



## **The Basic** Requirements of **Electrical Product Safety**



## Welcome PCB Carolina 2024 Attendees

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#### **Core Requirement**

## Protecting the <u>User</u> and <u>Service Personnel</u> from 6 potential hazards



#### **Understanding the Core Requirement**

## 1<sup>st</sup>: The 6 Hazards 2<sup>nd</sup>: Design Guidance



#### **6 Basic Safety Hazards**

# Applies to ALL<br/>safety standardsIECENULCSA



#### **6 Basic Safety Hazards**

- Risk of Shock
- Risk of Energy
- Risk of Fire
- Risk of Injury
- Radiation Hazards
- Chemical Hazards



### Requirement Differences Between Standards

#### The degree of concern towards each hazard depends on the type of product



#### **Requirement Differences Between Standards Different Hazard Weighting Power Tools > Risk of Injury** Microwaves > Radiation Hazards Heating Appliance > Risk of Fire



# The Core Requirements – Protection from 6 Hazards



#### **Risk of Shock**

Prevent access to <u>Hazardous Voltages</u>:

#### H.V. > 30 Vrms, 42.4 Vpk, or 60 Vdc

(Medical = H.V. > 25 VRMS)



#### **Risk of Shock**

 Access is defined as a circuit that can be contacted with the probes:





#### **Accessibility Probes**

#### Many other probes = check your standard!







#### **Risk of Shock**

- Circuits that can be "accessed" require
  2 levels of protection from H.V. =
  protection under a single fault condition
- Insulation System Dependent
  - : Operational, Basic, Supplementary, Double, Reinforced Insulation Systems



## **Risk of Energy**

- Prevent access to circuits <u>capable</u> of delivery 240 VA or more
  - : "Capable" is key word = not what the circuit draws but what it is capable of delivering = into any load including short circuit



## **Risk of Energy**

- High energy can melt watches, bracelets, rings
- Not all standards consider this a hazard = VERY GOOD idea regardless



- Limit flammability of combustible materials (limit "fuel to the fire")
- Limit temperatures on flammable materials (limit the "likelihood of ignition")
- Containment of Fire (even if there is a fire, keep it from getting out of the product)



No such thing as limiting access to fire = probes are not relevant for this hazard



**Background Information** 

- IEC/EN standards used to try and prove no potential for fire
- UL focus has been on fire containment
- NOW = combined approach



- Flame rated materials (5V, V-0, V-1, V-2, HB)
- Temperature test confirms limits not exceeded (using thermocouples)



#### Abnormal & fault testing confirms fire containment

: Tissue paper & cheesecloth are fire indicators





Fire Containment = fire that you can see inside the enclosure is <u>NOT</u> a fire hazard





- Limit access to hazardous moving parts, sharp edges, pinch points, etc.
  - : Barriers required up to the point where they prevent operation of the device





Sharp Edge access = when in doubt, test it with a sharp edge tester





#### Prevent implosions/explosions

- : Old CRT's had implosion protection,
- : Pressure vessels = pressure relief







#### Prevent tip-over of equipment

: 10° Tilt & Pushover Tests







### **Radiation Hazards**

- Limit exposure to radiation
- Lasers
  - : 21CFR CDRH verification
  - : IEC60825-1 and particulars
- X-Ray
- UV Light HOT new industry
  - : Air Purifiers/Covid Killers
  - : FDA Oversight



#### **Chemical Hazards**

Limit exposure to chemical hazards

- : Ozone
- : Tip-over test with liquids



The "6 Hazards" Conclusion

INTENT

- Risk of Shock
- Risk of Energy
- Risk of Fire
- Risk of Injury
- Radiation Hazards
- Chemical Hazards



Product Design & the Basic Requirements

#### Enclosure

MET Labs

- : Limit access to shock & energy hazards
- : Contain all internal fires = enclosure material, vent openings, bottom openings
- : Accessibility = probes = what internal circuits can you touch?
- : Open all doors, drawers, & access panels



Product Design & the Basic Requirements

#### Power Supply

MET Labs

- : Isolate secondary circuits = SELV outputs for accessible circuits – all communication connectors are "accessible"
- : Critical insulation systems = keep them cool = tested with fans? (CFM)
- : Warning test pin access when near vents



## Product Design & the Basic Requirements

Grounding (Earthing)

- : Ground accessible metal that can become energized in a single insulation fault
- : Reliable Ground is max. 0.1Ω @ 2x branch
- Overcurrent Protection
  - : Limit energy in accessible circuits
  - : Fire prevention/protection



Product Design & the Basic Requirements

- Wiring & Harnesses
  - : VW-1 fire resistance
  - : Fixing of wiring, connectors single faults
  - : O/I, B/I, S/I, D/I, or R/I?
- Lithium Batteries
  - : Serious Risk of Fire = UL R/C cells & packs with proper charge protection circuitry



Product Design & the Basic Requirements

Components

MET Labs

- : A bunch of Certified parts doesn't make a Certified product
- : Check the Conditions of Acceptability! (CofAs)
- Mains Connection
  - : Cordset, Power Cord, or Field Wiring Compartment with Terminals or Leads



Product Design & the Basic Requirements

Electrical spacings (creepage/clearance)

- : Mains to earth (basic)
- : Mains to accessible secondary

(double or reinforced)

: HV secondary to accessible secondary (double or reinforced)



**Product Design & the Basic Requirements** 

Electrical Ratings

MET Labs

- : 120/240 VAC vs. 100 240 VAC
- : 60 Hz vs. 50/60 Hz
- : A vs. W vs. VA
- Environmental Ratings
  - : 15° 40°C, 80% RH (Test at 40°C @ 93% RH)
  - : Elevated Ambient, Outdoor Use





# **Conclusion The Basic Requirements** of **Electrical Product Safety**



#### **THANK YOU** FOR ATTENDING **The Basic Requirements** of **Electrical Product Safety**

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