






XPerts in Power - Module 15

Safety Basics

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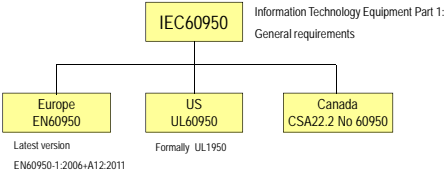


Module Content


- Specification numbers
- The scope of the standard
- Electric shock hazards
 - Level of protection (LOP)
 - Isolation/separation and test voltages
 - Earthing and leakage currents
- SELV
- Heat related hazards
 - Thermal testing
 - Insulation Classes
- Agency testing
- CB scheme and other approvals – CCC, PSE, KETI, BSMI
- CE Marking
 - LVD
 - EMC Directive
 - ROHS
 - EIP

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Specification Numbers



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graph TD; IEC60950[IEC60950  
Information Technology Equipment Part 1:  
General requirements] --> Europe[Europe  
EN60950  
Latest version  
EN60950-1:2006+A12:2011]; IEC60950 --> US[US  
UL60950  
Formerly UL1950]; IEC60950 --> Canada[Canada  
CSA22.2 No 60950];
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The Scope

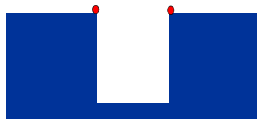
The standard covers end systems and components and is intended to reduce the likelihood of injury or damage due to:

- Electric shock
- Energy related hazards
- Fire
- Heat related hazards
- Radiation
- Chemical hazards

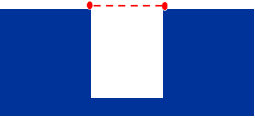
Level of Protection (LOP)

Abbr.	Earth Type	LOP
FE	FUNCTIONAL EARTH	0
PE	PROTECTIVE EARTH	1
	Insulation Type	
OP	OPERATIONAL (FUNCTIONAL)	0
B	BASIC	1
S	SUPPLEMENTARY	1
D	DOUBLE	2
R	REINFORCED	2


Creepage and Clearance



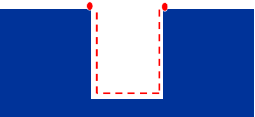
Creepage and Clearance




CLEARANCE is the distance between two points through AIR

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Creepage and Clearance




CREEPAGE is the distance between two points over the SURFACE

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Creepage and Clearance

Insulation type	Clearance	Creepage
Functional	1.5mm	3.2mm
Basic/Supplementary	2mm	3.2mm
Double/Reinforced	4mm	6.4mm

300V ac working voltage

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Test Voltages

Insulation type	Test Voltage
Functional	1500Vac
Basic/Supplementary	1500Vac
Double/Reinforced	3000Vac

300V ac working voltage

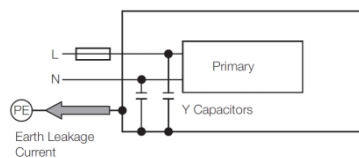
Earthing

Two types of earth can be present within a system

- **FE - Functional Earth.** This does not provide any safety function. i.e For EMC only like the screen on external PSU output lead.
- **PE - Protective Earth.** This provides protection against electric shock in a Class I system. It must meet certain performance criteria.

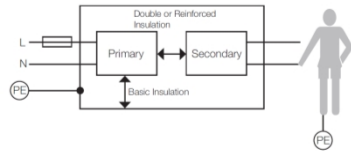
Protective Earth for pluggable equipment (<16A) must not exceed a resistance of 0.1 Ohms when tested at 1.5 x Current rating

Earth Leakage Current



Maximum allowed leakage current is 3.5mA for pluggable equipment

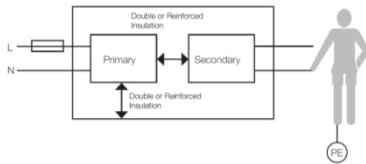
An Example Class I



Basic insulation provides 1 LOP
PE provides 1 LOP
Total LOP = 2

Double/Reinforced insulation
provides 2 LOP
Total LOP = 2

An Example Class II



Double/Reinforced insulation provides 2 LOP's
Total LOP = 2

SELV

Safe Extra Low Voltage

- To comply with SELV the output must NOT exceed 42.4Vac or 60Vdc under any condition
- Not all power supplies are tested to this

Thermal Considerations


Thermal measurements are made during normal operation under the worse case conditions and under single fault conditions

Included:

- Transformers
- Inductors
- Printed Circuit Boards
- Plastics
- Capacitors
- Optocouplers

Not Included:

- Transistors
- Diodes
- Resistors


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Insulation Classes

Transformers and PCB's have different insulation classes for maximum allowable temperatures.


	Class A	Class E	Class B	Class F	Class H
Max Temp (°C)	150	165	175	190	210

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Agency Testing

- Assess insulation system
- Thermal Testing
- Abnormal testing
- SELV Circuits
- Mechanical
- Labels

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CB Scheme and Other Approvals


- CB Scheme
- CCC (China Compulsory Certification)
- PSE ((Product Safety Electric Appliance and Materials, Japan)
- KETI (Korean Electrical Testing Institute, Korea)
- BSMI (Bureau of Standards, Metrology and Materials, Taiwan)

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CE Marking





- LVD (Low Voltage Directive) 2006/95/EC
- EMC (Electromagnetic Compatibility Directive) 2004/108/EC
- ROHS (Restriction of Hazardous Substances) 2011/65/EU
- ErP (Energy Related Products Directive) 2009/125/EC

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