

APPLICATION NOTE

# How to use the new arc-flash PPE tables in 2015 edition NFPA 70E

by Jim White, Shermco Industries

A number of changes have been made to the tables used to select arc-rated clothing and PPE in the 2015 edition of NFPA 70E *Standard for Electrical Safety in the Workplace*. Since the 2000 edition of NFPA 70E the task tables have been both a boon and a bane. They were a boon, because in the absence of an incident energy analysis the tables were often the only method available to choose arc-rated clothing and PPE. They were a bane, because they were difficult to use in the field and reduced the Hazard/Risk Category (HRC) number by 1, 2 or 3 numbers based on perceived risk.



It needs to be stated clearly that the table method is used if an incident energy analysis has not been conducted. If an incident energy analysis has been performed the actual incident energy exposure to the worker is calculated and an arc flash hazard warning label is applied to the equipment. Table H.3(B) in Annex H should be consulted when an incident energy analysis has been performed on a specific piece of equipment.

Table 130.7(C)(15)(A)(a) and Table 130.7(C)(15)(A)(b) in the 2015 edition of NFPA 70E represent a “clean sheet” approach that eliminates many of the shortcomings of the old table method, and also provides better safety for those following it.

High level summary of the guidelines:

- Does the level of risk associated with the task mandate PPE or does it depend on the job site conditions?
- Verify that conditions have been met for using the table method and that the estimated limits are not being exceeded.
- Use the table to determine the appropriate level of arc-rated clothing, PPE and non-arc-rated PPE for the task.
  - There are no more HRCs (Hazard/Risk Categories). They have been replaced by arc flash PPE categories
  - There is no arc flash PPE category 0 in the table method

## If you’re going to use it, use it correctly

Figure 1 shows Table 130.7(C)(15)(A)(a) “Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems”. This table is very similar to the table found in 29CFR1910.269, Appendix E “Protection from Flames and Electric Arcs.”

There are some tasks that always present a high risk of injury and these are noted in Table 130.7(C)(15)(A)(a), such as inserting or removing (racking) a circuit breaker or for the task of voltage testing. Arc-rated clothing and PPE are always required for these tasks. For many of the other tasks though, the use of arc-rated clothing and PPE may not be mandated.

The word “mandated” is used deliberately, as the table states “Arc Flash PPE Required.” In other words, arc-rated PPE may still be required for safe practices, even if it is not mandated by the table method.

- If the worker about to perform the task can say with certainty that all of the conditions have been met in the column marked “Equipment Conditions,” then arc-rated clothing and PPE are not mandated by the table method.
- If it cannot be stated with certainty that all of the conditions have been met, arc-rated clothing and PPE are mandated.

The condition of maintenance on the equipment is a common reason for PPE and arc-rated clothing to be required for a job. In large industrial facilities where there are electrical engineers and maintenance workers, condition of maintenance may not be an issue, but for smaller industrial facilities and for many commercial sites it can be. If there is any question about the condition of maintenance, the worker is automatically required to wear the PPE specified.

As an example, the task titled “Normal operation of a circuit breaker (CB), switch, contactor, or starter” is one used by many workers. If the equipment is properly installed, properly maintained, equipment doors and panel covers are in place and secured and there is no evidence of impending failure, no arc-rated clothing or PPE is “mandated.” The note attached to the table states:

“The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.”

Two key aspects to this note:

- First, the committee states that it cannot possibly know the extent of the risks posed by the specific piece of equipment that is about to be worked on. It is up to the technician to assess the equipment’s condition and whether the table method will adequately protect him or her.
- Another is the phrase “not likely.” “Not likely” does not mean that an arc flash won’t occur, nor does it mean that the table method can be used regardless of other conditions that may be present. “Not likely” means that the risk of an arc flash is considered low if all the conditions in the table are met. This also means observing the limits of use for the table method. Those limits of use are specified in Table 130.7(C)(15)(A)(b) “Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems,” shown as Figure 2.

Task	Equipment Condition	Arc flash PPE required
Perform infrared thermography and other noncontact inspections outside the restricted approach boundary	Any	No
Reading a panel meter while operating a meter switch	Any	No
Normal operation of a circuit breaker (CB), switch, contactor, or starter	All of the following: <ul style="list-style-type: none"> <li>• The equipment is properly installed</li> <li>• The equipment is properly maintained</li> <li>• All equipment doors are closed and secured</li> <li>• All equipment covers are in place and secured</li> <li>• There is no evidence of impending failure</li> </ul>	No
	One or more of the following: <ul style="list-style-type: none"> <li>• The equipment is not properly installed</li> <li>• The equipment is not properly maintained</li> <li>• Equipment doors are open or not secured</li> <li>• Equipment covers are off or not secured</li> <li>• There is evidence of impending failure</li> </ul>	Yes

**Figure 1.** Table 130.7(C)(15)(A)(a) provides some assistance in risk assessment. Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems.

A worker has to assess all factors involved with the equipment and task about to be performed.

- Operating a 40 A circuit breaker in a 480 V lighting panel probably does not present an increased risk of injury due to an arc flash. [The panel cover will probably contain most, if not all of the arc and whatever small amount of blast may be created.
- It would be advisable to wear cotton clothing, leather gloves, hearing protection and UV-rated safety glasses in the unlikely event that a projectile or molten metal could escape the cover.
- If operating a larger frame circuit breaker, especially anything with a frame size of 600A or greater it would be advisable to wear arc-rated clothing and PPE. It is not mandated by the table method, but if the circuit breaker did fail the consequences would far outweigh any consideration given to comfort. A few minutes of discomfort in an arc-rated flash suit and hood is much better than undergoing the pain and suffering of a large-scale burn, not matter how unlikely it may be.

**Table 130.7(C)(15)(A)(b)**

Table 130.7(C)(15)(A)(b) specifies the type of equipment, the parameters (or limitations of the table method), the working distance, the arc flash PPE category and the arc flash boundary. In order to use this table, Section 130.7(C)(15)(A) must be met. Section 130.7(C)(15)(A) states “An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

For conditions 1 through 4 the table method cannot be used. Too many workers attempt to use the table method without consideration of the limits on its use imposed by the NFPA 70E committee. The table method can only be used on lower energy electrical power systems and is not suitable for higher-energy systems. Misuse of the table method will cause serious injury or even death if an arc flash were to occur.

Equipment	Equipment Condition	Arc flash PPE required
Panelboards or other equipment rated 240 V and below Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 18 inches	1	600 mm (19 in)
Panelboards or other equipment rated > 240 V and up to 600 V Parameters: Maximum Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 18 inches	2	900 mm (3 ft)

Figure 2  
Table 130.7(C)(15)(A)(b), (Partial)  
Arc Flash Hazard PPE Categories for Alternating Current (ac) Systems  
From 2015 Edition of NFPA 70E

**Table 130.7(C)(16)**

Once it has been verified that the conditions have been met for using the table method and that the estimated limits are not being exceeded, Table 130.7(C)(16), shown as Figure 3 can be used to determine the appropriate arc-rated clothing, PPE and non-arc-rated PPE for the task.

Table 130.7(C)(16) is mostly unchanged from the 2012 edition of NFPA 70E, except there are no more HRCs (Hazard/Risk Categories). They have been replaced by arc flash PPE categories.

Also, note that there is no arc flash PPE category 0 in the table method, as the new table method only identifies arc-rated clothing and PPE, and HRC 0 specified cotton clothing. Cotton clothing worn as underlayers is still required by Section 130.7(C)(9)(a) "Layering" and 130.7(C)(9)(c) "Underlayers," but is no longer mentioned in the table method.

**Summary**

The new table method should prove to be easier to implement in the field and should also allow additional flexibility for those workers using it. It should also prove to be safer, as there are no reductions in PPE category number based on the perceived risk of the task. If arc flash PPE is mandated by the table method, full arc protection is specified.

Another aspect of the new table method that enhances worker safety is the fact that if any of the specified conditions are not met, arc-rated clothing and PPE are mandated.

Companies should train their qualified workers on how to properly use the new table method and ensure each of them demonstrate proficiency in its use. Reference Section 110.2(D) (3): "Retraining in safety-related work practices and applicable changes in this standard shall be performed at intervals not to exceed three years." This is not refresher training, but retraining that covers changes to the current edition of NFPA 70E, changes to a company's work rules and other safety-related information that may need to be provided.

Another important point is that the new arc flash PPE categories (PPE Category) are equivalent to the old HRC's. Arc-rated clothing or PPE with an HRC 2 rating will have the same characteristics as the new PPE Category 2.

**3-Step Method to Use NFPA 70E Table Method**

**Step 1—Determine the requirement for arc-rated clothing and PPE for a listed task**

- If task is not listed in Table 130.7(C)(15)(A)(a) the table method cannot be used
- If ALL conditions in the second column are met, arc-rated clothing and PPE are not required by the table method
  - Even if arc-rated clothing and PPE are not required, it may be advisable to use
- If ANY of the conditions in the second column are not met, arc-rated clothing and PPE are required
- If arc-rated clothing and PPE are required, proceed to Table 130.7(C)(15)(A)(b)

PPE Category	PPE
1	<p><b>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm<sup>2</sup> (see Note 1)</b>                      Arc-rated long-sleeve shirt and pants or arc-rated coverall                      Arc-rated face shield (see Note 2) or arc flash suit hood                      Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p style="text-align: center;"><b>Protective Equipment</b></p> <p style="text-align: center;">Hard hat                      Safety glasses or safety goggles (SR)                      Hearing protection (ear canal inserts)                      Heavy duty leather gloves (see Note 3)                      Leather footwear (AN)</p>
2	<p><b>Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm<sup>2</sup> (see Note 1)</b>                      Arc-rated long-sleeve shirt and pants or arc-rated coverall                      Arc-rated flash suit hood or arc-rated face shield (see Note 2) and arc-rated balaclava                      Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p style="text-align: center;"><b>Protective Equipment</b></p> <p style="text-align: center;">Hard hat                      Safety glasses or safety goggles (SR)                      Hearing protection (ear canal inserts)                      Heavy duty leather gloves (see Note 3)                      Leather footwear</p>

Table 130.7(C)(16) (Partial)  
 Personal Protective Equipment (PPE)  
 From 2015 Edition of NFPA 70E

Task	Equipment Condition*	Arc flash PPE required
Perform infrared thermography and other noncontact inspections outside the restricted approach boundary	Any	No
Reading a panel meter while operating a meter switch	Any	No
Normal operation of a circuit breaker (CB), switch, contactor, or starter	All of the following: <ul style="list-style-type: none"> <li>• The equipment is properly installed</li> <li>• The equipment is properly maintained</li> <li>• All equipment doors are closed and secured</li> <li>• All equipment covers are in place and secured</li> <li>• There is no evidence of impending failure</li> </ul>	No
	One or more of the following: <ul style="list-style-type: none"> <li>• The equipment is not properly installed</li> <li>• The equipment is not properly maintained</li> <li>• Equipment doors are open or not secured</li> <li>• Equipment covers are off or not secured</li> <li>• There is evidence of impending failure</li> </ul>	Yes

Table 130.7(C)(15)(A)(a)

**Step 2—Determine arc-flash PPE category**

- As an example, the task will be performed on a 480 V panelboard
- Estimate the available short circuit current and operating time of the overcurrent protective device (OCPD)
  - Available short circuit current and operating time of the OCPD are being estimated. If unable to determine either of these, defer the work until they can be estimated with confidence
- Ensure the limitations of Table 130.7(C)(15)(A)(b) are not exceeded
- Note working distance (18”) and arc flash boundary (3’) in the example
  - Always be aware of body position when working within the restricted approach boundary. As distance to the potential arc source decreases, incident energy increases rapidly (by the square of the distance)
  - Set up safety barriers, signs or attendants as needed (Section 130.7(E) “Alerting Techniques”)
- Proceed to Table 130.7(C)(16)

Equipment	Arc flash PPE category	Arc-flash boundary
Panelboards or other equipment rated 240 V and below Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 18 inches	1	600 mm (19 in)
Panelboards or other equipment rated > 240 V and up to 600 V Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 18 inches	2	900 mm (3 ft)

Table 130.7(C)(15)(A)(b)

**Step 3—Choose arc-rated clothing and PPE and non-arc-rated PPE using Table 130.7(C)(16)**

- In the example shown, PPE Category 2 (old HRC 2) is required
- Wear all listed PPE listed in Table 130.7(C)(16)

PPE Category	PPE
1	<p><b>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm<sup>2</sup> (see Note 1)</b>                      Arc-rated long-sleeve shirt and pants or arc-rated coverall                      Arc-rated face shield (see Note 2) or arc flash suit hood                      Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p style="text-align: center;"><b>Protective Equipment</b></p> <p style="text-align: center;">Hard hat                      Safety glasses or safety goggles (SR)                      Hearing protection (ear canal inserts)                      Heavy duty leather gloves (see Note 3)                      Leather footwear (AN)</p>
2	<p><b>Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm<sup>2</sup> (see Note 1)</b>                      Arc-rated long-sleeve shirt and pants or arc-rated coverall                      Arc-rated flash suit hood or arc-rated face shield (see Note 2) and arc-rated balaclava                      Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p style="text-align: center;"><b>Protective Equipment</b></p> <p style="text-align: center;">Hard hat                      Safety glasses or safety goggles (SR)                      Hearing protection (ear canal inserts)                      Heavy duty leather gloves (see Note 3)                      Leather footwear</p>

Table 130.7(C)(16)

**About Jim White**

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