Electrical Safety & Proper Hazard Assessment OSHA & NFPA 70E

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OSHA 30 Required Topics

- *Electrical Standards*
  - *General Industry CFR 29 1910.300*
  - *Construction CFR 29 1926.400*

Shall vs. How

- *Employer shall implement an electrical safety program*
- *General Duty Clause*
  - *provide workplace free from recognized hazards*
- *Shock - Arc Flash - Arc Blast - Fires*

OSHA Top 10 Violations

6. Electrical – Wiring Methods

This standard covers the grounding of electrical equipment, wiring and insulation. It includes temporary wiring and splicing such as flexible cords and cables.

Top 5 sections cited:

1910.305 (g)(1) – Failure to use flexible cords and cables properly (830)
1910.305 (b)(1) – Failure to effectively close conductors entering boxes, cabinets or fittings and protect from abrasion (774)
1910.305 (g)(2)(iii) – Failure to connect flexible cords to devices and fittings so strain relief is provided to prevent pull from being directly transmitted to joints or terminal screws (642)
1910.305 (b)(2) – Failure to provide all pull boxes, junction boxes and fittings with covers approved for the purpose (543)
1910.305 (a)(2) – Failure to apply to temporary wiring installations properly (155)

Standard 1910.305

Total violations: 3,371

Fiscal 2007 ranking: 7
(3,192 violations)

OSHA Top 10 Violations

- *Generated by volume of inspections - not accident investigations*
- *G.I. Regulations updated first time in over 25 years*
  - *used 2002 NEC & 2000 edition of NFPA 70E*

OSHA Adoption of 70E

- *Industry Consensus Standard*
- *Not formally adopted*
- *Could be used as "should have known" document*
- *Citation ref. OSHA standard first*
  - *1910.132(d)*

1910.132 (d)

Hazard assessment and equipment selection.

1910.132(d)(1)

The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall:

1910.132(d)(1)(i)

Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment;

Energized Work

- *Working On or Near*
- *Breaking the Plane*
- *Temporary Wiring*

Energized Work

- *OSHA =* http://www.orosha.org/pdf/rules/division_2/div2_s.pdf

  (1) Deenergized parts. Live parts to which an employee may be exposed shall be *deenergized before the employee works on or near them, unless the employer can demonstrate that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. Live parts that operate at less than 50 volts to ground need not be deenergized if there will be no increased exposure to electrical burns or to explosion due to electric arcs.*

Energized Work

(2) Energized parts.

If the exposed live parts are not de-energized (i.e., for reasons of increased or additional hazards or infeasibility), other safety-related work practices shall be used to protect employees who may be exposed to the electrical hazards involved. Such work practices shall protect employees against contact with energized circuit parts directly with any part of their body or indirectly through some other conductive object. The work practices that are used shall be suitable for the conditions under which the work is to be performed and for the voltage level of the exposed electric conductors or circuit parts.

1910.335(A)(2)(ii)

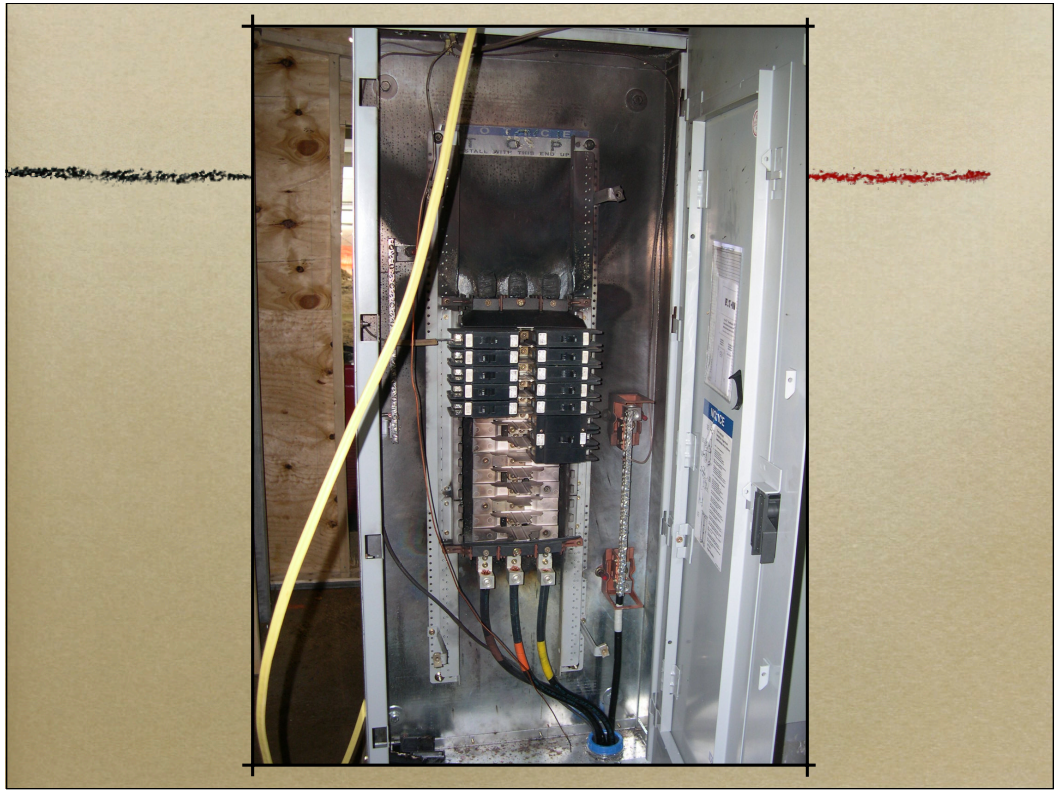
(ii) Protective shields, protective barriers, or insulating materials shall be used to *protect each employee from shock, burns, or other electrically related injuries while that employee is working near exposed energized parts which might be accidentally contacted or where dangerous electric heating or arcing might occur. When normally enclosed live parts are exposed for maintenance or repair, they shall be guarded to protect unqualified persons from contact with the live parts.*

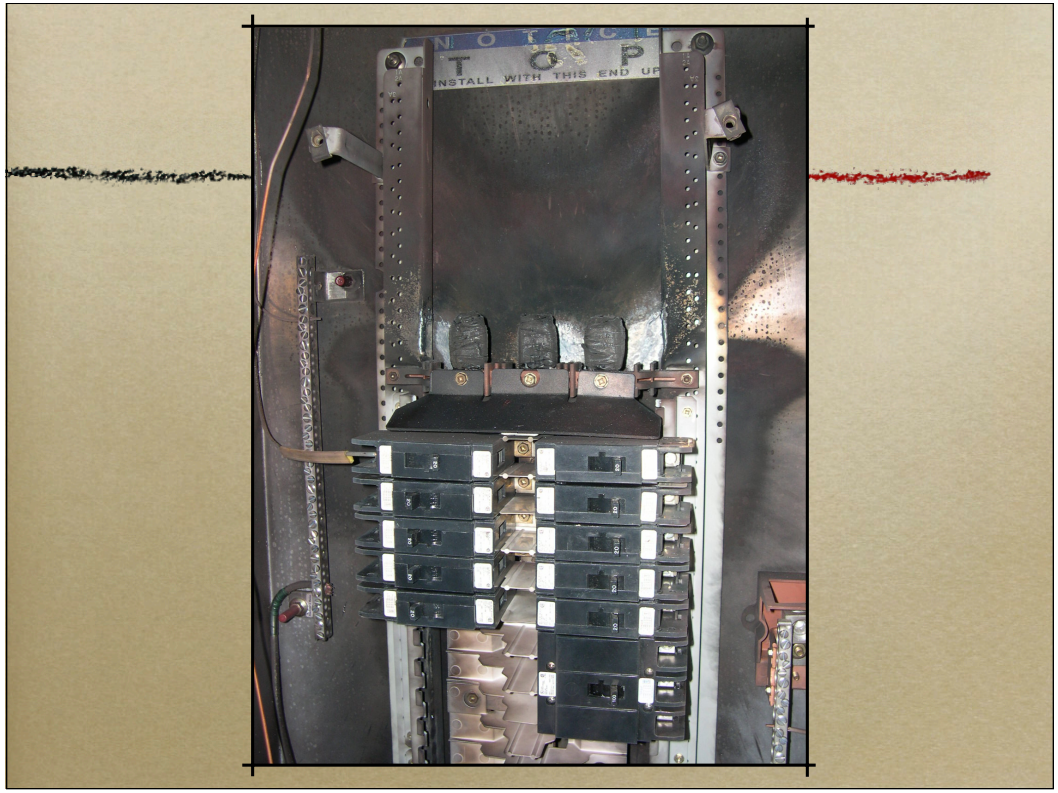
Guarding

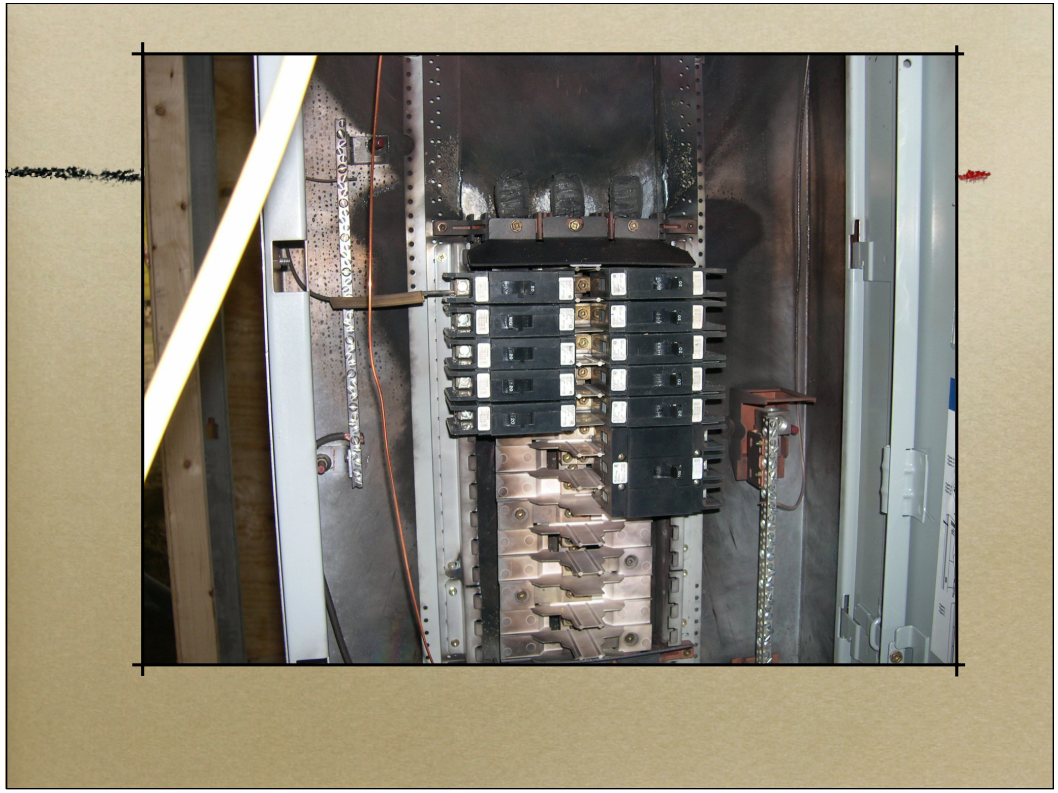
Temporary Power

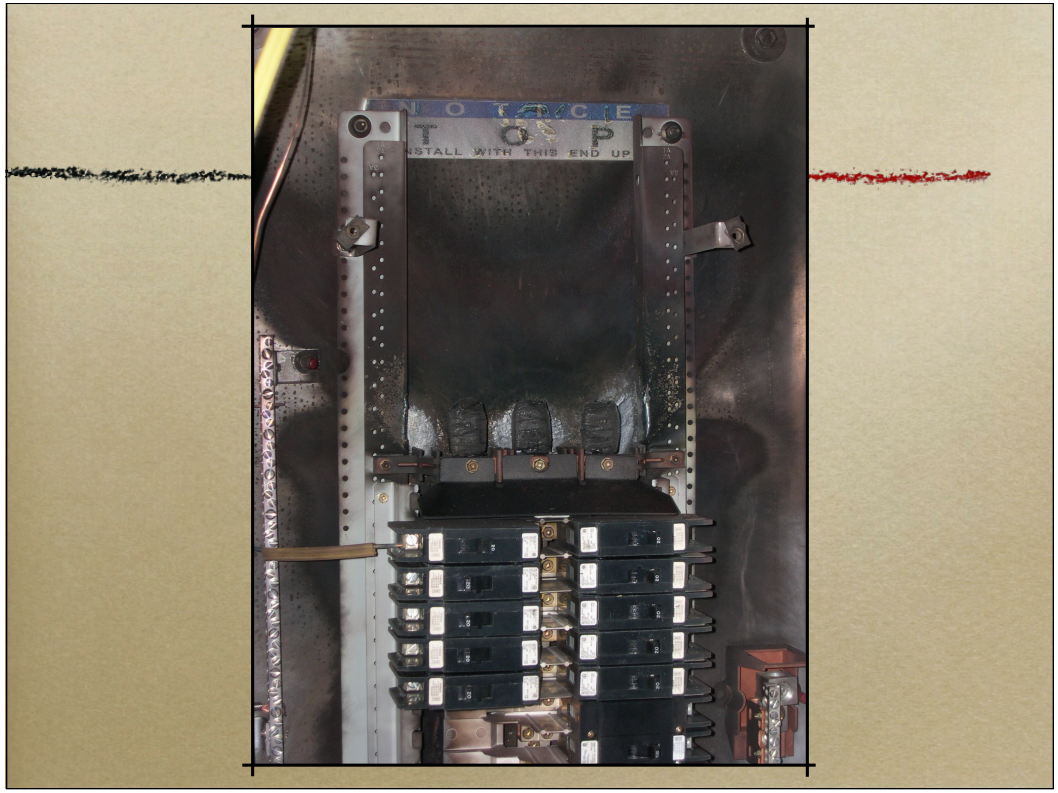
- *200 amp - 480 volt system*
- *Typical to most in the field today*
- *Apply energized work definition to the following work activity:*
  - *Install additional circuit to temporary power panel*

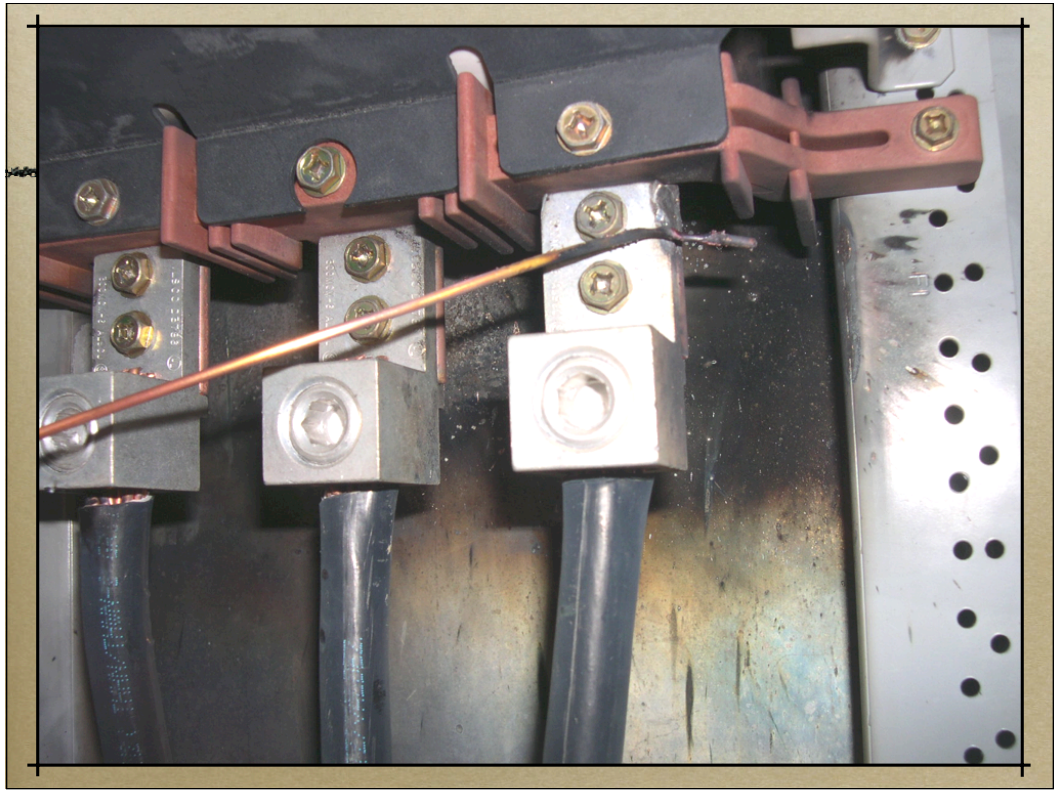

ON
OFF

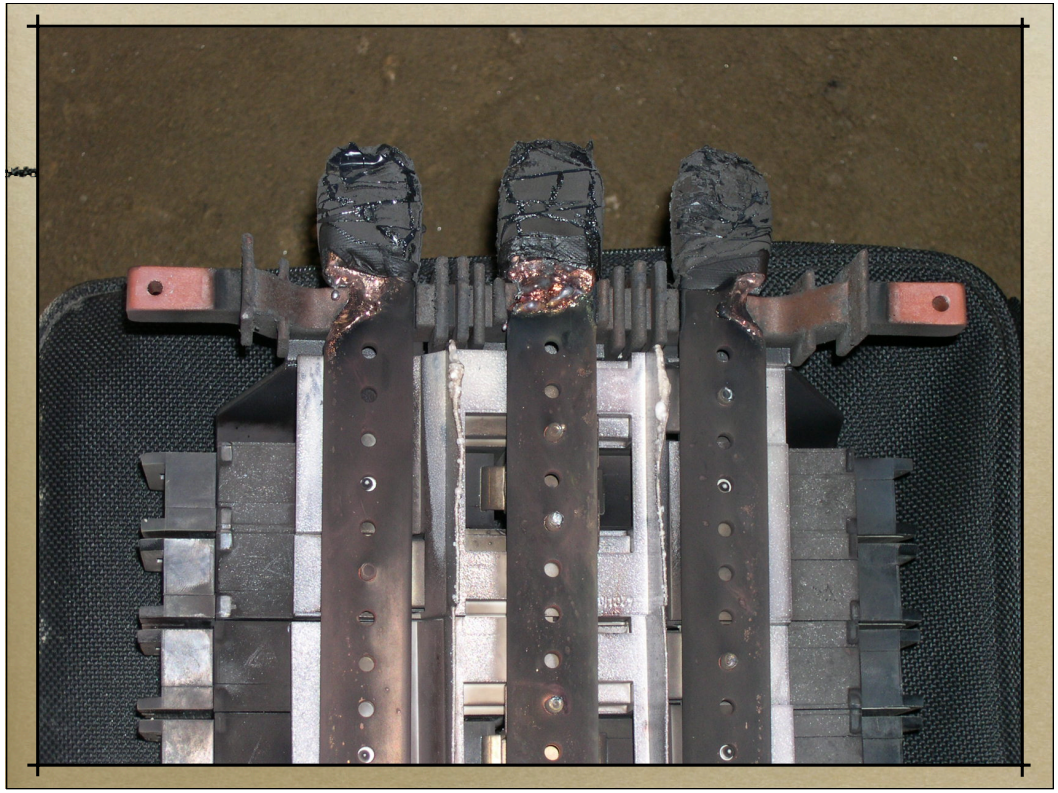



NOTICE
TOP
INSTALL WITH THIS END UP




T O P
STALL WITH THIS END UP

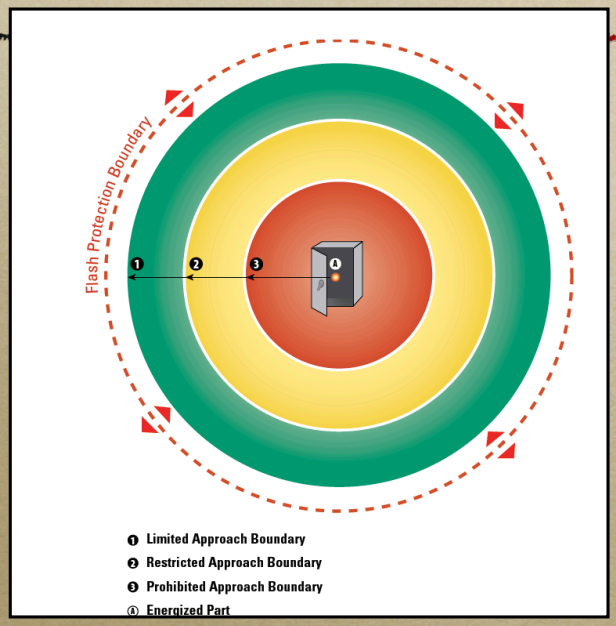




Electrical Hazard Assessments

- *Shock Hazard Analysis*
  - *available potential + / - 50 Volts*
  - *LU 46 JW 11/20/08 120v electrocution*
- *Arc Flash Hazard Analysis*
  - *magnitude (I sc, bf, af) & Time (clearing)*

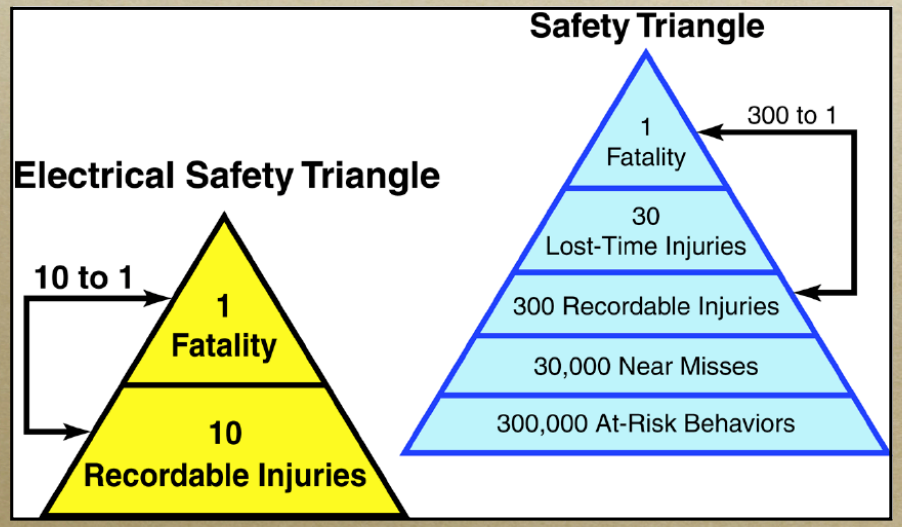
Shock Protection Boundaries



Shock Hazard Analysis

- *Dependent on voltage level - I.E. 480V*
- *Limited = 42 inches*
- *Restricted = 12 inches*
- *Prohibited = 1 inch*

Probability vs. Severity



DC Systems?

- *< 50 volt action level*

Arc Flash Hazard Analysis

- *How to begin*

Hazard Risk Categories vs. Incident Energies

- *Use either task matrix in 70E or*
  - *foot notes*
- *Perform incident energy calculations*
  - *many variables and unknowns*

Task Matrix Tables

TASK & EQUIPMENT Panelboards or Switchboards Rated > 240V and up to 600V (with molded case or insulated case circuit breakers) - Note 1	HAZARD RISK CATEGORY	SHOCK - USE V RATED GLOVES	SHOCK - USE V RATED TOOLS
Perform infrared thermography and other non-contact inspection outside of the restricted approach boundary	1	N	N
Circuit breaker (CB) or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	1	Y	N
Work on energized conductors or parts, including voltage testing	2*	Y	Y
Remove / install CBs or fused switches	2*	Y	Y
Removal of bolted covers, exposing worker to energized conductors, parts and equipment	2*	Y	N
Opening hinged covers, exposing worker to energized conductors, parts and equipment	2*	Y	N
Work on energized conductors or circuit parts of utilization equipment fed directly by a branch circuit of the panelboard	2*	Y	Y

Specific Notes as references in the table -
NOTE 1 = Maximum of 25KA short circuit current available; maximum of 0.03 seconds, (2 cycle) fault clearing time.

Available Fault Currents

- *Different from working currents*
- *Ground faults or short circuits*
- *How much incident energy can be released*
- *Enclosure considerations*
- *SPD book page # 192*

IEEE 1584 Calculations

- *Fed OSHA Interpretation letter*
- *Primary factors = magnitude of fault currents & clearing times of OCPD*
- *dc = distance to CURABLE burn*
- *Used to establish arc flash boundaries*

IEEE 1584 Calculations

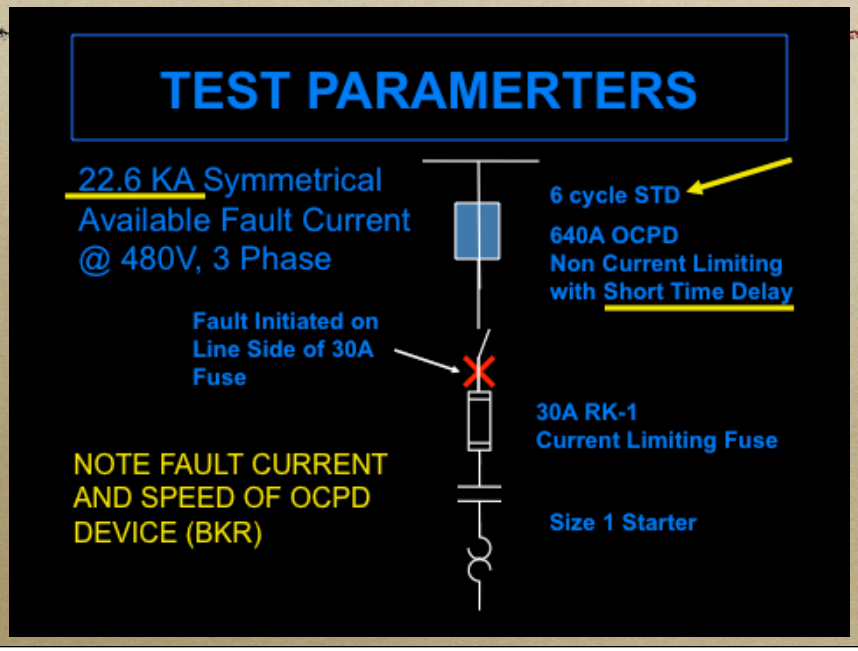
- *Incident Energy Calculations*
- *Used to determine PPE*
- *Unique units of measurement*
- *Calories per square centimeter*
- *Thermal value over specific size area*

IEEE 1584 Calculations

- $E_{MB} = 1038.7 D_B^{-1.4738} t_A [0.0093F^2 - 0.3453F + 5.9675]$
- E_{MB} = Energy within max 20 cubic inch box
- D_B = 18 inches distance from electrodes
- t_a = arc duration in seconds
- F = available short circuit current - bolted fault

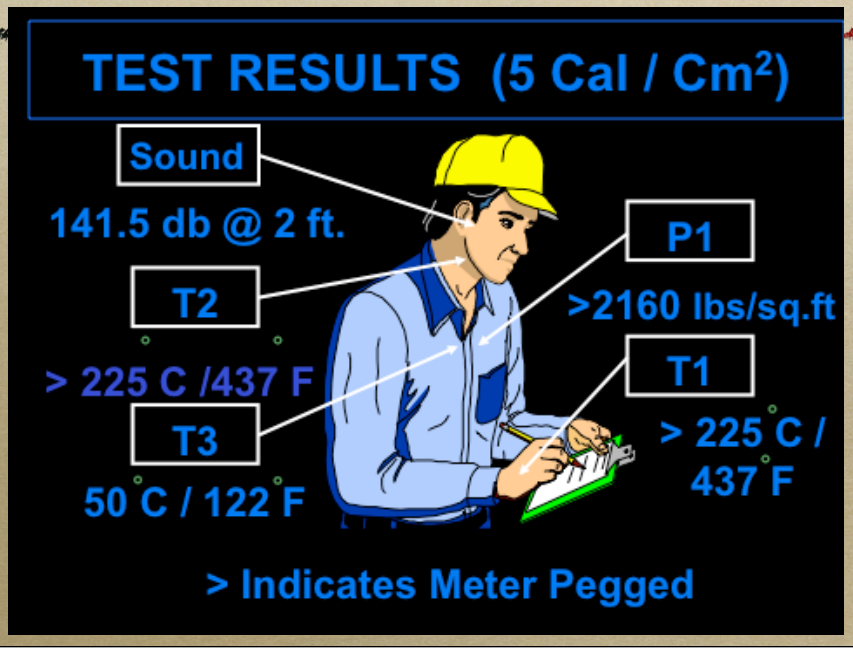
30 amp 480 Volt

System Parameters



5.3 Calorie / Cm Squared

Test Results



Arc Flash

Flash Boundary Calculator

Flash Protection Boundary

ISCAbf, amps: 46273
Voltage: 208
Time, seconds: .5
Calculate
Flash Protection Boundary, feet: 4.7

Incident Energy

ISCAbf, amps: 46273
Time, seconds: .5
Calculate
Calories per cm^2: 72.64

Short Circuit Calculation

Transformer KVA: 300
Secondary Voltage: 208
% Z: 1.8
Calculate
Available Fault Current: 46263

Arc Flash

Flash Boundary Calculator

Flash Protection Boundary

ISCAbf, amps:	46273
Voltage:	208
Time, seconds:	.0032

Calculate

Flash Protection Boundary, feet: 0.38

Incident Energy

ISCAbf, amps:	46273
Time, seconds:	.0032

Calculate

Calories per cm^2: 0.46

Short Circuit Calculation

Transformer KVA:	300
Secondary Voltage:	208
% Z:	1.8

Calculate

Available Fault Current: 46263

Arc Flash

Flash Boundary Calculator

Flash Protection Boundary

ISCAbf, amps: 46273
Voltage: 208
Time, seconds: .2
Calculate
Flash Protection Boundary, feet: 2.97

Incident Energy

ISCAbf, amps: 46273
Time, seconds: .2
Calculate
Calories per cm^2: 29.06

Short Circuit Calculation

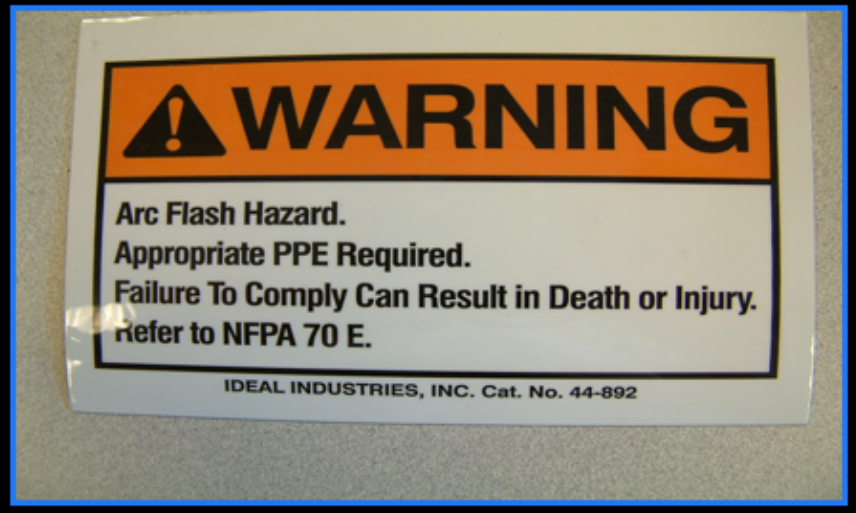
Transformer KVA: 300
Secondary Voltage: 208
% Z: 1.8
Calculate
Available Fault Current: 46263

NEC intro to NFPA 70E

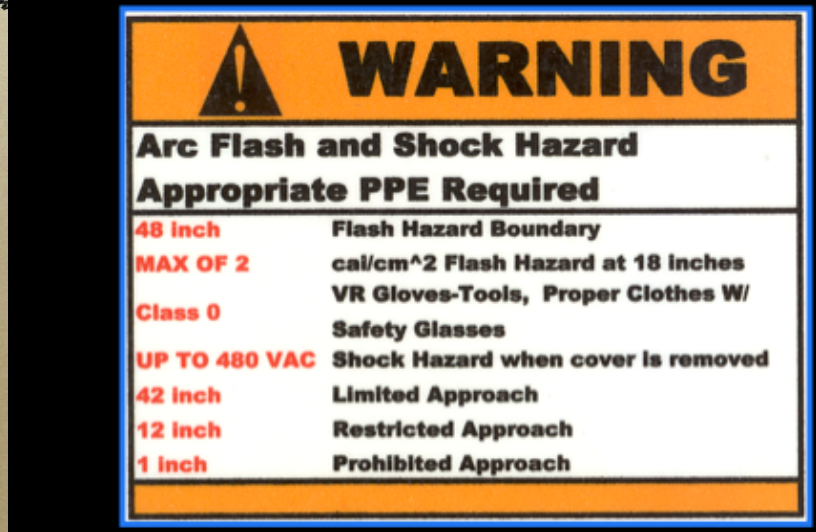
REQUIRED NEC LABELS

- 110.16 FLASH PROTECTION
  - REQUIRES FIELD LABELLING OF EQUIPMENT TO WARN QUALIFIED PERSONS ABOUT FLASH & SHOCK HAZARDS
  - INTRODUCES NFPA 70E AS A GUIDE TO DETEMINE THE LEVEL OF ELECTRICAL HAZARDS AND THE PROPER PPE FOR THOSE HAZARDS

REQUIRED LABEL



ADVANCED LABEL



NFPA 70E STRATEGIES

- ELECTRICAL SAFE WORK CONDITION
  - DE-ENERGIZATION WITH PROPER LOCK OUT / TAG OUT AND VERIFICATION
- TRAINING
  - DEFINITION OF QUALIFIED PERSON
- PLANNING
  - TASK ASSESSMENT AND JOB BRIEFING
- **PPE SELECTION**

Planning

- *Energized Electrical Work Permit*

ENERGIZED ELECTRICAL WORK PERMIT AND JOB BRIEFING FORM

Job Address _____ Job # _____ Date _____
City _____ State _____ Zip _____
Customer / General Contractor Contact Info _____

Electrical Equipment _____ Voltage _____
Available Fault Current _____ OCPD Clearing Time _____

Description of Work _____
_____
_____

Justification of why the circuit cannot be de-energized or the work to be deferred until the next scheduled outage _____
_____

I deny the request to shut off the equipment and authorize the energized work to be performed - (owner or representative signature) _____

Hazard Assessment - PPE Selection

Hazard Risk Category Number _____ or Calculated Incident Energy _____
Protection Boundaries - Arc Flash _____ Shock - Limited Approach _____
Shock - Restricted Approach _____ Shock - Prohibited Approach _____

Methods used to Restrict Access by Unqualified Persons _____
_____
Required PPE _____
_____

Approvals to perform energized work: Safety Manager _____
Project Manager _____ Foreman _____
Qualified Persons Performing Work _____
_____
(Note: 2 JW required for 480V and higher exposures per working agreement)