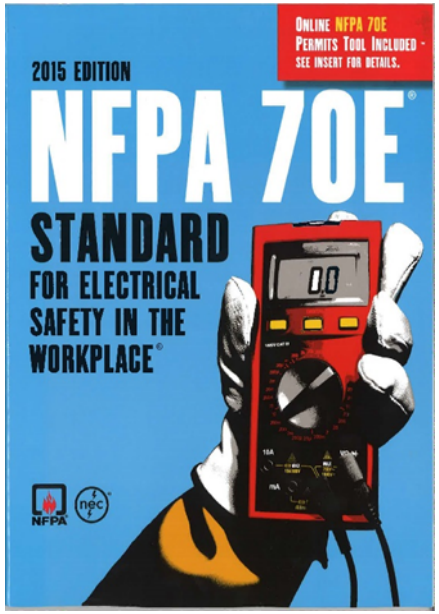
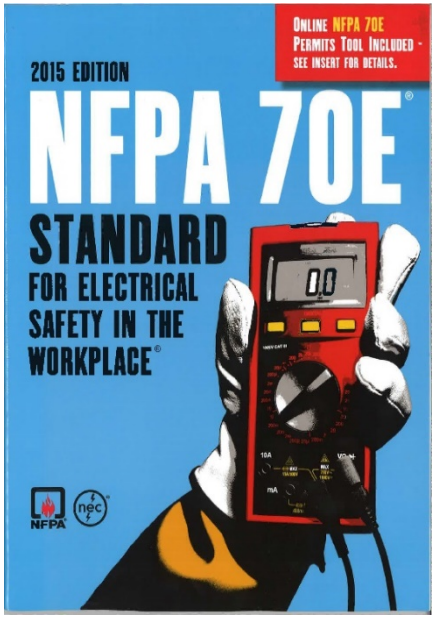
GARD

Unparalleled Protection

Mitigating Arc Flash by Following NFPA70E



What is an Arc Flash?



According to NFPA 70E:

A dangerous condition associated with the release of energy caused by an electric arc.

A hazard beyond shock and electrocution.

What does an Arc Flash Do?

What does it do?

- It hurts people !
- It destroys equipment !
- It Results in Penalties from OSHA
- It Causes outages !
- It Affects morale !

Informative Annex O Safety-Related Design Requirements

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(1) Reducing the likelihood of exposure

(2) Reducing the magnitude or severity of exposure

(3) Enabling achievement of an electrically safe work condition

O.2.3 Incident Energy Reduction Methods. The following methods have proved to be effective in reducing incident energy:

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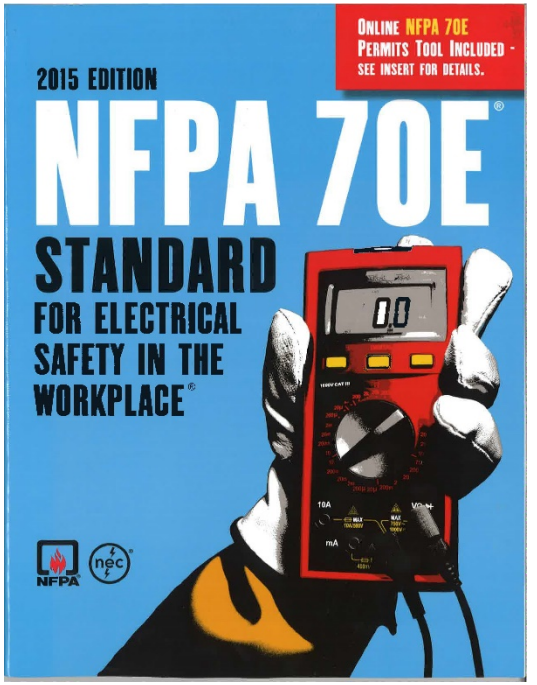

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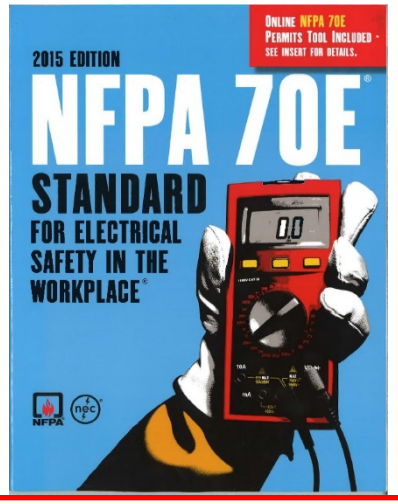

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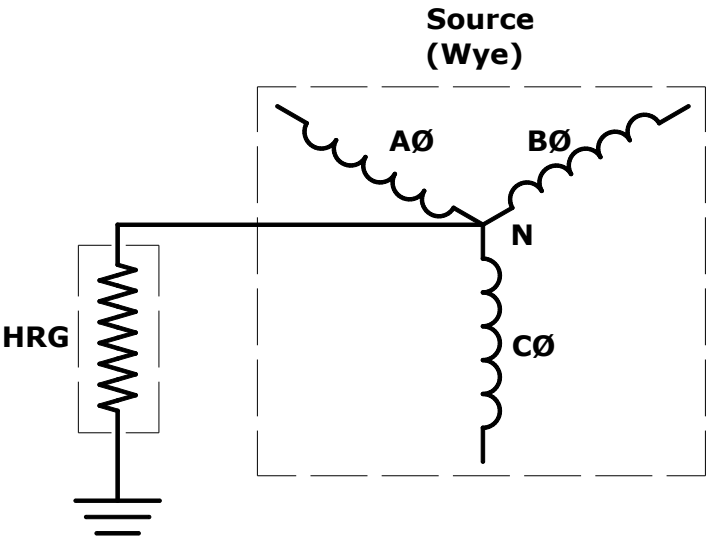
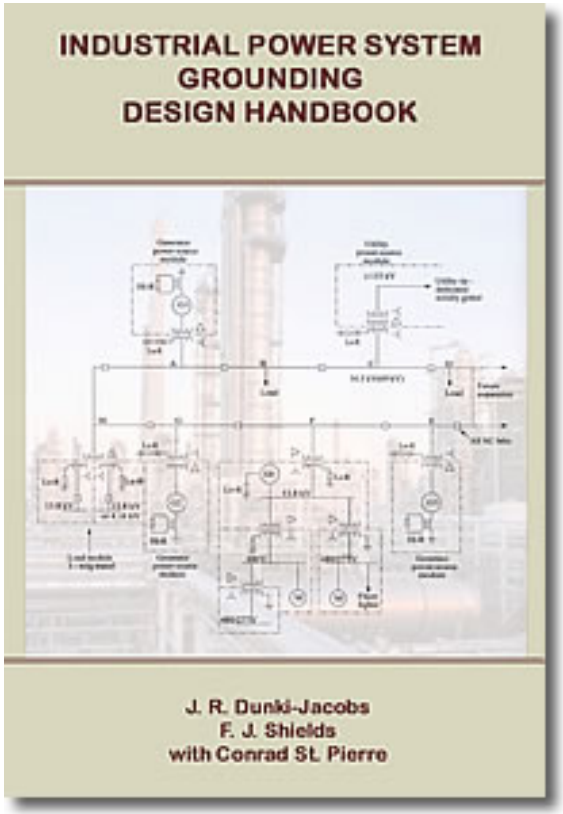
Reducing the Likelihood of Exposure
High Resistance Grounding

How Does HRG reduce Arc Flash?

According to Industrial Power System Grounding Design Handbook - 95% of all electrical faults are phase to ground faults.

By limiting the fault current to a low level, 10 amps or less, there is insufficient current for the arc to re-strike and it self-extinguishes.





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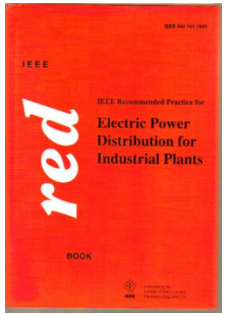
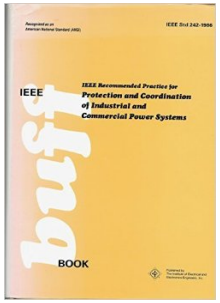


IEEE Std 141-1993 (Red Book)

7.2.2. High-resistance grounding provides the same advantages as ungrounded systems yet limits the steady state and severe transient over-voltages associated with ungrounded systems.



IEEE Std 242-1986 Recommended Practice for the Protection and Coordination of Industrial and Commercial Power Systems

7.2.5. Ungrounded systems offer no advantage over high-resistance grounded systems in terms of continuity of service and have the disadvantages of transient over-voltages, locating the first fault and burn-downs from a second ground fault. For these reasons, they are being used less frequently today than high-resistance grounded systems”

Reducing the Likelihood of Exposure
High Resistance Grounding

FM Global 5-18 Protection of Electrical Equipment Single Phase and Other Related Faults

- In ungrounded systems a phase to ground fault often produces dangerous overvoltage…
- Sustained arcing faults in low voltage apparatus are often initiated by a single-phase fault to ground which results in extensive damage to switchgear and motor control centers.

FM Global 5-10 Protective Grounding for Electric Power Systems and Equipment

- 2.3.3.1 Unlike the ungrounded system the high resistance grounded system prevents transient overvoltage which can cause potential failure of insulation.
- 2.3.4.1 Convert ungrounded systems to high resistance grounded systems.

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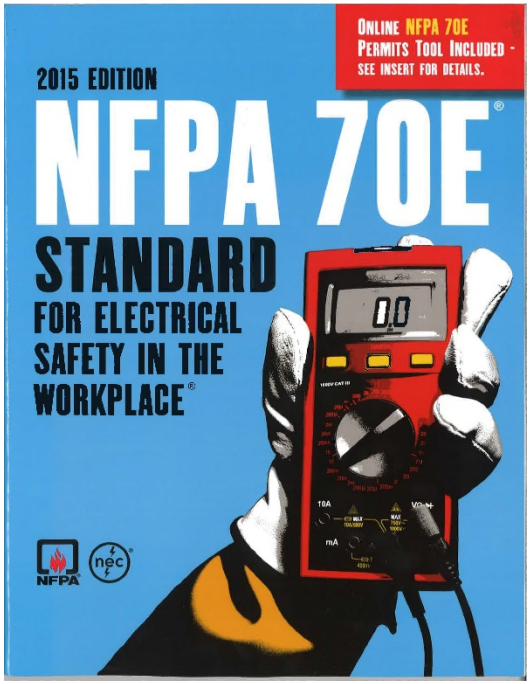

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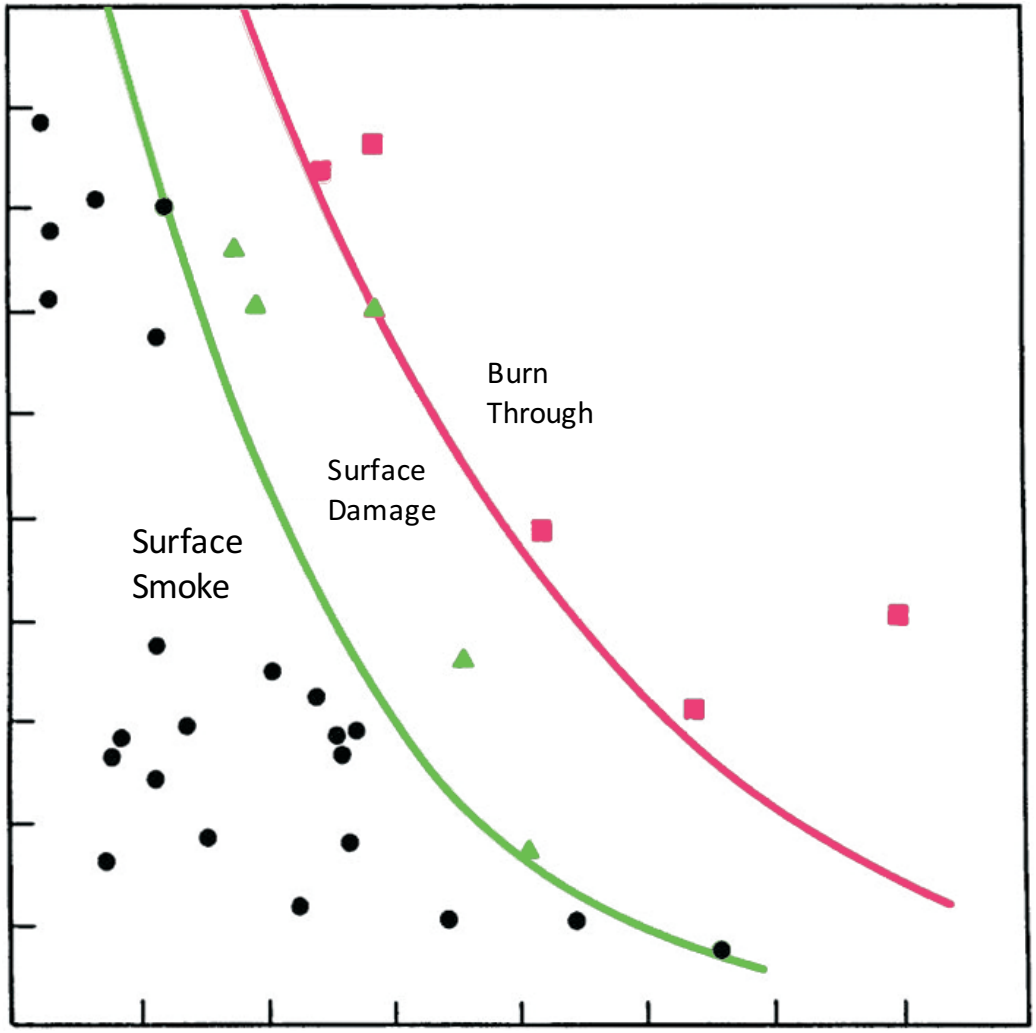
Reducing the Magnitude of Exposure

Arc Flash Relay



Arc damage curve showing arc current versus arc time

An arc is developed within milli-seconds and leads to the discharge of enormous amounts of destructive energy. The energy in the arc is directly proportional to the square of the short-circuit current and the time the arc takes to develop.

Reduce the Time,

Reduce the Damage,

Reduce the Incident Energy.

Reducing the Magnitude of Exposure

Arc Flash Relay

Protection at the Speed of Light

ARC-i-TEC: Optical Sensing Technology

- Sense and initiate trip in 1ms
- Use current and light inputs – 12 optical sensors
- Simultaneously trip up to 4 breakers
- ModBus Communication
- BIT: Built in tester – checking integrity at all times

SENTRi :Optical Sensing Technology

- Arc flash 1ms speed
- 3 light sensors with optional pressure sensors
- Simultaneously trip up to 3 breakers
- ModBus Communication

Reducing the Magnitude of Exposure

Arc Flash Relay

Incident Energy Comparison

PROTECTION TYPE	CLEARING TIME (SECONDS)	INCIDENT ENERGY (CAL/CM^2)
51 Overcurrent	2.00	211
50 Instantaneous	0.450	47
I-Gard ARC-I-TEC	0.084	9

- Assumes breaker clearing time of 5 cycles
- 480V and 65kA bolted fault current, 18 inches

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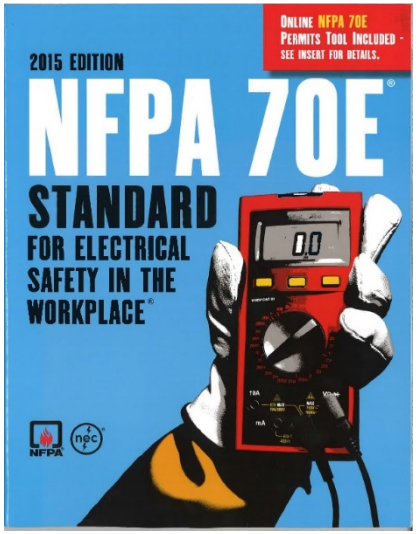

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Reducing the Magnitude of Exposure

Active Arc Mitigation

SHIELD:

Optical Arc Detection

- Detecting the arc flash through optical arc detection
- Detection time 1ms

Arc Quencher

- Reacting to the inputs signal of optical arc detection
- Initiating a 3 phase bolted fault in 3ms paralleling to the fault
- Quenching the arc as a result
- The arc no long has the energy to sustain itself

Current Limiting Resistors

- Limiting the fault current
- Reducing the impact of the fault energy

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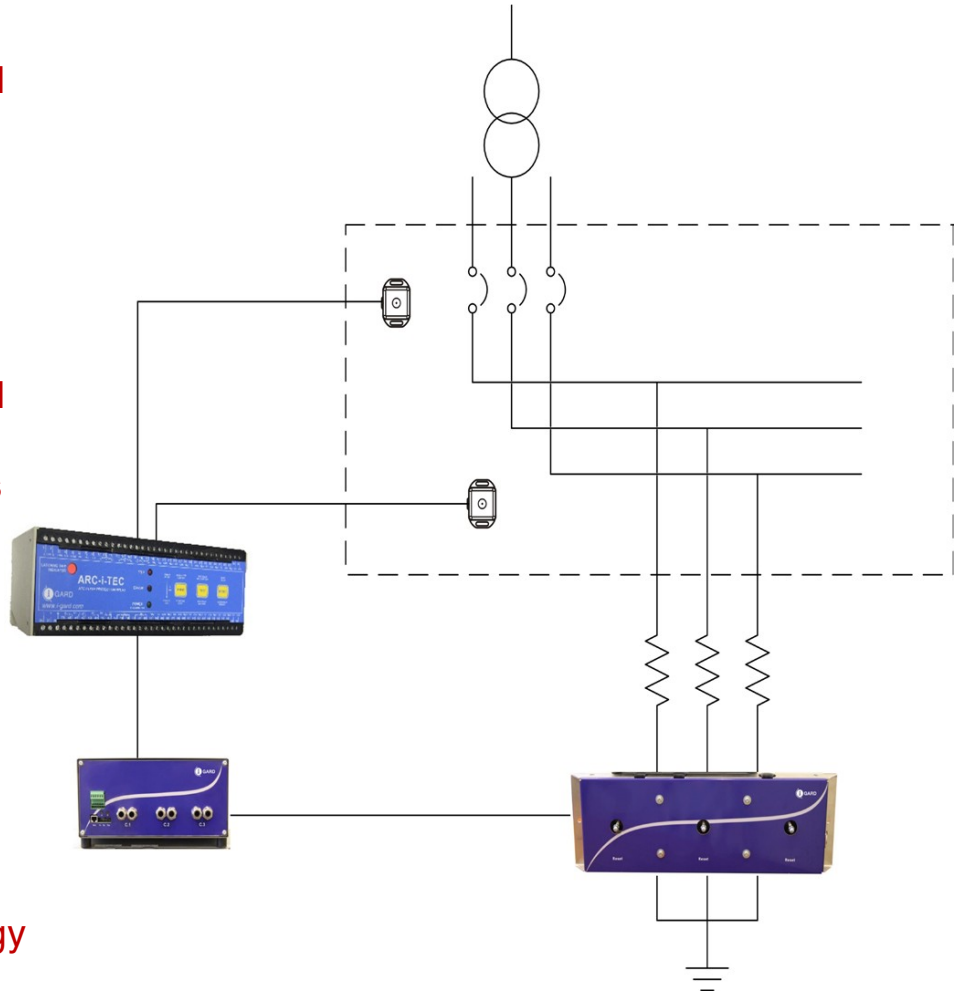

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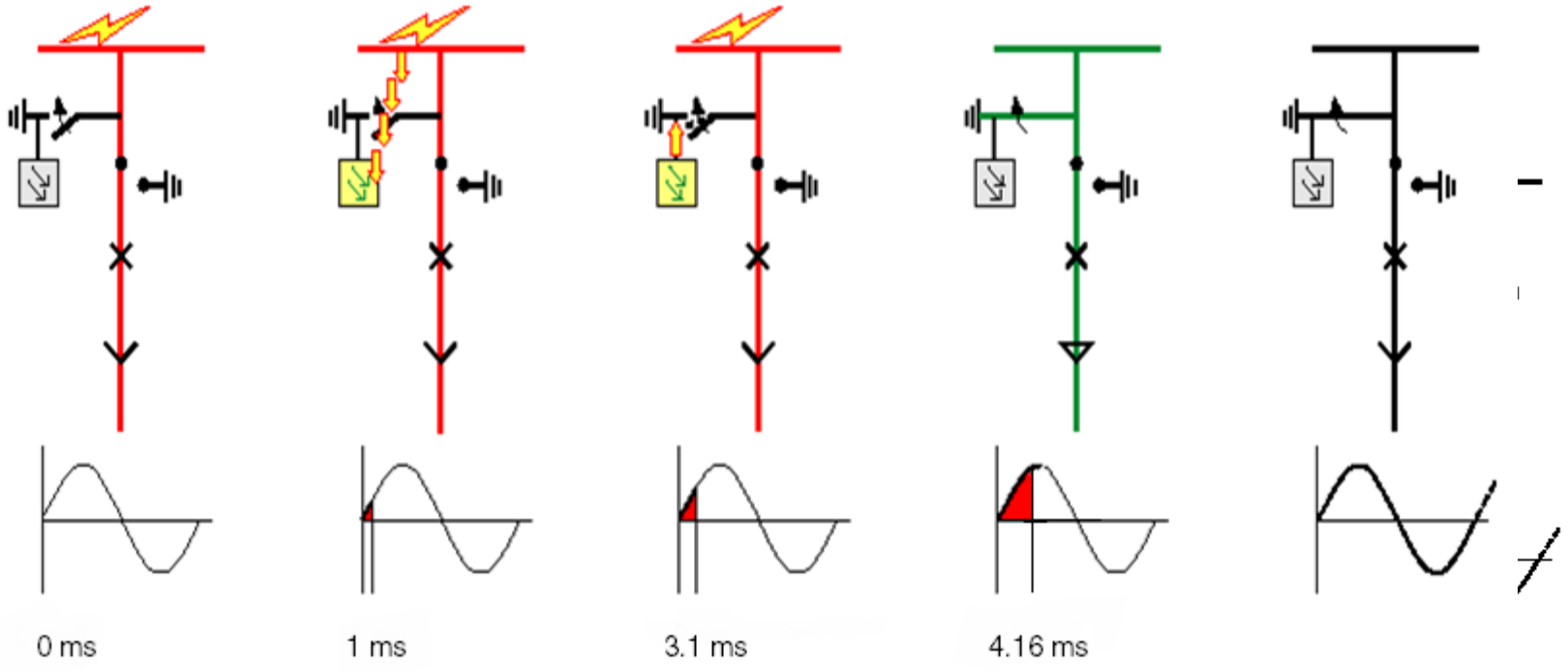

Arcing starts.

The sensors detect the arc.

The tripsignal is sent.

All the phases connected to ground through an impedance.
The arc is extinguished, he fault current is dampened and controlled.

The shortcircuit current is disconnected.

Reducing the Magnitude of Exposure

Active Arc Mitigation

Protection Type	Clearance Time	Incident Energy
Over-Current	2.00 seconds	211 Cal / cm^2
Instantaneous	0.45 seconds	47 Cal / cm^2
Optical Arc Detection	0.084 seconds	9 Cal / cm^2
I-Gard Shield	0.0031 seconds	1.17 Cal / cm^2

- Assumes circuit breaker interrupting time of 5 cycles
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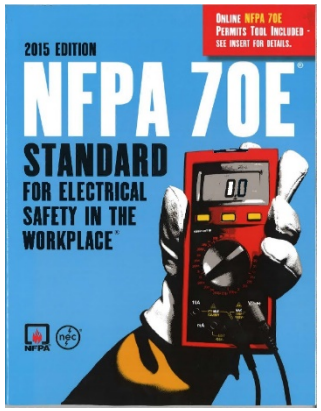

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(1)Reducing the likelihood of exposure = **High Resistance Grounding**

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