

## Table 2 - Arc Flash PPE Categories and Boundaries

### Section 2.1 - Arc Flash PPE Categories and Boundaries for Alternating Currents (AC)

#### List 2.1.1 Equipment with Arc Flash PPE Category 1

- Panelboards or other equipment rated 240 volts and below with the following parameters:
  - maximum of 25 kA available fault current;
  - maximum of 0.03 sec (2 cycles) fault clearing time;
  - minimum working distance 455 mm (18 in.).
  - The **arc flash boundary** is 485 mm (19 in.).

#### List 2.1.2 Equipment with Arc Flash PPE Category 2

- Panelboards or other equipment rated greater than 240 volts and up to 600 volts with the following parameters:
  - maximum of 25 kA available fault current;
  - maximum of 0.03 sec (2 cycles) fault clearing time;
  - minimum working distance 455 mm (18 in.).
  - The **arc flash boundary** is 900 mm (3 ft).
- 600-volt class motor control centers (MCCs) with the following parameters:
  - maximum of 65 kA available fault current;
  - maximum of 0.03 sec (2 cycles) fault clearing time;
  - minimum working distance 455 mm (18 in.).
  - The **arc flash boundary** is 1.5 m (5 ft).
- Other 600-volt class (277 volts through 600 volts, nominal) equipment with the following parameters:
  - maximum of 65 kA available fault current;
  - maximum of 0.03 sec (2 cycles) fault clearing time;
  - minimum working distance 455 mm (18 in.).
  - The **arc flash boundary** is 1.5 m (5 ft).

#### List 2.1.3 Equipment with Arc Flash PPE Category 4

- 600-volt class motor control centers (MCCs) with the following parameters:
  - maximum of 42 kA available fault current;
  - maximum of 0.33 sec (20 cycles) fault clearing time;
  - minimum working distance 455 mm (18 in.).
  - The **arc flash boundary** is 4.3 m (14 ft)
- 600-volt class switchgear (with power circuit breakers or fused switches) and 600-volt class switchboards with the following parameters:
  - maximum of 35 kA available fault current;
  - maximum of up to 0.5 sec (30 cycles) fault clearing time;

- minimum working distance 455 mm (18 in.).
- The **arc flash boundary** is 6 m (20 ft).
- NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV with the following parameters:
  - Maximum of 35 kA available fault current;
  - maximum of up to 0.24 sec (15 cycles) fault clearing time;
  - minimum working distance 910 mm (36 in.).
  - The **arc flash boundary** is 12 m (40 ft).
- Metal-clad switchgear, 1 kV through 15 kV with the following parameters:
  - maximum of 35 kA available fault current;
  - maximum of up to 0.24 sec (15 cycles) fault clearing time;
  - minimum working distance 910 mm (36 in.).
  - The **arc flash boundary** is 12 m (40 ft)
- Metal enclosed interrupter switchgear, fused or unfused type construction, 1 kV through 15 kV with the following parameters:
  - maximum of 35 kA available fault current;
  - maximum of 0.24 sec (15 cycles) fault clearing time;
  - minimum working distance 910 mm (36 in.).
  - The **arc flash boundary** is 12 m (40 ft).
- Other equipment 1 kV through 15 kV with the following parameters:
  - maximum of 35 kA available fault current;
  - maximum of up to 0.24 sec (15 cycles) fault clearing time;
  - minimum working distance 910 mm (36 in.).
  - The **arc flash boundary** is 12 m (40 ft).

#### List 2.1.4 Equipment Where Arc Flash PPE and Arc Flash Boundaries Are Not Applicable

- Arc-resistant equipment up to 600-volt class with the following parameters:
  - DOORS CLOSED and SECURED;
  - with an available fault current and a fault clearing time that does not exceed the arc-resistant rating of the equipment.
  - For DOORS OPEN refer to the corresponding non-arc-resistant equipment section of these lists.
- Arc-resistant equipment 1 kV through 15 kV with the following parameters:
  - DOORS CLOSED and SECURED;
  - with an available fault current and a fault clearing time that does not exceed the arc-resistant rating of the equipment.
  - DOORS OPEN refer to the corresponding non-arc-resistant equipment section of these lists.

## Notes

- For equipment rated 600 volts and below and protected by upstream current-limiting fuses or current-limiting molded case circuit breakers sized at 200 amperes or less, the arc flash PPE category can be reduced by one number but not below arc flash PPE category 1.
- The following are typical fault clearing times of overcurrent protective devices:
  - 0.5 cycle fault clearing time is typical for current-limiting fuses and current-limiting molded case circuit breakers when the fault current is within the current limiting range.
  - 1.5 cycle fault clearing time is typical for molded case circuit breakers rated less than 1000 volts with an instantaneous integral trip.
  - 3.0 cycle fault clearing time is typical for insulated case circuit breakers rated less than 1000 volts with an instantaneous integral trip or relay operated trip.
  - 5.0 cycle fault clearing time is typical for relay operated circuit breakers rated 1 kV to 35 kV when the relay operates in the instantaneous range (i.e., “no intentional delay”).
  - 20 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay for motor inrush.
  - 30 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay without instantaneous trip.
- See Table 1 of IEEE 1584, Guide for Performing Arc Flash Hazard Calculations, for further information regarding list items (2) through (4) in Note No. 2 above
- See IEEE C37.20.7, Guide for Testing Switchgear Rated Up to 52 kV for Internal Arcing Faults, for an example of a standard that provides information for arc-resistant equipment referred to in this table.
- See NFPA 70E, Informative Annex O.2.4(9) for information on arc-resistant equipment.

## Section 2.2 - Arc Flash PPE Categories and Boundaries for Direct Current (DC) Systems

Storage batteries, dc switchboards, and other dc supply sources greater than 150 volts and less than or equal to 600 volts; maximum arc duration and minimum working distance: 2 sec 455 mm (18 in.)

- Available fault current less than 1.5 kA
  - arc flash PPE Category 2;
  - **arc flash boundary** is 900 mm (3 ft)
- Available fault current greater than or equal to 1.5 kA and less than 3 kA
  - arc flash PPE Category 2;
  - **arc flash boundary** is 1.2 m (4 ft);
- Available fault current greater than or equal to 3 kA and less than 7 kA
  - arc flash PPE Category 3;
  - **arc flash boundary** is 1.8 m (6 ft.)
- Available fault current greater than or equal to 7 kA and less than 10 kA
  - arc flash PPE Category 4;
  - **arc flash boundary** is 2.5 m (8 ft)

### Notes

- Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:
  - Be evaluated for electrolyte protection. See ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing, for information on evaluating apparel for protection from electrolyte
- Be arc rated. See ASTM F1891, Standard Specification for Arc and Flame-Resistant Rainwear, for information on evaluating arc-rated apparel.
- A two-second arc duration is assumed if there is no overcurrent protective device (OCPD) or if the fault clearing time is not known. If the fault clearing time is known and is less than 2 seconds, an incident energy analysis could provide a more representative result.
- See NFPA 70E Appendix D.5 for the basis for table values and alternative methods to determine dc incident energy. Methods should be used with good engineering judgment. When determining available fault current, the effects of cables and any other impedances in the circuit should be included. Power system modeling is the best method to determine the available short-circuit current at the point of the arc. Battery cell short-circuit current can be obtained from the battery manufacturer.
- The methods for estimating the dc arc flash incident energy that were used to determine the categories for this table are based on open-air incident energy calculations. Open-air calculations were used because many battery systems and other dc process systems are in open areas or

rooms. If the specific task is within an enclosure, it would be prudent to consider additional PPE protection beyond the value shown in this table

- See the following references for dc voltages below 150 volts nominal:
  - J. G. Hildreth and K. Feeney, "Arc Flash Hazards Station Battery Systems," 2018 IEEE Power & Energy Society General Meeting (PESGM), 2018, pp. 1–5.
  - US Department of Energy Bonneville Power Administration Engineering and Technical Services Report BPA F 5450.05, "DC Arc Flash: 125V, 1300 amp-hour battery," May 11, 2017, doi: 10.1109/PESGM.2018.8586181.
  - K. Gray, S. Robert, and T. L. Gauthier, "Low Voltage 100–500 Vdc Arc Flash Testing," 2020 IEEE IAS Electrical Safety Workshop (ESW), 2020, pp. 1–7, doi: 10.1109/ESW42757.2020.9188336.