



ARC FLASH CONSULTANTS

Arc Flash 101

FAQ'S

Q: WHAT IS AN ARC FLASH?

A: "ARC FLASH IS AN ELECTRIC CURRENT THAT IS PASSED THROUGH AIR WHEN INSULATION OR ISOLATION BETWEEN ELECTRIFIED CONDUCTORS IS NO LONGER SUFFICIENT TO WITHSTAND THE APPLIED VOLTAGE. THE FLASH IS IMMEDIATE, BUT THE RESULTS CAN CAUSE SEVERE INJURY. 2000 TIMES A YEAR, WORKERS ARE ADMITTED TO BURN CENTERS FOR EXTENDED INJURY TREATMENT CAUSED BY ARC FLASH."

-IEEE/NFPA DEFINITION

Q: WHY COMPLY WITH OSHA AND NFPA 70E?

A: "THE EMPLOYER IS REQUIRED TO CONDUCT AN ASSESSMENT IN ACCORDANCE WITH CFR 1910.132(D)(1). IF AN ARC-FLASH IS PRESENT, OR LIKELY TO BE PRESENT, THEN THE EMPLOYER MUST SELECT AND REQUIRE EMPLOYEES TO USE THE PROTECTIVE APPAREL. EMPLOYEES WHO CONDUCT THE HAZARD/RISK ASSESSMENT, AND SELECT AND REQUIRE THEIR EMPLOYEES TO USE PROTECTIVE CLOTHING AND OTHER PPE APPROPRIATE FOR THE TASK, AS STATED IN THE NFPA 70E, ARE DEEMED IN COMPLIANCE WITH THE HAZARD ASSESSMENT AND EQUIPMENT SELECTION OSHA STANDARD."

-RICHARD S. TERRILL
OSHA REGIONAL ADMINISTRATOR

Q: IS AN EMPLOYER REQUIRED TO PROVIDE PROTECTION FROM ARC FLASH TO EMPLOYEES?

A: YES. ARC FLASH IS A "RECOGNIZED HAZARD" AND THEREFORE MAY BE CITED UNDER THE OSHA'S GENERAL DUTY CLAUSE AND THE PPE STANDARD.

Q: CAN I BE CITED FOR NOT COMPLYING WITH NFPA 70E?

A: YES. UNDER OSHA 29CFR 1910.335(A)(1)(I), AN EMPLOYER MUST ASSESS A WORKPLACE FOR ELECTRICAL HAZARDS AND APPROBATE THE CORRECT PPE. THE EMPLOYER IS EXPECTED TO DO SO BY THE BEST MEANS POSSIBLE AND THE NATIONAL CONSENSUS IS NFPA 70E. IF AN EMPLOYEE WERE TO BE INJURED, THE 70E CAN BE CITED AS EVIDENCE BY OSHA AS TO WHETHER THE EMPLOYER ACTED REASONABLY.

OSHA

GENERAL DUTY CLAUSE.

SECTION 5(A)(1)

EACH EMPLOYER SHALL FURNISH TO EACH OF HIS EMPLOYEES EMPLOYMENT AND A PLACE OF EMPLOYMENT WHICH ARE FREE FROM RECOGNIZED HAZARDS THAT ARE CAUSING OR ARE LIKELY TO CAUSE DEATH OR SERIOUS PHYSICAL HARM TO HIM OR HER.

1910.335(B)(1)

SAFETY-RELATED WORK PRACTICES SHALL BE EMPLOYED TO PREVENT ELECTRIC SHOCK OR OTHER INJURIES RESULTING FROM EITHER DIRECT OR INDIRECT ELECTRICAL CONTACTS, WHEN WORK IS PERFORMED NEAR OR ON EQUIPMENT OR CIRCUITS WHICH ARE OR MAY BE ENERGIZED. THE SPECIFIC SAFETY-RELATED WORK PRACTICES SHALL BE CONSISTENT WITH THE NATURE AND EXTENT OF THE ASSOCIATED ELECTRICAL HAZARDS.

1910.335(A)(1)(I) PERSONNEL PROTECTIVE EQUIPMENT

EMPLOYEES WORKING IN AREAS WHERE THERE ARE POTENTIAL ELECTRICAL HAZARDS SHALL BE PROVIDED WITH, AND SHALL USE, ELECTRICAL PROTECTIVE EQUIPMENT THAT IS APPROPRIATE FOR THE SPECIFIC PARTS OF THE BODY TO BE PROTECTED AND FOR THE WORK TO BE PERFORMED.

NEC

110.16 FLASH PROTECTION.

ELECTRICAL EQUIPMENT SUCH AS SWITCHBOARDS, PANELBOARDS, INDUSTRIAL CONTROL PANELS, METER SOCKET ENCLOSURES, AND MOTOR CONTROL CENTERS, THAT ARE IN OTHER THAN DWELLING OCCUPANCIES, AND ARE LIKELY TO REQUIRE EXAMINATION, ADJUSTMENT, SERVICING, OR MAINTENANCE WHILE ENERGIZED SHALL BE FIELD MARKED TO WARN QUALIFIED PERSONS OF POTENTIAL ELECTRIC ARC FLASH HAZARDS. THE MARKING SHALL BE LOCATED SO AS TO BE CLEARLY VISIBLE TO QUALIFIED PERSONS BEFORE EXAMINATION, ADJUSTMENT, SERVICING, OR MAINTENANCE OF EQUIPMENT.

NFPA 70E

130.3 ARC FLASH HAZARD ANALYSIS

AN ARC FLASH HAZARD ANALYSIS SHALL DETERMINE THE ARC FLASH PROTECTION BOUNDARY AND THE PERSONAL PROTECTIVE EQUIPMENT THAT PEOPLE WITHIN THE ARC FLASH PROTECTION BOUNDARY SHALL USE. THE ARC FLASH HAZARD ANALYSIS SHALL BE UPDATED WHEN A MAJOR MODIFICATION OR RENOVATION TAKES PLACE. IT SHALL BE REVIEWED PERIODICALLY, NOT TO EXCEED FIVE YEARS, TO ACCOUNT FOR CHANGES IN THE ELECTRICAL DISTRIBUTION SYSTEM THAT COULD AFFECT THE RESULTS OF THE ARC FLASH HAZARD ANALYSIS. THE ARC FLASH HAZARD ANALYSIS SHALL TAKE INTO CONSIDERATION THE DESIGN OF THE OVERCURRENT PROTECTION DEVICE AND ITS OPENING TIME, INCLUDING ITS CONDITION OF MAINTENANCE.

110.6 TRAINING REQUIREMENTS

(A) SAFETY TRAINING.

THE TRAINING REQUIREMENTS CONTAINED IN THIS SECTION SHALL APPLY TO EMPLOYEES WHO FACE A RISK OF ELECTRICAL HAZARD THAT IS NOT REDUCED TO A SAFE LEVEL BY THE APPLICABLE ELECTRICAL INSTALLATION REQUIREMENTS. SUCH EMPLOYEES SHALL BE TRAINED TO UNDERSTAND THE SPECIFIC HAZARDS ASSOCIATED WITH ELECTRICAL ENERGY. THEY SHALL BE TRAINED IN SAFETY-RELATED WORK PRACTICES AND PROCEDURAL REQUIREMENTS AS NECESSARY TO PROVIDE PROTECTION FROM THE ELECTRICAL HAZARDS ASSOCIATED WITH THEIR RESPECTIVE JOB OR ASSIGNMENTS. EMPLOYEES SHALL BE TRAINED TO IDENTIFY AND UNDERSTAND THE RELATIONSHIP BETWEEN ELECTRICAL HAZARDS AND POSSIBLY INJURY.

ARTICLE 130.7 PERSONAL AND OTHER PROTECTIVE EQUIPMENT.

130.7(C)(1) GENERAL. WHEN AN EMPLOYEE IS WORKING WITHIN THE FLASH PROTECTION BOUNDARY HE/SHE SHALL WEAR PROTECTIVE CLOTHING AND OTHER PERSONAL PROTECTIVE EQUIPMENT IN ACCORDANCE WITH 130.3. ALL PARTS OF THE BODY INSIDE THE ARC FLASH PROTECTION BOUNDARY SHALL BE PROTECTED. (THIS SECTION USES THE FLASH HAZARD ANALYSIS TO DETERMINE THE PROPER PPE)

HAZARD RISK CATEGORY TABLE

HRC	CAL/CM ²	REQUIRED PPE
0	0-1.2	UNTREATED COTTON LONG-SLEEVE SHIRT & LONG PANT, SAFETY GLASSES, HEARING PROTECTION, VOLTAGE-RATED ELECTRICAL GLOVES W/LEATHER PROTECTOR.
1	1.2-4.0	FR (MEET OR EXCEED CALCULATED INCIDENT ENERGY) LS SHIRT & PANTS (OR COVERALL), BALACLAVA, HARDHAT + ARC RATED FACE SHIELD W/ WRAPAROUND GUARD (OR FLASH SUIT HOOD), SAFETY GLASSES, HEARING PROTECTION, VOLTAGE-RATED ELECTRICAL GLOVES W/LEATHER PROTECTORS, HEAVY-DUTY LEATHER WORK SHOES.
2	4.0-8.0	FR (MEET OR EXCEED CALCULATED INCIDENT ENERGY) LS SHIRT & PANTS (OR COVERALL), BALACLAVA, HARDHAT + ARC RATED FACE SHIELD W/ WRAPAROUND GUARD (OR FLASH SUIT HOOD), SAFETY GLASSES, HEARING PROTECTION, VOLTAGE-RATED ELECTRICAL GLOVES W/LEATHER PROTECTORS, HEAVY-DUTY LEATHER WORK SHOES.
3	8.0-25.0	FR (MEET OR EXCEED CALCULATED INCIDENT ENERGY) LS SHIRT & PANTS (OR COVERALL) W/AF SUIT AND HOOD SO SYSTEM MEETS MIN REQUIRED RATING, HARDHAT + HARD HAT LINER OR BALACLAVA, SAFETY GLASSES, HEARING PROTECTION, VOLTAGE-RATED ELECTRICAL GLOVES WITH LEATHER PROTECTORS, HEAVY-DUTY LEATHER WORK SHOES.
4	25.0-40.0	FR (MEET OR EXCEED CALCULATED INCIDENT ENERGY) LS SHIRT & PANTS (OR COVERALL) W/AF SUIT AND HOOD SO SYSTEM MEETS MIN REQUIRED RATING, HARDHAT + HARD HAT LINER OR BALACLAVA, SAFETY GLASSES, HEARING PROTECTION, VOLTAGE-RATED ELECTRICAL GLOVES WITH LEATHER PROTECTORS, HEAVY-DUTY LEATHER WORK SHOES.
DANGER	ABOVE 40.0	NO ADEQUATE PPE TO PROTECT AGAINST ALL HAZARDS AT THIS CALCULATED INCIDENT ENERGY LEVEL.

IMPORTANT DEFINITIONS

ARC RATING-THE VALUE ATTRIBUTED TO MATERIALS THAT DESCRIBES THEIR PERFORMANCE TO EXPOSURE TO AN ELECTRICAL ARC DISCHARGE. THE ARC RATING IS EXPRESSED IN CAL/CM² AND IS DERIVED FROM THE DETERMINED VALUE (ATPV) OR ENERGY OF BREAKOPEN THRESHOLD (E_{BT})(SHOULD A MATERIAL SYSTEM EXHIBIT A BREAKOPEN RESPONSE BELOW THE ATPV VALUE) DERIVED FROM THE DETERMINED VALUE OF ATPV OR E_{BT}.

ARC FLASH PROTECTION BOUNDARY-WHEN AN ARC FLASH HAZARD EXISTS, AN APPROACH LIMIT AT A DISTANCE FROM A PROSPECTIVE ARC SOURCE WITHIN WHICH A PERSON COULD RECEIVE A SECOND DEGREE BURN IF AN ELECTRICAL ARC FLASH WERE TO OCCUR.

INCIDENT ENERGY-THE AMOUNT OF ENERGY IMPRESSED ON A SURFACE, A CERTAIN DISTANCE FROM THE SOURCE, GENERATED DURING AN ELECTRICAL ARC EVENT. ONE OF THE UNITS USED TO MEASURE INCIDENT ENERGY IS CALORIES PER CENTIMETER SQUARED (CAL/CM²).

QUALIFIED PERSON-ONE WHO HAS THE SKILLS AND KNOWLEDGE RELATED TO THE CONSTRUCTION AND OPERATION OF THE ELECTRICAL EQUIPMENT AND INSTALLATIONS AND HAS RECEIVED SAFETY TRAINING TO RECOGNIZE AND AVOID THE HAZARDS INVOLVED.

SHOCK HAZARD-A DANGEROUS CONDITION ASSOCIATED WITH THE POSSIBLE RELEASE OF ELECTRICAL ENERGY CAUSED BY CONTACT OR APPROACH TO ENERGIZED ELECTRICAL EQUIPMENT.

WORKING DISTANCE-THE DIMENSION BETWEEN THE POSSIBLE ARC POINT AND THE HEAD AND BODY OF THE WORKER POSITIONED IN PLACE TO PERFORM ASSIGNED TASK.

WARNING
Qualified Persons Only


Arc Flash and Shock Hazards
Appropriate PPE Required

REVIEW SAFE WORK PRACTICES PRIOR TO WORK

11 Inch Arc Flash Protection Boundary
0.50 cal/cm² AF Incident Energy @ Working Distance: **18 Inch**

Recommended (minimum) PPE:
Untreated Cotton Long-sleeve Shirt & Long Pant, Safety Glasses, Hearing Protection, Voltage-Rated Electrical Gloves w/Leather protector.

0

480 VAC 00	Shock Hazard Glove Class	 <small>HERZIG ENGINEERING INC. ALWAYS CONSULT THE SITE</small> Job# 2009-00-00-00-BHA Prepared 08/28/09
42 Inch	Limited Approach	
12 Inch	Restricted Approach	
1 Inch	Prohibited Approach	

Location: Glycol Pumps

WARNING
Qualified Persons Only

Arc Flash and Shock Hazards
Appropriate PPE Required

REVIEW SAFE WORK PRACTICES PRIOR TO WORK

31 Inch Arc Flash Protection Boundary
2.9 cal/cm² AF Incident Energy @ Working Distance: **18 Inch**

Recommended (minimum) PPE:
FR (meet or exceed calculated Incident Energy) LS Shirt & Pants (or coverall), Balaclava, Hardhat + Arc Rated Face Shield w/wraparound guard (or flash suit hood), Safety Glasses, Hearing Protection, Voltage-Rated Electrical Gloves with leather protectors, Heavy-duty Leather work shoes.

1

480 VAC 00	Shock Hazard Glove Class	 <small>HERZIG ENGINEERING INC. ALWAYS CONSULT THE SITE</small> Job# 2009-00-00-00-BHA Prepared 08/28/09
42 Inch	Limited Approach	
12 Inch	Restricted Approach	
1 Inch	Prohibited Approach	

Location: Buss Duct SEC1

WARNING
Qualified Persons Only


Arc Flash and Shock Hazards
Appropriate PPE Required

REVIEW SAFE WORK PRACTICES PRIOR TO WORK

46 Inch Arc Flash Protection Boundary
5.5 cal/cm² AF Incident Energy @ Working Distance: **18 Inch**

Recommended (minimum) PPE:
FR (meet or exceed calculated Incident Energy) LS Shirt & Pants (or coverall), Balaclava, Hardhat + Arc Rated Face Shield w/ wraparound guard (or flash suit hood), Safety Glasses, Hearing Protection, Voltage-Rated Electrical Gloves with leather protectors, Heavy-duty Leather work shoes.

2

480 VAC 00	Shock Hazard Glove Class	 <small>HERZIG ENGINEERING INC. ALWAYS CONSULT THE SITE</small> Job# 2009-00-00-00-BHA Prepared 08/28/09
42 Inch	Limited Approach	
12 Inch	Restricted Approach	
1 Inch	Prohibited Approach	

Location: T-1 XFRM DISC

WARNING
Qualified Persons Only


Arc Flash and Shock Hazards
Appropriate PPE Required

REVIEW SAFE WORK PRACTICES PRIOR TO WORK

67 Inch Arc Flash Protection Boundary
10 cal/cm² AF Incident Energy @ Working Distance: **18 Inch**

Recommended (minimum) PPE:
FR (meet or exceed calculated IE) LS Shirt & Pant (or FR Coverall) w/ AF Suit and Hood so system meets min required rating, Hardhat + FR hard hat liner or balaclava, Safety Glasses, Hearing Protection, Voltage-Rated Electrical Gloves with leather protectors, Heavy-duty Leather work shoes.

3

480 VAC 00	Shock Hazard Glove Class	 <small>HERZIG ENGINEERING INC. ALWAYS CONSULT THE SITE</small> Job# 2009-00-00-00-BHA Prepared 08/28/09
42 Inch	Limited Approach	
12 Inch	Restricted Approach	
1 Inch	Prohibited Approach	

Location: T-1 XFRM DISC

WARNING
Qualified Persons Only

Arc Flash and Shock Hazards
Appropriate PPE Required

REVIEW SAFE WORK PRACTICES PRIOR TO WORK

144 Inch Arc Flash Protection Boundary
36 cal/cm² AF Incident Energy @ Working Distance: **18 Inch**

Recommended (minimum) PPE:
FR (meet or exceed calculated IE) LS Shirt & Pant (or FR Coverall) w/ AF Suit and Hood so system meets min required rating, Hardhat + FR hard hat liner or balaclava, Safety Glasses, Hearing Protection, Voltage-Rated Electrical Gloves with leather protectors, Heavy-duty Leather work shoes.

4

480 VAC 00	Shock Hazard Glove Class	 <small>HERZIG ENGINEERING INC. ALWAYS CONSULT THE SITE</small> Job# 2009-00-00-00-BHA Prepared 08/28/09
42 Inch	Limited Approach	
12 Inch	Restricted Approach	
1 Inch	Prohibited Approach	

Location: DP5M201


DANGER
Qualified Persons Only

NO SAFE PPE EXISTS
ENERGIZED WORK PROHIBITED

REVIEW SAFE WORK PRACTICES PRIOR TO WORK

329 Inch Arc Flash Protection Boundary
140 cal/cm² AF Incident Energy @ Working Distance: **18 Inch**

Recommended (minimum) PPE:
No Adequate PPE to protect against all Hazards at this Calculated Incident Energy Level

480 VAC 00	Shock Hazard Glove Class	 <small>HERZIG ENGINEERING INC. ALWAYS CONSULT THE SITE</small> Job# 2009-00-00-00-BHA Prepared 08/28/09
42 Inch	Limited Approach	
12 Inch	Restricted Approach	
1 Inch	Prohibited Approach	

Location: SWBD MAIN



WARNING

Qualified Persons Only

Arc Flash and Shock Hazards Appropriate PPE Required

REVIEW SAFE WORK PRACTICES PRIOR TO WORK

67 Inch Arc Flash Protection Boundary

10 cal/cm² AF Incident Energy @ Working Distance: **18 Inch**

Recommended (minimum) PPE:

FR (meet or exceed calculated IE) LS Shirt & Pant (or FR Coverall) w/ AF Suit and Hood so system meets min required rating, Hardhat + FR hard hat liner or balaclava, Safety Glasses, Hearing Protection, Voltage-Rated Electrical Gloves with leather protectors, Heavy-duty Leather work shoes.

3

480 VAC	Shock Hazard
00	Glove Class
42 Inch	Limited Approach
12 Inch	Restricted Approach
1 Inch	Prohibited Approach



Job# 2009-00-00-00-BHA
Prepared 08/28/09

Location: T-1 XFRM DISC

LOCATION

INCIDENT
ENERGY

WORKING
DISTANCE

NOMINAL
VOLTAGE

HAZARD RISK
CATEGORY

APPROACH
BOUNDARIES

PPE

PROPER
WARNING