inspection agency for the particular site. The AHJ has great latitude in interpreting the requirements of the NEC, and enforcement of the code varies significantly from one jurisdiction to another. Thus, the user should always consult with the local AHJ before arriving at firm conclusions on requirements for installations, including issues of working space.



This discussion deals with the working space required to perform operations or examine the equipment, or to perform maintenance. It does not deal with the issue of clearances required around equipment from sides that are not required to be accessible for maintenance.

For example, if the manufacturer requires that the side of the equipment can be located a certain distance (for example, 6" (15 cm)) from the nearest wall, the NEC rules would not apply unless there is some maintenance operation or examination that would have to be performed at that side of the equipment. In simple terms, the NEC requirements for clear working space only apply to areas where work needs to be performed.

This article is intended for informational purposes only and is not meant to be a comprehensive summary of the requirements and specifications set forth in the NEC (NFPA 70). Equipment owners are solely responsible for ensuring safe working environments and compliance with regulations. Those responsible for design of facilities must comply with the clear working space requirements around equipment in the most current version of the NEC (NFPA 70) applicable to the installation.

The information provided in this document contains merely general descriptions or characteristics of performance which in case of actual use do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract.

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Siemens Industry, Inc.
7000 Siemens Road
Wendell, NC 27591

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For more information, contact: +1 (800) 347-6659

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