UL/CSA 60950-1
基本要求介绍

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SELF INTRODUCTION
自我介绍

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OBJECTIVE
培训目的

- 帮助客户了解UL认证的流程及信息技术产品的技术要求。提高产品在安全认证的通过率以及速度， 有助产品设计。

- 由于对标准的理解可能存在的因人或地域的差异，或由于标准的不断修订，本次培训的内容也许并不完全适用于某些情况。

Module 0
General Introduction to Standards
标准简介

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Standards
标准

国际标准

IEC 60950-1 Information Technology Equipment – Safety – Part 1: General Requirements

国家/区域标准

UL/CSA 60950-1 Information Technology Equipment – Safety – Part 1: General Requirements

EN 60950-1 Information Technology Equipment – Safety – Part 1: General Requirements

UL/CSA 60950-1 Scope 产品范围

This 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

本标准适用于电网供电的或电池供电的，额定电压不超过600V的信息技术设备。包括商用电气设备和与之相关的设备。

Designed to use the AC MAINS SUPPLY as a communication transmission medium

设计使用交流电网作为通信传播媒介的信息技术设备。

UL/CSA 60950-1 Scope 产品范围

Generic product type	Specific example of generic type
banking equipment	monetary processing machines including automated teller (cash dispensing) machines (ATM)
data and text processing machines and associated equipment	data preparation equipment, data processing equipment, data storage equipment, personal computers, plotters, printers, scanners, text processing equipment, visual display units
data network equipment	bridges, data circuit terminating equipment, data terminal equipment, routers
electrical and electronic retail equipment	cash registers, point of sale terminals including associated electronic scales
electrical and electronic office machines	calculators, copying machines, dictation equipment, document shredding machines, duplicators, erasers, micrographic office equipment, motor-operated files, paper trimmers (punchers, cutting machines, separators), paper jogging machines, pencil sharpeners, staplers, typewriters
other information technology equipment	photoprinting equipment, public information terminals, multimedia equipment
postage equipment	mail processing machines, postage machines
telecommunication network infrastructure equipment	billing equipment, multiplexers, network powering equipment, network terminating equipment, radio basestations, repeaters, transmission equipment, telecommunication switching equipment
telecommunication terminal equipment	facsimile equipment, key telephone systems, modems, PABXs, pagers, telephone answering machines, telephone sets (wired and wireless)

Additional requirement 附加要求

Requirements additional to those specified in this standard

对于下列设备，可能需要在本标准所规定的那些安全要求中附加一些要求：

1，equipment intended for operation in special environments (for example, extremes of temperature; excessive dust, moisture or vibration; flammable gases; and corrosive or explosive atmospheres); 预定要在诸如极高或极低温度，过量粉尘、高湿度或剧烈振动、可燃气体、腐蚀或易爆等特殊环境条件下工作的设备

2，electromedical applications with physical connections to the patient;与病人人体直接连接的医用电子设备；

3，equipment intended to be used in vehicles, on board ships or aircraft, in tropical countries, or at altitudes greater than 2 000 m;要在车辆、船舶或飞机上使用的设备，在热带地区或在海拔2000m 以上高原使用的设备

4，equipment intended for use where ingress of water is possible; for guidance on such requirements and on relevant testing,预定用在可能会进水的场合的设备，对这些设备的要求及相关的试验的导则见附录

Listed Product and Recognized Product

列名产品以及认可产品

Listed Product: 可以作为一个最终产品单独使用的产品. 被审核时把它的最终使用环境, 使用条件都包含进去了, 所以审核的内容多而全面.

Recognized Product: 不作为一个最终产品, 须作为一个零部件用在最终产品里, 此类产品在被审核时某些最终使用环境、使用条件因为不好定义或者无法满足, 所以用COA(Conditions Of Acceptability)来说明，并需通过最终产品的审核来弥补.

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Module 1
General Principles / 基本原则

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General Principles 基本原则

- It is essential that designers understand the underlying principles of safety requirements in order that they can engineer safe equipment.
  (设计人员需要理解安规要求的规则)
- These principles are not an alternative to the detailed requirements of this standard, but are intended to provide designers with an appreciation of the basis of these requirements.
  (这些规则不代表详细的标准条款要求，却是标准的基础)
- Where the equipment involves technologies and materials or methods of construction not specifically covered, the design of the equipment should provide a level of safety not less than those described in these principles of safety.
  (标准未涵盖的设计，结构和材料部分所涉及到的安规要求不能低于这些原则要求)

General Principles 基本原则

- Designers shall take into account not only normal operating conditions of the equipment but also likely fault conditions, consequential faults, foreseeable misuse and external influences such as temperature, altitude, pollution, moisture, over-voltages on the mains and over-voltages on a TELECOMMUNICATION NETWORK or a CABLE DISTRIBUTION SYSTEM.
设计应考虑不只是正常操作，而且需要考虑异常情况及破坏结果，可预知误用以及外界影响(温度，海拔，污染，湿度，电网过压，以及通信网络或分线系统高压)
- The following priorities should be observed in determining what design measures to adopt: 在设计中应遵守以下的优先次序
  - where possible, specify design criteria that will eliminate, reduce or guard against hazards;消除、减小危险或对危险进行防护的设计原则
  - where the above is not practicable because the functioning of the equipment would be impaired, specify the use of protective means independent of the equipment, such as personal protective equipment (which is not specified in this standard);以上原则将削弱设备的功能，那么应使用独立于设备的保护措施，如人身保护设备(标准未定义)
  - where neither of the above measures is practicable, or in addition to those measures, specify the provision of markings and instructions regarding the residual risks.残余的危险采取标识和说明的措施

User 使用者

- USER is the term applied to all persons other than SERVICE PERSONS. (维修人员以外的人)
- Requirements for protection should assume that USERS are not trained to identify hazards, but will not intentionally create a hazardous situation.安全保护要求是假定使用人员未经过如何识别危险的培训，但不会故意制造危险而提出的
- Consequently, the requirements will provide protection for cleaners and casual visitors as well as the assigned USERS.也为卫生清扫人员和临时来访人员提供保护.
- In general, USERS should not have access to hazardous parts, and to this end, such parts should only be in SERVICE ACCESS AREAS or in equipment located in RESTRICTED ACCESS LOCATIONS. When USERS are admitted to RESTRICTED ACCESS LOCATIONS they shall be suitably instructed.应限制使用者接触危险零部件，此类零部件应仅位于维修人员接触区域内或位于受限制接触区内的设备内

Service Personnel 维修人员

- SERVICE PERSONS are expected to use their training and skill to avoid possible injury to themselves and others due to obvious hazards which exist in SERVICE ACCESS AREAS of the equipment or on equipment located in RESTRICTED ACCESS LOCATIONS. 维修人员：当设备中的维修接触区域或处在受限制接触区内的设备存在明显危险时，可以运用他们所受的训练和技能避免可能的、对自己或他人伤害的专业人员
- However, SERVICE PERSONS should be protected against unexpected hazards. This can be done by, for example, locating parts that need to be accessible for servicing away from electrical and mechanical hazards, providing shields to avoid accidental contact with hazardous parts, and providing labels or instructions to warn personnel about any residual risk.应对维修人员就意外危险进行防护，以下方法，例如，维修时需要接触的零部件的安置远离电气和机械危险，设置屏蔽以避免意外接触危险零部件，标牌或警告说明提醒维修人员有残余的危险

Hazards 危险

Application of a safety standard is intended to reduce the risk of injury or damage due to the following安规标准的应用是减少以下的伤害或危害:

- Electric Shock 电击
- Energy Related 能量有关的危险
- Fire 火灾
- Heat Related 热相关
- Mechanical Related 机械危险
- Radiation 辐射
- Chemical Related 化学危险

Electric Shock 电击

- Electric shock is due to current passing through the human body. The resulting physiological effects depend on the value and duration of the current and the path it takes through the body.电击是由于电流通过人体而造成的，其引起的生理反应取决于电流值的大小和持续时间及其通过人体的路径
- The value of the current depends on the applied voltage, the impedance of the source and the impedance of the body. The body impedance depends in turn on the area of contact, moisture in the area of contact and the applied voltage and frequency. Currents of approximately half a milliampere can cause a reaction in persons in good health and may cause injury indirectly due to involuntary reaction. Higher currents can have more direct effects, such as burn, muscle tetanization or ventricular fibrillation.电流值取决于施加的电压及电源的阻抗和人体的阻抗，人体的阻抗取决于接触区域的湿度及施加的电压和频率.约0.5mA 的电流就能在健康的人体内产生反应，而且这种不知不觉的反应可能会导致间接的危害.电流再大些，就会产生直接的影响，例如烧伤或心室的纤维性颤动.

Electric Shock

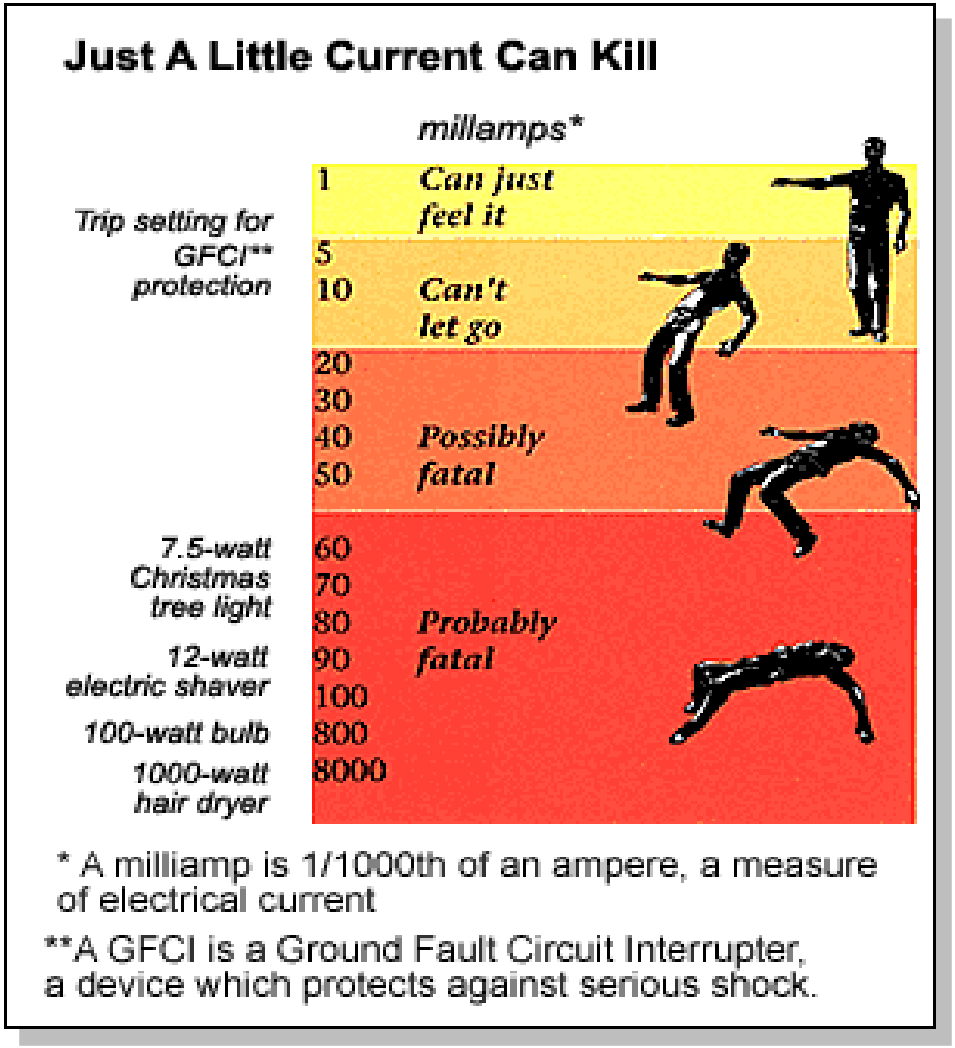
- Steady state voltages up to 42,4 V peak, or 60 V d.c., are not generally regarded as hazardous under dry conditions for an area of contact equivalent to a human hand. Bare parts which have to be touched or handled should be at earth potential or properly insulated. 在干燥条件下，相当于人的一只手的接触面积上，峰值电压高达42.4V 或直流电压高达60V 的稳电位通常不作为危险电压。 人可以摸到的裸露部件应该接地或作适当绝缘

- In order to protect user against electric shock, Double protection was needed to provided, including consideration of normal operation and abnormal condition. 为了防止使用人员遭到电击，通常要具有两级保护.因此，设备正常工作条件下和在单一故障(包括随之引起的其他故障)状态下运行都不会引起电击危险

Electric Shock 电击

Electric shock is due to current passing through the human body:
电击是由于电流在人体存在回路流过而造成。
1,Perception (up to 0.5 mA)
2, Reaction (> 0.5 mA)
3, Inability to let-go (> 5 mA)
4, Ventricular fibrillation (> 50 mA)
5, Electrical burn (> 70 mA)

以上数值是指流过人体的电流，不是触摸到的电流



Electric Shock 电击

Cause for Hazardous

Touch the bare part with hazardous voltage under normal operation

The insulation damaged protected Between Hazardous part and accessible part under normal or fault condition

造成的危险的原因

接触正常情况下带危险电压的裸露零部件

正常或故障情况下带危险电压的零部件和可触及的导电零部件的绝缘被击穿

Examples of measures to reduce risks:

Mechanical protection: locked cover, interlock Switch, discharge of hazardous capacitor

BASIC INSULATION and connect the accessible conductive parts and circuits to earth

provide a metal screen connected to protective earth between the parts,

provide DOUBLE INSULATION or REINFORCED INSULATION between the parts, so that breakdown to the accessible part is not likely to occur.

减少危险的方法示例：

--机械防护措施： 带锁面板、安全互锁装置
让带危险电压的电容器放电
--用基本绝缘把可触及的导电部件与电路接地
--在零部件间安装一个与保护地连接的金属屏蔽
--在零部件间采用双重绝缘或加强绝缘，以使可触及零部件间的绝缘不会击穿

Electric Shock 电击

Cause for Hazardous

Contact with circuits connected to TELECOMMUNICATION NETWORKS which exceed 42,4 V peak or 60 V d.c.
Limit the accessibility and area of contact of such

Breakdown of USER-accessible insulation.

造成的危险的原因

接触与峰值超过42.4V 或直流电压超过60V的通信网络或其他电路连接的电路的绝缘击穿

使用人员可触及及绝缘被击穿

Examples of measures to reduce risks:

Limit the accessibility and area of contact of such
circuits, and separate them from unearthed parts to
which access is not limited.

Insulation which is accessible to the USER should have adequate mechanical and electrical strength to reduce the likelihood of contact with HAZARDOUS VOLTAGES.

减少危险的方法示例：

限制这种电路的可触及性和接触区域
零部件隔离

提供有足够机械强度和电气强度以减少与危险电压接触的可能性

Electric Shock 电击

Cause for Hazardous
TOUCH CURRENT (leakage current) flowing from parts at HAZARDOUS VOLTAGES to accessible parts, or failure of a protective earthing connection.

TOUCH CURRENT may include current due to EMC filter components Connected between PRIMARY CIRCUITS and accessible parts.

造成的危险的原因

由于保护接地连接失效， 从危险电压过来的漏电流过大

Examples of measures to reduce risks:

Limit TOUCH CURRENT to a specified value, or provide a high integrity protective earthing connection.

减少危险的方法示例：

限制漏电流到特定值， 或提供可靠保护接地

Energy Related 能量有关的危险

Injury or fire may result from high current supplies or high capacitance circuits

- **– burns;**
- **– arcing;**
- **– ejection of molten metal.**

measures to reduce risks：

- **– separation;**
- **– shielding;**
- **– provision of SAFETY INTERLOCKS.**

大电流电源或大电容电路的相邻电极间短路时，可能导致引起下述的危险：

—燃烧：

—起弧：

—喷出熔融金属.

注意： 接触安全电压的电路也可能是危险的

减小危险的方法：

—隔离：—屏蔽：—使用安全互锁装置

Fire Related 火灾

Risk of fire may result from excessive temperatures either under normal operating conditions or due to overload, component failure, insulation breakdown or loose connections.

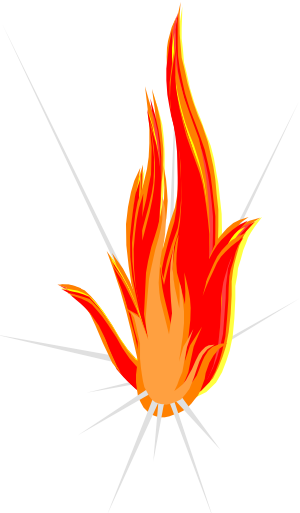
正常工作条件下过载、元件失效、绝缘击穿或连接松动都可能产生导致危险的过高温度。但是，应保证设备内着火点产生的火焰不会蔓延到火源泉近区以外，也不会对设备的周围造成损害.

Examples of measures

方法包括：

– providing overcurrent protection;

—提供过流保护装置



– using constructional materials having appropriate flammability properties for their purpose;

—使用符合要求的适当燃烧特性的结构材料；

Fire Related 火灾

– **selection of parts, components and consumable materials to avoid high temperature which might cause ignition;**

选择的零部件、元器件和耗料能避免产生可能引起着火的高温

– **limiting the quantity of combustible materials used;**

限制易燃材料的用量

– shielding or separating combustible materials from likely ignition sources;

把易燃材料与可能的引燃源屏蔽或隔离；

Fire Related 火灾

– using ENCLOSURES or barriers to limit the spread of fire within the equipment;

使用防护外壳或挡板，以限制火焰只在设备内部蔓延；

– using suitable materials for ENCLOSURES so as to reduce the likelihood of fire spreading from the equipment.

使用合适的材料制作外壳，以减小火焰向设备外蔓延的可能性。

Heat Related 热的危险

Injury may result from high temperatures under normal operating conditions

正常工作条件下的高温

– burns due to contact with hot accessible parts;

接触烫热的可触及零部件引起灼伤；

– degradation of insulation and of safety-critical components;

绝缘等级下降或安全元器件性能降低

– ignition of flammable liquids.

引燃可燃液体

Heat Related 热的危险

减少危险的方法

– taking steps to avoid high temperature of accessible parts;
采取措施避免可触及零部件产生高温

– avoiding temperatures above the ignition point of liquids;
避免使温度高于液体的引燃点

– provision of markings to warn USERS where access to hot parts is unavoidable.
如果不可避免接触高温的零部件，提供警告标识以告诫使用人员

Mechanical Related 机械相关危险

Injury may result from:
可能导致危险的原因是：

– sharp edges and corners;
尖锐的棱缘和拐角；
– moving parts which have the potential to cause injury;
可能潜在地引起危害的运动零部件：
– equipment instability;
设备的不稳定性；
– flying particles from imploding cathode ray tubes and exploding high pressure lamps.
内爆的阴极射线管和爆裂的高压灯产生的碎片.

Mechanical Related 机械相关危险

Examples of measures to reduce risks

减小这种危险的方法包括：

– rounding of sharp edges and corners;
倒圆尖锐的棱缘和拐角；

– guarding 配备防护装置；

– provision of SAFETY INTERLOCKS;
使用安全互锁装置；

– providing sufficient stability to free-standing equipment;
使用落地式设备有足够的稳定性；

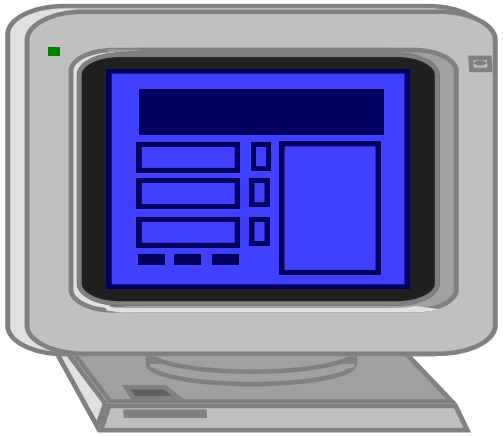
– selecting cathode ray tubes and high pressure lamps that are resistant to implosion and explosion respectively;
选择能抗内爆的阴极管和耐爆裂的高压灯；

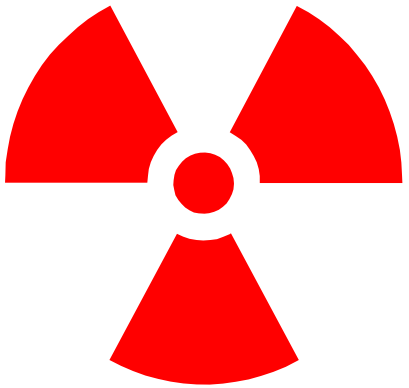
– provision of markings to warn USERS where access is unavoidable. 在不可避免接触时，提供警告标识以告诫使用人员

Radiation 辐射危险

Injury to USERS and to SERVICE PERSONS may result from some forms of radiation emitted by equipment. Examples are sonic (acoustic), radio frequency, infra-red, ultraviolet and ionizing radiation, and high intensity visible and coherent light (lasers).

设备产生的某种形式的辐射会对使用人员和维修人员造成危险，辐射可以是声频辐射、射频辐射、红外线辐射、红外线和电离辐射、高强度可见光和相干光(激光)辐射.





Radiation 辐射危险

Examples of measures to reduce risks include:

减小这种危险的方法包括：

– limiting the energy level of potential radiation sources;

限制潜在辐射源的能量等级；

– screening radiation sources;

屏蔽辐射源；

– provision of SAFETY INTERLOCKS;

使用安全互锁装置；

– provision of markings to warn USERS where exposure to the radiation hazard is unavoidable.

如果不可避免暴露于辐射危险中，要提供警告标识以告诫使用人员

Chemical Related 化学危险

Injury may result from contact with some chemicals or from inhalation of their vapours and fumes.
接触某些化学物品或吸入它们的气体和烟雾可能会造成危险

Examples of measures to reduce risks
减小这种危险的方法包括：
– avoiding the use of constructional and consumable materials likely to Cause injury by contact or inhalation during intended and normal conditions of use;
避免使用在预定的和正常条件下使用设备时可能接触或吸入的建材或耗材

– avoiding conditions likely to cause leakage or vaporization;
避免可能产生泄漏或气化的条件；

– provision of markings to warn USERS about the hazards.
提供警告标识以告诫使用人员危险。

Questions/Answers

Module 2
Basic conception and Critical component / 基本概念与关键元件

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Session Objectives 课程目标

At the conclusion of this session, you will learn the Scope of UL/CSA 60950-1, basic conception, classes of equipment, Critical component： enclosure, plastic properties, PWB, fabricated plastic parts etc.,

学到：UL/CSA 60950-1 产品范围，类别， 基本定义以及关键元件如 外壳，塑料特性，PWB，装饰塑料部件等的要求

Main Conception of circuit 电路的概念

1, SELV电路 safety extra-low voltage circuit

安全特低电压电路

2, LCC 电路 Limited current circuit

限制电流电路

3, Hazardous voltage

危险电压

4, LPS 限功率电源 Limited power source

限功率电源

SELV电路 Safety Extra-Low Voltage circuit

A SECONDARY CIRCUIT which is so designed and protected that under

Normal operating conditions, and

- **Voltages not exceed 42.4 V pk or 60 V dc**

Single fault conditions,

1. **For t = (0, 200 ms), V ≤ 71 V pk or 120 V dc**
2. **For t = (0.2 s, ∞), V ≤ 42.4 V pk or 60 V dc**

LCC 限流电路

Limited current circuit 限流电路

A circuit which is so designed and protected that, under both normal operating conditions and single fault conditions, the current which can be drawn is not hazardous.

作了适当的设计和保护的电路，使得在正常工作条件下和单一故障条件下，能从该电路流出的电流是非危险的电流。

Note：The limit values of currents under normal operating conditions and single fault conditions (see 1.4.14) are specified in 2.4.

注：正常工作条件下和单一故障条件下的电流限值在2.4中作也规定.

LCC – Part 1

The available current (A) shall not exceed the limits under both normal operating conditions and in the event of a single failure

- **For frequency not exceeding 1 kHz**
  - **A pk = V pk / 2000 Ω < 0.7 mA pk**
  - **A dc = V dc / 2000 Ω < 2.0 mA dc**
- **For frequency above 1 kHz**
  - **A pk = V pk / 2000 Ω < 0.7 mA X freq. (in kHz),**
  - **But available current (A) shall not exceed 70 mA**

LCC – Part 2

Limits of available energy

For voltage < 450 V peak or dc,

- **Capacitance ≤ 0.1 μF and was recorded in μF**

For voltage = (450, 15,000) V pk or dc,

- **Stored charge ≤ 45 μC and was recorded in**

  μC = (μF) V

For voltage > 15,000 V peak or dc,

- **Available energy ≤ 350 mJ and was recorded in**

J = 5 * $(10)^{-7}$ * (μF) * V^2

Hazardous voltage 危险电压

voltage exceeding 42,4 V peak, or 60 V d.c., existing in a circuit that does not meet the requirements for either a LIMITED CURRENT CIRCUIT or a TNV CIRCUIT

既不符合LCC电路要求也不符合TNV 电路要求的电路中，其交流峰值超过42.4V 或直流值超过60V 的电路；

LPS(功率受限电源)

1，Inherently limited power source内在受限制电源
2，Not Inherently limited power source(overcurrent protective device required)非内在受限制电源(带有过流保护)

Table 2B – Limits for power sources without an overcurrent protective device

Output voltage [a] (U_{oc})		Output current [b d] (I_{sc})	Apparent power [c d] (S)
V a.c.	V d.c.	A	VA
≤ 30	≤ 30	≤ 8,0	≤ 100
–	30 < U_{oc} ≤ 60	≤ 150/U_{oc}	≤ 100

a U_{oc}: Output voltage measured in accordance with 1.4.5 with all load circuits disconnected. Voltages are for substantially sinusoidal a.c. and ripple free d.c. For non-sinusoidal a.c. and d.c. with ripple greater than 10 % of the peak, the peak voltage shall not exceed 42,4 V.

b I_{sc}: Maximum output current with any non-capacitive load, including a short-circuit.

c S (VA): Maximum output VA with any non-capacitive load.

d Measurement of I_{sc} and S are made 5 s after application of the load if protection is by an electronic circuit or a positive temperature coefficient device, and 60 s in other cases.

LPS(功率受限电源)

Table 2C – Limits for power sources with an overcurrent protective device

Output voltage [a] (U_{oc})		Output current [b d] (I_{sc})	Apparent power [c d] (S)	Current rating of overcurrent protective device [e]
V a.c.	V d.c.	A	VA	A
≤ 20	≤ 20	≤ 1 000/U_{oc}	≤ 250	≤ 5,0
20 < U_{oc} ≤ 30	20 < U_{oc} ≤ 30			≤ 100/U_{oc}
–	30 < U_{oc} ≤ 60			≤ 100/U_{oc}

[a] U_{oc}: Output voltage measured in accordance with 1.4.5 with all load circuits disconnected. Voltages are for substantially sinusoidal a.c. and ripple free d.c. For non-sinusoidal a.c. and for d.c. with ripple greater than 10 % of the peak, the peak voltage shall not exceed 42,4 V.

[b] I_{sc}: Maximum output current with any non-capacitive load, including a short-circuit, measured 60 s after application of the load.

[c] S (VA): Maximum output VA with any non-capacitive load measured 60 s after application of the load.

[d] Current limiting impedances remain in the circuit during measurement, but overcurrent protective devices are bypassed.

NOTE The reason for making measurements with overcurrent protective devices bypassed is to determine the amount of energy that is available to cause possible overheating during the operating time of the overcurrent protective devices.

[e] The current ratings of overcurrent protective devices are based on fuses and circuit-breakers that break the circuit within 120 s with a current equal to 210 % of the current rating specified in the table.

Electrical insulation 电气绝缘

Protection against electric shock

1 功能绝缘functional insulation(F)

设备正常工作仅需要的绝缘.

注：所定义的功能绝缘并不起防电击的作用.但是，它可以用来减小引燃和着火的危险的可能性

2 基本绝缘basic insulation(B)

对防电击提供基本保护的绝缘.

3 附加绝缘supplementary insulation(S)

除了基本绝缘以外施加的独立的绝缘，用以减小在基本绝缘一旦失效时仍能防止电击

4 双重绝缘double insulation(D)

由基本绝缘加上附加绝缘构成的绝缘

5 加强绝缘reinforced insulation(R)

一种单一的绝缘结构，在本标准规定的条件下，其所提供的防电击的保护等级相当于双重绝缘.

Levels of Protection(保护级数)

TYPE of INSULATION or PROTECTION	LEVEL of PROTECTION against ELECTRIC SHOCK
FUNCTIONAL	0
BASIC	1
SUPPLEMENTARY	1
DOUBLE	2
REINFORCED	2
PROTECTIVE EARTH	1

Protection against Electric Shock (电击的保护)

The following combinations can be used to achieve two levels of protection against electric shock: 两种电击保护的结合

- B + S = D
- B + E = Two Levels of Protection
- R = D
- B + B ≠ D

Pollution Degree of Equipment 设备的污染等级

Pollution Degree – UL/CSA 60950-1 污染等级

- Pollution Degree 1 for components and assemblies which are sealed so as to exclude dust and moisture.(密封无尘无潮湿)
- Pollution Degree 2 generally for equipment covered by the scope of this standard.(本标准包括的一般的设备)
- Pollution Degree 3 where a local internal environment within the equipment is subject to conductive pollution or to dry non-conductive pollution which could become conductive due to expected condensation.(导电污染，能变成导电的干燥非导电污染)

Impact 影响: The minimum CLEARANCE and CREEPAGE DISTANCE values.

Critical component 关键元件

Materials and components used in the construction of equipment should be so selected and arranged that they can be expected to perform in a reliable manner for the anticipated life of the equipment without creating a hazard, and would not contribute significantly to the development of a serious fire hazard.

设备结构所使用的材料和元器件应适当选择和合理配置，以便使设备在预定寿命期间安全可靠的运行，不会产生危险，而且在出现严重着火危险时，不会加剧焰的蔓延.选择的元器件应在正常工作条件下保持在制造厂商设定的额定值内，在故障条件下也不会产生危险.

General Critical component list
一般的关键元器件清单

Marking Label	标签	Power Supply Cord	电源线
Case	外壳	Appliance Inlet	插座
Internal Wire	内部线	Fuse	保险丝
Fusible resistor	保险电阻	X Cap & Y Cap	X 电容，Y电容
Varistor	压敏电阻	Line Filter	滤波器
Thermistor	热敏电阻	Transformer	变压器
Optical isolators	光耦	Tubing	套管
PWB	线路板	DC output cord	互连线
Switch	开关	Adhesive	胶
Fuse-holder	保险丝座	Thermal cut-out	热断路器
Thermostat	恒温器	Terminal Block	端子排
Insulation material	(塑料)绝缘材料		

Enclosure 外壳

Safety enclosure UL 60950-1 定义: 安全外壳

- **FIRE ENCLOSURE:**用来使设备内以生的着火或火焰的蔓延减小到最低限度的设备部件
- **MECHANICAL ENCLOSURE**:用来减小由机械危险和其他物理危险伤害的危险的设备部件
- **ELECTRICAL ENCLOSURE:**用来限制与可能带危险电压或达到危险能量等级的零部件或TNV 电路中的零部件接触的设备部件
- **DECORATIVE ENCLOSURE:** 装饰外壳

NOTE: 一种外壳可以在另外一种功能外壳里面；而一个外壳可以同时作为防火外壳以及电气外壳等.

Metallic Enclosure consideration 金属外壳的考虑

Metallic enclosure should provided adequate protection, such as rigidity, resist-corrupt, resistance; Electrical distance and opening.

金属外壳应该要提供足够的符合标准的强度，如硬度， 抗腐蚀，导电阻抗； 另外金属外壳与危险电压，保护地要有足够的电气距离。其开孔要需要符合标准要求。

Which might impact against:

- Impact Test
- Steady Force Test
- Grounding Continuity Test
- Electric Strength Test
- Drop Test
- Stabilities Test
- Others

Plastic Enclosure 塑料外壳

Plastic enclosure should provided adequate strength, such as rigidity, operating temperature, flammability, and distance through opening, and thickness and opening.

塑料外壳应该提供符合标准的足够强度， 如硬度，工作温度，燃烧等级，另外与危险电压的电气距离以及开孔厚度也需要符合相应的要求。

Which might impact against:

- Steady Force Test
- Stress Relief Test
- Impact Test
- Drop Test
- Stabilities Test
- Ball Pressure Test (Direct Plug – In Unit)
- Others

Plastics 塑料

According to the performance after heat deserved, Plastic could be two class:
按受热后特性来分，塑料大体可以分为热固性材料 Thermosets 和 热塑性材料Thermoplastics

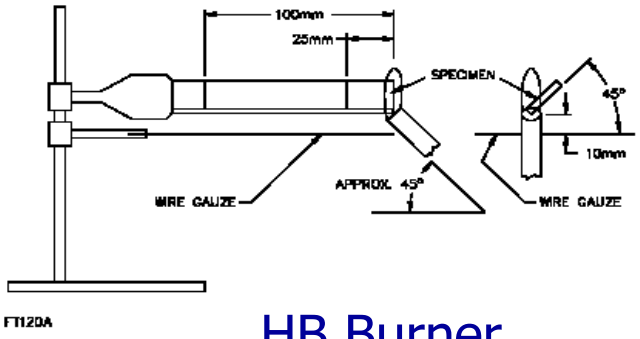
Others:
通常所用的塑料并不是一种纯物质，它是由许多材料配制而成的。其中高分子聚合物(或称合成树脂)是塑料的主要成分，此外，为了改进塑料的性能，还要在聚合物中添加各种辅助材料，如填料、增塑剂、润滑剂、稳定剂、着色剂等，才能成为性能良好的塑料

Plastics Flammability 阻燃特性

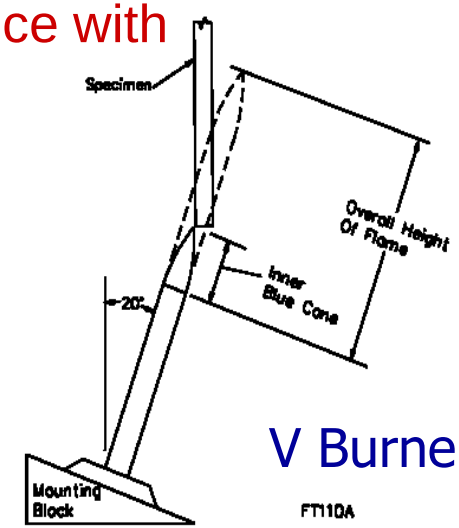
Flammability Tests for UL 94阻燃等级

- Horizontal Burning: HB
- Vertical Burning: V-2, V-1, V-0, 5V-A, 5V-B
- Thin Sheet Burning: VTM-2, VTM-1, VTM-0
- Foam Burning: HBF, HF-2, HF-1

Related factor: Thickness , color must compliance with Requirement of standard.



HB Burner



V Burner

Plastics operating temperature 塑料温度特性

Long Term Thermo Aging for UL 746B:长期老化测试

RTI: Relative Thermal Index(相对热指数)

- **RTI (Electrical)(电气的相对热指数):** 与电气绝缘特性有关
- **RTI Mechanical (Impact)(机械冲击的相对热指数):** Associated with critical impact resistance, *toughness, elongation* resilience and flexibility properties与关键的抗撞击性，硬度，弹性，拉伸性有关.
- **RTI Mechanical (Strength)(机械强度的相对热指数):** Associated with critical mechanical strength and structural integrity where impact resistance, resilience and flexibility are may not be essential.与关键的机械强度，结构密度有关，相对来说，这个参数不关注于抗撞击性以及弹性

UL PLASTICS DATABASE QMFZ2 塑料认证

QMFZ2 Component - Plastics

Friday, October 24, 2003

E123456 (NBK)

ANY PLASTICS CO LTD
1 PLASTICS DR NORTHFIELD CA 95555

Material Designation: **708B**

Product Description: Polycarbonate (PC), designated “Maxite" furnished as pellets.

Color	Min. Thick. mm	Flame Class	HWI	HAI	RTI Elec	RTI Imp	RTI Str	IEC GWIT	IEC GWFI
ALL	0.7	HB	-	-	115	115	115	-	-
	1.1	HB	3	2	115	115	115	-	-
	1.5	HB	2	0	130	125	125	-	-
	3.0	HB	2	1	130	130	130	-	-

CTI: 2 HVTR: 2 D495: - IEC BP: -

NOTE - Material designation may be followed by a color nomenclature consisiting of either an alpha/numeric or numeric/alpha combination.

Report Date: 8/7/1968

Underwriters Laboratories Inc®

1234567890

Diel. St	31	Dim. Stal	0	Izod Imp	-	Tnsl. Imp	473	Heat Def	141
Vol. Res	16	Water Abs	0.24	Tnsl. St	62	Flex. St	-		

Plastics electrical performance 塑料电气特性

Electrical Short Term Test for UL 746A
短期电气测试

- Hot-Wire Ignition (HWI)热电线点燃
- High Amp Arc Ignition (HAI) 高电流电弧点燃
- Comparative Tracking Index (CTI) 相对起痕指数
- Dielectric Strength耐压能力
- Volume/Surface Resistivity 体积/表面电阻系数

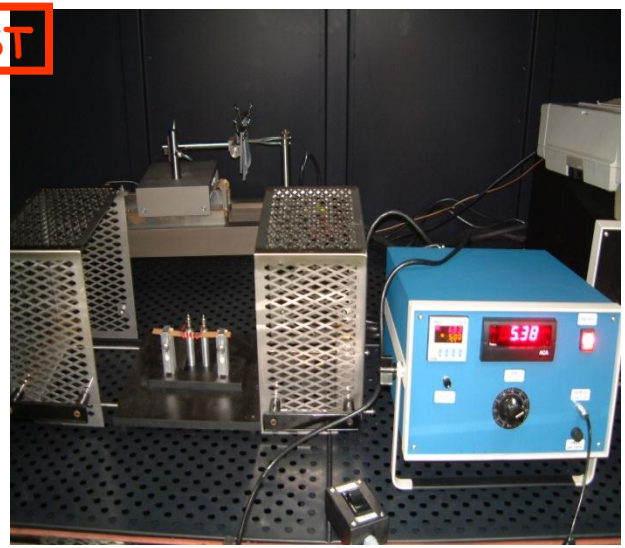
Hot-Wire Ignition (HWI)热电线点燃

Hot-Wire Ignition: (HWI; ASTM D3874, IEC 60695-2-20)
Performance is expressed as the mean number of seconds needed to either ignite standard specimens or to burn through the specimens without ignition. 点燃时间秒数表示HWI的范值(测试图如下页)

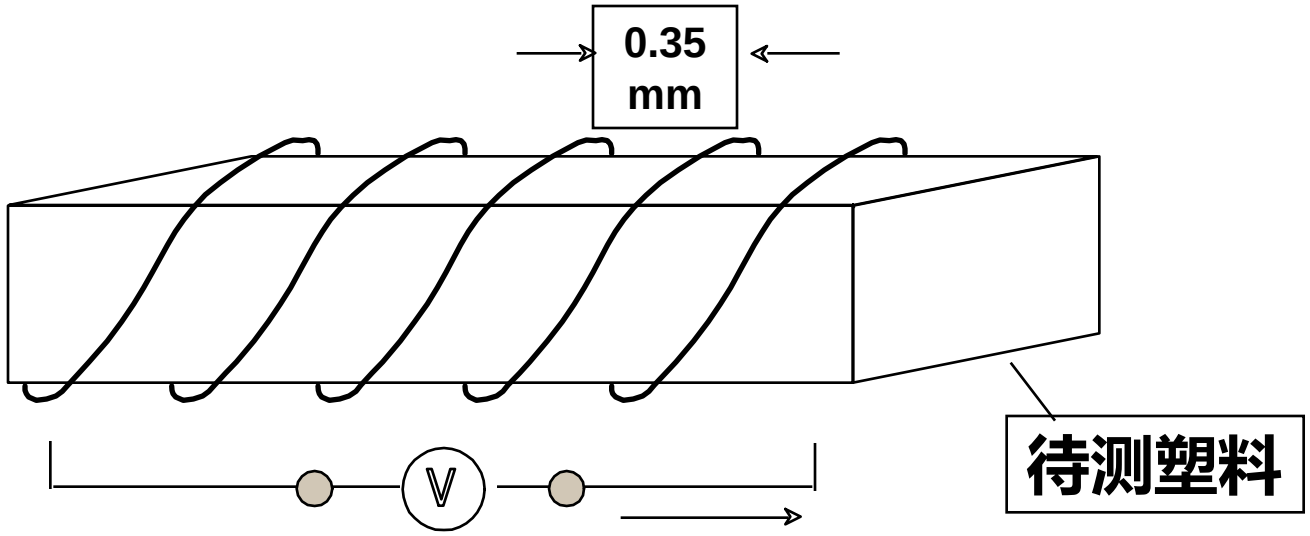
HWI Range Mean Ignition Time (in sec)	Assigned PLC
>120	0
60~119	1
30~59	2
15~29	3
7~14	4
<7	5

BEST

WORST



Hot-Wire Ignition (HWI)热电线点燃



Power Dissipation: 0.26 Watts/mm

High Amp Arc Ignition (HAI) 高电流电弧点燃

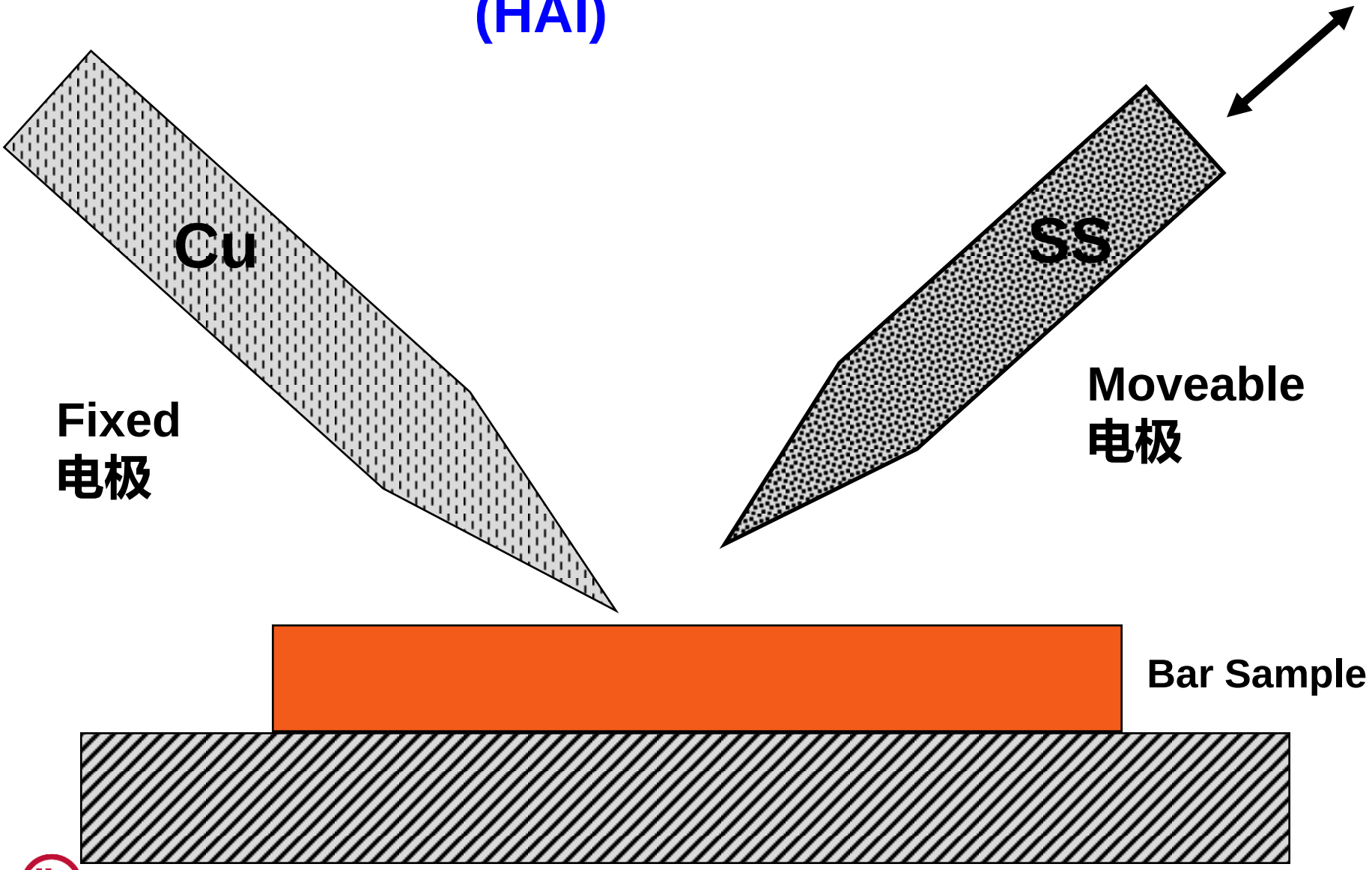
High Current Arc Ignition: (HAI; ANSI/UL 746A) Performance is expressed as the number of arc rupture exposures (standardized as to electrode type and shape and electric circuit) that are necessary to ignite a material when they are applied at a standard rate on the surface of the material. 引起点燃的电弧数表示HAI范值(测试图如下页)

HAI Range Mean Number of Arcs to Cause Ignition	Assign PLC
≥120	0
60~119	1
30~59	2
15~29	3
<15	4

BEST

WORST

RESISTANCE TO HIGH AMP IGNITION (HAI)



Comparative Tracking Index相比漏电起痕指数

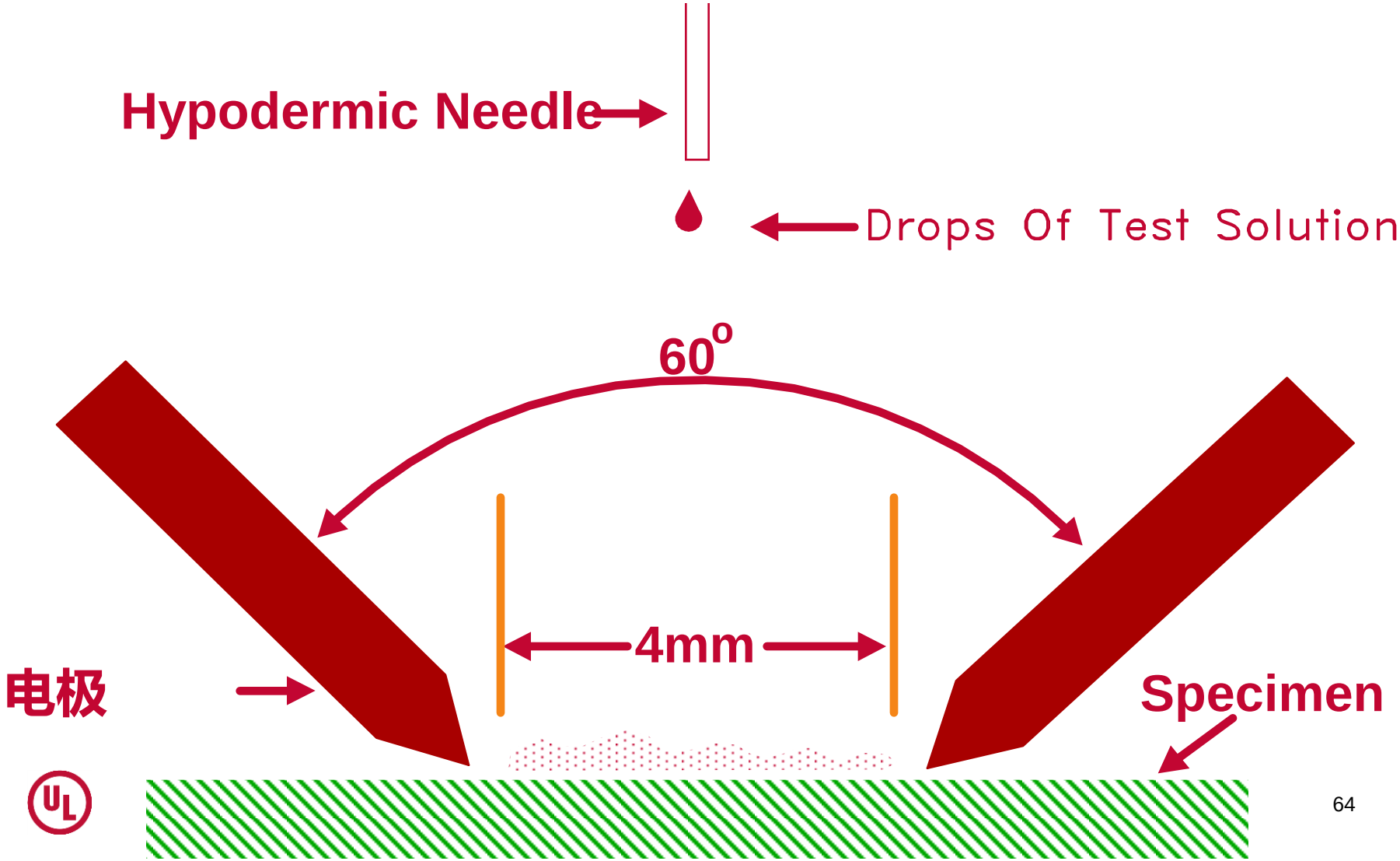
Comparative Tracking Index相比漏电起痕指数: (CTI; ASTM D3638) 在50滴0.1%氯化氨溶液滴过后的塑料引起起痕的电压数表示相比起痕指数，在此测试中，3 mm 厚度代表不同厚度的塑料特性

Material Group(与在这种材料表面的爬电距离有关)

Material Group I		CTI ≥ 600
Material Group II	400 ≤	CTI < 600
Material Group IIIa	175 ≤	CTI < 400
Material Group IIIb	100 ≤	CTI < 175

CTI Range Tracking Index (in volts)	Assigned PLC
>600	0
400~599	1
250~399	2
175~249	3
100~174	4
100	5

Comparative Tracking Index相比漏电起痕指数



Fabricated Plastic Parts 塑料制造件

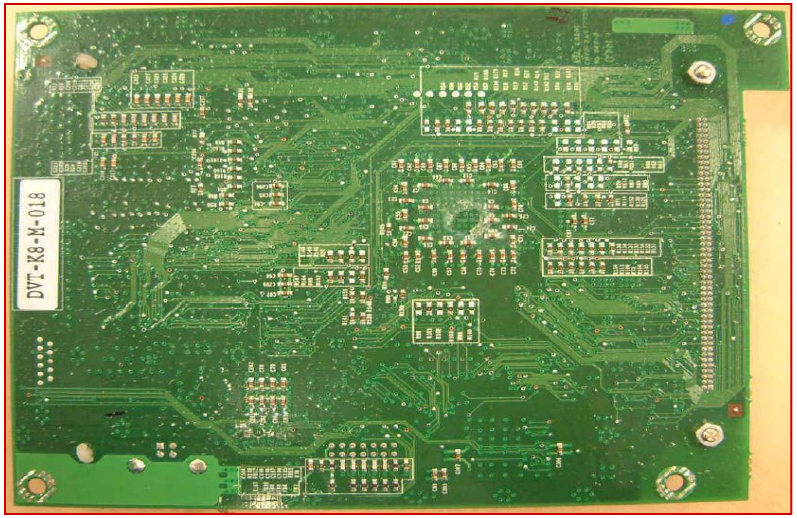
Fabricated Plastic Parts塑料制造件
is a sub-category under the main product category, Plastics (QMFZ2). They are parts whose polymeric material identity is traceable through various manufacturing processes including molding, encapsulation, potting and other fabrications. The required information are marked either on the part, shipping container, or on an accompanying specification sheet.

Reference Materials: UL 746D Polymeric Materials – Fabricated Parts.

Printed Wiring Board 印刷线路板

Printed Wring Board consideration:

- Type
- Minimum Conductor Width
- Minimum Conductor Thickness
- Max Operating Temperature
- UL 94 Flame Class
- Comparative Tracking Index; CTI

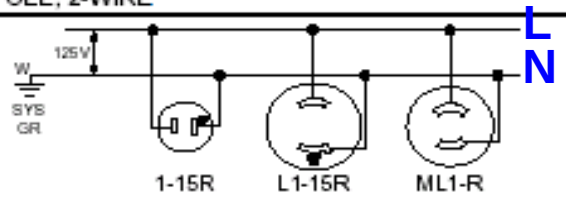


Supply Mains 配电线网

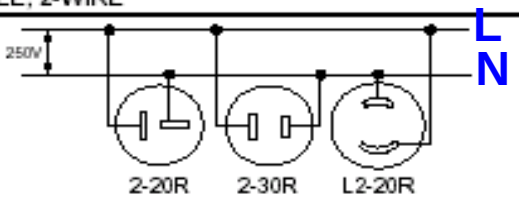
Circuit Wiring Diagrams

WIRING DIAGRAMS FOR NEMA CONFIGURATIONS

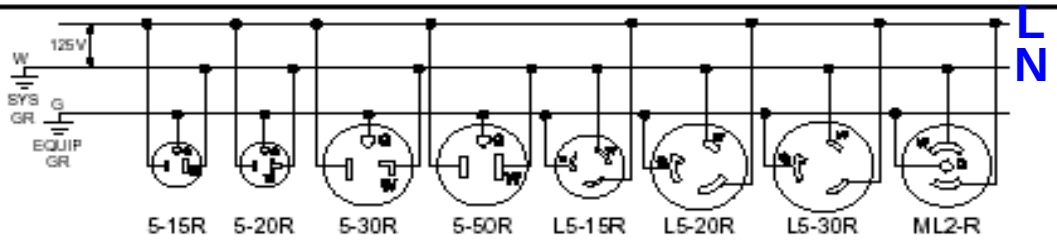
125V — 2-POLE, 2-WIRE



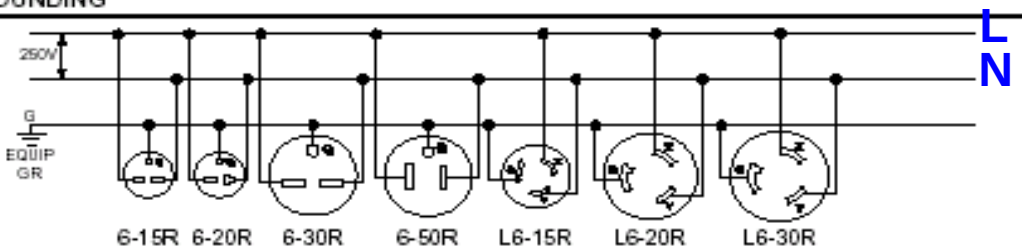
250V — 2-POLE, 2-WIRE



125V — 2-POLE, 3-WIRE GROUNDING



250V — 2-POLE, 3-WIRE GROUNDING



Supply Mains 配电线网

Polar definition 极性的定义

- 火线 Hot Side of Line/Line/Ungrounded – Current carry(带电流)
- 零线 Neutral/Grounded – Current carry
- 接地线 Grounding/Earthing – Non-current carry
- 线的颜色 Wire Color Identification: **Black** for line; **white** for neutral and **green** for grounding.

Connect to Supply main 配电线网连接

1，Pluggable equipment type A A 型可插式设备

Equipment that is intended for connection to a MAINS supply via a non-industrial plug and socket-outlet or a non-industrial appliance coupler, or both预定要通过非工业用插头和插座，或通过非工业用器具耦合器，或者通过这两者与建筑物安装配线连接的设备

2， Pluggable equipment type B B 型可插式设备

Connection to a MAINS supply via an industrial plug and socket-outlet or an appliance coupler, or both, complying with IEC60309 or with a comparable national standard 通过IEC60309工业用插头和插座或通过工业用器具耦合器，或者通过这两者与建筑物安装配线连接的设备。

3，Permanently connected equipment 永久性连接式设备

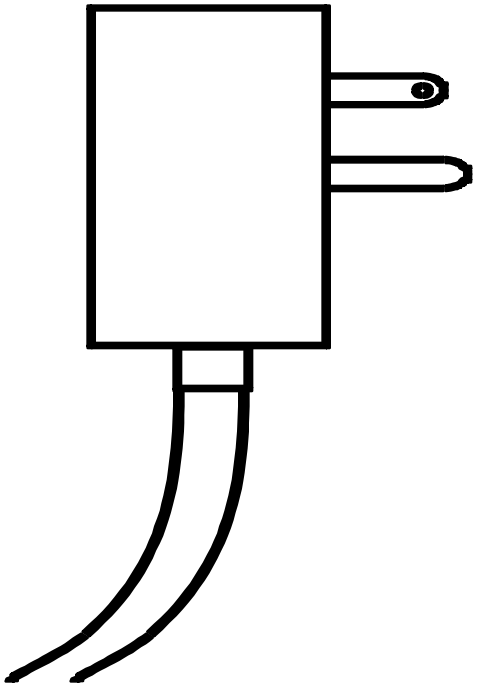
预定要用螺钉接线端子或其他可靠方法与建筑物安装配线连接的设备

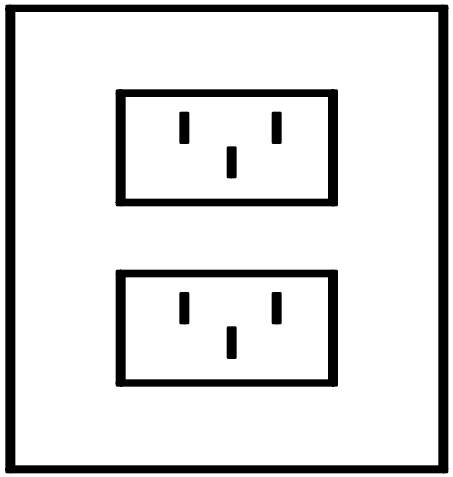
4，Detachable power supply cord 预定要利用适当的器具耦合器与设备连接，用以供电的软线

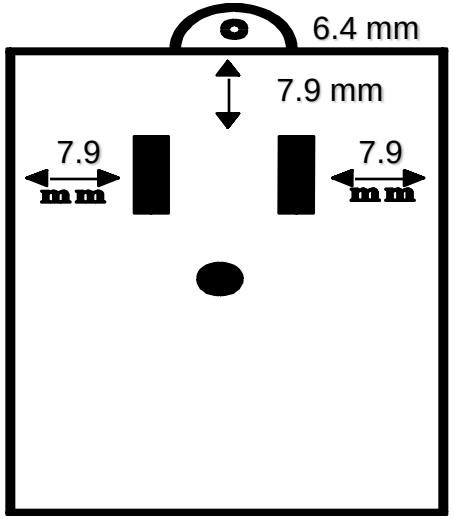
5，Non-detachable power supply cord 固定在设备上的或与设备装配在一起的用以供电的软线.

Connect to Supply main配电线网连接

6. Direct Plug-in Equipment
直插式







Note: For UL60950-1 requirement, 7.9 mm could be 5.1 mm

Straight Blade AND Receptacles Configuration
插头刀片以及插座的规格

NEMA Configuration

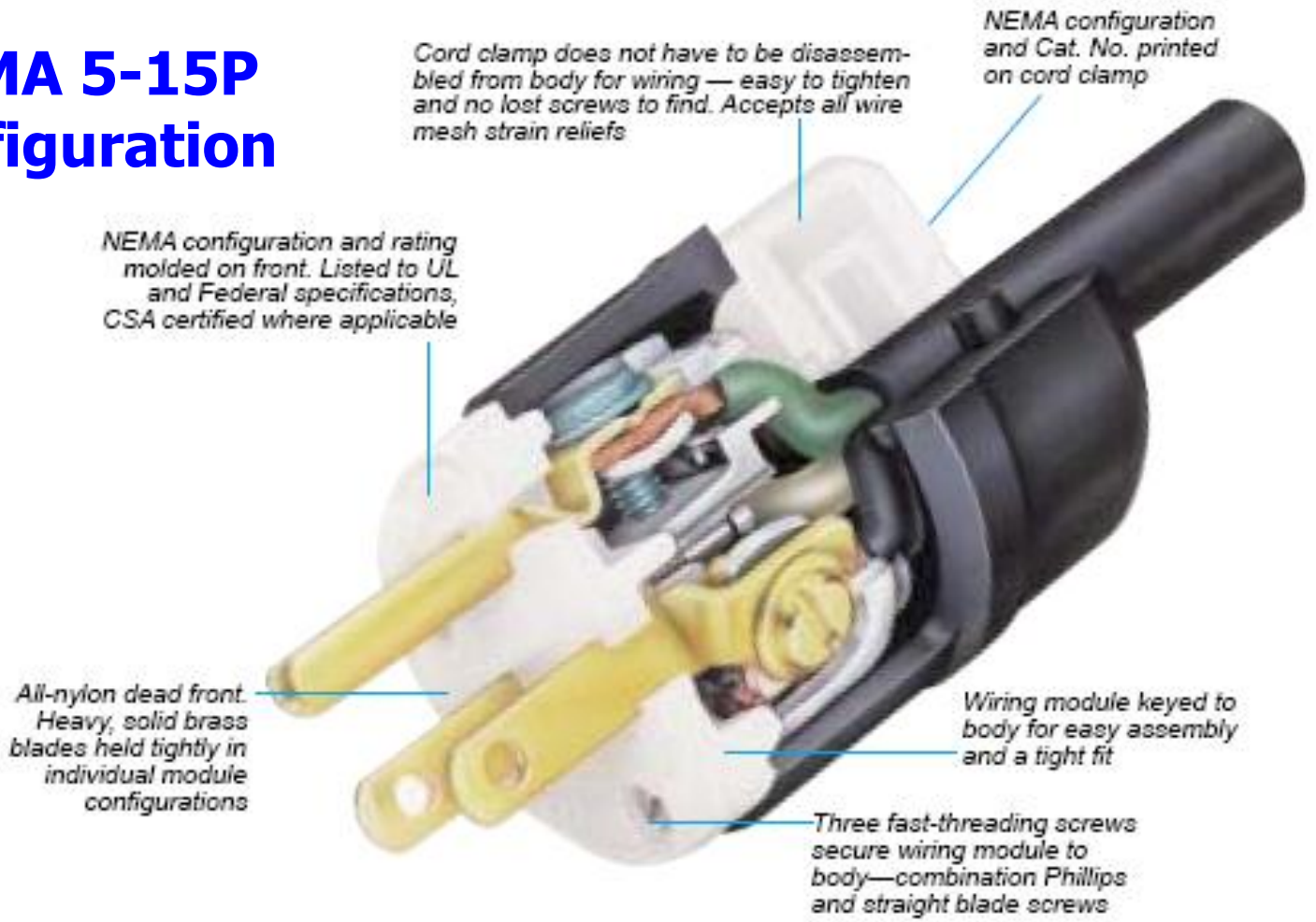
NEMA Straight Blade Configurations

NEMA CONFIGURATIONS FOR GENERAL-PURPOSE NONLOCKING PLUGS AND RECEPTACLES

WIRING / VOLTAGE			15 AMPERE		20 AMPERE		30 AMPERE		50 AMPERE		60 AMPERE	
			RECEPTACLE	PLUG	RECEPTACLE	PLUG	RECEPTACLE	PLUG	RECEPTACLE	PLUG	RECEPTACLE	PLUG
2-POLE 2-WIRE	125V	1	1-15R	1-15P								
	250V	2		2-15P	2-20R	2-20P	2-30R	2-30P				
	277V AC	3				RESERVED FOR FUTURE CONFIGURATIONS						
	600V	4				RESERVED FOR FUTURE CONFIGURATIONS						
2-POLE 3-WIRE GROUNDING	125V	5	5-15R	5-15P	5-20R	5-20P	5-30R	5-30P	5-50R	5-50P		
	250V	6	6-15R	6-15P	6-20R	6-20P	6-30R	6-30P	6-50R	6-50P		
	277V AC	7	7-15R	7-15P	7-20R	7-20P	7-30R	7-30P	7-50R	7-50P		
	347V AC	24	24-15R	24-15P	24-20R	24-20P	24-30R	24-30P	24-50R	25-50P		
	480V AC	8				RESERVED FOR FUTURE CONFIGURATIONS						
	600V	9				RESERVED FOR FUTURE CONFIGURATIONS						

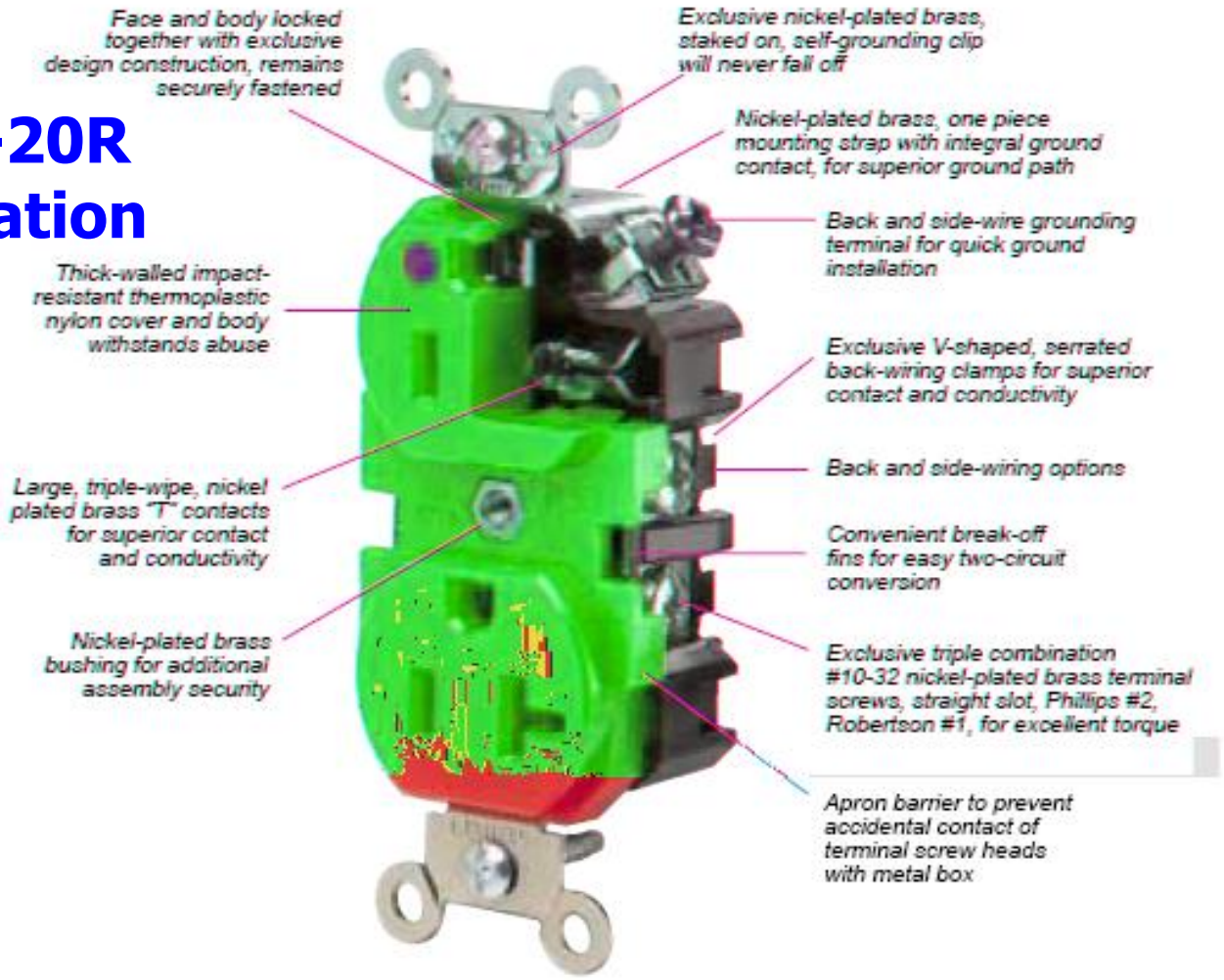
Straight Blade Plugs 直插刀片规格

NEMA 5-15P Configuration



Straight Blade Receptacles 直脚插座

NEMA 5-20R Configuration



Wiring and connections securing requirement 连接连线的固定

Securing of internal wiring内部线的固定:

No loosing, no excessive strain relief, insulation damage

Termination of conductor 导体的端子:

It is permitted to use soldered, welded, crimped, screwless (push-in) and similar terminations for the connection of conductors. For soldered terminations, the conductor shall be positioned or fixed so that reliance is not placed upon the soldering alone to maintain the conductor in position.

Primary wiring 初级线路

- **Primary wiring 初级线路**

- - Suitably rated for voltage and current, and recognized Appliance Wiring Material (AWM) i.e., wires and cables.
采用适合的额定电压和电流，以及经过验证的电器布线材料(AWM)，例如电线和电缆。

- - Materials to be PVC, neoprene, TFE, PTFE, FEP, and polyimide or rated VW-1 (UL) or FT-1 (CSA).

- - If wiring is above openings in the bottom, only VW-1 or V-1 tested wires or wires made from TFE or PTFE or FEP or PVC or Neoprene or polyimide are considered acceptable.
如果线路在底部向上开放，则仅有VW-1或V-1测试线路，或TFE、PTFE、PEP、PVC、氯丁橡胶或聚酰亚胺材质的线路可被接受使用。

Secondary wiring 次级电路

- **Secondary wiring 次级电路**

- Suitably rated for voltage and current.
合适的额定电压和电流。

- Materials to be PVC, neoprene, TFE, PTFE, FEP, and polyimide or rated VW-1 (by UL) or FT-1 (by CSA).

- If wiring is above openings in the bottom, then only VW-1 or V-1 tested or made from PVC or Neoprene or TFE or PTFE or FEP or polyimide is considered acceptable
如果线路在底部向上开放，则仅有VW-1或V-1测试线路，或TFE、PTFE、PEP、PVC、氯丁橡胶或聚酰亚胺材质的线路可被接受使用。

Power Supply Cord 电源线

Power supply cord (UL 817)
常见电源线

1. Non-detachable power supply cords不可拆电源线
2. Detachable power supply cords 可拆电源线
3. Cord sets 线束装置

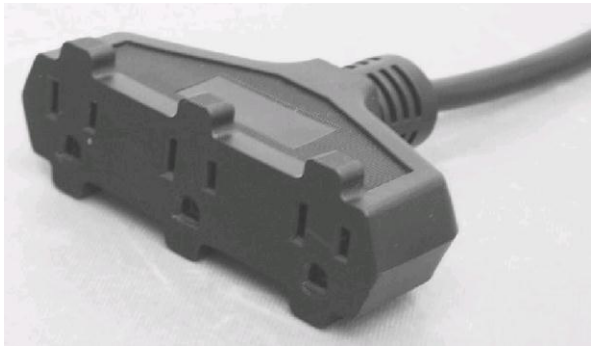
Note：CSA treats items 2, 3 as cord sets

Power Supply Cord 电源线

Application requirement 应用要求:

- Diameter 线径 Minimum 18 AWG; 使具体额定电流选择合适的线径 Table 3B(Next page)
- Electrical 电气特性 Within max. V, A ratings; Insulation
- NAE Requirement: 线长 1.5 至4.5 m.
- Plug rating 不少于设备的额定输入电流的125%

(**注意比较**：
互连线DC Output cord， Interconnected cable的线长不大于3.05 m)



Power Supply Cord 电源线

Table 3B – Sizes of conductors

RATED CURRENT of equipment A	Minimum conductor sizes		
	Nominal cross-sectional area mm^2		AWG or kcmil [cross-sectional area in mm^2] see note 2
Up to and including 6		0,75 [1)]	18 [0,8]
Over 6 up to and including 10	(0,75) [2]	1,00	16 [1,3]
Over 10 up to and including 13	(1,0) [3]	1,25	16 [1,3]
Over 13 up to and including 16	(1,0) [3]	1,5	14 [2]
Over 16 up to and including 25		2,5	12 [3]
Over 25 up to and including 32		4,0	10 [5]
Over 32 up to and including 40		6,0	8 [8]
Over 40 up to and including 63		10	6 [13]
Over 63 up to and including 80		16	4 [21]
Over 80 up to and including 100		25	2 [33]
Over 100 up to and including 125		35	1 [42]

Strain Relief Means 应力装置

Cord Anchorages

带有 NON-DETACHABLE POWER SUPPLY CORD, a cord anchorage 线卡(strain relief means) 应该要提供来满足下面两点:

- the connecting points of the cord conductors are relieved from strain; 线导体的连接点能承受拉应力
- the outer covering of the cord is protected from abrasion. 线的外部需要提供破损保护

Test consideration 测试考虑：推拉该线后不应该增加线或其导体的导电性；或者引起内部的元件损坏以及松动

Table 3C – Physical tests on power supply cords

Mass (M) of the equipment kg	Pull N
Up to and including 1	30
Over 1 up to and including 4	60
Over 4	100

Disconnect Device 断接装置

AC Mains supply disconnecting device 交流电网电源的断接装置

Below method could acts as disconnect device以下几种都可以作为分离装置:

- Plug of non-detachable power supply cord.
- Appliance coupler for detachable power supply cord, IEC 60320(Appliance Inlet).
- Switch has 3 mm air gap between contacts (IEC).
- Plug face for direct plug in unit.
- Circuit breaker.

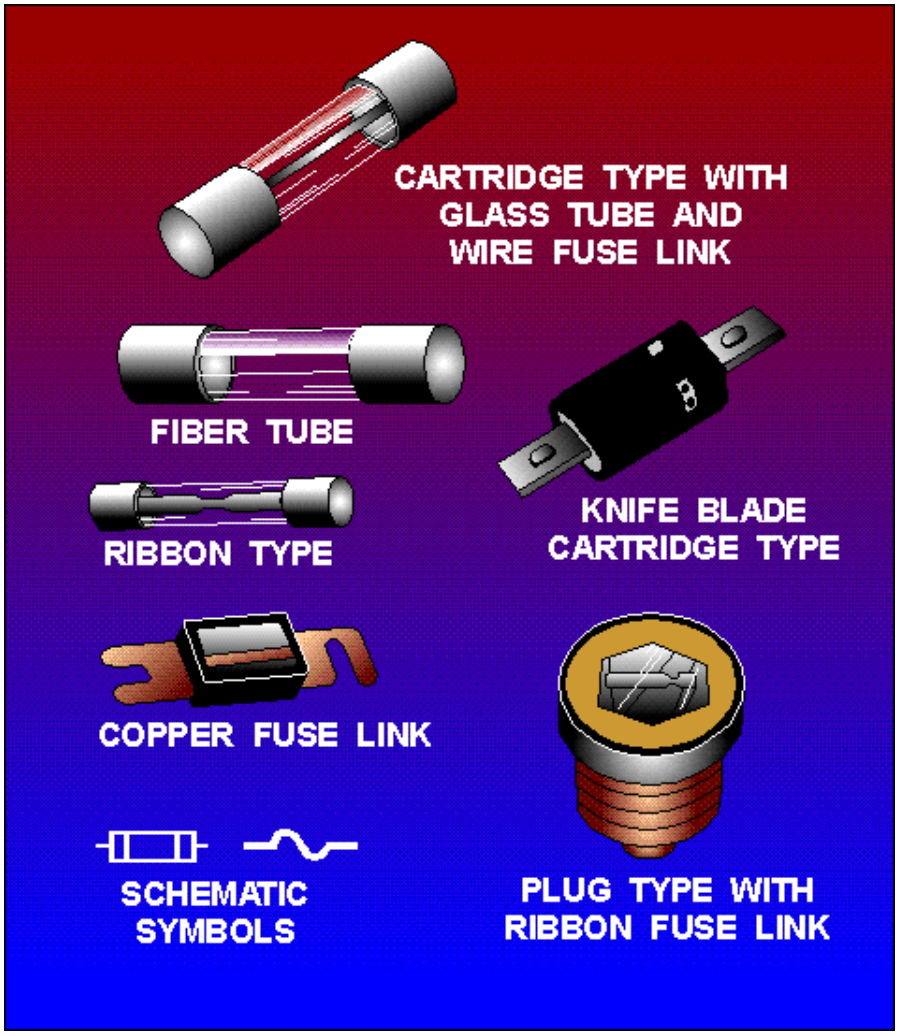
Note: 当断接装置装在设备内时，应尽可能地靠近电源入口处.

Supplementary Fuse 保险丝

Fuse configuration

- **型号**: Cartridge圆筒状,微型miniature, subminiature (micro), midget, automotive blade, PC board, protective etc.,
- **尺寸**: 5φx20 mm; 6.35φx15.9 mm; 6.35φx31.8 mm etc for 筒状; 带引脚或支柱。
- **特性**: Resettable, indicating
- **套管材料**: Glass, ceramic
- **安装**: Solderable (surface mount), solderable (with leads), replaceable (with holder or clips), others.
- **动作特性:** Fast acting (normal blow), time lag (slow blow) etc.,

Supplementary Fuse 保险丝



Supplementary Fuse保险丝

Application consideration

- **Certification 认证**: UL 248-1, -14 and/or IEC 60127 series。
- **Standard test 标准测试**：
  拉135% rated current，fuse 应该 1 hs内动作.
  拉 200% rated current，fuse 应该 1 min内动作.
- **Fuse marking 附近在PCB标示：**Electrical Rating (A/V) should be marked in adjacent to device.
- **Caution 使用者更换的警告**: "CAUTION: For continue protection against the risk of fire, replace only with same type and rating of fuse."
- Note: 在异常测试时，Fuse 不能爆裂， 如过爆裂，采取包套管的方式也不能接受

Supplementary Fuse 保险丝

Selection of a supplementary circuit protector must usually satisfy 3 basic criteria选用电路保护Fuse的时候必须考虑满足以下几个原则:

1. Electrical performance / ratings电气特性，额定值.
2. Safety agency approval / requirements 安规要求.
3. Mechanical properties / physical dimensions机械特性，物理尺寸.

Pay attention to something 值得注意

Fuse consideration for UL certification： UL 认证过的保险丝有列名和认可两种类型，客户应明确自己使用的是哪一种保险丝及型号。

在最终的报告中，保险丝在规格不变的前提下，客户可以选用不同品牌的列名保险丝， 但对于认可保险丝，客户只能使用报备时的品牌。

	Category Name	Link to File
	Fuses, Supplemental	JDYX.E10480
	Fuses, Supplemental - Component	JDYX2.E10480
	Fuses, Supplemental Certified For Canada	JDYX7.E10480
	Fuses, Supplemental Certified for Canada - Component	JDYX8.E10480
	File/CCN/Subscriber ID/Keyword Search	

采用UL listed 的Fuse 可以不限厂家型号； 但如果是R/C的fuse必须每一个报备的Fuse相应都通过测试，并控制厂家型号(或分析分断特性)

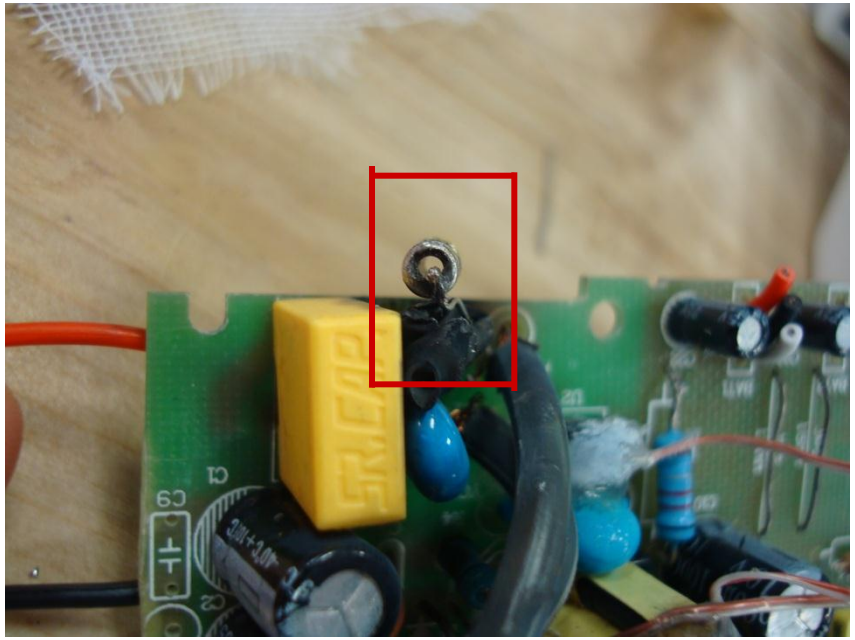
Fuse Bursting 保险丝爆炸

Fuse in primary circuit acts as supplementary current Protection 初级电路做保护元件的Fuse

A fuse that bursts is not an acceptable result and termination of a test. If a fuse bursts during fault testing per sub-clause 5.3, it does not have adequate breaking (rupturing) capacity. Therefore, such a fuse should be replaced by the manufacturer with another fuse having high breaking capacity.

Placement of heat shrink or similar **tubing is not suitable** solution

Documented at 1997 meeting of the Bi-National Working Group.

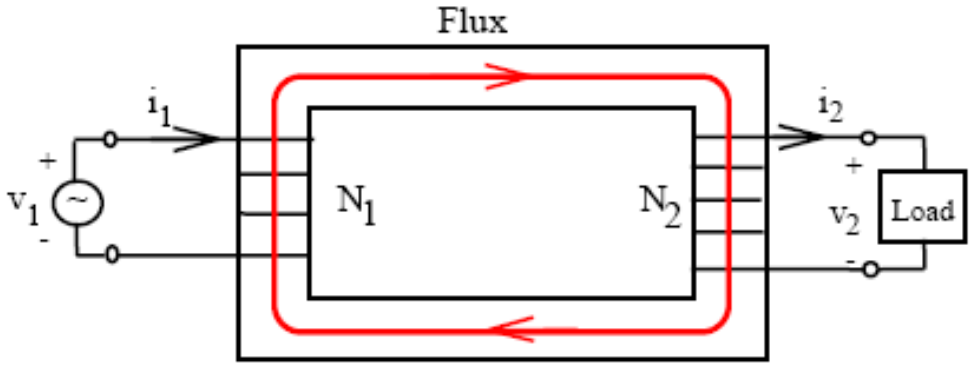


Transformer 变压器

Transformer 变压器

Static Electric Machinery静态电气机械:

Electric Energy ➲ Magnetic Energy ➲ Electric Energy



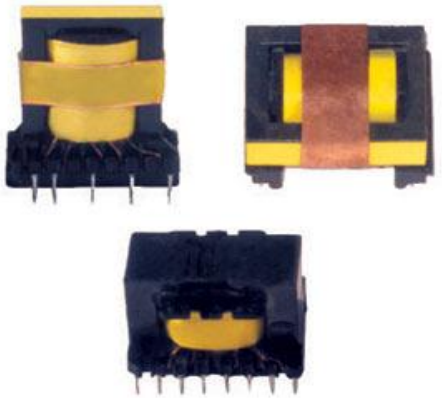
Functions:

1. Voltage/Current Transformation: $V_1/V_2 = i_2/i_1 = N_1/N_2$
2. Impedance transformation
3. Isolation

Transformer 变压器

Transformer Construction 变压器结构:

- Toroidal(环形)
- Laminated(叠片)
- Switching Mode(开关式)
- Others(其他)

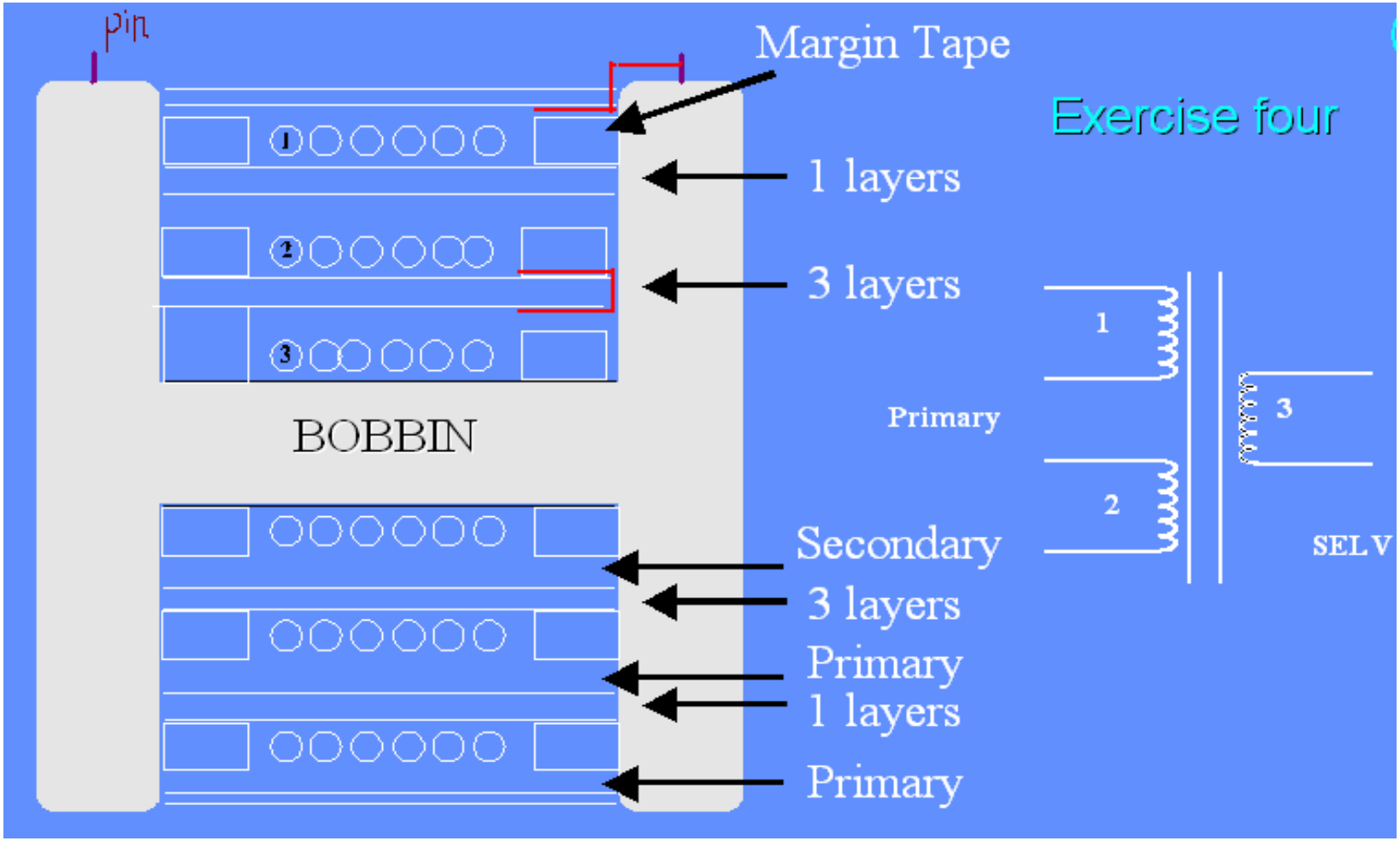


Transformer 变压器

Cirtical component list in Transformer,变压器中的关键零部件:

- Bobbin, **塑料骨架**
- Insulation Tape, **绝缘胶带**
- Margin Tape / Barrier Tape / Spacer, **挡墙(端控)胶带**
- Insulation (Teflon) Tubing, **绝缘套管**
- Triple Insulated Wire, **三层绝缘线**
- Magnet Wire, **漆包线**
- Varnish, **浸漆**
- Thermal cutoff (fuse) **热熔断保险丝**

Transformer 变压器



Transformer 变压器

Normal issue 常见问题- Not Enough Distance

1，Primary/Secondary winding are magnetic coil

Primary to Core/ Primary to Secondary/ Secondary to Core

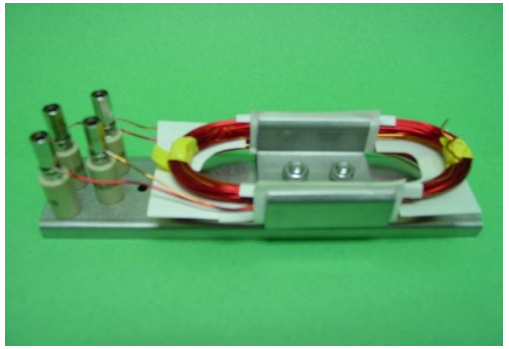
2, Secondary winding is triple insulation

Primary to Secondary Pins

Insulation System 绝缘系统

Insulation systems are unique combinations of materials that have been tested and proven to be chemically compatible for use at certain maximum temperatures. These systems are evaluated in accordance with the Standard for Systems of Insulating Materials, UL1446. These groups of materials are used to produce motors, transformers, solenoid valves and other electrical devices with windings. 绝缘系统配方(OBJS2)， 所有的配方材料经过UL1446标准的认证, 长期老化实验。 变压器采用Class B(OBJY2)的绝缘系统时，各种材料必须在绝缘系统对应的配方表中，材料的厂家型号也须一致

配方一般清单：Magnet Wire， Triple insulation wire，bobbin，tape， tube， varnish， margin tape



Insulation System 绝缘系统

Maximum allowable temperature rise.

- Class A 100 °C
- Class E 115 °C
- Class B 120 °C
- Class F 140 °C
- Class H 165 °C

Double insulation/Reinforced insulation component 跨接加强绝缘的元件

Double insulation/Reinforced insulation

双重绝缘/加强绝缘的元件

Normal located between primary and secondary 可以直接位于初次极之间

Normal componenet: Transformer, Y1 cap, Optical isolator, resistor

常见：变压器，Y1 电容，光耦， 电阻

Interconnecting cable(con'd) 互连线

UL/CSA National difference requirement

INTERCONNECTING CABLES used for external interconnection between parts of equipment or systems shall be constructed of cable acceptable for external use and shall be rated for the application with respect to voltage, current, anticipated temperature, flammability, mechanical serviceability and the like. D1 D1 D1 D1

jacketed appliance wiring material, suitable for the maximum voltage, current and temperature, rated VW-1 or FT-1 or better.

For cable supplied by LPS:

Rated VW-1 or FT-1 or better with no additional requirements.

Module 3
General requirement and consideration
基本要求与考虑

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Section 1

Requirement about
Electric Shock Hazard protection
关于电击危害的防护要求

General 概要

Between any accessible conductive part and the point where he/she stands

- **Ground (referenced 0 V) in general.**

Between any accessible conductive part and another accessible conductive part

- **Where stands different potentials (e.g. floating circuit).**

Permissibility in Operator Access Area (2.1.1) (操作者可触及的区域)

Operator/User is allowed to gain access to…

1. SELV Circuits (2.2);
2. LCC (Limited Current Circuits, 2.4);
3. TNV (2.3) upon 2.1.1.1
4. Protectively earthed conductive parts (2.6)
5. Non-conductive parts

- **If Hazardous Voltages greater than 1000 V ac or 1500 V dc, the air gap shall comply with Basic Insulation according to either 2.10 or 5.2.2**

Methods for SELV Circuits (2.2.3)(安全特低电压的隔离方法)

1. Separation by double insulation or reinforced insulation or distance
2. Separation by earthed screen (2.6) and at least basic insulation
3. Protection by earthing of the SELV circuit

- **The SELV CIRCUIT shall have adequate fault current-carrying capacity to ensure operation of the protective device, if any, and to assure the integrity of the fault current path to earth.**

WORKING VOLTAGES 工作电压

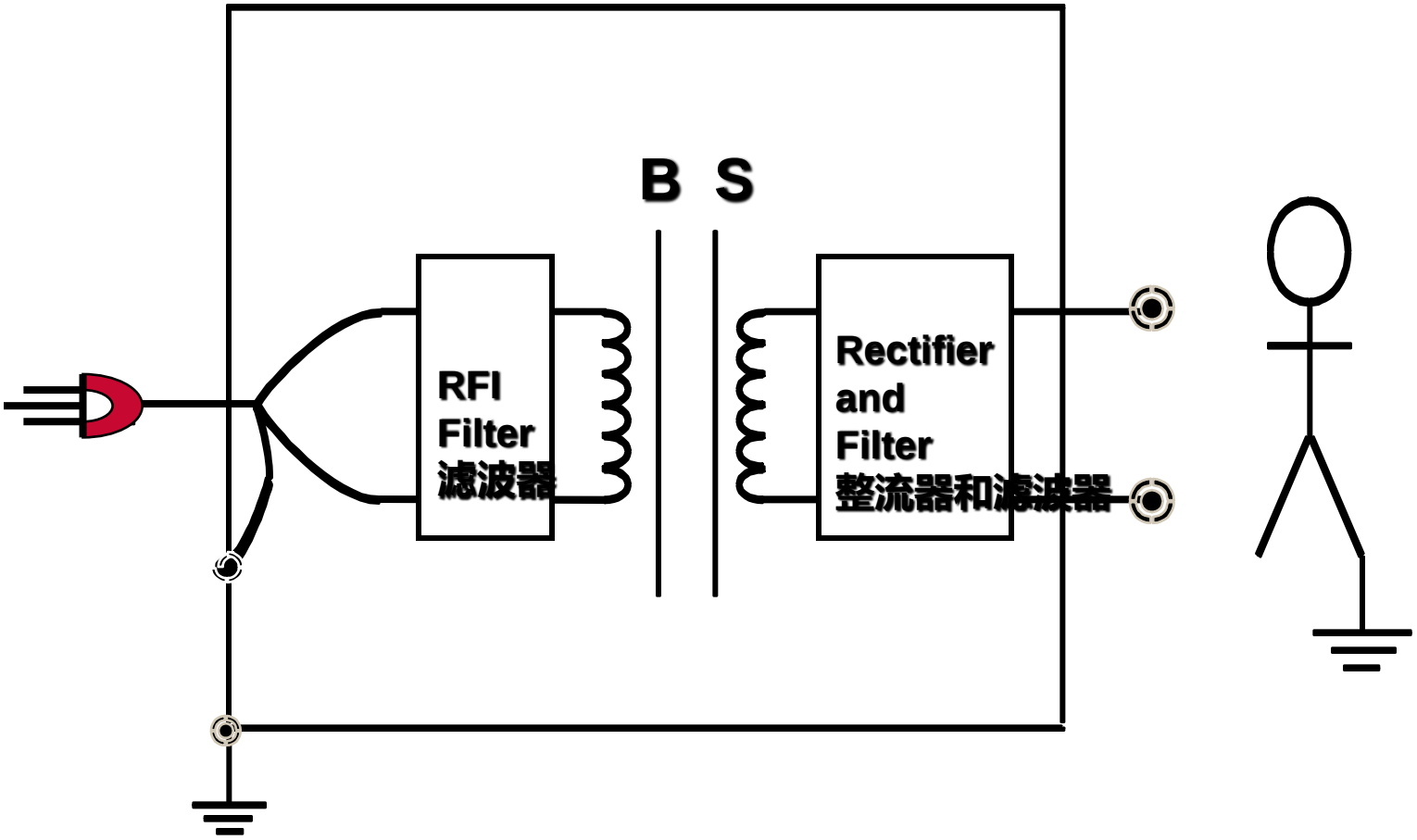
Working Voltages 2.10.2:

工作电压2.10.2

It is necessary to measure Peak, DC and RMS voltages:
必须测量峰值、直流和均方根电压：

- Peak: Measured for determination of clearances and for the electric strength test voltage for solid insulation.
  峰值：测量以确定电气间隙以及固体绝缘的耐压测试电压。
- Mains transients are not part of the working voltage measurement but are taken into account.
  电源瞬变不是工作电压测量的一部分，但是要加以考虑。
- RMS and dc: Measured for creepage distances.
  均方根电压和直流电：测量爬电距离。

WORKING VOLTAGE 工作电压

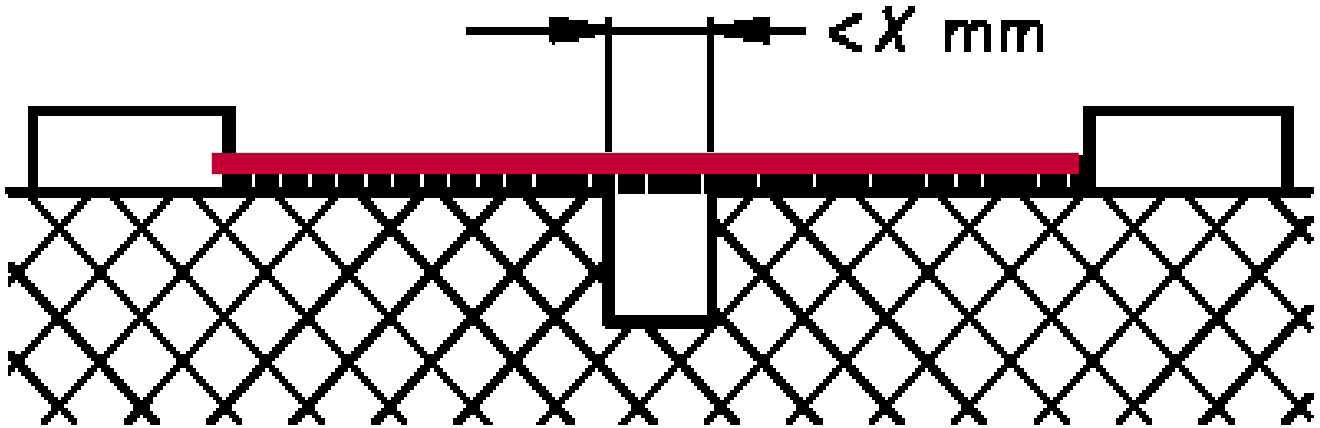


Example of a linear power supply 线性电源供应器示例

Clearance (空气间隙)

The shortest distance between two conductive parts measured through air.

Air is said to be “renewable” insulation. Thus, clearance is self-healing.



PD	X (mm)
1	0.25
2	1
3	1.5

Clearance 2.10.3.2(空气间隙)

For primary circuit:

- **MAINS TRANSIENT VOLTAGE(Overvoltage category), Mains voltage, Vpeak**
- **Pollution degree**
- **Insulation grade**

Value from:

Table 2K: Minimum CLEARANCE value for a WORKING VOLTAGE equal to the AC MAINS SUPPLY voltage

Table 2L: the appropriate additional CLEARANCE value(PEAK WORKING VOLTAGE>peak value of the AC MAINS SUPPLY voltage)

For Secondary circuit

Table 2M

Creepage (爬电距离)

The shortest path between two conductive parts measured along the surface of the insulation.

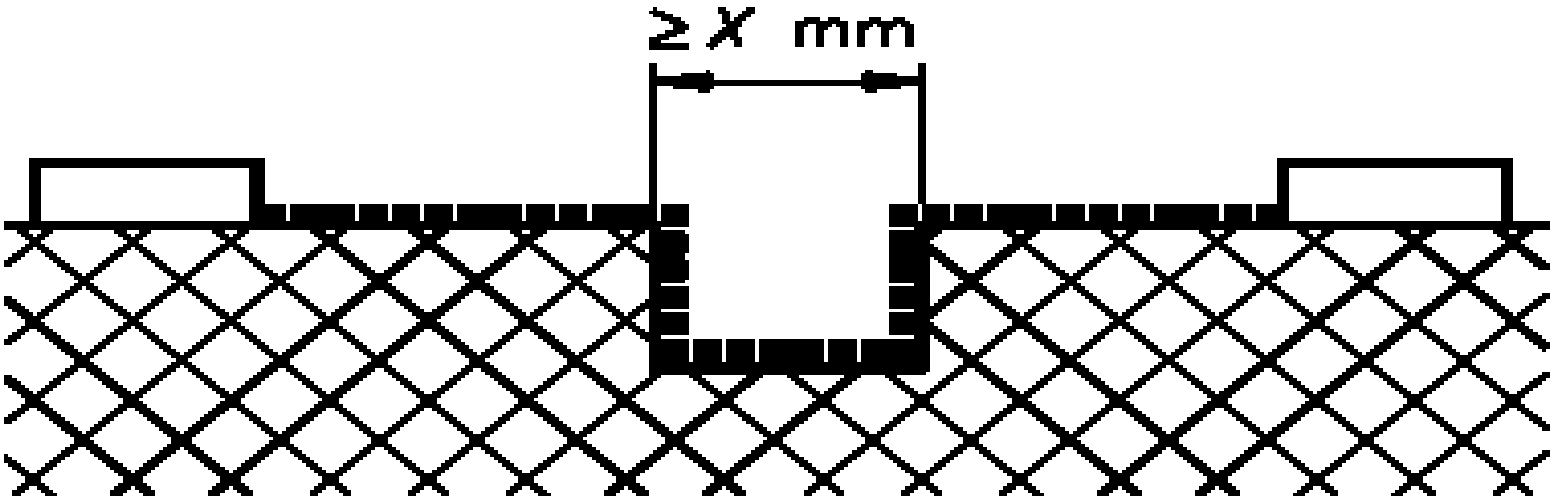


Table 2N Minimum creepage distances

PD		X (mm)
1		0.25
2		1
3		1.5

Creepage (爬电距离)

1. Material Group-Comparative tracking index (CTI)

-The material group is verified IEC 60112 using 50 drops of solution A.

-Material Group IIIb shall be assumed, if without detail data.

Material Group I		CTI = 600
Material Group II		400 = CTI < 600
Material Group IIIa		175 = CTI < 400
Material Group IIIb		100 = CTI < 175

2. Pollution Degree

3. Insulation Grade

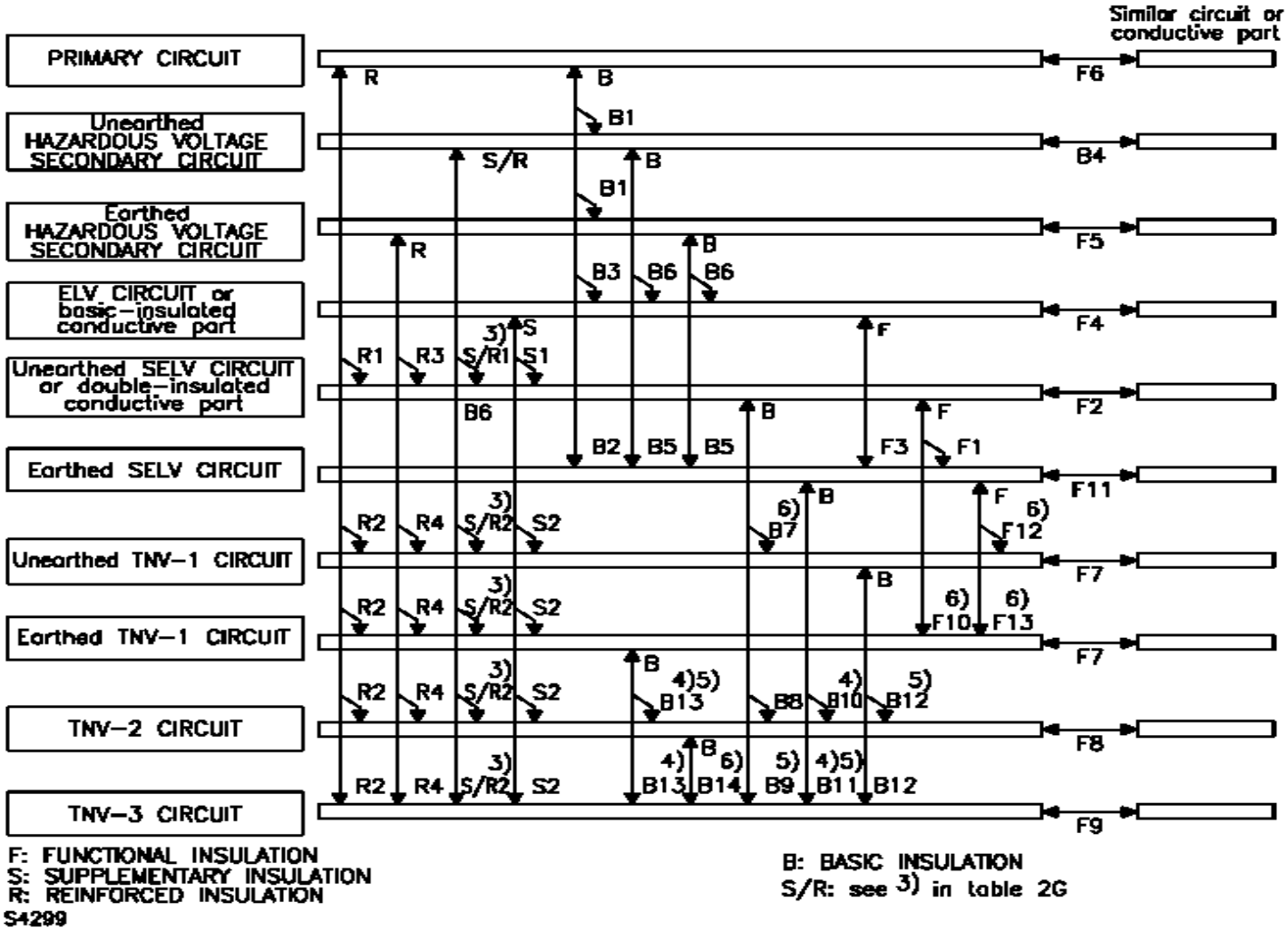
4. Working voltage Vrms

Humidity Test Condition(潮热测试条件)

The elements of the model are texture/material dependent.

After the treatment of 93% RH, 20~30 deg. C for 48 hours duration, the material will “full” of water and the electric field will be easier to find the ways out (e.g. hygroscopic materials), the subsequence will affect the insulation adversely.

Grade of insulation 绝缘级别



Some electrical requirement referred to the Grade of insulation:

- -5.2 Electric strength requirement; -- 2.10 Clearance and creepage

Electric strength requirement(5.2.2) 耐压要求

The electric strength of the solid insulation used in the equipment shall be adequate.

Determined according to Table 5B

1.Grade of insulation
2.Working voltage

Note:
Well heated condition

Table 5B – Test voltages for electric strength tests based on peak working voltages
Part 1

Grade of Insulation	Points of application (as appropriate)						
	PRIMARY CIRCUIT to BODY PRIMARY CIRCUIT to SECONDARY CIRCUIT between parts in PRIMARY CIRCUITS					SECONDARY CIRCUIT to BODY between independent SECONDARY CIRCUITS	
	WORKING VOLTAGE *U*, peak or d.c.					WORKING VOLTAGE *U*	
	Up to and including 210 V [a]	Over 210 V up to and including 420 V [b]	Over 420 V up to and including 1,41 kV	Over 1,41 kV up to and including 10 kV [c]	Over 10 kV up to and including 50 kV	Up to and including 42,4 V peak or 60 V d.c. [d]	Over 42,4 V peak or 60 V d.c. up to and including 10 kV peak or d.c. [d]
	Test voltage, volts a.c. r.m.s.						
FUNCTIONAL	1 000	1 500	see V_a in Table 5B, part 2	see V_a in Table 5B, part 2	1,06 *U*	500	see V_a in Table 5B, part 2
BASIC, SUPPLE-MENTARY	1 000	1 500	see V_a in Table 5B, part 2	see V_a in Table 5B, part 2	1,06 *U*	No test	see V_a in Table 5B, part 2
REINFORCED	2 000	3 000	3 000	see V_b in Table 5B, part 2	1,06 *U*	No test	see V_b in Table 5B, part 2

Case study

Measuring CLEARANCES from an ENCLOSURE of insulating material through a slot or opening in the ENCLOSURE(Use test finger to touch, fig 2A)

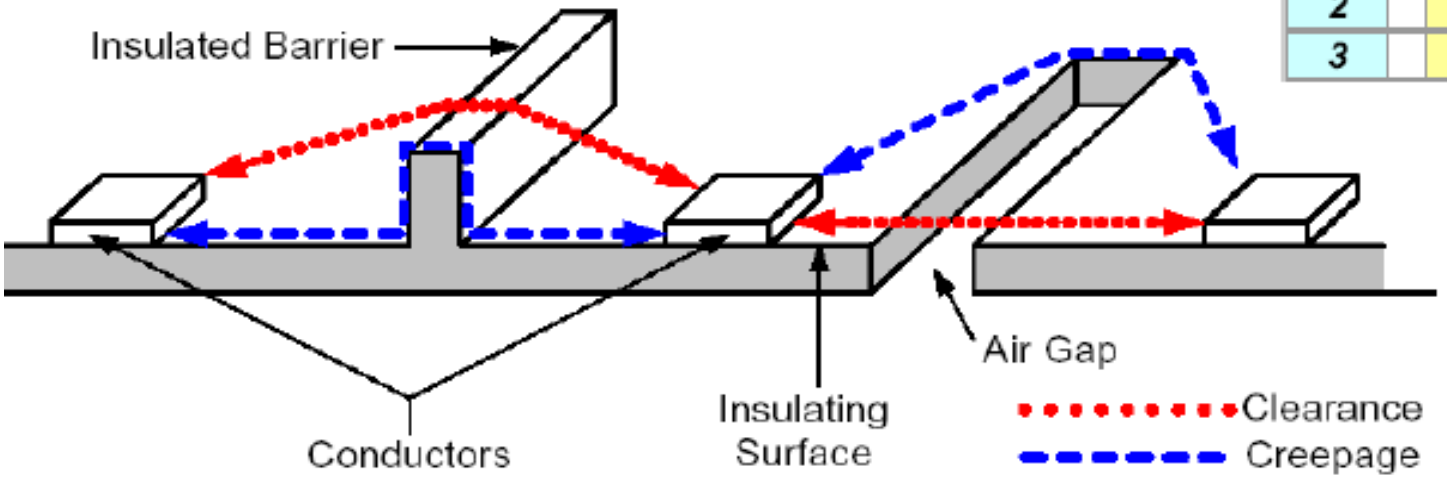
Distances Coordination(电气距离配合考虑)

Creepage values must always be equal to or larger than clearance.

10 N consideration in internal parts

Steady force in outside enclosure

PD		X (mm)
1		0.25
2		1
3		1.5



Solid Insulation (2.10.5) 固体绝缘

DTI (Distance Through Insulation) (2.10.5.2)

Peak WV = (71, ∞) AND S/R Min. 0.4 mm

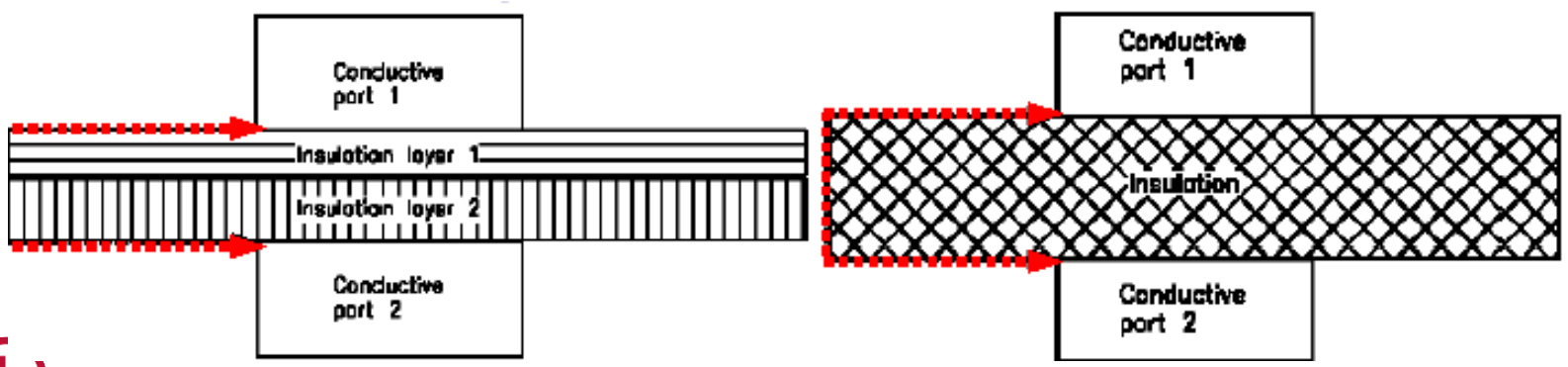
Otherwise, none， Accepted per performance (5.2)

Thin sheet material (2.10.5.6)

For F/B, none of particular requirements

For S/R, single failure concept applied, additionally

For non-separable S/R, 200%/150% + Mandrel (Annex. AA)



Requirements for Electrical Enclosure (防电外壳的要求)

Mechanical Strength (4.2)机械测试要求

Top and Side opening(4.6, requirement as fire enclosure)开孔要求

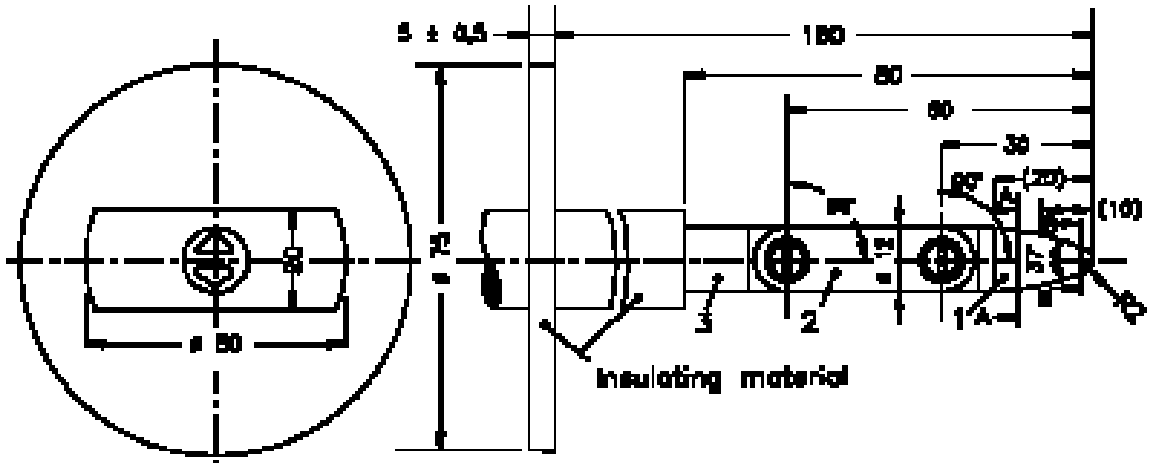
Accessibility (2.1.1.1)可触及性要求

- **Inspection;**
- **Test finger;**
- **Test pin**
- **Test probe (TNV Circuits).**

Insulation (2.10.5) if serve as solid insulation**绝缘的要求**

2.1.1.1 Access to Energized Parts (带电部分的触及)

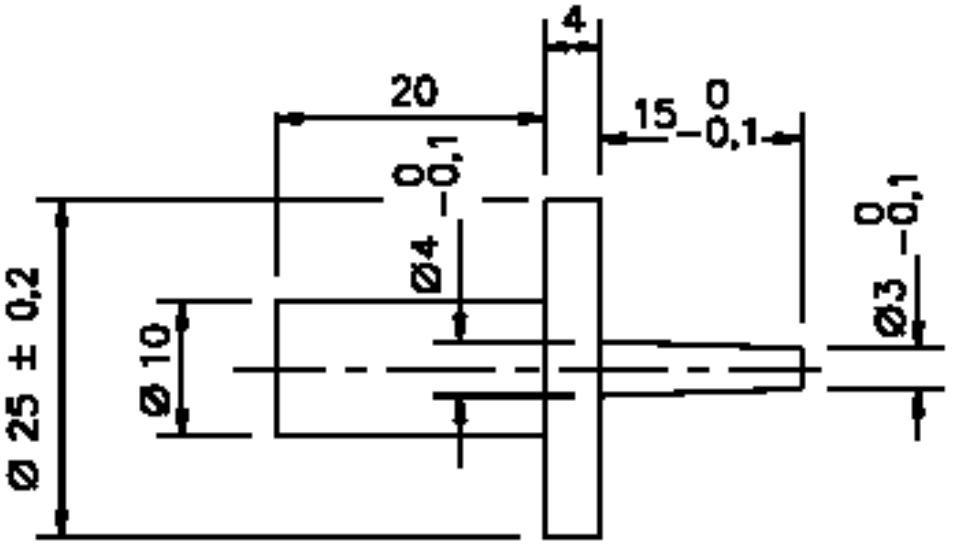
- Inspection
- Test finger (30 N)
  - Shall not reach for any parts with only basic insulation to ELV circuits or hazardous voltages
  - Connectors are tested during disconnection



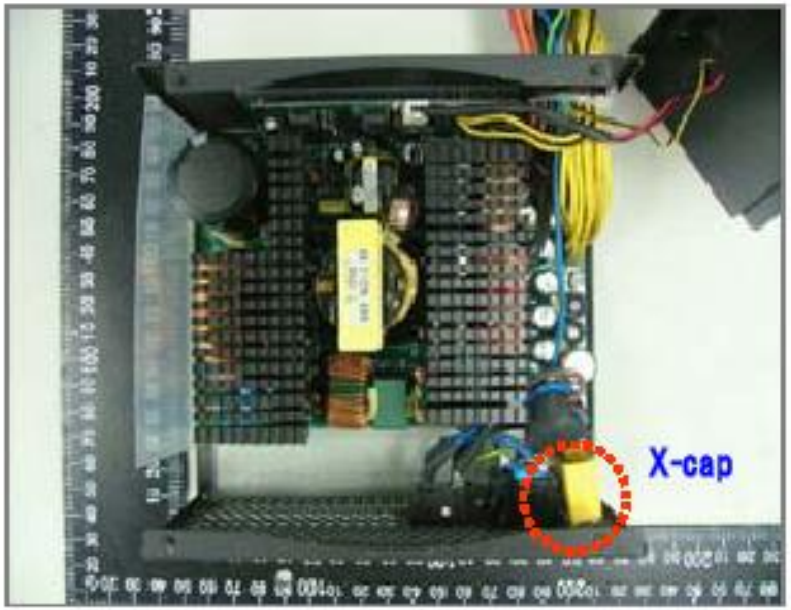
2.1.1.1 Access to Energized Parts (带电部分的触及)

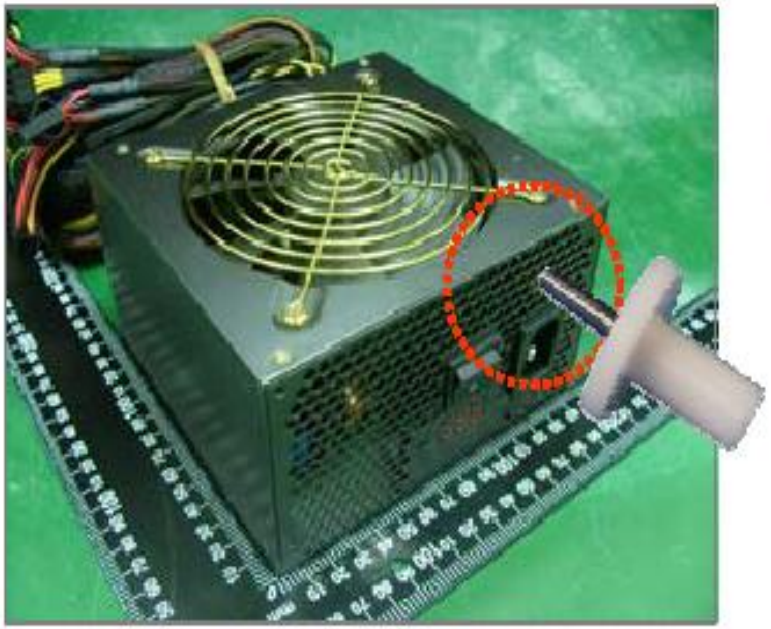
Test pin

- **Shall not reach for any bare parts at hazardous voltages**



Case study





Touch Current (接触电流)

Limit Current through human body

0.25 mA for accessible parts and circuits not connected to protective earth;

- **Touch Current**

0.75 mA for Handheld Equipment with main protective earthing terminal;

3.5 mA for Equipment connected to main protective earthing terminal.

- **Protective Conductor Current flows through human body while PE is disconnected.**

Section 2

Requirement about Energy-related hazards protection (关于能量危害的防护要求)

General 概要

Caused by short-circuiting resulting in burns due to arcing or ejection of molten metal 短路引起电弧或喷出熔融金属以至引起起火与烧伤

Can happen in low-voltage circuits低电压电路中也有可能产生

Protection can be provided by

- Limiting user accessibility, 限制使用者接触
- Providing interlocks and 提供互锁开关
- Guarding against accidental contact for service personnel

Sample of energy hazard 危险能量 图例

Loose Input Contacts

Loose Output Contacts

Hazardous Energy Level (2.1.1.5) (危险能量)

HAZARDOUS ENERGY LEVEL

- A stored energy level of 20 J or more, or an available continuous power level of 240 VA or more, at a potential of 2 V or more电压不小于2V，存储能量不小于20J或持续功率不小于240VA

It shall not be possible to bridge with this test finger two or more bare parts, one of which may be an earthed conductive part, between which a HAZARDOUS ENERGY LEVEL exists.用测试指不应该能够短路到危险能量电路

Section 3

Section 3 Requirement about
Heat related hazard
关于热的危险防护要求

General for heat related hazards 热相关伤害概要

It may result from high temperatures under normal operating conditions, causing有可能因为正常工作产生的高温导致

- **Burns due to contact with hot accessible parts;接触到高温部件导致烫伤**
- **Degradation of insulation and of safety-critical components;使得绝缘或安全相关零部件能力降低**
- **Ignition of flammable liquids.引燃易燃液体**

Heat-related Hazard(热的危害)

- Taking steps to avoid high temperature of accessible parts;
- Avoiding temperatures above the ignition point of liquids;
- Provision of markings to warn USERS where access to hot parts is unavoidable.

Thermal requirement 热的要求

Subclause 4.5 specifies requirements intended to prevent:

– touchable parts from exceeding certain temperatures; and

– components, parts, insulation and plastic materials from exceeding temperatures which may degrade electrical, mechanical, or other properties during normal use over the expected life of the equipment.

Consideration:

On a long-term basis, if the electrical and mechanical properties of certain insulating materials may be adversely affected (for example, by softeners evaporating at temperatures below the normal softening temperatures of the materials)

Thermal requirement 热的要求

Heating test 温升测试：

- Winding temperature measurement, by change of resistance method or by thermocouples. The permitted maximum temperatures of table 4B, are reduced by 10° C if the temperature is measured by thermocouples unless the thermocouples are embedded in the winding.
  通过改变电阻的方法或者使用热电偶测量线圈温度。如果通过热电偶测量温度，则表4B中最大许可温度降低10° C，除非热电偶嵌入在线圈中。
- For switch mode power supply transformer, use only those thermocouples that are not affected by the high frequency (use copper/constantan type T or other equivalent to avoid high frequency effects).
  对于开关式电源变压器，只使用那些不受高频影响的热电偶就行(使用铜/铜镍合金类型的T或其他同类材质以避免高频效应)。

Thermal consideration 热防护的考虑

4.5.1 Maximum temperatures

Test Conditions

- **Input: -10% and +6% (+10%)**
- **Condition: Maximum normal load**

Thermal consideration 热防护的考虑

- THERMAL CUT-OUTS and overcurrent protection devices shall not operate;
- THERMOSTATS are permitted to operate, but shall not interrupt the normal operation;
- TEMPERATURE LIMITERS are permitted to operate;

Sealing compounds, if any, shall not flow out.

Thermal consideration 热防护的考虑

Thermal Equilibrium温度平衡

- Minimum test duration = 45 minutes
  最小测试时间为45分钟
- The difference of three successive readings are within 1ºC
  三个连续时间段的温度读数差别不超过1 °C
- Each interval shall not less than 15 minutes
  每个间隔时间不小于15分钟

Thermal requirement value 温度限值

Table 4B – Temperature limits, materials and components

Part	Maximum temperature (T_{max}) °C
Insulation, including winding insulation:	
– of Class 105 material (A)	100 [a b c]
– of Class 120 material (E)	115 [a b c]
– of Class 130 material (B)	120 [a b c]
– of Class 155 material (F)	140 [a b c]
– of Class 180 material (H)	165 [a b c]
– of Class 200 material	180 [a b]
– of Class 220 material	200 [a b]
– of Class 250 material	225 [a b]
Rubber or PVC insulation of internal and external wiring, including power supply cords:	
– without temperature marking	75 [d]
– with temperature marking	Temperature marking
Other thermoplastic insulation	See [e]
Terminals, including earthing terminals for external earthing conductors of STATIONARY EQUIPMENT, unless provided with a NON-DETACHABLE POWER SUPPLY CORD	85
Parts in contact with a flammable liquid	See 4.3.12
Components	See 1.5.1

Thermal requirement value 温度限值

Table 4C – Touch temperature limits

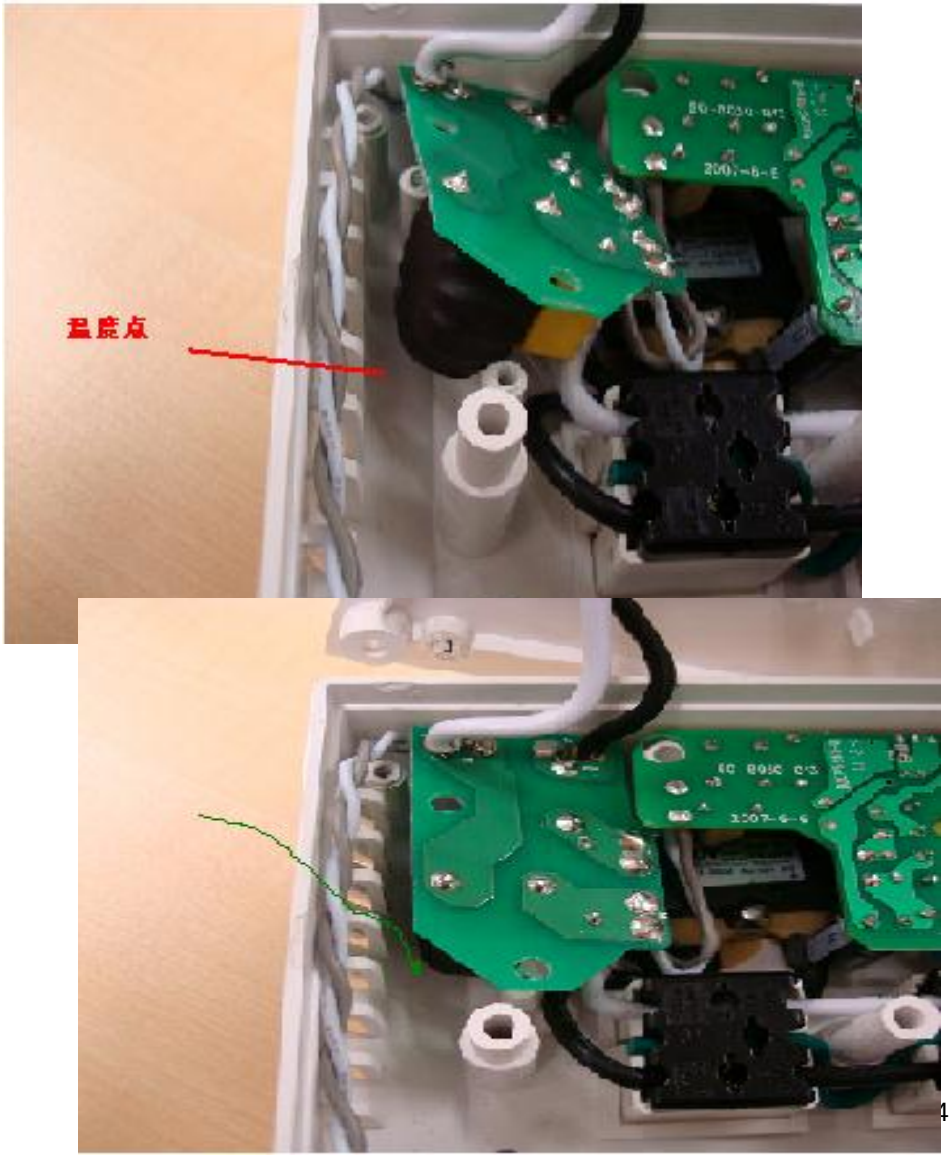
Parts in OPERATOR ACCESS AREAS	Maximum temperature (T_{max}) °C		
	Metal	Glass, porcelain and vitreous material	Plastic and rubber [b]
Handles, knobs, grips, etc., held or touched for short periods only	60	70	85
Handles, knobs, grips, etc., continuously held in normal use	55	65	75
External surfaces of equipment that may be touched [a]	70	80	95
Parts inside the equipment that may be touched [c]	70	80	95

Case study 案例

Enclosure RTI: 65 Deg.

However
Test point: T tested: 80

So Note:
The point of vicinity of heat component



Section 4

Requirement about fire hazard protection
关于火灾危险的防护要求

Fire Hazard(火灾的危害)

It may be caused by high temperatures resulting from

- **Overloads过载**
- **Component Failure零部件失效**
- **Insulation breakdown绝缘失效**
- **High contact resistance高接触电阻**
- **Loose connections连接松动**

Resistance for Fire Hazard(防止火灾危害)

Reduce the risk of ignition and the spread of flame:

Providing Overcurrent or Energy protection;提供过电流/功率保护

Selection of parts and components to avoid high temperature which might cause ignition;选择合适的材料避免被高温点燃

Components mounted on material of FLAMMABILITY CLASS V-1 零部件安装在防火等级V-1以上的材料上(or Limit power source to 15 VA under normal and abnormal condition)

Limiting the quantity of combustible materials;限制可燃材料数量

Shielding or separating combustible materials from likely ignition sources;将可燃材料和可能的引燃源分隔

Using ENCLOSURES or barriers to limit the spread of fire within the equipment and reduce the likelihood of fire spreading outsides使用外壳或者挡板限制或从产品内部蔓延到外部

Parts Requiring Fire Enclosure (需要防火外壳的零件)

Components in PRIMARY CIRCUITS;

Components in SECONDARY CIRCUITS not supplied by power sources of 2.5 (LPS), or supplied by LPS but not mounted on materials of minimum V-1;

Note: Power source limit 15VA on normal and single fault

Unenclosed components in a circuit at HAZARDOUS VOLTAGE or at a HAZARDOUS ENERGY LEVEL; and

Insulated wiring.

Material Flammability of Fire Enclosure (防火外壳的阻燃等级)

5VB > V-0 > V-1 > V-2 > HB

- **HF (form material) and VTM (thin material);**
- **No tests for metals, ceramic materials and glass.**

For mass ≤ 18 kg.

- **Flammability Class V-1 minimum or test A.2**

For mass > 18 kg or stationary or wall/ceiling mount:

- **Flammability Class 5VB or test A.1**

Arcing parts shall be distant from min. 13 mm; non-arcing parts shall be tested for IEC 60695-2-20 (Hot Wire Ignitability Test)

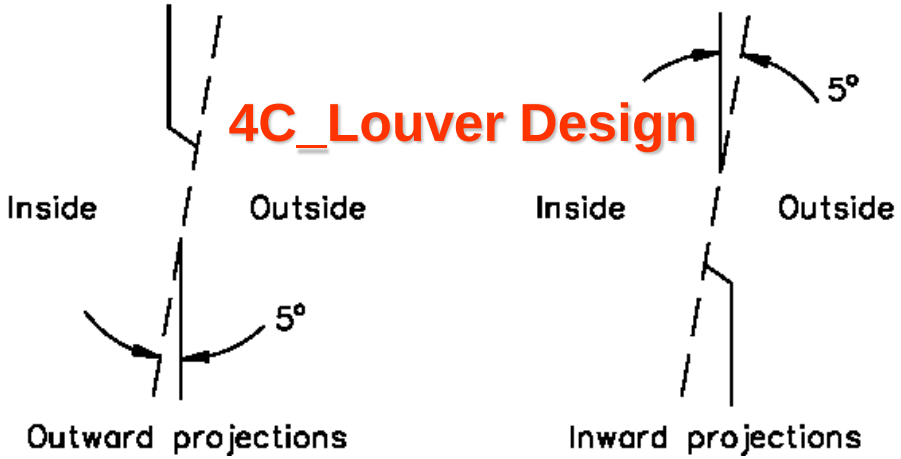
Parts filled in opening of fire enclosure: V-1 min

Note: Components and decorate parts out of fire enclosure need HB

Top and Side Openings (4.6.1)
(顶部和侧边开孔)

1. ≤ 5 mm in any dimension (diagonal);
2. ≤ 1 mm in width regardless of length;
3. Top openings preventing vertical entry (4B);
4. Side openings deflecting outwards an external vertically falling object (4C);

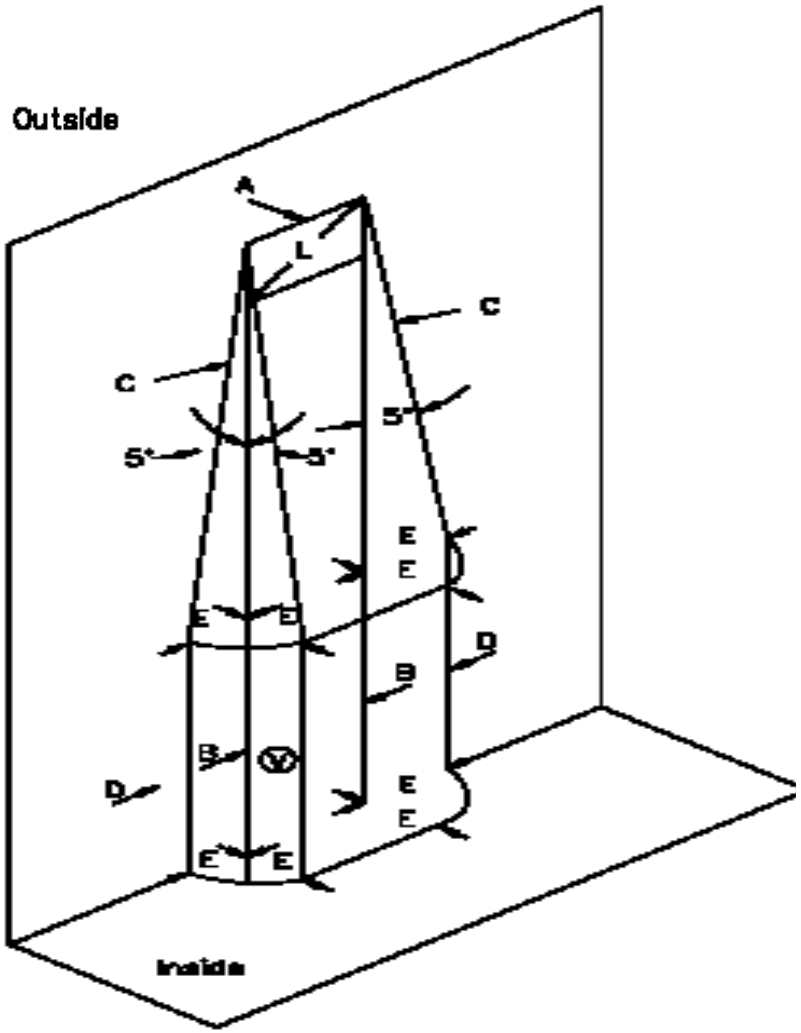
4B_Slanted/Vertical Openings

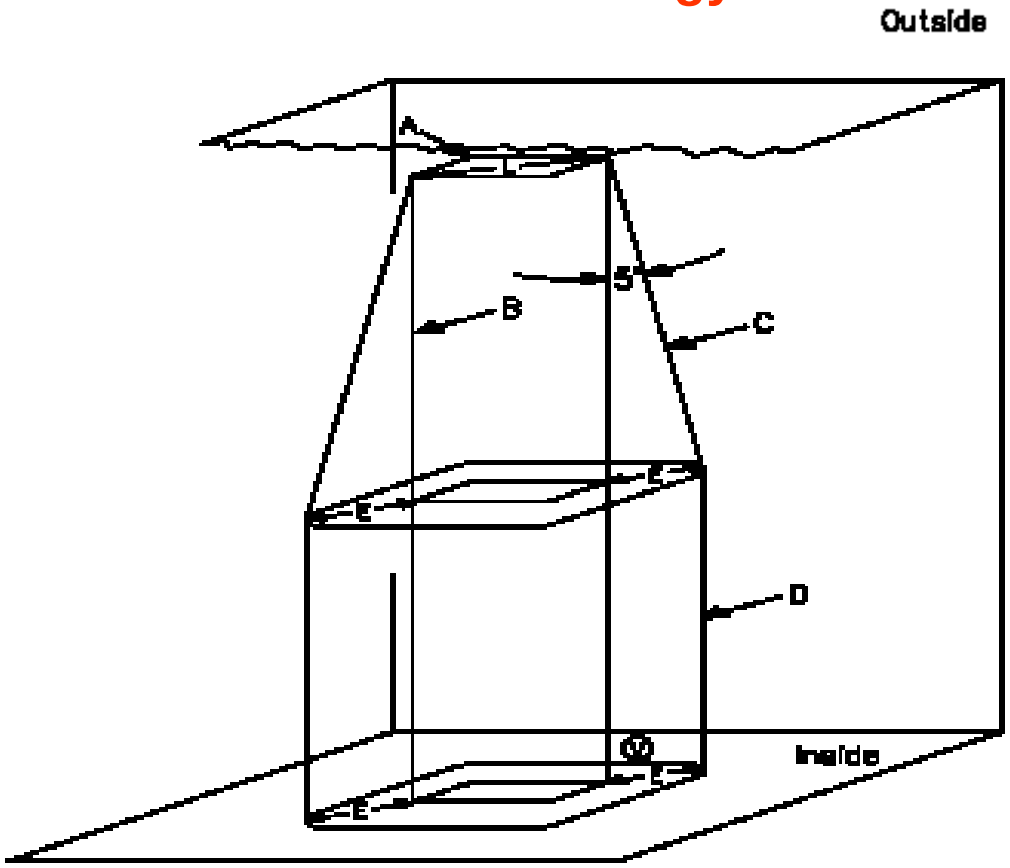


Top and Side Openings (4.6.1)
(顶部和侧边开孔)

5. 5° vertical projection

- Hazardous Voltage
- Hazardous Energy Level

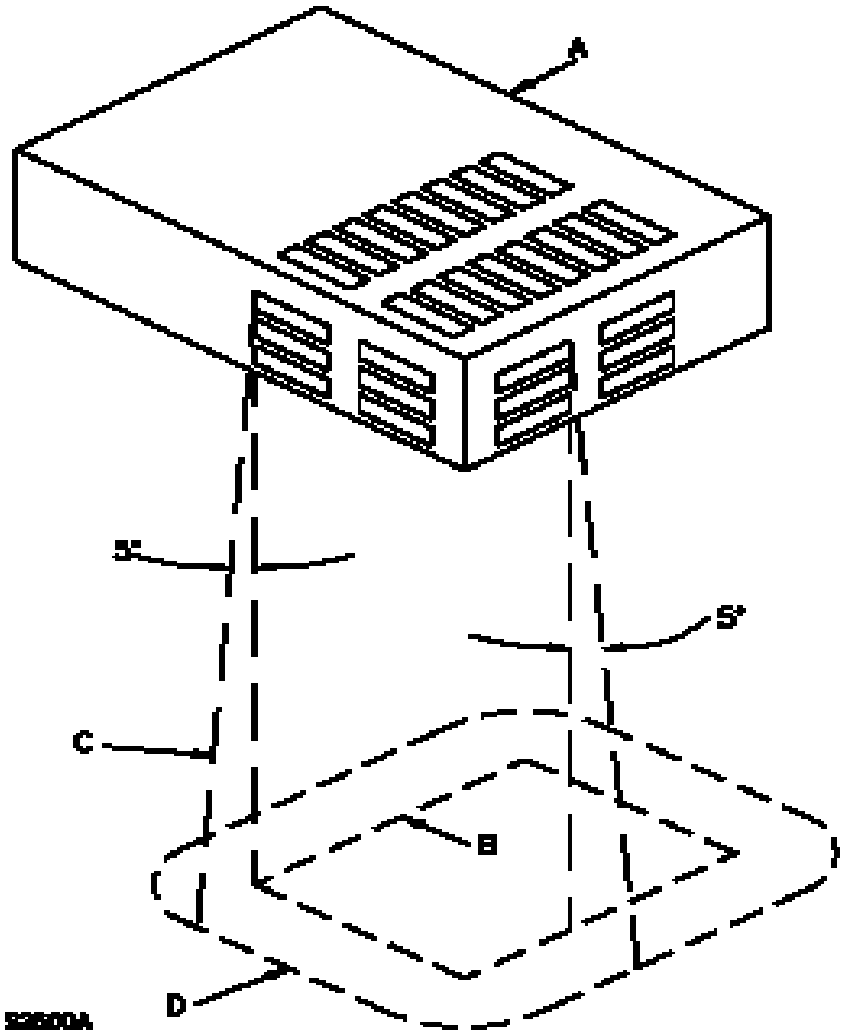




Bottom Openings (4.6.2)(底部 开孔)

Side opening falls within the area traced out by the 5° angle in 4E,

The bottom or barrier shall be no smaller than in area than in figure 4E



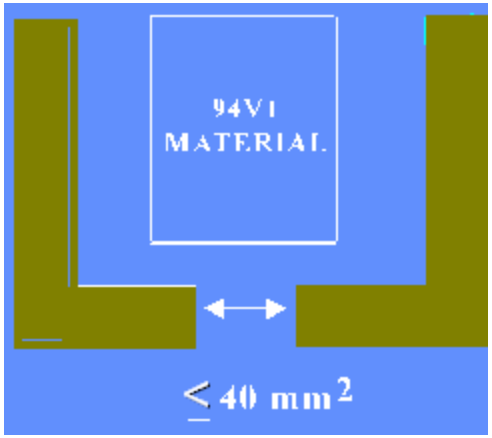
Bottom Openings (4.6.2) (底部 开孔)

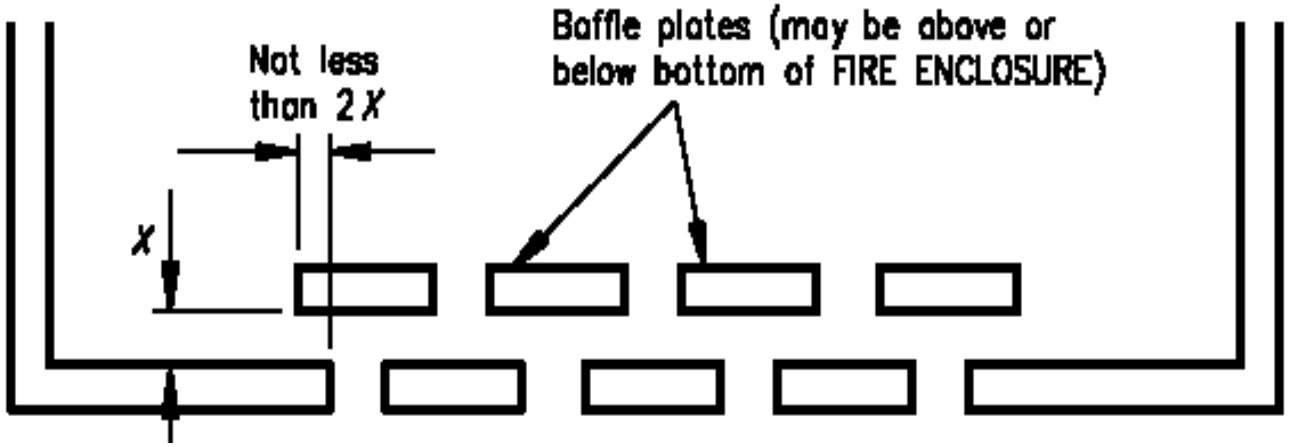
No opening in the bottom;

FIRE ENCLOSURE as internal barrier or screen

≤ 40 mm², baffled by material of V-1 or better;

Baffle plate construction as illustrated in 4F;





4F

Bottom Openings (4.6.2) (底部 开孔)

Metal bottoms with dimensional limits in Table 4D;

Metallic mesh with openings ≤ 2 mm between center lines and with wire diameters ≥ 0,45 mm

Applicable to circular holes			Applicable to other shaped openings	
Metal bottom minimum thickness mm	Maximum diameter of holes mm	Minimum spacing of holes centre to centre mm	Maximum area mm^2	Minimum spacing of openings border to border mm
0,66	1,1	1,7	1,1	0,56
0,66	1,2	2,3	1,2	1,1
0,76	1,1	1,7	1,1	0,55
0,76	1,2	2,3	1,2	1,1
0,81	1,9	3,1	2,9	1,1
0,89	1,9	3,1	2,9	1,2
0,91	1,6	2,7	2,1	1,1
0,91	2,0	3,1	3,1	1,2
1,0	1,6	2,7	2,1	1,1
1,0	2,0	3,0	3,2	1,0

Transportable Equipment (4.6.4) (便携式设备)

≤ 1 mm in width regardless of length;

Metallic mesh with openings ≤ 2 mm between centre lines and with wire diameters ≥ 0,45 mm

Providing internal barrier.

While metallized parts within 13 mm where available power > 15 VA, either

- Additional barrier shall be provided, or
- Faults shall be simulated without any ignition.

Section 5

Requirement about
Mechanical Hazard protection
(关于机械危害防护的要求)

Mechanical Hazard(机械危害)

Equipment shall have adequate mechanical strength and shall be so constructed as to remain safe:

Rounding or guarding of sharp edges and corners;

Provision of SAFETY INTERLOCKS;

Providing sufficient stability to free-standing equipment;

Selecting cathode ray tubes and high pressure lamps that are resistant to implosion and explosion respectively;

Provision of markings to warn USERS where access is unavoidable.

Section 6

Requirement about Radiation Hazard protection
(关于放射危害的防护要求)

Radiation Hazard (辐射的危害)

Injury to USERS and to SERVICE PERSONS may result from some forms of radiation emitted by equipment such as

- **Sonic (acoustic),**
- **Radio frequency (RF),**
- **Infra-red (IR), ultraviolet (UV) and ionizing radiation (e.g. X-ray), and**
- **High intensity visible and coherent light (e.g. lasers).**

Q&A