This guide shall only be used in conjunction with performing the necessary calculations contained in a flash hazard analysis to determine the proper cal/cm². If the results of the calculations exceed the cal/cm² that correspond to the HRC found on this guide, you must use clothing that complies with the calculation.

Panelboards or Other Equipment Rated 240V and Below - Parameters 1

TASK (equipment is energized & work is done within the flash protection boundary)	V-Rated Gloves	V-Rated Tools	HRC
Perform infrared thermography and other non-contact inspection outside the restricted approach boundary			0
Circuit Breaker (CB) or fused switch operation with covers on			0
CB or fused switch operation with covers off			0
Work on energized electrical conductors and circuit parts, including voltage testing	Y	Y	1
Remove/install CBs or fused switches	Y	Y	1
Removal of bolted covers (to exposed bare, energized electrical conductors and circuit parts)			1
Open hinged covers (to exposed bare, energized electrical conductors and circuit parts)			0
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panelboard	Y	Y	1

Panelboards or Switchboards Rated >240V and up to 600 V (with molded or insulated case circuit breakers) - Parmeters 2

TASK (equipment is energized & work is done within the flash protection boundary)	V-Rated Gloves	V-Rated Tools	HRC
Perform infrared thermography and other non-contact inspection outside the restricted approach boundary			1
Circuit Breaker (CB) or fused switch operation with covers on			0
CB or fused switch operation with covers off	Y		1
Work on energized electrical conductors and circuit parts, including voltage testing	Y	Y	2
Remove/install CBs or fused switches	Y	Y	2
Removal of bolted covers (to exposed bare, energized electrical conductors and circuit parts)			1
Open hinged covers (to exposed bare, energized electrical conductors and circuit parts)			0
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panelboard	Y	Y	2

600 V Class Motor Control Center (MCCs)-- Parameters 3

TASK (equipment is energized & work is done within the flash protection boundary)	V-Rated Gloves	V-Rated Tools	HRC
Perform infrared thermography and other non-contact inspection outside the restricted approach boundary			1
CB or fused switch or starter operation with enclosure doors closed			0
Reading a panel meter while operation a meter switch			0
CB or fused switch or starter operation with enclosure doors open			1
Work on energized electrical conductors and circuit parts, including voltage testing	Y	Y	2
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	Y	Y	0
Work on control circuits with enerqized electrical conductor and circuit parts >120 V, exposed	Y	Y	2
Application of temporary protective grounding equipment, after voltage test	Y		2
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the motor control center	Y	Y	2

600 V Class Motor Control Center (MCCs) Parameters 4

TASK (equipment is energized & work is done within the flash protection boundary)	V-Rated Gloves	V-Rated Tools	HRC
Insert or removal of individual starter "bucket" from MCC	Y		4
Removal of bolted covers (to exposed bare, energized electrical conductors and circuit parts)			4
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)			1

600 V Class Switchgear (with power circuit breakers or fused switches) and 600 V Class Switchboards--Parameters 5

TASK (equipment is energized & work is done within the flash protection boundary)	V-Rated Gloves	V-Rated Tools	HRC
Perform infrared thermography and other non-contact inspection outside the restricted approach boundary			2
CB or fused switch or starter operation with enclosure doors closed			0
Reading a panel meter while operation a meter switch			0
CB or fused switch operation with enclosure doors open			1
Work on energized electrical conductors and circuit parts, including voltage testing	Y	Y	2
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	Y	Y	0
Work on control circuits with energized electrical conductor and circuit parts >120 V, exposed	Y	Y	2
Insertion or removal (racking) of CBs from cubicles, doors open or closed			4
Application of safety grounds, after voltage test	Y		2
Removal of bolted covers (to exposed bare, energized electrical conductors and circuit parts)			4
Open hinged covers (to exposed bare, energized electrical conductors and circuit parts)			2

Other 600 V Class (277 V through 600 V, nominal) Equipment Parameters 3

TASK (equipment is energized & work is done within the flash protection boundary)	V-Rated Gloves	V-Rated Tools	HRC
Lighting or small Power transformer (600 V. Maximum)-below next 4 lines			
Removal of bolted cover (to expose bare, energized electrical conductors and circuit parts)			2
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)			1
Work on energized electrical conductors and circuit parts, including voltage testing	Y	Y	2
Application of temporary protective grounding equipment, after voltage test	Y		2
Revenue meters (kW-hour, at primary voltage and current) Insertion or removal	Y		2
Cable trough or tray cover removal or installation			1
Miscellaneous Equipment cover removal or installation			1
Work on energized electrical conductors and circuit parts, including voltage testing	Y	Y	2
Application of temporary protective grounding equipment, after voltage test	Y		2
Insertion or removal of plug-in devices into or from busways	Y		2

NFPA 70 E Compliance Guide

See next page for Clothing Requirements and Definitions and Parameters---Revised 09-12 (2012)

Nema E2 (fused contactor) Motor Starters, 2.3 kV Through 7.2 kV Parameters 6

TASK (equipment is energized & work is done within the flash protection boundary)	V-Rated Gloves	V-Rated Tools	HRC
Perform infrared thermography and other non-contact inspection outside the restricted approach boundary			3
Contactor operation with encloseure doors closed			0
Reading a panel meter while operating a meter switch			0
Contactor operation with encloseure doors open			2
Work on energized electrical conductors and circuit parts, including voltage testing	Y	Y	4
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	Y	Y	0
Work on control circuits with energized electrical conductor and circuit parts >120 V, exposed	Y	Y	3
Insertion or removal (racking) of starters from cubicles, doors open or closed			4
Application of temporary protective grounding equipment, after voltage test	Y		3
Removal of bolted cover (to expose bare, energized electrical conductors and circuit parts)			4
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)			3
Insertion or removal (racking) of starters from cubicles of arc-resistant construction, tested in accordance with IEEE C37.20.7, doors closed only			0

Metal Clad Switchgear, 1 kV Through 38 kV Parameter 6

TASK (equipment is energized & work is done within the flash protection boundary)	V-Rated Gloves	V-Rated Tools	HRC
Perform infrared thermography and other non-contact inspection outside the restricted approach boundary			3
CB operation with enclosure doors closed			2
Reading a panel meter while operating a meter switch			0
CB operation with enclosure doors open			4
Work on energized electrical conductors and circuit parts, including voltage testing	Y	Y	4
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	Y	Y	2
Work on control circuits with energized electrical conductor and circuit parts >120 V, exposed	Y	Y	4
Insertion or removal (racking) of CBs from cubicles, doors open or closed			4
Application of temporary protective grounding equipment, after voltage test	Y		4
Removal of bolted cover (to expose bare, energized electrical conductors and circuit parts)			4
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)			3
Opening voltage transformer or control power transformer compartments			4

Arc-Resistant Switchgear Type 1 or 2 (for clearing times of <0.5 sec with a perspective fault current not exceed the arc resistant rating of equip.) Parameters 6

TASK (equipment is energized & work is done within the flash protection boundary)	V-Rated Gloves	V-Rated Tools	HRC
CB operation with enclosure doors closed			0
Insertion or removal (racking) of CBs from cubicles, doors closed			0
Insertion or removal of CBs from cubicles, doors open			4
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	Y	Y	2
Insertion or removal (racking) of ground and test device with doors closed			0
Insertion or removal (racking) voltage transformer on or off the bus door closed			0

NFPA 70E COMPLIANCE GUIDE

Other Equipment 1 kV Through 38 kV Parameters 6			
TASK (equipment is energized & work is done within the flash protection boundary)	**V-Rated Gloves**	**V-Rated Tools**	**HRC**
Metal-enclosed interrupter switchgear, fused or unfused-below next 5 lines			
Switch operation of arc-resistant-type construction, tested in accordance with IEEE C37.20.7, doors closed only			0
Switch operation , doors closed			2
Work on energized electrical conductors and circuit parts, including voltage testing	Y	Y	4
Removal of bolted cover (to expose bare, energized electrical conductors and circuit parts)			4
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)			3
Outdoor disconnect switch operation (hook-stick operated)	Y	Y	3
Outdoor disconnect switch operation (gang-operated,from grade)	Y		2
Insulated cable examination, in manhole or other confined space	Y		4
Insulated cable examination, in open area	Y		2

HRC	Protective Clothing	Minimum cal/cm²	PPE(Safety glasses, hearing protection, leather safety shoes required for all)
0	Natural fiber long-sleeved shirt and pants (non melting)	**N/A**	Hard Hat
1	AR long-sleeved shirt and AR pants OR AR coveralls	**4**	Hard Hat, Arc-Rated Face Shield OR Flash suit hood
2	AR long-sleeved shirt and AR pants OR AR coveralls	**8**	Hard Hat, Arc-Rated Face Shield with AR Balaclava (sock hood) OR Flash suit hood
3	Multi-Layer flash suit over AR long-sleeved shirt and pants over natural fiber short-sleeved T-shirt and pants OR Multi-Layer flash suit over AR coveralls over natural fiber short-sleeved T-shirt and pants	**25**	Hard Hat, Multi-Layer Switching Hood
4	Multi-Layer flash suit over AR long-sleeved shirt and pants over natural fiber short-sleeved T-shirt and pants OR Multi-Layer flash suit over AR coveralls over natural fiber short-sleeved T-shirt and pants	**40**	Hard Hat, Multi-Layer Switching Hood

Definitions: Y=Yes (Required)

V-Rated Gloves : Rubber Insulating gloves rated and tested for the maximum line-to-line voltage upon which work will be done. Leather protectors must be worn externally if rubber insulating gloves could be damaged.
V-Rated Tools : Insulated and Insulating Hand Tools rated and tested for the maximum line-to-line voltage upon which work will be done.
HRC : Hazard Risk Category
AR : Arc Rated (replaces FR 2012 NFPA 70E)

* If the Parameters cannot be satisfied, work must be performed de-energized.

Parameter 1: Maximum of 25 kA short circuit current available, maximum of 0.03 second (2 cycle) fault clearing time; minimum 18 inch working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 19 inches
Parameter 2: Maximum of 25 kA short circuit current available, maximum of 0.03 second (2 cycle) fault clearing time; minimum 18 inch working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 30 inches
Parameter 3: Maximum of 65 kA short circuit current available, maximum of 0.03 second (2 cycle) fault clearing time; minimum 18 inch working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 53 inches
Parameter 4: Maximum of 42 kA short circuit current available, maximum of 0.33 second (20 cycle) fault clearing time; minimum 18 inch working distance. Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 165 inches
Parameter 5: Maximum of 35 kA short circuit current available, maximum of 0.5 second (30 cycle) fault clearing time; minimum 18 inch working distance. Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 233 inches
Parameter 6: Maximum of 35 kA short circuit current available, maximum of 0.2 second (12 cycle) fault clearing time; minimum 36 inch working distance. Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 422 inches
*Working on circuits over 40 **cal/cm²** should be avoided because of blast hazards.

(1) Rubber insulating gloves are gloves rated for the maximum voltage upon which work will be done.

(2) Insulated and insulating hand tools are tools rated and tested for the maximum line-to-line voltage upon which work will be done, and are manufactured and tested in accordance with ASTM F 1505, *Standard Specification for Insulated and Insulating Hand Tools*.

(3) The use of “N” does not indicate that rubber insulating gloves and insulated and insulating hand tools are not required in all cases. Rubber insulating gloves and insulated and insulating hand tools may be required by 130.4, 130.8 (C) (7), and 130.8(D).

(4) For equipment protected by upstream current limiting fuses with arcing fault current in their current limiting range (1/2 cycle fault clearing time or less), the hazard/risk category required may be reduced by one number.

(5) For power systems up to 600 V the arc flash boundary was determined by using the following information: When 0.03 second trip time was used, that indicated MCC or panelboard equipment protected by a molded-case circuit breaker. Working distance used was 18 in. (455 mm). Arc gap used was 32 mm for switchgear and 25 rnm for MCC and protective device type 0 for all. When 0.33 or 0.5 second trip time was used, that indicated a LVPCB (drawout circuit breaker) in switchgear. Working distance was 24 in. (610 mm). Arc gap used was 32 mm and protective device type 0 for all. All numbers were rounded up or down depending on closest multiple of 5.

(6) For power systems from I kV to 38 kV the arc flash boundary was determined by using the following information: No maximum values were given in the 2009 edition of NFPA 70E for short-circuit current or operating time. Two sets of equations were performed: 35 kA AIC and 0.2 second operating time and 26 kA AIC and 0.2 second operating time. 0.2 seconds was used by adding the typical maximum total clearing time of the circuit breaker to an estimated value for relay operation. This coincides with the IEEE 1584 values of 0.18 second operating time and 0.08 tripping time rounded off. A short-circuit curent of 35 kA was used as a maximum (HRC-4 @ ~ 40 cal/cm ²) and 26 kA was used to compare the effects of lowering the short circuit current (HRC-4 @ ~ 30 cal/cm ²). Working distance used was 36 in. (909 mm), arc gap was 6 in. (455 mm), and protective device type 0 for all.