



COMPLIANCE TRAINING
ONLINE.com

Cal/OSHA, DOT HAZMAT, EEOC, EPA, HIPAA, IATA, IMDG, TDG, MSHA, OSHA, Australia WHS, and Canada OHS Regulations and Safety Online Training

This document is provided as a training aid
and may not reflect current laws and regulations.

Be sure and consult with the appropriate governing agencies
or publication providers listed in the "Resources" section of our website.

www.ComplianceTrainingOnline.com



[Facebook](#)



[LinkedIn](#)



[Twitter](#)



[Google Plus](#)



[Website](#)



Arc Flash → Blast

DMME

Division of Mineral Mining

AR Training

Updated 2012



What Causes An Arc Flash?

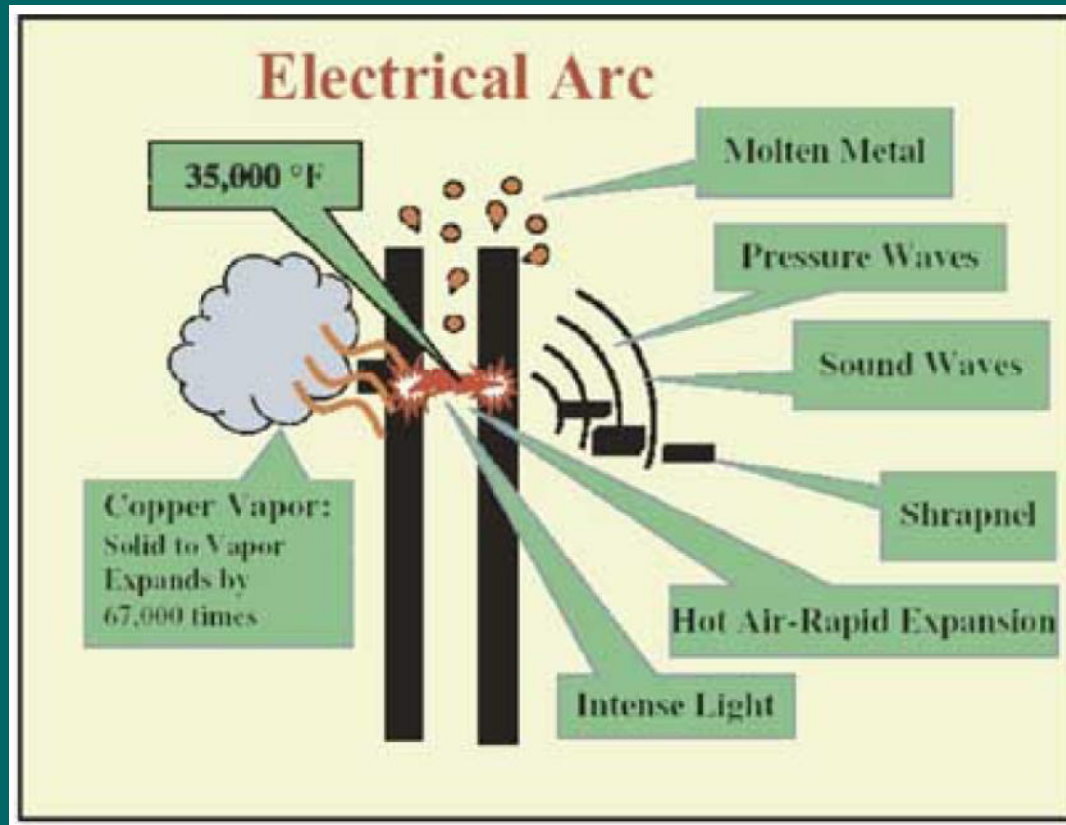
- Getting too close to “live” components with conductive tools will result in an arc, as well as:
 - Movement of loose connections.
 - Dust/dirt/corrosion on components.
 - Damaged or deteriorated insulation.
 - Improper testing procedures or testing equipment use.
 - Water or vapor can create a path to ground.
- Depending on the voltage and other factors, these arcs can produce temperatures up to 35,000 degrees!



What Causes An Arc Blast?

- A flash creating temperatures up to 35,000 degrees will super heat the air as well as melt and/or vaporize the materials it contacts. All known materials will vaporize at this temperature!
- Air and materials exposed to this kind of heat expand very rapidly creating an explosive force or blast.
 - For example, when copper vaporizes it expands 67,000 times normal. Water 1,670 times.
 - In a confined space, such as an electrical cabinet, the blast is directed and magnified.

What Happens?



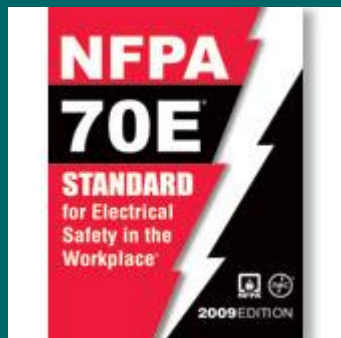


What Are The Effects?

- Obviously, these kinds of temperatures pose a severe burn hazard and the arc is a shock hazard.
- The flash/light can easily cause eye damage.
- Molten metal and shrapnel are spewed out at speeds reaching 700 miles per hour easily penetrating the human body.
- An arc blast creates a pressure wave that can reach 2,000 lbs./sq. ft. Noise can exceed 140 dB.
 - Ear drums can be damaged at 720 lbs./sq. ft.
 - 1,728 lbs./sq. ft. can result in lung damage.
 - A 170 lb. person can be thrown across a room at over 100 miles an hour.

When Is There A Danger?

- The danger is there only if current is. If work must be performed on or near energized parts, then NFPA (National Fire Protection Association) publication 70E should be your guide.
- According to NFPA 70E:
 - Circuits carrying less than 50 volts present little or no danger.
 - Up to 240 volts served by a single transformer of less than 125 Kva, the danger is minimal.
 - If the circuit is above 240 volts and/or served by more than one transformer larger than 125 Kva, then a significant hazard may exist.



How Can The Danger Be Avoided?

- The easy answer is don't allow any work to be done "live" or in proximity to "live" components. Post and enforce a strict de-energize and lockout policy per NFPA 70E.
- If the possibility of "live work" exists, then an arc flash analysis should be done on all subject installations.
 - This analysis should be done by a competent engineer using guidance from NFPA 70E and IEEE (Institute of Electrical and Electronic Engineers) Standard 1584.





What Will Analysis Tell Us?

- One key result will be to identify the “incident energy” level that could be expected in an arc flash event at a specific electrical installation. The incident energy level provided by the study will be given in calories per centimeter squared (cal/cm^2).
 - Incident energy is defined in NFPA 70E as, “the amount of energy impressed on a surface, a certain distance from the source, generated during an electrical arc event”.
 - A calorie is a measure of heat energy.
- The $\text{calories}/\text{cm}^2$ provided by the study will be reviewed to determine what level of PPE is required, among other things.



How Do We Choose PPE?

- NFPA 70E contains 5 hazard risk categories (HRC), 0 through 4.
 - The categories relate to cal/cm² levels or the ATPV (arc thermal performance value) rating assigned to clothing and other items.
 - The ATPV rating is based on the cal/cm² that will cause a second degree burn. 1.2 cal/cm² is the threshold for second degree burns.
 - Clothing, face shields, gloves, etc. should be selected based on the HRC or ATPV rating assigned by the manufacturer.
- The chart on the next slide shows the HRC's and associated ATPV's and describes the clothing requirements.
- Note that 40 cal/cm² is the highest level on the chart. No PPE presently available offers protection above 40 cal/cm². **Work should not be done "live" if this level may be exceeded!!**



Hazard/Risk Category

Clothing Description

ATPV
Rating
Cal/cm²



0 Untreated Cotton, Wool, Rayon, Silk, or Blend. Fabric weight >4.5oz/Yd² (1 layer) N/A

1 FR* Shirt and FR Pants or FR Coverall (1 layer) 4

2 Cotton underwear plus FR shirt and FR pants (1 or 2 layers) 8

3 Cotton underwear plus FR shirt and FR pants plus FR coverall, cotton underwear plus two FR Coveralls (2 or 3 layers) 25

4 Cotton underwear plus FR shirt and FR pants plus multilayer flash suit (3 or more layers) 40

* FR = fire resistant



Other Analysis Information

- As required in NFPA 70E under “Safety Practices When Working Live”:

- Determine Shock Hazard Boundaries (3):

- Limited Approach Boundary.
 - Entered if accompanied by a qualified person.
- Restricted Approach Boundary.
 - Entered only by a qualified person.
- Prohibited Approach Boundary.
 - Entered only by qualified person with precautions taken for live part contact.
- These boundaries determine when voltage rated gloves and tools must be used.



- Determine Flash Protection Boundary.

- Entered by qualified person wearing appropriate PPE; arc flash – arc blast clothing and equipment.
- This boundary usually ranges from 4 to 20 feet.
 - The default boundary for systems operating at 600 volts is 48 inches.



Actions Based On Analysis

- If “live work” is to be allowed:
 - Label enclosures with the appropriate ‘boundary’ information.
 - Make sure appropriate PPE and tools are available.
 - Make sure personnel are properly trained.
 - NFPA 70E recommends a written live work permit program.
- If live work is not allowed; label enclosures, and post MCC buildings to that effect. Train personnel accordingly.
- Remember, entering an energized enclosure, even for testing purposes, with no intention of touching live components is in fact “live work”.

3' - 4" 4.9 #2	Flash Hazard Boundary cal/cm2 Flash Hazard at 18 Inches PPE Level Cotton underwear plus FR shirt and FR pants
0.48 3' - 6" 1' - 0" 0' - 1"	kV Shock Hazard when cover is removed Limited Approach Restricted Approach - Class 00 Voltage Gloves Prohibited Approach - Class 00 VoltageGloves
Equipment Name SWG-2A	
IEEE 1584 Hazards; Project 1289A -- Safety Procedure #A6D24 -- EasyPower File: "Plant-A6.dez" -- Date: September 9, 2003	

Summary



- Policies and procedures must be in place governing “live work”:
 - The best policy is no “live work”.
 - Remember, any access, even for testing, is “live work”.
 - Post your policy and train your people.
 - If “live work” may be necessary:
 - Determine the level of danger and the various “boundaries”.
 - Post/label equipment with specific information.
 - Ensure that proper procedures are followed, proper PPE and tools are available and used.
- Even with proper PPE, severe injury may result from the force of the pressure wave and shrapnel.
- Never allow, or perform, “live work” where the capability of available PPE might be exceeded.



NIOSH Film

25 minutes

Access film: <http://www.msha.gov/streaming/wvx/arcflash.wvx>