



Shock Boundaries & Approach Distances

TOOLBOX TALK: Shock Boundaries & Approach Distances

RATTLIR Safety Series – “Strike Before It Bites”

Purpose

Shock hazards increase with system voltage. NFPA 70E Table 130.4(E)(a) defines Limited and Restricted Approach Boundaries for alternating-current (AC) systems to reduce the risk of electric shock. This toolbox talk summarizes those boundaries for exposed fixed circuit parts, from low voltage panels through extra-high-voltage (EHV) transmission levels up to 800 kV, with emphasis on power generation and substation environments.



Shock Approach Boundaries (AC Systems)

Shock boundaries are distance-based controls used to prevent personnel or conductive objects from contacting energized electrical parts.



Shock Boundaries & Approach Distances

Limited Approach Boundary:

Distance from an exposed energized part within which a shock hazard exists for unqualified persons. Unqualified workers may only cross this boundary when escorted by a Qualified Electrical Worker (QEW) and when no contact with energized parts is possible.

Restricted Approach Boundary:

Closer distance that accounts for inadvertent movement and arc-over risk. Only QEWs who are trained, authorized, and using appropriate PPE and insulated tools may cross this boundary.

Figure 1 summarizes NFPA 70E (2024) Table 130.4(E)(a) for AC systems and should be used during job planning to establish safe boundaries.

Nominal System Voltage Range, Phase to Phase	Limited Approach Boundary	Restricted Approach Boundary
Less than 50 V	Not Specified	Not Specified
50–150 V	3 ft 6 in	Avoid Contact
151–750 V	3 ft 6 in	1 ft 0 in
751 V–5 kV	3 ft 6 in	2 ft 1 in
5.1–15 kV	5 ft 0 in	2 ft 2 in
15.1–36 kV	6 ft 0 in	2 ft 7 in
36.1–46 kV	8 ft 0 in	2 ft 10 in
46.1–72.5 kV	8 ft 0 in	3 ft 4 in
72.6–121 kV	8 ft 0 in	3 ft 9 in
121.1–145 kV	10 ft 0 in	4 ft 4 in
145.1–169 kV	11 ft 8 in	4 ft 10 in
169.1–242 kV	13 ft 0 in	6 ft 8 in
242.1–362 kV	15 ft 4 in	11 ft 2 in
362.1–420 kV	19 ft 0 in	14 ft 0 in
420.1–550 kV	19 ft 0 in	16 ft 8 in
550.1–800 kV	23 ft 9 in	22 ft 7 in

Figure 1 – NFPA 70E 2024 summary for AC systems (fixed circuit parts).



Shock Boundaries & Approach Distances

Qualified vs. Unqualified Personnel

NFPA 70E shock protection relies on clearly distinguishing between electrically qualified and unqualified personnel, as this distinction determines who may cross approach boundaries and under what conditions.

Qualified Electrical Workers (QEWs):

- Can identify exposed energized parts and determine nominal system voltage.
- Understand approach boundaries, shock/arc hazards, and required PPE.
- Are permitted to cross Limited and Restricted boundaries when justified by the task and protected by procedures.

Unqualified Personnel:

- Must remain outside the Limited Approach Boundary.
- May not perform work on or near exposed energized parts.

Applying NFPA 70E in the Field

Correct application of NFPA 70E approach boundaries requires understanding both voltage level and exposure type.

- Confirm nominal system voltage before selecting the table row.
- Identify whether exposure involves an exposed movable conductor or and exposed fixed circuit part.
 - Movable conductors have a more restrictive approach boundary.
- Establish barricades, signs, and escort requirements before work begins.
- Restricted Approach includes allowance for inadvertent movement and must be respected at all times.

PPE and Work Practices Inside Restricted Boundary

- Use voltage-rated gloves and leather protectors appropriate to system voltage.
- Use insulated tools, hot sticks, and live-line equipment where required.
- Wear arc-rated clothing based on incident energy analysis.
- Control conductive objects such as ladders, tape measures, antennas, and hand tools.

Best Practices Near HV/EHV Equipment

- Treat all conductors as energized unless properly de-energized, grounded, and verified.



Shock Boundaries & Approach Distances

- Use barriers, markers, and attendants at approach boundaries.
- Account for induced voltage and transferred potential in substations and switchyards.
- Coordinate with system operators and follow utility or plant-specific switching procedures.

Emergency Response

- Never touch a suspected shock victim until the circuit is de-energized and verified safe.
- Call emergency services immediately.
- Begin CPR/AED only when it is safe to approach.
- Secure the area to prevent additional exposures.

Discussion Questions

- What are the applicable shock boundaries for today's work location and voltage level?
- Which workers are considered QEWs for this task?
- Are our site-specific procedures more conservative than the NFPA 70E minimums?

RATTLIR Takeaway

Shock boundaries are not suggestions – they are engineered distances based on voltage and human factors. Using the NFPA 70E values and site procedures ensures we strike before it bites around energized equipment.