

**Shock Protection Boundaries and PPE
Fermilab Summary for NFPA 70E**

System Voltage Range Phase to Phase	Limited Approach Boundary (Fixed Parts)	Restricted Approach Boundary	Prohibited Approach Boundary	Shock Protection Insulating PPE
50 to 300 Including 120, 277 and 120/208	3 Ft 6 In	Avoid Contact	Avoid Contact	LAB - None RAB - Wear/Use if Contact Likely PAB - Wear/Use if Contact Likely
301 to 750 Including 480/277	3 Ft 6 In	1 Foot	1 Inch	LAB - None RAB - Must Wear PAB - Must Wear
751 to 15K Including 13.8K	5 Feet	2 Ft 2 In	7 Inches	LAB - None RAB - Must Wear PAB - Must Wear
345K to 362K	15 Ft 4 In	8 Ft 6 In	8 Feet	LAB - None RAB - Must Wear PAB - Must Wear

Within the Limited Approach Boundary	Non-Qualified Worker Allowed Within Only if Advised and Escorted by a QW. Insulated Equipment/Tools if Contact Likely.
Within the Restricted Approach Boundary	Only Qualified Worker Allowed Within. May Not Enter with Conductive Objects. Body Parts Must be Insulated.
Within the Prohibited Approach Boundary	Consider Activity as Same as Working On.

Arc-Flash Hazard/Risk Categories - Required Clothing - Required PPE
Fermilab Summary for NFPA 70E

Calculated Exposure from Prospective Arc-Flash	Hazard/Risk Category	Minimum Required ATPV	Clothing Requirements	Additional PPE
Zero up to 1.2 cal/cm ²	-1	NA	Cotton Tee Shirt and Pants	Safety Glasses
Zero up to 1.2 cal/cm ²	0	NA	Long Sleeve Cotton Shirt and Pants	Safety Glasses
More than 1.2 and up to 4 cal/cm ²	1	4 cal/cm ²	FR Coverall*	Hard Hat, Safety Glasses
More than 4 and up to 8 cal/cm ²	2	8 cal/cm ²	Cotton Clothing Under FR Coverall*	Hard Hat, Safety Glasses, Face Shield, Hearing Protection, Leather Gloves, Leather Work Shoes
More than 4 and up to 8 cal/cm ²	2*	8 cal/cm ²	Cotton Clothing Under FR Coverall*	Hard Hat, Safety Glasses, Double-Layer Switching Hood, Hearing Protection, Leather Gloves, Leather Work Shoes
More than 8 and up to 25 cal/cm ²	3	25 cal/cm ²	Cotton Clothing Under 2 x FR Coveralls*	Hard Hat, Safety Glasses, Flash Suit Hood, Hearing Protection, Leather Gloves, Leather Work Shoes
More than 25 and up to 40 cal/cm ²	4	40 cal/cm ²	Cotton Clothing Under FR Coverall* plus Multilayer Flash Suit Jacket & Pants	Hard Hat, Safety Glasses, Flash Suit Hood, Hearing Protection, Leather Gloves, Leather Work Shoes
* Coverall Rated at 8 cal/cm ² Available from Fermilab Stockroom				

Simplified Guidance for Electrical Work on Fermilab **AC POWER DISTRIBUTION** Equipment

Diagnostic Work Including LOTO Voltage Testing Unless Otherwise Noted, Plus Some Additional Operations

Equipment	Voltage	Rated Full Load Current	Hazard/Risk Category	Conditions or Qualifications
Primary Panelboards SWBD DHP	480/277 VAC	More than 1,200 Amps	3	Primary Transformer Larger than 1000 KVA (Assuming More Than 25,000 I _{SC} Available with Fault Clearing Time >2 Cycles) Take Advantage of Installed Panelboard Meter for LOTO Verification if Present.
Motor Control Centers MCC	480 VAC	Typical 600 Amps and Above	2*	Take Advantage of Installed Central Monitoring Unit for LOTO Verification if Present
Primary or Secondary Panelboards DHP PHP LP	480/277 VAC	400 to 1,200 Amps	2*	Proximity to Transformer Power Source Presumed
Operating 13.8 KV Disconnects with Doors Closed	13.8 KV	NA	2	Booster Brentford or RF Anode Power Supplies are Examples
Secondary Panelboards PHP LP	480/277 VAC	100 to 225 Amps	1	Assuming Less Than 10,000 I _{SC} Available More Than 200 Feet from Panelboard Sourcing Power
Lighting Panelboards LP	480/277 VAC	100 Amps	1	Assuming Less Than 10,000 I _{SC} Available More Than 100 Feet from Secondary Panelboard Sourcing Power
Utility Panelboards	120/208 VAC 120/240 VAC	Below 400 Amps	0	No Known Fault Currents Above 10,000 Amps. Knowing Transformer KVA and %IZ, Apply Formula for Suspect Installations
Operating Circuit Breakers and Disconnect Switches with Covers On or Closed	480/277 VAC	NA	0	Requirement Direct from NFPA 70E C9 Table
	120/208 VAC 120/240 VAC	NA	-1	No Known Fault Currents Above 10,000 Amps. Knowing Transformer KVA and %IZ, Apply Formula for Suspect Installations

**This Simplified Table for AC Power Distribution Equipment Has Been Approved by the Electrical Safety Subcommittee.
Guidance Assumes the Transformer Powering the AC Power Distribution System Has an Impedance in the Range of 4.5 to 6 %IZ.
If Stated Conditions or Qualifications Are Not Met or the Circumstances of the Work Activity Appear Unique,
Refer to NFPA 70E Table 130.7(C)(9)(a) or Consult with Your D/S Electrical Coordinator.**

Simplified Guidance for Electrical Work on Fermilab UTILIZATION Equipment
Diagnostic Work Including LOTO Voltage Testing Unless Otherwise Noted

Equipment	Voltage	Sourcing Branch CB	Hazard/Risk Category	Conditions or Qualifications
Power Supplies	480 VAC	Various	Can Range from 0 to 3	Ask Your Department for an Assessment. Take Advantage of Installed Panel Meters for LOTO Verification.
Various Equipment	480 VAC or 480/277 VAC	100 to Less than 400 Amps	2	Distance from Primary Panelboards and Feed Conductors Limit Available Fault Currents
Various Equipment	480 VAC or 480/277 VAC	Less Than 100 Amps	1	Distance from Primary Panelboards and Feed Conductors Limit Available Fault Currents
Sump Pump Controllers Motor Controllers HVAC Equipment	480 VAC	60 Amps and Below	1	Distance from Primary Panelboards and Feed Conductors Limit Available Fault Currents
Ballasts and Light Fixtures	277 VAC	30 Amps and Below	0	Typical Lighting Ballast
Power Supplies	208 VAC	225 Amps and Below	0	No Known Fault Currents Above 10,000 Amps. Knowing Transformer KVA and %IZ, Apply Formula for Suspect Installations
Various Equipment	120/208 VAC	225 Amps and Below	0	No Known Fault Currents Above 10,000 Amps. Knowing Transformer KVA and %IZ, Apply Formula for Suspect Installations
Various Equipment	120 VAC	30 Amps and Below	-1	Bench Testing. No Known Fault Currents Above 10,000 Amps.

**This Simplified Table for Utilization Equipment Has Been Approved by the Electrical Safety Subcommittee.
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Refer to NFPA 70E Table 130.7(C)(9)(a) or Consult with Your D/S Electrical Coordinator.**