



Reply to the attention of:

JUL 13 2015

Titus J. Diamond, P.E.  
Flint Energies  
PO Box 6719  
Warner Robins, GA 31095-6719

Dear Mr. Diamond:

Thank you for your March 4, 2015 correspondence to the Occupational Safety and Health Administration (OSHA), Directorate of Enforcement Programs. You requested guidance concerning OSHA requirements for protective clothing and equipment in the Electric Power Generation, Transmission and Distribution Standard (29 CFR 1910.269). Your question, and our reply, follow.

**Question:** Under 29 CFR 1910.269, can an employer use Table 410-1 of the 2012 National Electrical Safety Code (NEC) to select protective clothing and equipment?<sup>1</sup>

**Response:** Paragraph (l)(8)(ii) of 29 CFR 1910.269 provides that “[f]or each employee exposed to hazards from electric arcs, the employer . . . make a reasonable estimate of the incident heat energy to which the employee would be exposed.” The employer must use that estimate for purposes of complying with requirements for protective clothing and other protective equipment (see 29 CFR 1910.269(l)(8)(v)).

Note 1 to 29 CFR 1910.269(l)(8)(ii) provides that an employer can use any method of calculating incident heat energy that reasonably predicts the incident energy to which employees would be exposed. And Appendix E to 29 CFR 1910.269 provides guidance on estimating available heat energy. In developing the guidance in Appendix E, OSHA emphasized calculation methods that are supported by testing data. While Appendix E does not specifically address Table 410-1 in the 2012 NESC, OSHA has reviewed that table and its lengthy set of explanatory notes to determine if the arc-rating values it provides for various types of equipment provide reasonable estimates of incident energy as required by 29 CFR 1910.269(l)(8)(ii).

Table 410-1 of the 2012 NESC provides values for “the effective arc rating of clothing or a clothing system to be worn by employees working on or near energized lines, parts, or equipment.” (See Rule 410.A.3.a.) The Agency has determined that many of the values listed in Table 410-1 are acceptable for compliance with 29 CFR 1910.269(l)(8)(ii) because the notes to the table make clear that those values are based either on testing data or on calculations performed using methods described in IEEE Std 1584-2002 (IEEE Guide for Performing Arc Flash Hazard Calculations). However, the 2012 NESC does not contain enough information for OSHA to evaluate the reasonableness of the values in Table 410-1 to which notes 7 and 8 to that table apply. The text of notes 7 and 8 suggest that the values to which those notes apply are not

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<sup>1</sup> Although you inquired only about OSHA’s general industry standard for electric power generation, transmission, and distribution (29 CFR 1910.269), the guidance provided in this letter also applies to the construction requirements at 29 CFR 1926.960(g)(2) and (5).

based on testing data or generally recognized calculation methods. Therefore, at this time OSHA can state only that it will accept the use of Table 410-1 in the 2012 NESC with respect to the values in that table to which notes 7 and 8 do not apply. When the employer's estimates follow this guidance, OSHA will accept arc-rated protection based on those estimates under 29 CFR 1910.269(l)(8)(v).

Thank you for your interest in occupational safety and health. We hope you find this information helpful. OSHA requirements are set by statute, standards, and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at <http://www.osha.gov>. If you have any further questions, please feel free to contact the Directorate of Enforcement Programs at (202) 693-2100.

Sincerely,



*For* Thomas Galassi, Director  
Directorate of Enforcement Programs

employee performing work in a manner that is unduly hazardous to the employee or to other workers.

B. Emergency and first aid procedures

1. Employees shall be informed of the procedures to be followed in case of emergencies and first aid including approved methods of resuscitation. Copies of such procedures should be accessible where the number of employees and the nature of the work warrants.
2. Employees working on communications or electric supply equipment or lines shall be regularly instructed in methods of first aid and emergency procedures, if their duties warrant such training.

C. Responsibility

1. A designated person shall be in charge of the operation of the equipment and lines and shall be responsible for their safe operation.
2. If more than one person is engaged in work on or about the same equipment or line, one person shall be designated as in charge of the work to be performed. Where there are separate work locations, one person may be designated at each location.

**Table 410-1—Clothing and clothing systems (cal/cm<sup>2</sup>) for voltages 50 V to 1000 V (ac)** <sup>①</sup>  
(See Rule 410A3.)

Equipment type	Nominal voltage range and cal/cm <sup>2</sup>		
	50 V to 250 V	251 V to 600 V <sup>⑭</sup>	601 V to 1000 V
Self-contained meters / cabinets	4 <sup>②</sup>	20 <sup>④</sup>	30 <sup>⑧</sup>
Pad-mounted transformers	4 <sup>⑨</sup>	4 <sup>⑨</sup>	6 <sup>⑧</sup>
CT meters and control wiring	4 <sup>②</sup>	4 <sup>⑤</sup>	6 <sup>⑧</sup>
Metal-clad switchgear / motor control centers	8 <sup>③</sup>	40 <sup>⑥</sup>	60 <sup>⑧</sup>
Pedestals / pull boxes / hand holes	4 <sup>②</sup>	8 <sup>⑦</sup>	12 <sup>⑧</sup>
Open air (includes lines)	4 <sup>②</sup>	4 <sup>⑦</sup>	6 <sup>⑧</sup>
Equipment type	Nominal voltage range and cal/cm <sup>2</sup>		
	50 V to 250 V	251 V to 600 V <sup>⑭</sup>	601 V to 1000 V
Network protectors	4 <sup>⑩</sup>	⑪	⑪
Panel boards—single phase (all) / three phase (≤100 A)	4 <sup>②</sup>	8 <sup>⑫</sup>	12 <sup>⑧</sup>
Panel boards—three phase (>100 A)	4 <sup>②</sup>	⑬	⑬

- ① This table was developed from fault testing based on equipment type and is independent of fault current unless otherwise noted.  
Calculations and test data are based on a 46 cm (18 in) separation distance from the arc to the employee. See IEEE Std 1584-2002.  
Other methods are available to estimate arc exposure values and may yield slightly different but equally acceptable results.  
The use of the table in the selection of clothing is intended to reduce the amount or degree of injury but may not prevent all burns.
- ② Industry testing on this equipment by two separate major utilities and a research institute has demonstrated that voltages 50 V to 250 V will not sustain arcs for more than 2 cycles, thereby limiting exposure to less than 4 cal/cm<sup>2</sup>. (See *208-V Arc Flash Testing* [B1].)
- ③ Value based on IEEE 1584 formula for Motor Control Centers. [Gap = 2.54 cm (1 in)] ( $X_d = 1.641$ ) [46 cm (18 in) distance] 51 kA (Based on a 208 V, 1000 kVA, 5.3% Z, served from a 500 MVA system) Maximum duration without circuit protective device operation from industry testing (see *208-V Arc Flash Testing* [B1]) is 10 cycles:  $46.5 \text{ cal/s/cm}^2 \times 0.167 \text{ s} = 7.8 \text{ cal/cm}^2$ .
- ④ Industry testing on 480 V equipment indicates exposures for self-contained meters do not exceed 20 cal/cm<sup>2</sup>.
- ⑤ Industry testing on 480 V equipment indicates exposures for CT meters and control wiring does not exceed 4 cal/cm<sup>2</sup>.
- ⑥ Value based on IEEE 1584 formula for Motor Control Centers. [Gap = 2.54 cm (1 in)] ( $X_d = 1.641$ ) [46 cm (18 in) distance] 12.7 kA at 480 V (worst-case energy value from testing). (See Eblen and Short [B31].) Maximum duration without circuit protective device operation from tests is 85 cycles:  $26.2 \text{ cal/s/cm}^2 \times 1.42 \text{ s} = 37 \text{ cal/cm}^2$ .
- ⑦ Incident analysis on this equipment indicates exposures do not exceed the values in the table.
- ⑧ Engineering analysis indicates that applying a 150% multiplier to the 480 V exposure values provides a conservative value for equipment and open air lines operating at 601 V to 1000 V.
- ⑨ Industry testing on 480 V equipment indicates exposures on pad-mounted transformers do not exceed 4 cal/cm<sup>2</sup>. (See Eblen and Short [B31].)
- ⑩ Industry testing on 208 V network protectors indicates exposures do not exceed 4 cal/cm<sup>2</sup>. (See *208-V Arc Flash Testing* [B1].)
- ⑪ Industry testing on 480 V network protectors indicates arcs will not self-extinguish and heat flux rates will exceed 60 cal/cm<sup>2</sup>/s at 24 in working distance. Perform arc hazard analysis. (See Eblen and Short [B31].)
- ⑫ Industry testing on 480 V panels with non-edge mounted bus bars indicates exposures do not exceed 8 cal/cm<sup>2</sup>. (See Eblen and Short [B31].)
- ⑬ Industry testing on panelboards with edge-mounted, parallel bus bars indicate arcs will not self-extinguish and heat flux rates will exceed 60 cal/cm<sup>2</sup>/s at 46 cm (18 in) working distance. Perform arc hazard analysis. (See Eblen and Short [B31].)
- ⑭ IEEE 1584 original test data indicates there is no significant difference between heat flux rates for 400 V class equipment versus 600 V class equipment.