

Electrical Safety at Work Place -- NFPA 70E Provisions

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Preface

Most of the national and international standards define safety requirements for electrical installations and are mainly design oriented standards. There were no standards covering electrical safety in functional work places. Nearly 56% accidents in industrial work places are related to electrical equipment and shock & many of them are fatal. Hence there was need for standards for electrical safety at work places pursuant to Occupational Safety and Health Administration, and the Act is called OSH Act 1970 in USA. To fulfill this need National Fire Protection Association of America prepared standard NFPA 70 E.

NFPA 70 E concentrates on functional work place related safety and does not replace NEC or any other design standard used for design of electrical systems. This is very relevant to India and other countries when it comes to work place safety.

What NFPA 70 E Covers

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- Safety Related work practices
- Safety related maintenance requirements
- Safety requirement of special equipment like battery & battery rooms, laser equipment power electronic equipment & R & D Laboratories.

Standard concentrates on specific electrical Hazards in functional work place.

- Electrical shock
- Arc Flash & Arc Blast.
- Fire ignition due to electrical equipment.

Installations listed below are not covered by NFPA 70 E

- ◆ Ships & Water crafts.
- ◆ Air crafts
- ◆ Automotive vehicles
- ◆ Railway rolling stock and Railway installation
- ◆ Mines
- ◆ Utility company installations.

Responsibilities

Specific responsibilities have been fixed for owner, contractor & workers.

- **OWNER:** - Hiring a authorized contractor does not absolve owner of the facility (Host employer) from assuring safe work place & practices. Owner must inform contractor known hazards related to work and installation where work is to be carried out. Owner shall also be responsible

to report safety procedure related violations by contractor's employees to contractor.

- **CONTRACTOR:** - Contractor in turn shall communicate hazards and safe work practices to his employees. Contractor shall also convey unique hazards of his work and any unexpected hazards encountered during work. He also shall report corrected measure taken to correct violation. Contractor shall also be responsible for training of employees exposed to hazards both on job and in classroom.
- **EMPLOYEES:** - Contractors employees shall follow all safe work practices required by standard and safety related rules set by owner.

Compliance to NFPA 70 E

The base compliance to standard requires establishing and following electrically safe work process. This is done with assistance of:

- ❖ Develop & Audit safe work practices policy.
- ❖ Conduct study to determine degree of Arc flash hazard, incident energy
- ❖ Provide appropriate labeling.
- ❖ Form strategy to mitigate & control Arc Flash hazard.
- ❖ Determine shock protection boundaries.
 - ◆ Limited approach
 - ◆ Restricted approach
 - ◆ Prohibited approach
- ❖ Determine & provide Personal Protective Equipment (PPE).
- ❖ Conduct safety training of all employees.
- ❖ Maintain all electrical system & equipment.

The electrical safety policy shall be audited regularly and revised to make improvements based on experiences.

How to Reduce Risk

- ◆ Plan and execute preventive maintenance to minimize arc flash possibility due to incident energy.

- ◆ Avoid working in live (hot) environment. If it is essential to work in live equipment, obtain necessary hot permits.
- ◆ Use proper PPE required by such permit.
- ◆ Voltages less than 230 V may not need PPE but it is advisable to get analysis done.
- ◆ Use safety glasses, long sleeve shirts for normal operation of breaker.
- ◆ Do not reclose breaker tripped on fault multiple times.
- ◆ Breaker should be reclosed once only if it is crucial. Investigate reason for tripping.

Response to Electrical Accident

- Identify personnel trained in CPR and make them available.
- Turn off power immediately. Remember speed of action is important.
- Extinguish flames.
- Call for help and begin CPR.

DESIGN ASPECTS

Though NFPA 70 E is not a design standard, certain design aspects have been included in the standard which can be considered while designing respective areas / equipment.

◆ PANELS

- ❖ NFPA 70E is not a design standard hence there are no design or testing guidelines in the standard. NEC or other regular design standard and guidelines are to be followed for electrical system design, installation and testing.
- ❖ The standard does not specifically say anywhere that Internal Arc flash tested/ Resistant panels are to be used. The standard provides procedure & PPE requirements for standard equipment /Panels.

However compliance requirement of control of Arc flash hazard can be done by using Internal Arc flash tested panels.

NFPA 70E specifies IEEE C 37.20.7-2007 standard for internal Arc flash testing. (It has not mentioned IEC 64641 anywhere.)

- ❖ In the electrically safe work place procedure use of lock out tag out devices and forming lock out tag out procedure is a requirement. Panels should have necessary facility for lock out tagout provisions.

◆ BATTERY ROOMS

There are specific requirements for battery room which need to be addressed at design and installation stage only.

- ❖ Separate battery room with door opening outside.
- ❖ Aisle width minimum 900 mm.
- ❖ 25 mm gap between the two cells and from walls structure.
- ❖ 100 mm clearance between two rows of batteries in two row installation & aisle on both ends.
- ❖ Battery terminals shall be shrouded.
- ❖ If charger is inside battery room clearance shall be 900 mm after doors are fully opened.
- ❖ Insulating barriers between two rows of batteries 100 mm beyond batteries horizontally and 400 mm above connection.
- ❖ Minimum illumination level shall be 300 lux with emergency lighting for egress. Fixtures shall not be installed above cells.

Arc Flash Hazard

Major thrust is given on Arch flash hazard in the standard as Arch flash has potential to cause maximum damage and injuries / deaths.

Arc flash currents can cause temperatures up to 35000 °F. (19426 °C). Most metals will be in molten state at this temperature. Copper expand 67000 times at this temperature. This create intense heat, sound and pressure waves, intense light, shrapnel's etc. Any system 240 V and above has capability to have total Arch flash event. Threshold for second degree (just curable) burn is skin temperature of 175 °F (80 °C) for 0.1 Sec and that for third degree burn is 200 °F (94 °C) for 0.1 sec. This shows possible severity of burn due to arc flash.

Also the shock wave can damage ear drums (700 lbs/ft²) or even lungs (1728 lbs/ft²)

Causes of Arc Flash

- ◆ Dust, impurities and corrosion of contacts.
- ◆ Sparks produced during racking of breakers, changing of fuses or closing on fault.
- ◆ Rodent attack
- ◆ Accidental dropping of tools, nut, bolts, metal parts etc.

Measures

- ◆ Time of fault clearing is very important which can be seen from fact that arc flash cleared in 5-6 cycles will be fetal but that cleared in ½ cycle will cause nominal damage to panels and no injuries to operator.
- ◆ Use of proper PPF.
- ◆ Use of arc flash tested panels which will with stand the stresses and will blow up wards.
- ◆ Plan and execute preventive maintenance of panels and equipment.