



CERT Laboratories

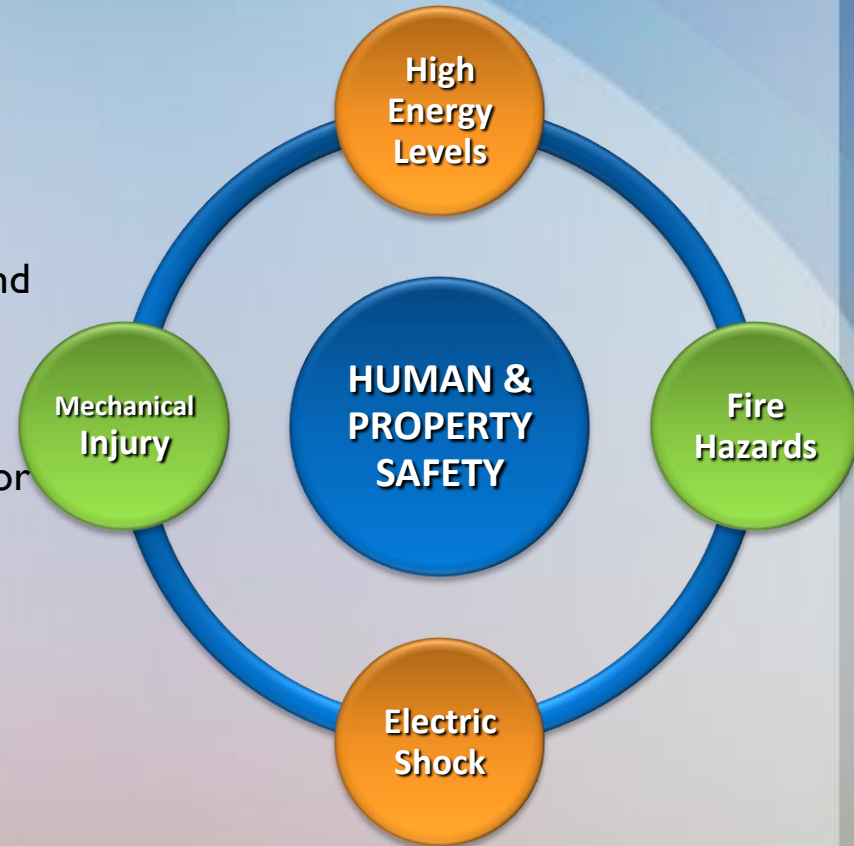
Electrical Safety Laboratory

Introduction

- ◆ The "Low Voltage" tests are used to check whether the electrical and electronic devices comply with the essential requirements set out in European Directives.
- ◆ These tests are based on national and European standards and are essential for:
 - ❑ Ensure the safety of users and consumers of these products,
 - ❑ Ensure the free movement of products within the market,
 - ❑ Limit the environmental impact of products on the market.

Introduction

- ❑ All products placed on the market must be safe !
- ❑ The product must comply with the design and test requirements of the proper safety standard
- ❑ General Product Safety Directive 2006/95/CE for Electrical equipment



Standardisation

- ◆ Large system of European electro technical standards based on international standards (> 600)
- ◆ Example : EN 60950-1 “Information technology equipment – Safety – Part 1 : General requirements”
- ◆ Reduction of risk of injury or damage due to
 - ❑ Electric shock
 - ❑ Energy related hazards
 - ❑ Fire
 - ❑ Heat related hazards
 - ❑ Mechanical hazards
 - ❑ Radiation
 - ❑ Chemical hazards



Scope of the standard EN 60950-1

- ◆ The Standard is applicable to :
 - mains-powered or battery-powered information technology equipment including electrical business equipment and associated equipment, with a **RATED VOLTAGE** not exceeding 600 V
- ◆ This standard is also applicable to such information technology (ITE) equipment designed and intended to :
 - be connected directly to a TELECOMMUNICATION NETWORK, regardless of the source of power.
 - to use the AC MAINS SUPPLY as a telecommunication transmission medium

Tests and requirements specified by the Standard



Tests and requirements

- ◆ Visual checks and identification (eg markings, signs, documentation)
- ◆ Power measurement,
- ◆ Safety check and compliance of construction,
- ◆ Control of mechanical strength,
- ◆ Control checking that the dangerous parts are not accessible (protection against dangers)
- ◆ Verification of protection against electric shock,
- ◆ Control of internal and external electrical cables and conductors,

Tests and requirements

- ◆ Measure of ground resistance,
- ◆ Verification of resistance to moisture,
- ◆ Testing of electrical insulation and dielectric strength,
- ◆ Measure of leakage/ touch currents,
- ◆ Checking screw connections
- ◆ Measurement of creepage distances and isolation,
- ◆ Endurance tests,
- ◆ Measuring the temperature rise of the apparatus,
- ◆ Abnormal operating and fault conditions analysis,
- ◆ Test of the resistance to heat, fire and tracking currents,
- ◆ Connection to telecommunication networks
- ◆



- ◆ So these tests called "electrical safety" is not only limited to electrical testing, but also cover thermal and mechanical aspects.
- ◆ Some of the "low voltage" tests are destructive, at the end of testing the device under test "DUT" may no longer be operational.

General requirements and Marking




Marking

◆ Clause : 1.7.13


◆ Test :

- ❑ Checking the characteristics posted on the equipment, notices and information to the user,
- ❑ Sufficient information shall be provided to the USER concerning any condition necessary to ensure that, when used as prescribed by the manufacturer, the equipment is unlikely to present a hazard.
- ❑ Markings durability test:
 - Compliance is checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.
 - After this test, the marking shall be legible; it shall not be possible to remove marking plates easily and they shall show no curling

Checking using the right markings on the product

- ◆ RATED VOLTAGE(S) or RATED VOLTAGE RANGE(S), in volts;
- ◆ Symbol for nature of supply, for d.c. only;
- ◆ RATED FREQUENCY or RATED FREQUENCY RANGE, in hertz, unless the equipment is designed for d.c. only;
- ◆ RATED CURRENT, in milliamperes or amperes;
- ◆ Manufacturer's name or trade-mark or identification mark;
- ◆ Manufacturer's model or type reference;
- ◆ Symbol 60417-1-IEC-5172, for CLASS II EQUIPMENT only. 

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Visual inspection

- ◆ **Clause : 1.7**
- ◆ **Description:**
 - ❑ Check visually by examining the appearance of the product Construction.
 - ❑ This analysis may require complete disassembly of the product.

Input current

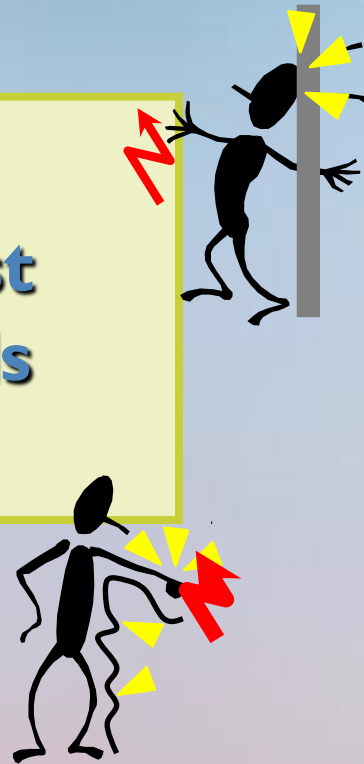
- ◆ **Clause :** 1.6.2
- ◆ **Description:**
 - ❑ Current measurement absorbed after stabilization
- ◆ **Used material:**
 - ❑ Voltmeter / ammeter
 - ❑ Stabilized supply (AC-DC)



Input current: Description

- ◆ The current consumption in continuous operation by the equipment must not exceed the RATED current of more than 10% under NORMAL load.
- ◆ This is checked by measurement under the following conditions:
 - ❑ If the product works with several nominal voltages the current is measured for each voltage.
 - ❑ If the equipment has one or more nominal ranges the current is measured at each end of each nominal voltage range.
 - ❑ The readings are performed after the current stabilization.
 - ❑ If the current varies during the normal operating cycle the current drawn is taken as the average value over a representative period.

Protection against electrical hazards



Access to energized parts

- ◆ **Class I EQUIPMENT** : Equipment for which the protection against electric shock relies on Basic Insulation and on the equipment grounding. This type of equipment must have a grounding terminal.
- ◆ **CLASS II EQUIPMENT**: Equipment in which protection against electric shock does not rely on BASIC INSULATION only, but in which additional safety precautions, such as DOUBLE INSULATION or REINFORCED INSULATION. This type of equipment does not have a grounding terminal.
- ◆ **CLASS III EQUIPMENT**: Equipment in which protection against electric shock relies upon supply from SELV CIRCUITS and in which HAZARDOUS VOLTAGES are not generated.



Access to energized parts

◆ **Clause : 2.1.1.1 et 2.1.1.2**

◆ **Description:**

- ❑ Checking the accessibility of the active parts in the operator access area: Direct contacts.
- ❑ The equipment shall be so constructed that in OPERATOR ACCESS AREAS there is adequate protection against contact with:
 - parts of ELV CIRCUITS; and
 - parts at HAZARDOUS VOLTAGES; and
 - FUNCTIONAL or BASIC INSULATION of parts or wiring at HAZARDOUS VOLTAGES; and
 - unearthed conductive parts separated from ELV CIRCUITS or from parts at HAZARDOUS VOLTAGES by FUNCTIONAL or BASIC INSULATION only;
 - parts of TNV CIRCUITS,

◆ Compliance is checked by all of the following:

- ❑ a) inspection; and
- ❑ b) a test with the test finger, figure 2A, which shall not contact parts described above when applied to openings in the ENCLOSURES after removal of parts that can be detached by an OPERATOR, including fuseholders, and with OPERATOR access doors and covers open. It is permitted to leave lamps in place for this test. Connectors that can be separated by an OPERATOR, other than plugs and socket-outlets complying with IEC 60083, shall also be tested during disconnection; and
- ❑ c) a test with the test pin, figure 2B, which shall not contact bare parts at HAZARDOUS VOLTAGES when applied to openings in an external ELECTRICAL ENCLOSURE.
- ❑ d) a test with the test probe, figure 2C.

Access to energized parts: Used Equipments



Rigid Test finger (2A)



Jointed Test finger (2A)



2C - Test probe



2B - Test pin

Provisions for earthing and bonding

◆ Clause : 2.6

◆ Description:

- Compliance is checked by inspection and measurement and for the protection of ground connecting conductors
- Measuring the earth connection resistance
- Measuring the voltage drop across the conductor : If the current rating of the circuit under test is 16 A or less, the test current, test voltage and the duration of the test are determined as follows:
 - the test current is two times the current rating of the circuit under test; and
 - the test voltage is not to exceed 12 V; and
 - the duration of the test is 120 s;
 - and the resistance of the PROTECTIVE BONDING CONDUCTOR, calculated from the voltage drop, shall not exceed 0,1 Ω .

Resistance of earthing conductors

Used Equipments

- ◆ DC power supply,
- ◆ Multimeter,
- ◆ Milliohmmeter.



Humidity conditioning

- ◆ **Clause : 2.9.2**
- ◆ **Description :**
- ◆ Humidity conditioning is carried out for 48 h in a climatic chamber cabinet or room containing air with a :
 - ❑ Relative humidity of 91 % to 95 %.
 - ❑ The temperature is maintained within 1 °C of any convenient value between 20 °C and 30 °C such that condensation does not occur.
 - ❑ During this conditioning the component or subassembly is not energized.
 - ❑ With the concurrence of the manufacturer, it is permitted to increase the 48 h time duration.

Humidity conditioning

Used test equipments

- ◆ Climatic chamber



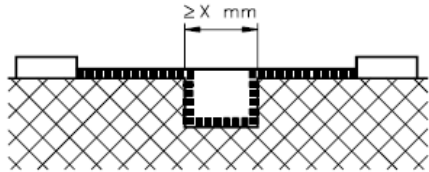
Clearances, creepage distances and distances through insulation

◆ **Clause : 2.10**

◆ **Description:**

- ❑ Dimensioning of the insulating parts in contact with live parts.
- ❑ Measuring minimum distances between two current carrying parts.
- ❑ CLEARANCES shall be so dimensioned that overvoltage transients which may enter the equipment, and peak voltages which may be generated within the equipment, do not break down the CLEARANCE
- ❑ CREEPAGE DISTANCES shall be so dimensioned that, for a given WORKING VOLTAGE and Pollution Degree, no flashover or breakdown of insulation will occur.

Clearances, creepage distances and distances through insulation



Condition: Path under consideration includes a parallel-sided groove of any depth, and equal to or more than X mm wide.

Rule: CLEARANCE is the "line of sight" distance. CREEPAGE DISTANCE path follows the contour of the groove.

— Clearance
- - - - - Creepage distance

- ◆ calipers
- ◆ Micrometer
- ◆ optical comparator
- ◆ gages chocks
- ◆ test finger



Electric strength

- ◆ **Clause : 5.2**

- ◆ **Description:**

- ❑ The insulation is subjected either to a voltage of sine-wave form having a frequency of 50 Hz or 60 Hz, or to a DC VOLTAGE equal to the peak voltage of the prescribed a.c. test voltage
- ❑ The voltage applied to the insulation under test is gradually raised from zero to the prescribed voltage and held at that value for 60 s.
- ❑ Compliance is checked while the equipment is still in a well-heated condition immediately following the heating test
- ❑ There shall be no insulation breakdown during the test.

Used Equipements

- ◆ dielectric strength tester
- ◆ With accessories:



Touch current and protective conductor current

◆ **Clause : 5.1**

◆ **Description:**

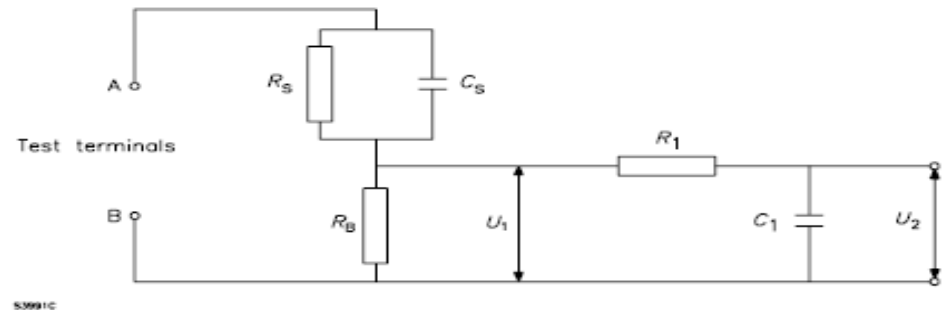
- ❑ Measurements of current through networks simulating the impedance of the human body are referred to as measurements of TOUCH CURRENT
- ❑ Equipment shall be so designed and constructed that neither TOUCH CURRENT nor PROTECTIVE CONDUCTOR CURRENT is likely to create an electric shock hazard.
- ❑ Equipment is tested using the test circuit from IEC 60990,

Touch current and protective conductor current

- ◆ None of the values measured shall exceed the relevant limits in table 5A of this standard,



Test Equipement



R_S	1 500 Ω
R_B	500 Ω
R_1	10 k Ω
C_S	0,22 μF
C_1	0,022 μF
Voltmeter or oscilloscope (r.m.s. or peak reading)	Input resistance: >1 M Ω
	Input capacitance: <200 pF
	Frequency range: 15 Hz up to 1 MHz (appropriate for the highest frequency of interest, see 1.4.7)

Mechanical strength



Steady force tests

◆ **Clause** : 4.2.2, 4.2.3 et 4.2.4

◆ **Description:**

- ❑ Steady force test, 10 N
- ❑ steady force test of $30\text{ N} \pm 3\text{ N}$ for a period of 5 s, applied by means of a straight unjointed version of the test finger
- ❑ External ENCLOSURES are subjected to a steady force of $250\text{ N} \pm 10\text{ N}$ for a period of 5 s, applied in turn to the top, bottom and sides of the ENCLOSURE

Steady force tests- Used equipments

- ◆ Dynamometer,
- ◆ Test finger,
- ◆ Circular flat surface of 30mm diameter,



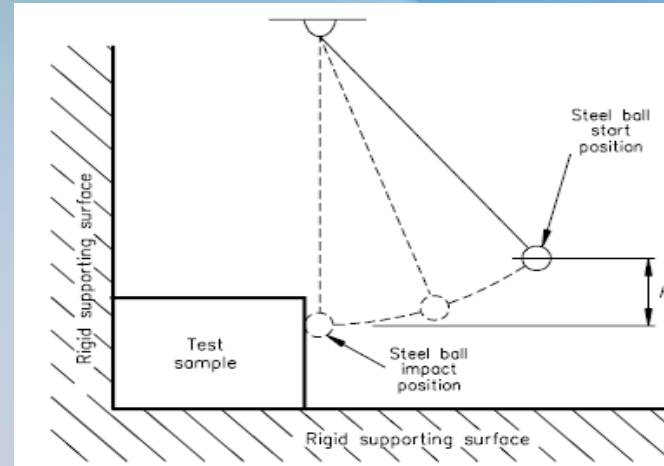
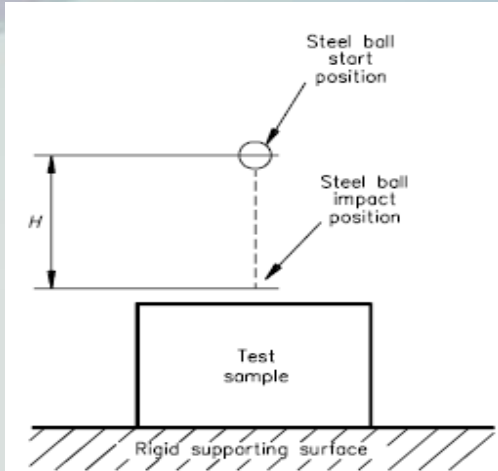
Impact test

- ◆ **Clause : 4.2.5**

- ◆ **Description:**

- ❑ The materials are subjected to an impact test using a steel Ball.
- ❑ The steel ball, approximately 50 mm in diameter and with a mass of 500 g \pm 25 g, is permitted to fall freely from rest through a vertical distance (H) of 1,3 m onto the sample
- ❑ In addition, the steel ball is suspended by a cord and swung as a pendulum in order to apply a horizontal impact, dropping through a vertical distance (H) of 1,3 m

Impact test



Drop test

◆ **Clause : 4.2.6**

◆ **Description:**

- Equipment subjected to a drop test:
 - HAND-HELD EQUIPMENT;
 - DIRECT PLUG-IN EQUIPMENT;
 - TRANSPORTABLE EQUIPMENT;
 - Desk-top equipment having a mass of 5 kg or less
- A sample of the complete equipment is subjected to three impacts that result from being dropped onto a horizontal surface
- The height of the drop shall be:
 - 750 mm \pm 10 mm for desk-top equipment as described above;
 - – 1 000 mm \pm 10 mm for HAND-HELD EQUIPMENT, DIRECT PLUG-IN EQUIPMENT and TRANSPORTABLE EQUIPMENT.

Essai de chute : Description

- ◆ Un échantillon du matériel complet est soumis à l'impact de trois chutes sur une surface horizontale dans les positions susceptibles d'entraîner les résultats les plus défavorables.
- ◆ La hauteur de chute doit être de:
 - 750mm \pm 10mm pour les matériels à poser sur un bureau,
 - 1000mm \pm 10mm pour Matériels portatifs, Matériels enfichables directement et Matériels transportables.

Thermal requirements



Thermal requirements

◆ **Clause : 4.5**

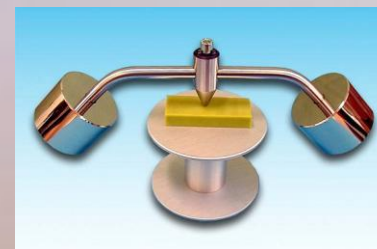
◆ **Description:**

- ❑ Materials used in components and in the construction of the equipment shall be selected such that under NORMAL LOAD operation, temperatures do not exceed safe values
- ❑ Direct measures by temperature sensor of a part of a powered device in normal condition.
- ❑ Thermoplastic parts on which are mounted directly hazardous live parts shall be resistant to abnormal heat.

Prescriptions thermiques

Matériels utilisés

- ◆ Recording thermometer,
- ◆ Rhermocouples,
- ◆ Oven or climatic chamber,
- ◆ Multimeter,
- ◆ BALL PRESSURE TEST APPARATUS



Abnormal operating and fault conditions

◆ **Clause : 5.3**

◆ **Description:**

- ❑ **Protection against overload and abnormal operation :** Equipment shall be so designed that the risk of fire or electric shock due to mechanical or electrical overload or failure, or due to abnormal operation or careless use, is limited as far as practicable.
- ❑ **Motors:** Under overload, locked rotor and other abnormal conditions, motors shall not cause hazard because of excessive temperatures.
- ❑ Transformers shall be protected against overload, for example by:
 - Overcurrent protection;
 - Internal THERMAL CUT-OUTS;
 - Use of current limiting transformers.