

IEC 60950-1:2001 介紹

IEC60950-1 安規要求介紹

Internal Document

Confidential

IEC 60950-1:2001介紹

本講義主要內容:

1. 一般安全原理

2. 定義

3. General Requirements

4. 危險的防護

5. 物理特性的要求

IEC 60950-1:2001介紹

1. 一般安全原理

在IEC/EN 60950-1的條文內，主要是在防止人體受到下述危險的傷害，人體泛指使用者及服務人員此二種類型的人：

危險的種類	適用否?
電殛 (Electric shock)	Yes
危險能量 (Energy hazards)	Yes
火災 (Fire)	Yes
機械及熱的危險 (Mechanical and heat hazards)	Yes
輻射危險 (Radiation hazards)	Yes
化學的危險 (Chemical hazards)	Yes
材料及零件 (Materials and components)	Yes

IEC 60950-1:2001介紹

- Electric shock

電殞的發生情形是因為有電流通過人體,只要有數毫安培的電流,即可對正常健康人造成影響,並且有可能因不自覺地反應而造成間接性危險。當然,更大的電流會造成更危險的情形。一般而言,在乾燥情形下,小於**40Vpeak**或**60Vdc**的電壓,通常視為不具危險的電壓。但是,可被觸碰的零件或是提把皆應接至大地或是將其適當地隔離之。

在設備發生某一操作或零件失效(**single fault**)狀態,為避免操作人員導致電殞危險,因此設備須提供雙重(two levels)防護措施,如基本絕緣加上接地或補充性絕緣。

IEC 60950-1:2001介紹

- Energy hazards

具大電流供應或高電容線路的相鄰兩端子間,如果在短路的情形下,有可能會造成電弧放電或是在燃燒中射出熔化之金屬。因此,即使是屬於低電壓線路,也可能造成能量危險。

一般降低能量危險的方式,如 隔離, 屏蔽 或 安全內鎖 的防護。

IEC 60950-1:2001介紹

- Fire

在過載、零件失誤、絕緣崩潰、高阻抗或是連接器鬆脫的情形下,其所造成的異常溫度有可能形成火災危險。然而,設備內起火後不可散佈到起火點之鄰近區域及對設備外的區域造成危險。

降低火災危險的方式有:

- 提供過電流保護
- 結構使用的材料具有適當的燃燒等級
- 選用不會因過熱導致燃燒的零件及易燃材料
- 限制易燃材料的使用數量
- 將易燃材料與燃燒源隔離
- 使用殼罩或擋牆抑制火燄擴散至設備外
- 使用具適當的燃燒等級殼罩,以抑制火燄擴散至設備外

IEC 60950-1:2001 介紹

- Mechanical hazards

機械的危險是因下列原因而產生：

- 設備的機構穩定度及結構穩固
- 避免結構上銳邊尖角
- 受危險可動零件所傷
- 受陰極射線管或高壓燈泡爆裂的碎片所傷

降低機械的危險的方式有：

- 設備的銳邊或銳角 圓弧化
- 提供 安全內鎖 裝置
- 提供 防護罩
- 適當的 穩定度 設計
- 選用陰極射線管及高壓燈泡具 防爆 功能
- 當無法避免使用者會因接觸而造成機械危險的區域時須提供 標示 以警告使用者

IEC 60950-1:2001介紹

- Heat hazards

設備正常工作下，因下列因素(高溫)導致熱的危險：

- 因觸碰到高溫零件而造成的傷害
- 設備的絕緣能力及安全零件被破壞
- 可燃液體燃燒起來

降低熱的危險的方式有：

- 避免高溫零件暴露在 使用者可接觸 的區域
- 避免高溫零件置放在 可燃液體 上方
- 當無法避免高溫零件暴露在 使用者可接觸 的區域時，須提供標示以警告使用者

IEC60950-1:2001介紹

- Radiation hazards

輻射的形式可能為音頻、無線電頻率、紅外線、高強度可見光、凝聚光、紫外線、離子化輻射等。

如果設備內會釋出某種型式的輻射，則針對使用者及維修者所能接受程度的輻射值，訂有規定。

降低輻射危險的方式有：

- 限制輻射源的能量值
- 提供安全內鎖裝置
- 當無法避免使用者可接觸可能造成輻射危險的區域時，須提供標示以警告使用者

IEC 60950-1:2001介紹

- Chemical hazards

有毒化學物質本身及其蒸汽，如果人體直接接觸到，則會造成傷害。因此，設備的設計，亦應避免在正常操作及異常操作情況下，產生此類的化學危險。

降低化學危險的方式有：

- 避免使用會因接觸或吸入會導致危險之結構材料及易燃材料
- 當無法避免使用者因接觸而造成幅射危險的區域時，須提供標示以警告使用者

IEC 60950-1:2001介紹

Materials and components hazards

在設備內所使用的材料及零件，須給予適當的選擇及安置，故其不會在正常或異常工作時，導致上述的危險。

Scope:

IEC 60950規章主要是適用於mains-powered or battery -powered 資訊產品(含商業電子設備)及其週邊產品, 請額定電壓低於600V.

IEC 60950-1:2001 介紹

2. 重要定義

2.1 **RATED VOLTAGE:** The supply voltage (for a three-phase AC MAINS SUPPLY, the line-to-line voltage) as declared by the manufacturer.

2.2 **RATED VOLTAGE RANGE:** The supply voltage range as declared by the manufacturer, expressed by its lower and upper RATED VOLTAGES.

2.3 **RATED CURRENT:** The input current of the equipment as declared by the manufacturer.

2.4 **RATED FREQUENCY:** The supply frequency as declared by the manufacturer.

2.5 **RATED FREQUENCY RANGE:** The supply frequency range as declared by the manufacturer, expressed by its lower and upper RATED FREQUENCIES.

2.6 **MOVABLE EQUIPMENT:** Equipment which is either:

- 18 kg or less in mass and not fixed, or
- equipment with wheels, castors or other means to facilitate movement by

the OPERATOR as required to perform its intended use.

IEC 60950-1:2001 介紹

2.7 EQUIPMENT FOR BUILDING-IN: Equipment intended to be installed in a prepared recess, such as in a wall, or similar situation.
NOTE In general, **EQUIPMENT FOR BUILDING-IN** does not have an **ENCLOSURE** on all sides, as some of the sides will be protected after installation.

2.8 DIRECT PLUG-IN EQUIPMENT: Equipment that is intended to be used without a power supply cord; the mains plug forms an integral part of the equipment **ENCLOSURE** so that the weight of the equipment is taken by the socket-outlet.

2.9 CLASS I EQUIPMENT: Equipment where protection against electric shock is achieved by:

- using **BASIC INSULATION**, and also
- providing a means of connection to the **PROTECTIVE EARTHING CONDUCTOR** in the building wiring those conductive parts that are otherwise capable of assuming **HAZARDOUS VOLTAGES** if the **BASIC INSULATION** fails.

NOTE CLASS I EQUIPMENT may have parts with **DOUBLE INSULATION** or **REINFORCED INSULATION**.

IEC 60950-1:2001 介紹

2.10 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 are provided, there being no reliance on protective earthing.

2.11 PLUGGABLE EQUIPMENT TYPE A: Equipment which is intended for connection to the building installation wiring via a non-industrial plug and socket-outlet or a non-industrial appliance coupler, or both.

2.12 PLUGGABLE EQUIPMENT TYPE B: Equipment which is intended for connection to the building installation wiring via an industrial plug and socket-outlet or an appliance coupler, or both, complying with IEC 60309 2) or with a comparable national standard.

2.13 PERMANENTLY CONNECTED EQUIPMENT: Equipment which is intended for connection to the building installation wiring using screw terminals or other reliable means.

IEC 60950-1:2001 介紹

2.14 FIRE ENCLOSURE: A part of the equipment intended to minimize the spread of fire or flames from within.

2.15 MECHANICAL ENCLOSURE: A part of the equipment intended to reduce the risk of injury due to mechanical and other physical hazards.

2.16 ELECTRICAL ENCLOSURE: A part of the equipment intended to limit access to parts that may be at **HAZARDOUS VOLTAGES** or **HAZARDOUS ENERGY LEVELS** or are in **TNV CIRCUITS**.

2.17 DECORATIVE PART: A part of the equipment, outside the **ENCLOSURE**, which has no safety function.

2.18 AC MAINS SUPPLY: An a.c. power distribution system external to the equipment for supplying power to a.c. powered equipment. These power sources include public or private utilities and, unless otherwise specified in the standard (for example, 1.4.5), equivalent sources such as motor-driven generators and uninterruptible power supplies.

IEC 60950-1:2001 介紹

2.19 DC MAINS SUPPLY: A d.c. power distribution system, with or without batteries, external to the equipment, for supplying power to d.c. powered equipment, excluding:

- a d.c. supply providing power over TELECOMMUNICATION NETWORK wiring to remote equipment;
- a limited power source (see 2.5) whose open circuit voltage is less than or equal to 42,4 V d.c.;
- a d.c. supply whose open circuit voltage is greater than 42,4 V d.c. and less than or equal to 60 V d.c., and whose available power output is less than 240 VA.

Circuitry connected to a DC MAINS SUPPLY is considered to be a SECONDARY CIRCUIT in the meaning of this standard (see 2.10.3.3).

2.20 PRIMARY CIRCUIT: A circuit which is directly connected to the AC MAINS SUPPLY. It includes, for example, the means for connection to the AC MAINS SUPPLY, the primary windings of transformers, motors and other loading devices.

IEC 60950-1:2001 介紹

2.21 SECONDARY CIRCUIT: A circuit which has no direct connection to a PRIMARY CIRCUIT and derives its power from a transformer, converter or equivalent isolation device, or from a battery.

2.22 HAZARDOUS VOLTAGE: A voltage exceeding 42,4 V peak, or 60 V d.c., existing in a circuit which does not meet the requirements for either a LIMITED CURRENT CIRCUIT or a TNV CIRCUIT.

2.23 ELV CIRCUIT: A SECONDARY CIRCUIT with voltages between any two conductors of the circuit, and between any one such conductor and earth (see 1.4.9), not exceeding 42,4 V peak, or 60 V d.c., under normal operating conditions, which is separated from HAZARDOUS VOLTAGE by BASIC INSULATION, and which neither meets all of the requirements for an SELV CIRCUIT nor meets all of the requirements for a LIMITED CURRENT CIRCUIT.

2.24 SELV CIRCUIT: A SECONDARY CIRCUIT which is so designed and protected that under normal operating conditions and single fault conditions, its voltages do not exceed a safe value.

IEC 60950-1:2001 介紹

2.25 LIMITED CURRENT CIRCUIT: 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.

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

2.26 HAZARDOUS ENERGY LEVEL: An available power level of 240 VA or more having a duration of 60 s or more, or a stored energy level of 20 J or more (for example, from one or more capacitors), at a potential of 2 V or more.

2.27 FUNCTIONAL INSULATION: Insulation that is necessary only for the correct functioning of the equipment.

2.28 BASIC INSULATION: Insulation to provide basic protection against electric shock.

2.29 SUPPLEMENTARY INSULATION: Independent insulation applied in addition to BASIC INSULATION in order to reduce the risk of electric shock in the event of a failure of the BASIC INSULATION.

IEC 60950-1:2001 介紹

2.30 DOUBLE INSULATION: Insulation comprising both **BASIC INSULATION** and **SUPPLEMENTARY INSULATION**.

2.31 REINFORCED INSULATION: A single insulation system which provides a degree of protection against electric shock equivalent to **DOUBLE INSULATION** under the conditions specified in this standard.

2.32 CLEARANCE: The shortest distance between two conductive parts, or between a conductive part and the **BOUNDING SURFACE** of the equipment, measured through air.

2.33 CREEPAGE DISTANCE: The shortest path between two conductive parts, or between a conductive part and the **BOUNDING SURFACE** of the equipment, measured along the surface of the insulation.

IEC 60950-1:2001 介紹

2.34 FUNCTIONAL EARTHING: The earthing of a point in equipment or in a system, which is necessary for a purpose other than safety. [IEV 195-01-13, modified].

2.35 PROTECTIVE EARTHING CONDUCTOR: A conductor in the building installation wiring, or in the power supply cord, connecting a main protective earthing terminal in the equipment to an earth point in the building installation.

2.36 PROTECTIVE BONDING CONDUCTOR: A conductor in the equipment, or a combination of conductive parts in the equipment, connecting a main protective earthing terminal to a part of the equipment that is required to be earthed for safety purposes.

IEC 60950-1:2001 介紹

2.37 TOUCH CURRENT: Electric current through a human body when it touches one or more accessible parts. [IEV 195-05-21, modified]

NOTE TOUCH CURRENT was previously included in the term "leakage current".

2.38 PROTECTIVE CONDUCTOR CURRENT: Current flowing through the PROTECTIVE EARTHING CONDUCTOR under normal operating conditions.

NOTE PROTECTIVE CONDUCTOR CURRENT was previously included in the term "leakage current".

IEC 60950-1:2001介紹

3.1 零件的選用

- 與安全性有關的零件，應選用有相關安規機構認證的零件，或是能符合該零件的相關規定。
- 取得零件單體認證的零件，必須先確定此零件是否依額定值使用，再按相關的零件規章進行單體的相關測試，其後，此零件再配合產品整體做相關測試；對於已取得零件單體認證的零件，則僅須配合產品整體做相關測試即可！
- 溫控零件須根據**Annex K**測試。
- 變壓器須符合規章內所有的(含**Annex C**)相關規定。
- 若在電源L-L或L-N間連接之電容(即X電容)，須符合下列其中符合**IEC60384-14/1993**的X1或X2電容；且通過**IEC60384-14**條款**4.12**，21天的熱蒸氣穩態測試(the damp heat, steady state test)。
- 若在電源初級電路及PE間連接之電容(即Y電容)，須符合**IEC60384-14/1993**的Y1或Y2或Y4電容的規定。但此規定對連接在次級危險電壓電路及PE間之電容不要求；只要符合規章**5.2.2**電氣強度的測試即可。

IEC 60950-1:2001介紹

— 若在要求**Double or Reinforced insulation**電路間跨接一個電容，該電容須符合IEC60384-14 /1993的Y1電容的規定 (Y1電容視為**Reinforced insulation**)；或僅跨接一個符合IEC60384-14 /1993的Y2電容,但該設備的額定電壓須小於**150V**；或跨接兩個具相同容抗並符合IEC60384-14/1993的Y2或Y4的電容；且其額定電壓值須適合跨接點間的工作電壓。

— 若在要求**Double or Reinforced insulation**電路間跨接兩個相同阻抗電阻，則根據跨接點間的工作電壓，任一電阻之端點距離須符合規章**2.10.3 (cl)**及**2.10.4 (cr)**的規定。



— 若使用者可接觸的導電零件或電路；使用上述的跨接電阻或電容，因而與其他零件達到雙重絕緣的隔離，則此類可接觸的導電零件，須在絕緣電氣強度測試後；仍符合規章**2.4**”限電流電路”的規定。

— 若設備欲接到IT電源系統者，在電源初級電路及PE間連接之零件須能承受Line -line的電壓若是電容則須符合IEC 60384-14/1993的Y1或Y2或Y4電容的規定；且其額定電壓值僅須適合Line - Neutral間的工作電壓。(在挪威因IT電源系統之故，電容的額定電壓值，須至少為Line – Line間的電壓)

IEC 60950-1:2001介紹

● 4.2 Marking

● 4.2.1 電源介面標示: 設備外表應有娥定電力標示(如銘版),清楚告知設備的正確使用電壓,頻率,電流. 標示內須包含:

1. 額定電壓或是額定電壓範圍,單位為V。
2. 輸入電壓為直流,則需加上"  "的符號
3. 額定頻率或額定頻率範圍,單位為Hz (z是小寫)。
4. 如這設備須連接至多相電力系統,則需另外標示相數,例如: 2 φ , 3 φ 系
5. 額定電流,單位為 mA 或 A。
6. 製造商名稱或商標符號或辨識符號。
7. 設備的型號。
8. 如設備為Class II,則需加入  的符號

註: 設備可以有額外的標示,但是先決條件是不可以造成誤導或混淆。

IEC 60950-1:2001介紹

- 3.2.2 設備內含有標準型電源輸出插座（符合 IEC 60083 的規定），則在插座旁須有清楚標示註明其所能承受之最大負載。

設備內含有可切換電壓的開關，應在其使用手冊內詳細述明其用途及使用方法，並在開關旁註明下述或類似的句子：

- 3.2.3 "SEE INSTALLATION INSTRUCTIONS BEFORE CONNECTING TO THE SUPPLY"（英文）

設備內保險絲旁須有下述標示：

1. 額定電流
2. 額定電壓
3. 熔斷特性，例如：F = fast, T = time lag
4. 防爆特性，例如：L = Low-breaking, H = High-breaking

- 3.2.4 註：範例為 T 2AL/250V 或 F 6.3AH/250V

IEC 60950-1:2001介紹

- 3.2.5 接地保護端子旁，應有"⊕"的標示。
- 3.2.6 電源"水"線端子旁，應標示英文字母"N"。
- 3.2.7 電源開關旁，須依開關型式，應有ON及OFF的標示
 - Push button 或 rocker type = 標示"■"代表ON, "○"代表OFF
 - Push push type = 標示"ⓐ"
 - stand-by type = 標示"ⓑ"設備標示不可置於設備可取下的物件上。所有須清晰辨，且為恆久的標示。
- 3.2.8 以上設備標示的符號須依據IEC 60417規定標示，所有標示或指示說明，均須以該適用國家通用語言為主，如德國則只接受德文，英美國只接受英文。

IEC 60950-1:2001介紹

4. 危險的防護

4.1 操作人員可碰觸下列電路或零件：

- SELV 電路的裸露零件
- 限電流 電路的裸露零件
- 符合2.1.1.1.規定條件的TNV 電路

IEC 60950-1:2001介紹

4.2 操作人員不可碰觸下列電路或零件：

- ELV 電路的裸露零件，
- 具 危險電壓 的裸露零件，
- ELV電路內只有 功能 絕緣或 基本 絕緣的零件或線材，但符合規章條款2.1.1.3規定除外
- 危險電壓電路內只有 功能 絕緣或 基本 絕緣的零件或線材
- 未接地 的導電零件與在危險電壓電路或ELV電路內的零件，只有 功能 絕緣或 基本 絕緣隔離

IEC60950-1:2001介紹

4.3 功能接地(Functional Earthing)規定;若可觸及或其他的導體零件必須要功能接地者，下列的所有要求可提供:

a.) 功能接地電路與危險電壓電路的電性隔離，須使用下列至少一種的方法來達到:

— 雙重或加強 絕緣

— 基本絕緣及使用保護罩(Protective screen)連接到PE端子

b.) 功能接地電路允許接到 PE端子 或 Protective Bonding conductor

c.) 只作功能接地的接線端子不可標示IEC 60417 No. 5017，或 5019 的符號，除非該功能接地的接線端子是由如 terminal block 零件，或半成品所提供，則用IEC 60417 No. 5017 的符號標示是可接受的。



(60417-2-IEC-5019)

 (60417-2-IEC-5017)

d.) 設備內的功能接地的導線不能用 黃綠色 線。

e.) 若電源線使用 黃綠色 絕緣線僅作為功能接地連接，則設備不能標示 Class II 的符號。

IEC 60950-1:2001 介紹

4.4 Protective earthing conductors 截面積大小，須符合規章條款 3.2.5 表3B最小尺寸的規定。

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⁾	16 [1,3]
Over 10 up to and including 13	(1,0) ³⁾	16 [1,3]
Over 13 up to and including 16	(1,0) ³⁾	14 [2]
Over 16 up to and including 25	2,5	12 [3]
Over 25 up to and including 32	4	10 [5]
Over 32 up to and including 40	6	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]
Over 125 up to and including 160	50	0 [53]
Over 160 up to and including 190	70	000 [85]
Over 190 up to and including 230	95	0000 [107]
Over 230 up to and including 260	120	250 kcmil [126]
Over 260 up to and including 300	150	300 kcmil [152]
Over 300 up to and including 340	185	400 kcmil [202]
Over 340 up to and including 400	240	500 kcmil [253]
Over 400 up to and including 460	300	600 kcmil [304]

1) For RATED CURRENT up to 3A, a nominal cross-sectional area of 0,5 mm² is permitted in some countries provided that the length of the cord does not exceed 2 m.

2) The value in parentheses applies to DETACHABLE POWER SUPPLY CORDS fitted with the connectors rated 10 A in accordance with IEC 60320 (types C13, C15, C15A and C17) provided that the length of the cord does not exceed 2 m.

3) The value in parentheses applies to DETACHABLE POWER SUPPLY CORDS fitted with the connectors rated 16 A in accordance with IEC 60320 (types C19, C21 and C23) provided that the length of the cord does not exceed 2 m.

NOTE 1 – IEC 60320 specifies acceptable combinations of appliance couplers and flexible cords, including those covered by items 1), 2) and 3). However, a number of countries have indicated that they do not accept all of the values listed in table 3B, particularly those covered by items 1), 2) and 3).

NOTE 2 – AWG and kcmil sizes are provided for information only. The associated cross-sectional areas, in square brackets, have been rounded to show significant figures only. AWG refers to the American Wire Gage and the term "cmil" refers to circular mils where one circular mil is equal to the area of a circle having a diameter of one mil (one thousandth of an inch). These terms are commonly used to designate wire sizes in North America.

IEC 60950-1:2001 介紹

4.5 Protective bonding conductors 截面積大小，須符合規章條款 3.2.5 表3B 最小尺寸的規定，或規章條款 2.6.3.3. 的規定當額定電流大於16A時，且導體大小符合規章表2D 最小尺寸的規定。

Current rating of the circuit under consideration A	Minimum conductor sizes	
	Cross-sectional area mm ²	AWG or kcmil (cross-sectional area in mm ²)
Up to and including 16	Size not specified	Size not specified
Over 16 up to and including 25	1,5	14 (2)
Over 25 up to and including 32	2,5	12 (3)
Over 32 up to and including 40	4,0	10 (5)
Over 40 up to and including 63	6,0	8 (8)
Over 63 up to and including 80	10	6 (13)
Over 80 up to and including 100	16	4 (21)
Over 100 up to and including 125	25	2 (33)
Over 125 up to and including 160	35	1 (42)
Over 160 up to and including 190	50	0 (53)
Over 190 up to and including 230	70	000 (85)
Over 230 up to and including 260	95	0000 (107)
Over 260 up to and including 300	120	250 kcmil (126)
Over 300 up to and including 340	150	300 kcmil (152)
Over 340 up to and including 400	185	400 kcmil (202)
Over 400 up to and including 460	240	500 kcmil (253)

NOTE – AWG and kcmil sizes are provided for information only. The associated cross-sectional areas have been rounded to show significant figures only. AWG refers to the American Wire Gage and the term "cmil" refers to circular mils where one circular mil is equal to the area of a circle having a diameter of one mil (one thousandth of an inch). These terms are commonly used to designate wire sizes in North America.

IEC 60950-1:2001 介紹

4.6 Protective protective bonding conductors; 若不符合規章條款 3.2.5.表3B最小尺寸，及條款 3.3.5. 表3E最小端子尺寸的規定，則須作接地阻抗測試。

RATED CURRENT of equipment A	Minimum nominal thread diameter mm	
	Pillar type or stud type	Screw type ¹⁾
Up to and including 10	3,0	3,5
Over 10 up to and including 16	3,5	4,0
Over 16 up to and including 25	4,0	5,0
Over 25 up to and including 32	4,0	5,0
Over 32 up to and including 40	5,0	5,0
Over 40 up to and including 63	6,0	6,0

¹⁾ "Screw type" refers to a terminal that clamps the conductor under the head of a screw, with or without a washer.

IEC 60950-1:2001介紹

4.7 接地線絕緣物的顏色的規定：

- 電源線的Protective earthing conductors顏色須為黃綠色。
- Protective bonding conductor若有絕緣物時，則其顏色須為黃綠色，除非當使用編織線時，則其顏色須為黃綠色或透明色。
- 若Protective bonding conductor是組合元件的一部份(Assembly)如ribbon cables，busbars，printed wiring等，任何顏色均可接受，只要不發生使用上誤認混淆即可。

IEC 60950-1:2001 介紹

4.8 接地其它規定：

- 接地保護導體中，不可包含保險絲或開關。
- 在斷開接地保護連結時，應能先將或同時將設備內的危險電壓解除。
- **Operator** 可拆卸的 parts, 操作人員可拆卸的 connector a plug on a power supply cord
an appliance coupler 其保護接地線連接應 **make earlier and break later.**
- 在維修時，接地保護連結處應不可被斷開，除非危險電壓能先除去。
- 接地保護導體，常會因不同金屬的使用，經長時間的接觸而產生腐蝕現象，故接地保護導體使用之金屬應參考表 J.1 的要求（相互間電化學電位應小於0.6 V，方符合要求），以避免腐蝕發生，而影響接地的連續性。

IEC 60950-1:2001 介紹

4.8 接地其它規定 (continue):

— 接地螺絲若為自攻螺絲則需提供至少2個螺釘於每一個連接處. However, it is permitted to use a single 自攻螺絲但 Metal part 厚度 min. **1.6mm** for thread-cutting type or min. **0.9mm** for thread-forming type .

IEC 60950-1:2001 介紹

Table J.1 – Electrochemical potentials

Magnesium, magnesium alloys	Zinc, zinc alloys	B0 tin/20 Zn on steel, Zn on iron or steel	Aluminium	Cr on steel	Al/Mg alloy	Mild steel	Duralumin	Lead	Cr on steel, soft solder	Cr on Ni on steel, tin on steel 12 % Cr stainless steel	High Cr stainless steel	Copper, copper alloys	Silver solder, Austenitic stainless steel	Ni on steel	Silver	Rh on Ag on Cu, silver/gold alloy	Carbon	Gold, platinum	
0	0,6	0,66	0,7	0,8	0,86	0,9	1,0	1,05	1,1	1,15	1,26	1,36	1,4	1,46	1,6	1,65	1,7	1,75	Magnesium, magnesium alloys
	0	0,06	0,2	0,3	0,36	0,4	0,5	0,55	0,6	0,66	0,76	0,86	0,9	0,96	1,1	1,15	1,2	1,25	Zinc, zinc alloys
		0	0,16	0,26	0,3	0,36	0,45	0,5	0,6	0,6	0,7	0,8	0,86	0,9	1,06	1,1	1,15	1,2	B0 tin/20 Zn on steel, Zn on iron or steel
			0	0,1	0,16	0,2	0,3	0,36	0,4	0,46	0,55	0,65	0,7	0,75	0,9	0,96	1,0	1,05	Aluminium
				0	0,06	0,1	0,2	0,25	0,3	0,36	0,46	0,55	0,6	0,66	0,8	0,86	0,9	0,95	Cr on steel
Ag	Silver			0	0,06	0,15	0,2	0,2	0,3	0,4	0,5	0,56	0,6	0,76	0,8	0,86	0,9		Al/Mg alloy
Al	Aluminium				0	0,1	0,15	0,2	0,26	0,36	0,46	0,5	0,55	0,7	0,75	0,8	0,85		Mild steel
Cr	Chromium																		Duralumin
Cd	Cadmium					0	0,06	0,1	0,16	0,26	0,36	0,4	0,46	0,6	0,66	0,7	0,75		
Mg	Magnesium																		Lead
Ni	Nickel						0	0,5	0,1	0,2	0,3	0,36	0,4	0,66	0,6	0,66	0,7		
Rh	Rhodium								0	0,06	0,16	0,26	0,3	0,36	0,6	0,66	0,6	0,65	
Zn	Zinc									0	0,1	0,2	0,26	0,3	0,46	0,6	0,66	0,6	
											0	0,1	0,16	0,2	0,36	0,4	0,45	0,5	
												0	0,06	0,1	0,25	0,3	0,35	0,4	
													0	0,16	0,2	0,25	0,3	0,35	
														0	0,16	0,2	0,25	0,3	
															0	0,6	0,1	0,15	
																0	0,06	0,1	
																	0	0,6	
																		0	

NOTE – Corrosion due to electrochemical action between dissimilar metals which are in contact is minimised if the combined electrochemical potential is below about 0,6 V. In the table the combined electrochemical potentials are listed for a number of pairs of metals in common use; combinations above the dividing line should be avoided.

IEC 60950-1:2001 介紹

4.9 各式絕緣之適用情形;詳請參考表2G及圖2F，簡單範例如下：

絕緣型式	between	and
功能絕緣型	unearthed SELV CIRCUIT or double-insulated conductive part	<ul style="list-style-type: none"> - earthed conductive part - double-insulated conductive part - unearthed SELV CIRCUIT - earthed SELV CIRCUIT - earthed TNV-1 CIRCUIT
	earthed SELV CIRCUIT	<ul style="list-style-type: none"> - earthed conductive part - unearthed SELV CIRCUIT - unearthed TNV-1 CIRCUIT - earthed TNV-1 CIRCUIT
	ELV CIRCUIT or basic insulated conductive part	<ul style="list-style-type: none"> - earthed conductive part - earthed SELV CIRCUIT - basic insulated conductive part - ELV CIRCUIT
	Earthed hazardous voltage secondary circuit	Earthed hazardous voltage secondary circuit
	TNV-1 CIRCUIT	TNV-1 CIRCUIT
	TNV-2 CIRCUIT	TNV-2 CIRCUIT
	TNV-3 CIRCUIT	TNV-3 CIRCUIT

IEC 60950-1:2001 介紹

<p>基本絕緣型</p>	<p>PRIMARY CIRCUIT</p>	<ul style="list-style-type: none"> - earthed or unearthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT - earthed conductive part - earthed SELV CIRCUIT - basic-insulated conductive part - ELV CIRCUIT
	<p>Earthed or unearthed hazardous voltage secondary circuit</p>	<ul style="list-style-type: none"> - unearthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT - earthed conductive part - earthed SELV CIRCUIT - basic-insulated conductive part - ELV CIRCUIT
	<p>unearthed SELV CIRCUIT or double-insulated conductive part</p>	<ul style="list-style-type: none"> - unearthed TNV-1 CIRCUIT - TNV-2 CIRCUIT - TNV-3 CIRCUIT
	<p>earthed SELV CIRCUIT</p>	<ul style="list-style-type: none"> - TNV-2 CIRCUIT - TNV-3 CIRCUIT
	<p>TNV-2 CIRCUIT</p>	<ul style="list-style-type: none"> - unearthed TNV-1 CIRCUIT - earthed TNV-1 CIRCUIT - TNV-3 CIRCUIT
	<p>TNV-3 CIRCUIT</p>	<ul style="list-style-type: none"> - unearthed TNV-1 CIRCUIT - earthed TNV-1 CIRCUIT

IEC60950-1:2001 介紹

補充絕緣型	basic-insulated conductive part or ELV CIRCUIT	<ul style="list-style-type: none"> - double-insulated conductive part - unearthed SELV CIRCUIT
	TNV CIRCUIT	<ul style="list-style-type: none"> - basic-insulated conductive part - ELV CIRCUIT
補充絕緣/ 加強絕緣型	unearthed hazardous voltage secondary circuit	<ul style="list-style-type: none"> - double -insulated conductive part - unearthed SELV CIRCUIT - TNV CIRCUIT
加強絕緣型	PRIMARY CIRCUIT	<ul style="list-style-type: none"> - double-insulated conductive part - unearthed SELV CIRCUIT - TNV CIRCUIT
	earthed HAZARDOUS VOLTAGE SECONDARY CIRCUIT	<ul style="list-style-type: none"> - double-insulated conductive part - unearthed SELV CIRCUIT - TNV CIRCUIT

IEC 60950-1:2001 介紹

4.10 空間距離(clearance)的決定：

已知工作電壓及絕緣等級後，即可決定空間距離。

- 危險電壓零件與外殼未接地可觸及的導體零件間的空氣間距離，須至少 **10** mm。此要求只針對地板式設備的外殼或桌上型設備的外殼之非垂直上方表面(non-vertical top surface)
 - 危險電壓零件與外殼接地可觸及的導體零件間的空氣間距離，須至少 **2** mm。
 - 在初級電路內clearance的規定須符合表2H(rms)及2J(peak)。最小的空氣間距離，須從等於AC主電源值的欄位取得，如230Va.c.，則cl.為4.0mm。
 - 在次級電路內clearance的規定須符合表2K。
- 決定是否符合要求前，內部零件應先施於 **10** N力，外殼施以 **30** N力，以減少其距離，使確認在最糟情況下，空間距離仍符合規定。

IEC 60950-1:2001 介紹

4.11 沿面距離(creepage distances)的決定：

- 由量測的得知的工作電壓，確認絕緣等級，並根據汙染及材質等級，查表2L決定所需最小之沿面距離。
- 加強絕緣的沿面距離是表2L規定的基本絕緣限值的兩倍。
- 若是由表2L取得的沿面距離限值，小於表2H或2J或2K的空氣間距離限值時，那麼空氣間距離限值須被當作最小的沿面距離限值。
- 針對玻璃，雲母或類似的材質，可允許使用最小的沿面距離限值，等於空氣間距離限值。
- 工作電壓以真值或直流電壓，若使用直流電壓，任何漣波均不列入考量，短暫的訊號，如TNV電路的振鈴亦不列入考量。
- 若不知TNV電路的工作電壓，則假設TNV-1電路是60Vd.c.，而TNV-2及TNV-3電路是120Vd.c.。

IEC 60950-1:2001 介紹

Table 2H – Minimum clearances for insulation in primary circuits and between primary and secondary circuits

CLEARANCES in millimetres

WORKING VOLTAGE up to and including		Nominal AC MAINS SUPPLY voltage ≤150 V (MAINS TRANSIENT VOLTAGE 1 500 V)						Nominal AC MAINS SUPPLY voltage >150 V ≤ 300 V (MAINS TRANSIENT VOLTAGE 2 500 V)						Nominal AC MAINS SUPPLY voltage >300 V ≤ 600 V (MAINS TRANSIENT VOLTAGE 4 000 V)		
Voltage peak or d.c.	Voltage r.m.s. (sinusoidal)	Pollution Degrees 1 and 2			Pollution Degree 3			Pollution Degrees 1 and 2			Pollution Degree 3			Pollution Degrees 1, 2 and 3		
V	V	F	B/S	R	F	B/S	R	F	B/S	R	F	B/S	R	F	B/S	R
71	50	0,4	1,0 (0,5)	2,0 (1,0)	0,8	1,3 (0,8)	2,6 (1,6)	1,0	2,0 (1,5)	4,0 (3,0)	1,3	2,0 (1,5)	4,0 (3,0)	2,0	3,2 (3,0)	6,4 (6,0)
210	150	0,5	1,0 (0,5)	2,0 (1,0)	0,8	1,3 (0,8)	2,6 (1,6)	1,4	2,0 (1,5)	4,0 (3,0)	1,5	2,0 (1,5)	4,0 (3,0)	2,0	3,2 (3,0)	6,4 (6,0)
420	300	F 1,5 B/S 2,0 (1,5) R 4,0 (3,0)												2,5	3,2 (3,0)	6,4 (6,0)
840	600	F 3,0 B/S 3,2 (3,0) R 6,4 (6,0)														
1 400	1 000	F/BS 4,2 R 6,4														
2 800	2 000	F/B/S/R 8,4														
7 000	5 000	F/B/S/R 17, 5														
9 800	7 000	F/B/S/R 25														
14 000	10 000	F/B/S/R 37														
28 000	20 000	F/B/S/R 80														
42 000	30 000	F/B/S/R 130														

1) The values in the table are applicable to FUNCTIONAL (F), BASIC (B), SUPPLEMENTARY (S) and REINFORCED (R) insulation.

2) The values in parentheses are applicable to BASIC, SUPPLEMENTARY or REINFORCED INSULATION only if manufacturing is subjected to a quality control programme that provides at least the same level of assurance as the example given in annex R.2. In particular, DOUBLE and REINFORCED INSULATION shall be subjected to ROUTINE TESTS for electric strength.

3) For WORKING VOLTAGES between 2 800 V peak or d.c. and 42 000 V peak or d.c., linear interpolation is permitted between the nearest two points, the calculated spacing being rounded up to the next higher 0,1 mm increment.

IEC 60950-1:2001 介紹

Table 2J – Additional clearances for insulation in primary circuits with peak working voltages exceeding the peak value of the nominal a.c. mains supply voltage

Nominal AC MAINS SUPPLY voltage ≤150 V		Nominal AC MAINS SUPPLY voltage >150 V ≤ 300 V	Additional CLEARANCE mm	
Pollution Degrees 1 and 2	Pollution Degree 3	Pollution Degrees 1, 2 and 3	FUNCTIONAL, BASIC or SUPPLEMENTARY INSULATION	REINFORCED INSULATION
Maximum PEAK WORKING VOLTAGE V	Maximum PEAK WORKING VOLTAGE V	Maximum PEAK WORKING VOLTAGE V		
210 (210)	210 (210)	420 (420)	0	0
298 (288)	294 (293)	493 (497)	0,1	0,2
386 (366)	379 (376)	567 (575)	0,2	0,4
474 (444)	463 (459)	640 (652)	0,3	0,6
562 (522)	547 (541)	713 (729)	0,4	0,8
650 (600)	632 (624)	787 (807)	0,5	1,0
738 (678)	715 (707)	860 (884)	0,6	1,2
826 (756)	800 (790)	933 (961)	0,7	1,4
914 (839)		1 006 (1 039)	0,8	1,6
1 002 (912)		1 080 (1 116)	0,9	1,8
1 090 (990)		1 153 (1 193)	1,0	2,0
		1 226 (1 271)	1,1	2,2
		1 300 (1 348)	1,2	2,4
		– (1 425)	1,3	2,6

– The values in parentheses shall be used:
 – when the values in parentheses in table 2H are used in accordance with item 2) of table 2H; and
 – for FUNCTIONAL INSULATION.

IEC 60950-1:2001 介紹

Table 2K – Minimum clearances in secondary circuits

CLEARANCES in millimetres

WORKING VOLTAGE up to and including		Nominal AC MAINS SUPPLY voltage ≤ 150 V (transient rating for SECONDARY CIRCUIT 800 V) see 5)						Nominal AC MAINS SUPPLY voltage >150 V ≤ 300 V (transient rating for SECONDARY CIRCUIT 1 500 V) see 5)						Nominal AC MAINS SUPPLY voltage >300 V ≤ 600 V (transient rating for SECONDARY CIRCUIT 2 500 V) see 5)						Circuit not subject to transient overvoltages see 4)		
Voltage peak or d.c. V	Voltage r.m.s. (sinusoidal) V	Pollution Degrees 1 and 2			Pollution Degree 3			Pollution Degrees 1 and 2			Pollution Degree 3			Pollution Degrees 1, 2 and 3			Pollution Degrees 1 and 2 only					
		F	B/S	R	F	B/S	R	F	B/S	R	F	B/S	R	F	B/S	R	F	B/S	R			
71	50	0,4 (0,2)	0,7 (0,2)	1,4 (0,4)	1,0 (0,8)	1,3 (0,8)	2,6 (1,6)	0,7 (0,5)	1,0 (0,5)	2,0 (1,0)	1,0 (0,8)	1,3 (0,8)	2,6 (1,6)	1,7 (1,5)	2,0 (1,5)	4,0 (3,0)	0,4 (0,2)	0,4 (0,2)	0,8 (0,4)			
140	100	0,6 (0,2)	0,7 (0,2)	1,4 (0,4)	1,0 (0,8)	1,3 (0,8)	2,6 (1,6)	0,7 (0,5)	1,0 (0,5)	2,0 (1,0)	1,0 (0,8)	1,3 (0,8)	2,6 (1,6)	1,7 (1,5)	2,0 (1,5)	4,0 (3,0)	0,6 (0,2)	0,7 (0,2)	1,4 (0,4)			
210	150	0,6 (0,2)	0,9 (0,2)	1,8 (0,4)	1,0 (0,8)	1,3 (0,8)	2,6 (1,6)	0,7 (0,5)	1,0 (0,5)	2,0 (1,0)	1,0 (0,8)	1,3 (0,8)	2,6 (1,6)	1,7 (1,5)	2,0 (1,5)	4,0 (3,0)	0,6 (0,2)	0,7 (0,2)	1,4 (0,4)			
280	200	F 1,1 (0,8) B/S 1,4 (0,8) R 2,8 (1,6)												1,7 (1,5)	2,0 (1,5)	4,0 (3,0)	1,1 (0,2)	1,1 (0,2)	2,2 (0,4)			
420	300	F 1,6 (1,0) B/S 1,9 (1,0) R 3,8 (2,0)												1,7 (1,5)	2,0 (1,5)	4,0 (3,0)	1,4 (0,2)	1,4 (0,2)	2,8 (0,4)			
700	500													F/B/S 2,5			R, 5,0					
840	600													F/B/S 3,2			R, 5,0					
1 400	1 000													F/B/S 4,2			R, 5,0					
2 800	2 000													F/B/S/R 8,4			See 6)					
7 000	5 000													F/B/S/R 17,5			See 6)					
9 800	7 000													F/B/S/R 25			See 6)					
14 000	10 000													F/B/S/R 37			See 6)					
26 000	20 000													F/B/S/R 80			See 6)					
42 000	30 000													F/B/S/R 130			See 6)					

1) The values in the table are applicable to FUNCTIONAL (F), BASIC (B), SUPPLEMENTARY (S) and REINFORCED (R) INSULATION.

2) The values in parentheses are applicable to BASIC, SUPPLEMENTARY or REINFORCED INSULATION only if manufacturing is subjected to a quality control programme that provides at least the same level of assurance as the example given in annex R.2. In particular, DOUBLE and REINFORCED INSULATION shall be subjected to ROUTINE TESTS for electric strength.

3) For WORKING VOLTAGES between 2 800 V peak or d.c. and 42 000 V peak or d.c., linear interpolation is permitted between the nearest two points, the calculated spacing being rounded up to the next higher 0,1 mm increment.

4) The values are applicable to d.c. SECONDARY CIRCUITS which are reliably connected to earth and have capacitive filtering which limits the peak-to-peak ripple to 10 % of the DC VOLTAGE.

5) Where transients in the equipment exceed this value, the appropriate higher CLEARANCE shall be used.

6) Compliance with a CLEARANCE value of 8,4 mm or greater is not required if the CLEARANCE path is:

- entirely through air, or
- wholly or partly along the surface of an insulating material of Material Group I; and the insulation involved passes an electric strength test according to 5.2.2 using:
 - an a.c. test voltage whose r.m.s. value is equal to 1,06 times the PEAK WORKING VOLTAGE, or
 - a d.c. test voltage equal to the peak value of the a.c. test voltage prescribed above.

If the CLEARANCE path is partly along the surface of a material that is not Material Group I, the electric strength test is conducted across the air gap only.

IEC 60950-1:2001 介紹

Table 2L – Minimum creepage distances

CREEPAGE DISTANCES in millimetres

WORKING VOLTAGE V r.m.s or d.c	FUNCTIONAL, BASIC AND SUPPLEMENTARY INSULATION						
	Pollution Degree 1	Pollution Degree 2			Pollution Degree 3		
	Material Group	Material Group			Material Group		
	I, II, IIIa or IIIb	I	II	IIIa or IIIb	I	II	IIIa or IIIb
≤50		0,6	0,9	1,2	1,5	1,7	1,9
100	Use the CLEARANCE from the appropriate table	0,7	1,0	1,4	1,8	2,0	2,2
125		0,8	1,1	1,5	1,9	2,1	2,4
150		0,8	1,1	1,6	2,0	2,2	2,5
200		1,0	1,4	2,0	2,5	2,8	3,2
250		1,3	1,8	2,5	3,2	3,6	4,0
300		1,6	2,2	3,2	4,0	4,5	5,0
400		2,0	2,8	4,0	5,0	5,6	6,3
600		3,2	4,5	6,3	8,0	9,6	10,0
800		4,0	5,6	8,0	10,0	11,0	12,5
1000	5,0	7,1	10,0	12,5	14,0	16,0	

Linear interpolation is permitted between the nearest two points, the calculated spacing being rounded to the next higher 0,1 mm increment.

IEC/EN 60950-1:2001 介紹

4.11 沿面距離(creepage distances)的決定 (continued)

— 材質等級是根據IEC 60112的測試後定義如下，若無法確認，則假設為material group IIIb:

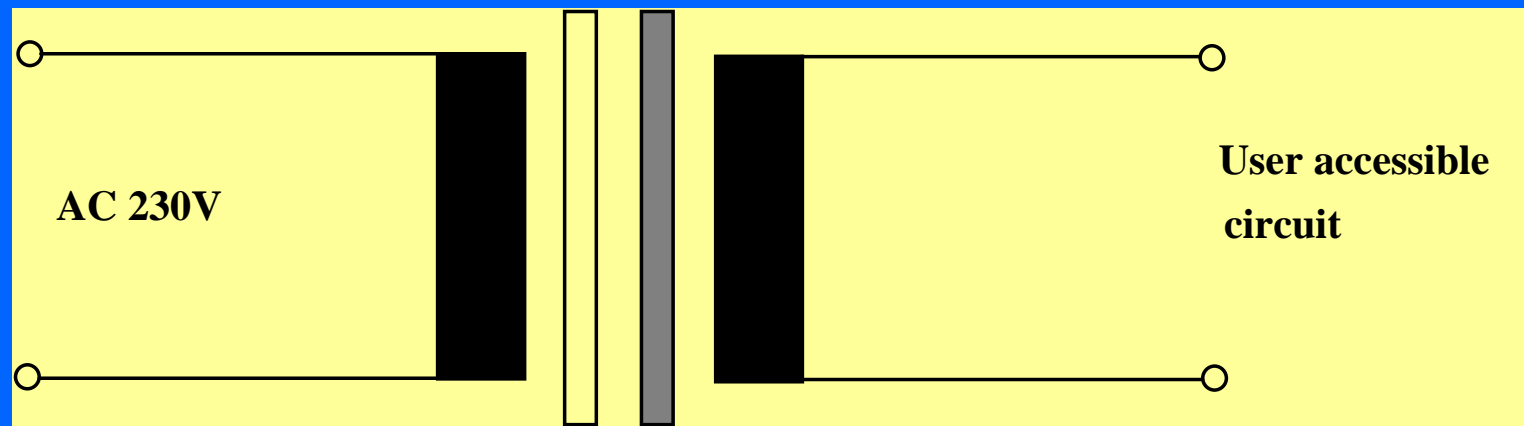
1. Material group I	<u>600</u> £CTI (comparative tracking index)
2. Material group II	<u>400</u> £CTI < <u>600</u>
3. Material group IIIa	<u>175</u> £CTI < <u>400</u>
4. Material group IIIb	<u>100</u> £CTI < <u>175</u>



— 測量沿面距離時，須參照Annex F。

IEC 60950-1:2001 介紹

4.12 常見範例:

FIGURE A, TWO INSULATION SYSTEM IN SERIES BETWEEN MAINS PRIMARY CIRCUITS AND USER ACCESSIBLE CIRCUITS

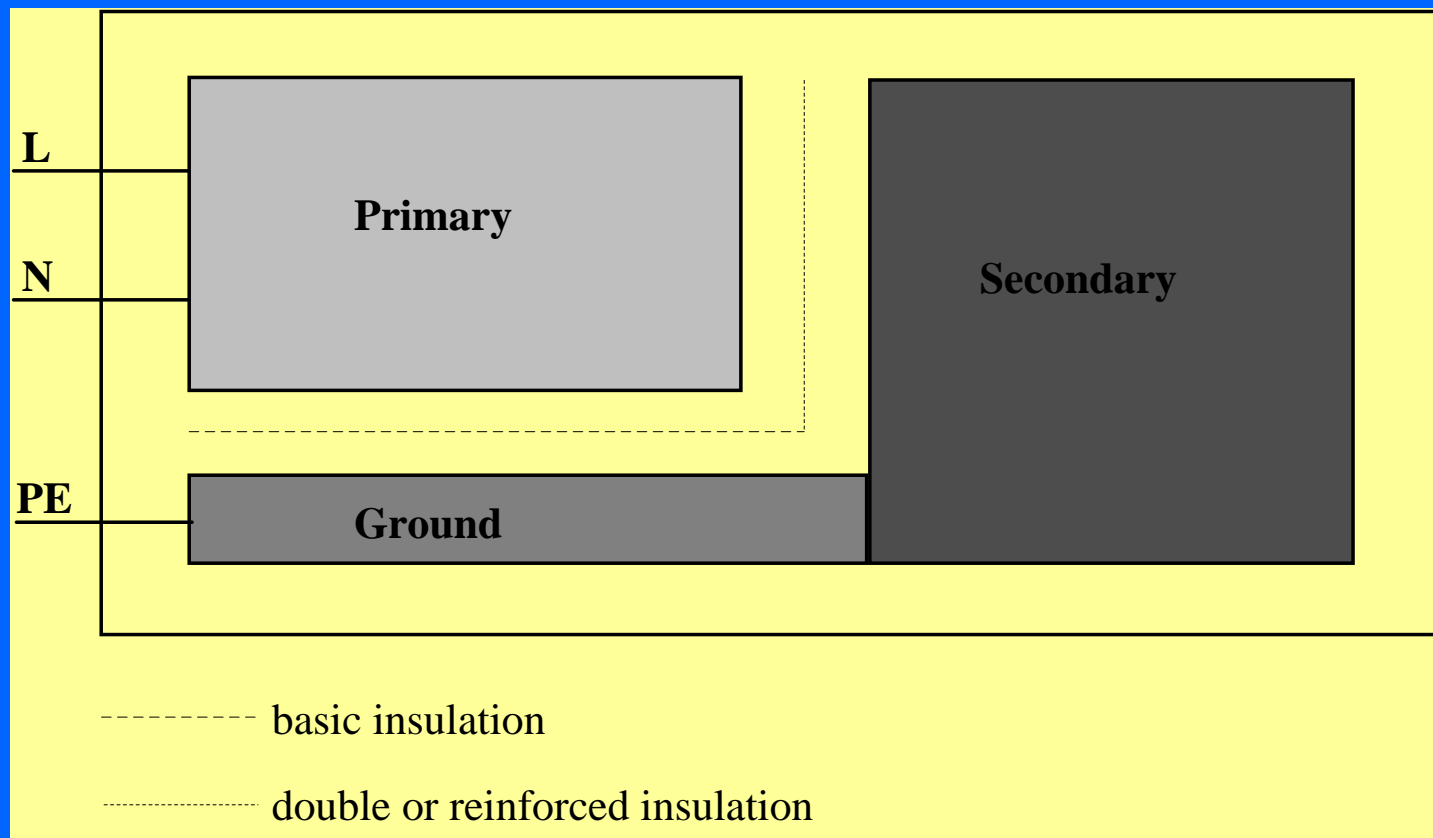


-  基本絕緣
-  補充絕緣

IEC/EN 60950-1:2001 介紹

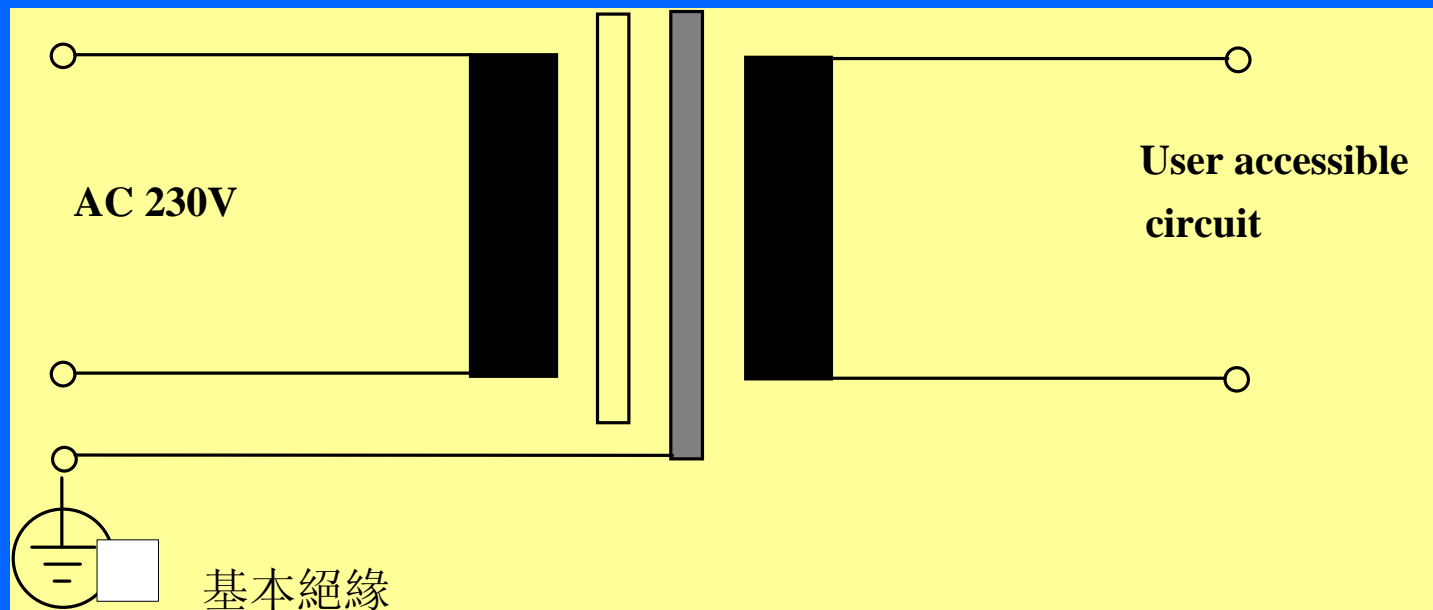
FIGURE B, PCB LAYOUT OF A CLASS I SWITCHING POWER SUPPLY

PCB



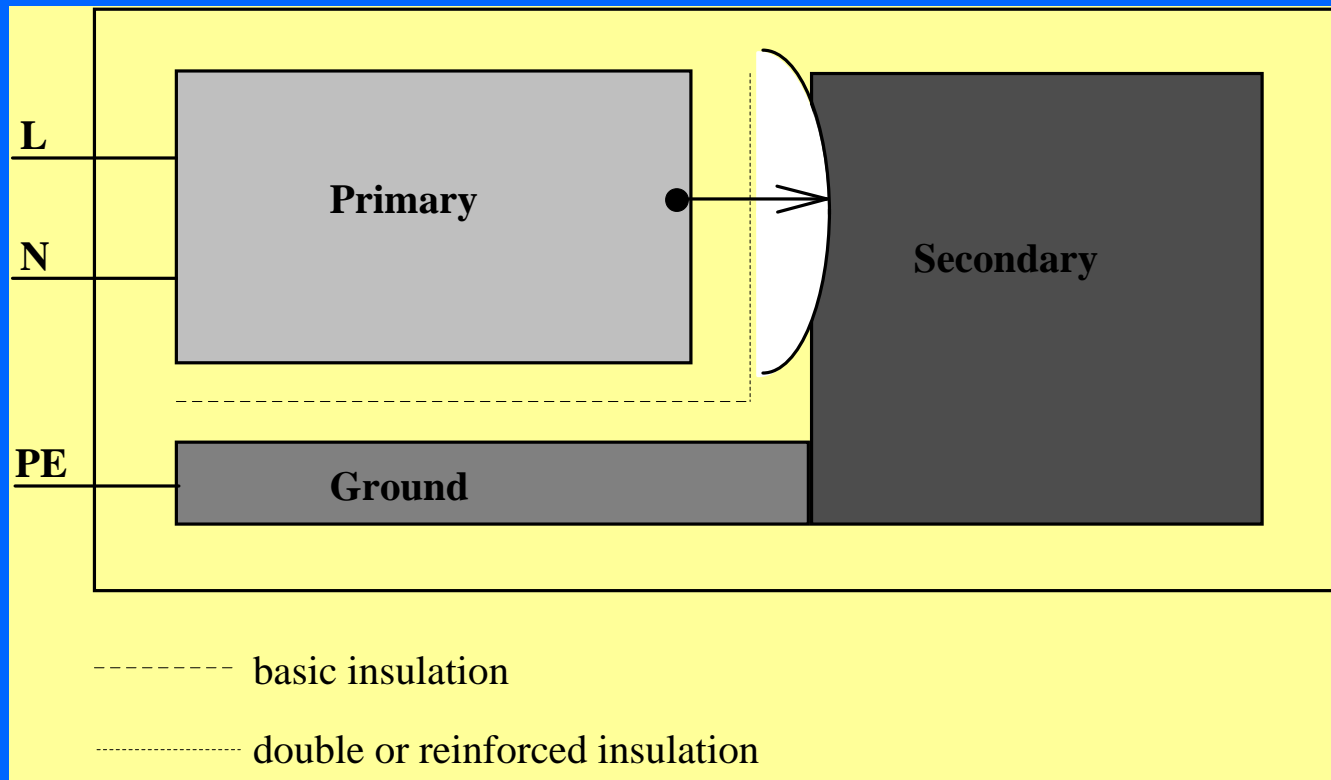
IEC/EN 60950-1:2001 介紹

FIGURE C, ONE INSULATION SYSTEM AND SHIELDING CONNECTED TO PE BETWEEN MAINS PRIMARY CIRCUITS AND USER ACCESSIBLE CIRCUITS



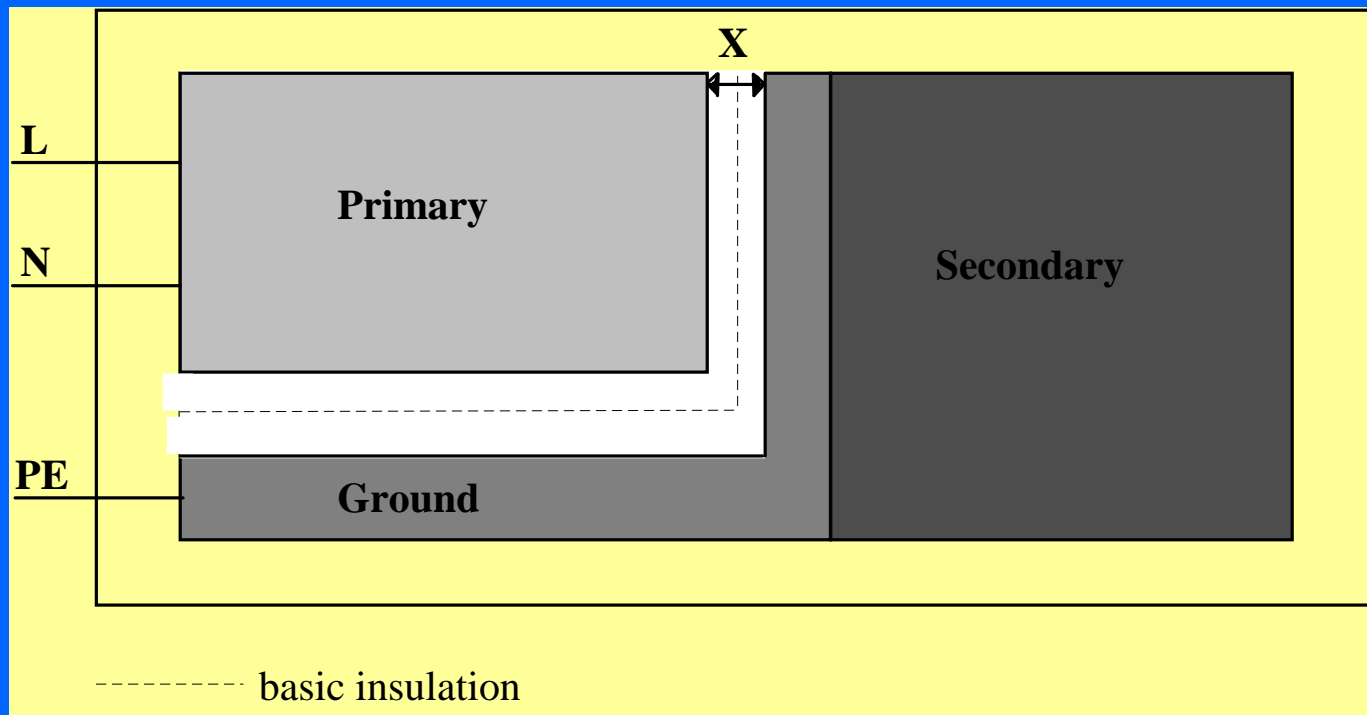
IEC/EN 60950-1:2001 介紹

FIGURE D, WORKING VOLTAGE HIGHER THAN MAINS
VOLTAGE
PCB



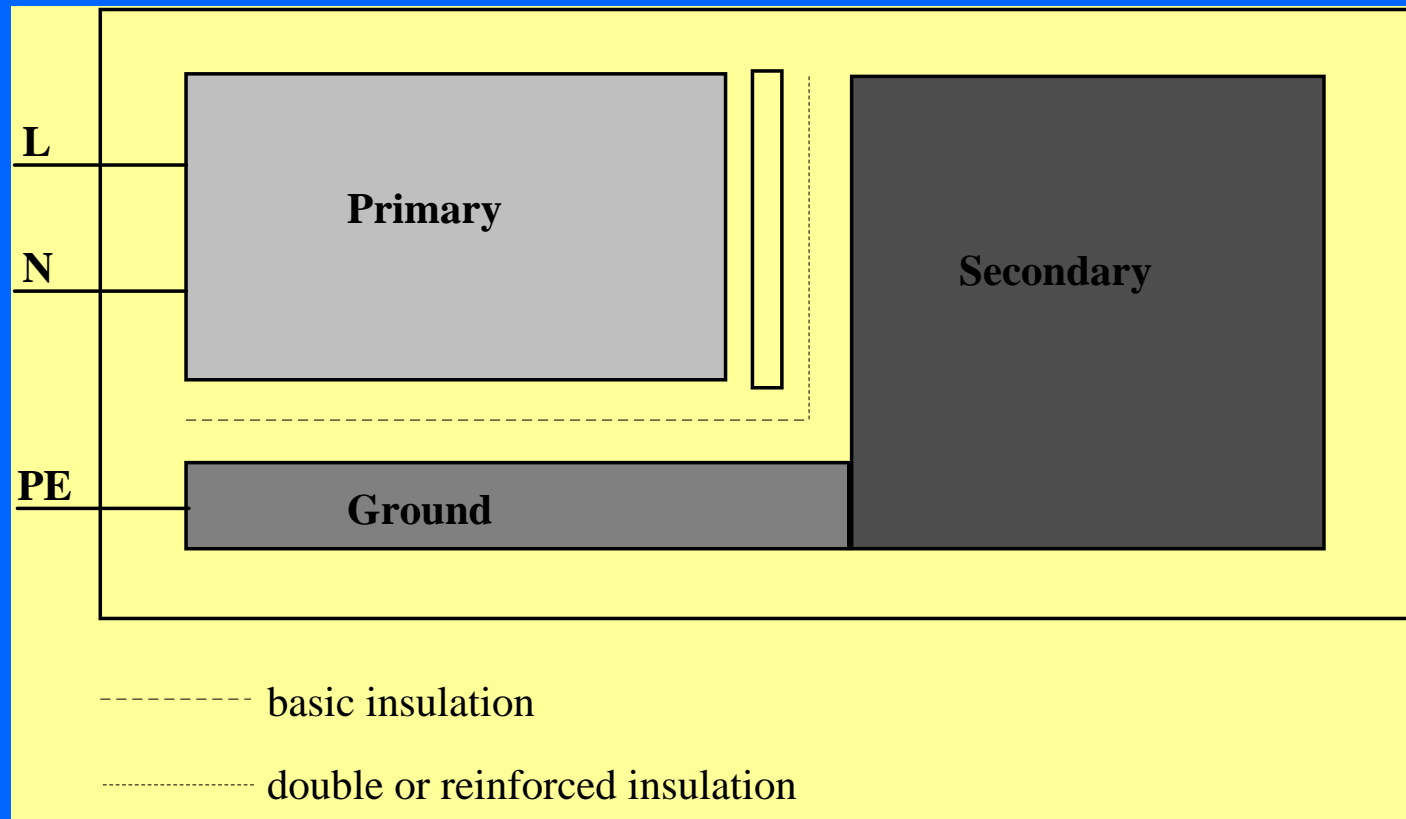
IEC/EN 60950-1:2001 介紹

FIGURE E, SHIELDING OF SECONDARY CIRCUIT WITH GND TRACE PCB



IEC/EN 60950-1:2001 介紹

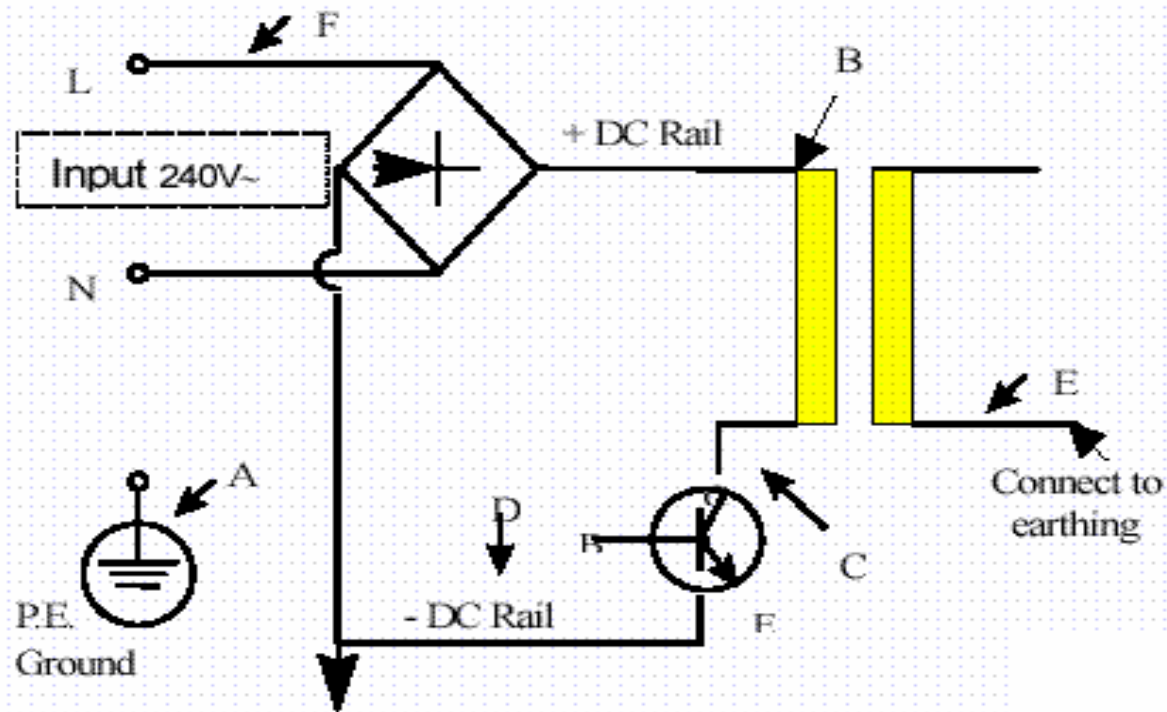
FIGURE F, SLOT INSIDE THE PCB BETWEEN PRIMARY AND SECONDARY PCB



IEC/EN 60950-1:2001介紹

空間及沿面距離量測及計算範例：

下圖為交換式資訊的簡圖作為介紹沿面及空氣間距離計算及判讀



IEC/EN 60950-1:2001介紹

經測量各定點間得其true r.m.s及peak值如下表:

TRUE RMS VOLTMETER			OSCILLOSCOPE		
<u>Measured true Vrms values</u>			<u>Measured Vpeak values</u>		
A-C	(Basic)	:277V	A-C	(Basic)	:410V
C-E	(Reinforced)	:238V	C-E	(Reinforced)	:392V
B-E	(Reinforced)	:293V	B-E	(Reinforced)	:432V
A-B	(Basic)	:256V	A-B	(Basic)	:335V
A-D	(Basic)	:238V	A-D	(Basic)	:335V
B-C	(Functional)	:111V	B-C	(Functional)	:446V
C-D	(Functional)	:351V	C-D	(Functional)	:450V
A-F	(Basic)	:240V	A-F	(Basic)	:340V

IEC/EN 60950-1:2001介紹

我們可根據方法一及查表2H、2J及2L取得沿面及空氣間距離值如下：

trace	insulation	creepage distances (mm)	Clearances (mm)
A-C	(Basic)	3.2	2.0
C-E	(Reinforced)	5.0	4.0
B-E	(Reinforced)	6.4	4.0+0.2
A-B	(Basic)	3.2	2.0
A-D	(Basic)	2.5 *)	2.0
B-C	(Functional)	2.5 **)	1.5+0.1
C-D	(Functional)	4.0 **)	1.5+0.1
A-F	(Basic)	2.5	2.0

Note:

*) min. working voltage between primary and secondary shall equal to nominal supply voltage or max. rated voltage range.

***) For functional insulation, creepage distance and clearances smaller than the specified values in tables are permitted subject to the requirements of item b (electric strength test) or item c (short-circuit test) of cl. 5.3.4.

IEC/EN 60950-1:2001 介紹

4.13 絕緣厚度的決定 (clause 2.10.5.1-2.10.5.2)

絕緣厚度應依工作電壓及絕緣等級及下述之情形決定之 (2.10.5.1)。

- 工作電壓不超過 **50** V (**71** V_{peak}或d.c.) 則無厚度要求；
- 補充絕緣時，絕緣厚度須至少有 **0.4** mm；
- 加強絕緣時，絕緣厚度須能在正常工作下，不附加任何機械應力，保持 **0.4** mm 的最小厚度。
- 多層印刷電路板的內層，其同層相鄰的兩導體間 (two tracks)，可視為絕緣厚度，須符合2.10.5.1的要求。

IEC/EN 60950-1:2001 介紹

4.14 絕緣厚度的決定 (continued)

上述厚度要求，並不適用於薄片絕緣物，只要此薄片絕緣物是用於設備內，且不致因使用者使用而觸摸或磨損即可，及須符合下列任一條件(2.10.5.2)；

- 補充絕緣至少由 **2** 層薄片絕緣物組成，且其中任何 **1** 層均需通過補充絕緣所要求的電氣強度測試；或
- 補充絕緣由 **3** 層薄片絕緣物組成，其中任 **2** 層的組合，均需通過補充絕緣所要求的電氣強度測試；或
- 加強絕緣至少由 **2** 層薄片絕緣物組成，其中任何 **1** 層均需通過加強絕緣所要求的電氣強度測試。
- 加強絕緣由 **3** 層薄片絕緣物組成，其中任 **2** 層的組合，均需通過補充絕緣所要求的電氣強度測試。

IEC/EN 60950-1:2001 介紹

4.14 繞線零件的規定 (clause 2.10.5.4, Wound components):

若變壓器符合下列其中一種結構的要求，則不必要求層間絕緣，無論是其須符合基本(basic)，補充(supplementary)，雙重(double)或加強(reinforced)絕緣，繞線零件(如變壓器)符合條款2.10.5.1 或/及 2.10.5.2 或能符合下列a)，b)或c)項的規定：

- a) 繞線(如變壓器)的絕緣並非為水溶性的漆包線，且符合條款2.10.5.1 或
- b) 繞線(如變壓器)為多層絕緣線時，且絕緣線能獨自通過電擊強度測試，並符合條款2.10.5.2及附錄U的要求 或

IEC/EN 60950-1:2001 介紹

4.14 繞線零件的規定 (continue):

c) 繞線(如變壓器)為多層絕緣線時，且僅完成品能通過電擊強度測試，並符合附錄U的要求，而多層絕緣線(含 **extruded**或**wrapped type**)的絕緣等級是根據導線的層間結構來決定:

— 層間結構要求為基本絕緣時:若為”**Extruded**”型式; 則可接受 **1** 層, **wrapped**型式; 則至少須 **2** 層。

— 層間結構要求為補充絕緣時:無論是**extruded**或**wrapped type**;則至少須 **2** 層。

— 層間結構要求為加強絕緣時:無論是**extruded**或**wrapped type**;則至少須 **3** 層。

IEC/EN 60950-1:2001 介紹

4.14 繞線零件的規定 (continue):

在條款2.10.5.4 b)及2.10.5.4 c)的規定內，若繞線為螺旋方式在每一層間的沿面距離，若小於表2L”汙染等級1”的規定值，則每一層間的路徑均須密封，如條款2.10.8的規定，且根據附錄U.2的型式測試電壓須增加1.6倍。

任兩條上述多層絕緣繞線彼此接觸，且其交會點的角度在45-90度之間，則變壓器結構上，必須有物理方式的隔離，例如使用絕緣套管或絕緣片(膠帶)，或使用兩倍以上的絕緣層(膠帶)，因而能減輕該交會點的機械應力。而此具多層絕緣繞線的變壓器成品，須根據條款5.2.2.通過例行的電擊強度測試，一般測試值為初次級間3000Vac,1 min.。

IEC/EN 60950-1:2001 介紹

4.14 繞線零件的規定 (continue):

Manufacturer	Type	Working Voltage	Insulation class	
Furukawa	TEX-E	<u>700</u> Vrms <u>1000</u> Vpeak	<u>120</u> °C (<u>E</u>)	
Totoku	TIW-2	<u>1000</u> Vrms <u>1400</u> Vpeak	<u>120</u> °C (<u>E</u>)	
Totoku	TIW-3	<u>1000</u> Vrms <u>1400</u> Vpeak	<u>155</u> °C (<u>F</u>)	
Totoku	TIW-E, 3S-ETFE	<u>1000</u> Vrms <u>1400</u> Vpeak	<u>130</u> °C (<u>B</u>)	

IEC/EN 60950-1:2001 介紹

5 物理特性的要求

5.1 設備具有危險的移動式零件的規定有 (clause 4.4.1-4.4.4) :

對於設備具有危險的移動式零件，則須有適度的安置或護蓋等，以保護使用者不至於發生危險。若意外的啓動會導致危險的產生，則自動重設熱切斷零件，或自動重設的過電流保護零件，或自動啓動零件(**automatic timer starting**)不可裝置在設備內。

— 在使用者可接觸的區域，須要有適當的結構，以避免使用者碰到危險的移動性零件。或者將危險的移動性零件，置入于一具有電氣式安全內鎖裝置的電氣或機械外殼內，以至於可停止該危險的移動性零件，當使用者欲接觸之時。

IEC/EN 60950-1:2001 介紹

5.1 設備具有危險的移動式零件的規定有 (clause 4.4.1-4.4.4) : (continued)

— 在維護人員可接觸的區域，須要有適當的結構，以避免維護人員不經意的碰到危險的移動性零件。

— 若設備具有危險的移動式零件，在設備 使用說明書 及 標示 ；須有如下的適當文字：

“WARNING: HAZARDOUS MOVING PARTS, KEEP FINGERS AND OTHER BODY PARTS AWAY.”

IEC/EN 60950-1:2001 介紹

5.2 Thermal requirements

- A. 一般電子零件,依零件規格之額定溫度值,決定其溫度上限.
- B. Thermoplastic materials: 無一定值,但必須pass “Ball Pressure Test” at min. 125°C.
- C. 其他之temperature limits如table 4B所示.

IEC/EN 60950-1:2001 介紹

Table 4B – Temperature limits
Part 1


Part	Maximum temperature (T_{max}) °C
Insulation, including winding insulation: <ul style="list-style-type: none">– of Class A material– of Class E material– of Class B material– of Class F material– of Class H material	100 1), 2), 3) 115 1), 2), 3) 120 1), 2), 3) 140 1), 2), 3) 165 1), 2), 3)
Synthetic rubber or PVC insulation of internal and external wiring, including power supply cords: <ul style="list-style-type: none">– without temperature marking– with temperature marking	75 Temperature marking minus 25
Other thermoplastic insulation	4)
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

IEC/EN 60950-1:2001 介紹

Temperature Limits
Part 2

Parts in OPERATOR ACCESS AREAS	Maximum temperature (T_{max}) °C		
	Metal	Glass, porcelain and vitreous material	Plastic and rubber 3)
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 which may be touched 5)	70	80	95
Parts inside the equipment which may be touched 6)	70	80	95

Table 4B (part 1 and part 2)

- 1) If the temperature of a winding is determined by thermocouples, these values are reduced by 10 °C, except in the case of
 - a motor, or
 - a winding with embedded thermocouples.
- 2) The classification of insulating materials (Classes A, E, B, F and H) is in accordance with IEC 60085.
- 3) For each material, account shall be taken of the data for that material to determine the appropriate maximum temperature.
- 4) Due to their wide variety, it is not possible to specify maximum permitted temperatures for thermoplastic materials. These shall pass the tests specified in 4.5.2.
- 5) ~~For areas on the external surface of equipment and having no dimension exceeding 50 mm, and which are not likely to be touched in normal use, temperatures up to 100 °C are permitted.~~
- 6) Temperatures exceeding the limits are permitted provided that the following conditions are met:
 - unintentional contact with such a part is unlikely;
 - the part has a marking indicating that this part is hot. It is permitted to use the symbol  (60417-1-IEC-5041) to provide this information.

IEC/EN 60950-1:2001 介紹

5.3 設備外殼開孔規定

除Transportable equipment enclosure之外，其他設備的外殼上方，側面及底部開孔要求如下：

— 外殼上方開孔符合下列其中任何一項要求即可：

- a. 任何一方向量測，尺寸不超過 **5** mm。
- b. 寬度在 **1** mm內，長度則不限。
- c. 尺寸大小不限，但須確保外物不會直接掉入孔內，而碰觸到具危險電壓零件，如規章附圖**4B**所示的結構。
- d. 開孔位置適當，並在其投影 **5** 度角的範圍內，沒有任何具危險電壓的零件存在。投影 **5** 度角範圍的定義如附圖**4D**所示。

IEC/EN 60950-1:2001 介紹

5.3 設備外殼開孔規定: (continued)

- 外殼側面開孔符合下列其中任何一項要求即可:
 - a. 任何一方向量測，尺寸不超過 **5** mm。
 - b. 寬度在 **1** mm 內，長度則不限。
 - c. 如百葉窗之開孔，以避免外物進入，其結構如規章附圖 4C 所示。
 - d. 開孔位置適當，並在其投影 **5** 度角的範圍內，沒有任何具危險電壓或能量的零件存在。投影 **5** 度角範圍的定義如附圖 4D 所示。

IEC/EN 60950-1:2001 介紹

5.3 設備外殼開孔規定 (continue)

— 外殼底部開孔符合下列其中任何一項要求即可：

a. 無任何開孔

b. 孔大小不限，但須在下列物品之下方；

1. PVC，TFE，PTFE，TEP及neoprene做成的絕緣導體及連接頭。

2. 具 阻抗保護 或 過熱保護 的馬達。

3. 符合防火外殼要求的 內部屏障 或是 細目金屬網 或是其餘類似物。

c. 可有 40 mm²以下的開孔，但須在防火等級 V-1 以上的零件之下。

IEC/EN 60950-1:2001 介紹

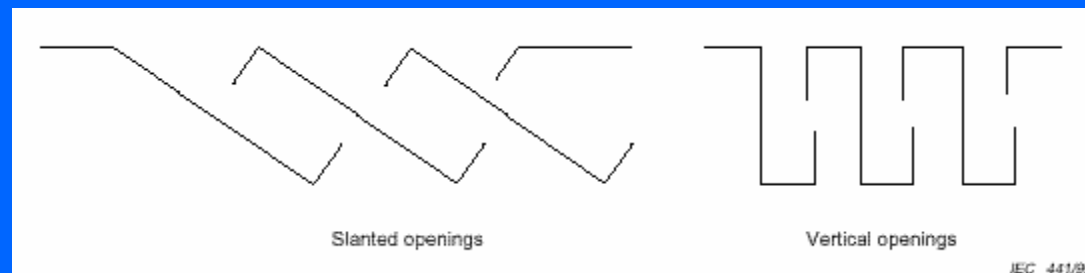
5.3 設備外殼開孔規定 (continue)

- d. 孔大小不限，但開孔上方須裝設遮蔽板，其構造如圖4F所示。
- e. 若為金屬底殼時，開孔大小及孔距應符合表4B之要求。
- f. 以細目金屬網做屏蔽，但網目大小不超過 **2** **2**
____mmx____mm， **0.45**
且織網金屬線之直徑不小於_____mm。

IEC/EN 60950-1:2001 介紹

5.3 設備外殼開孔規定 (continue)

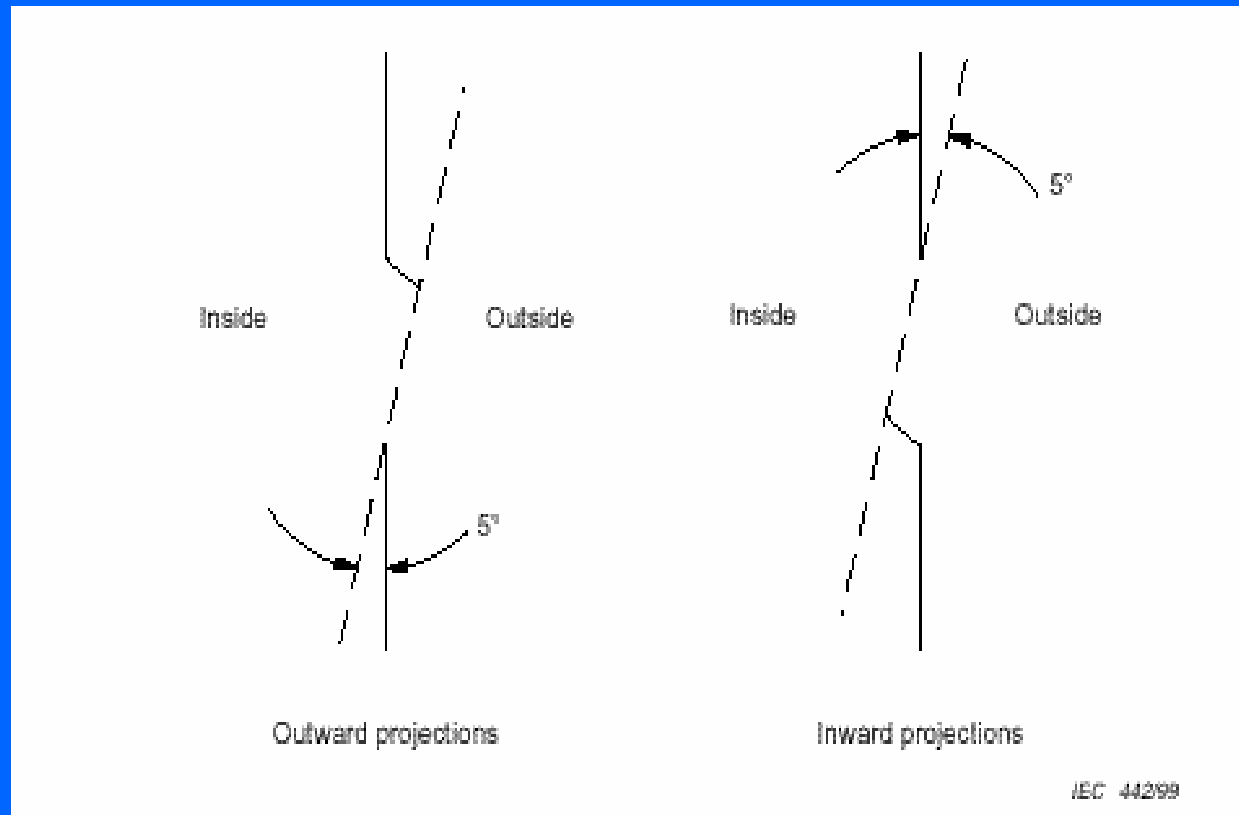
Figure 4B – Examples of cross-sections of designs of openings preventing vertical access



IEC/EN 60950-1:2001 介紹

5.3 設備外殼開孔規定 (continue)

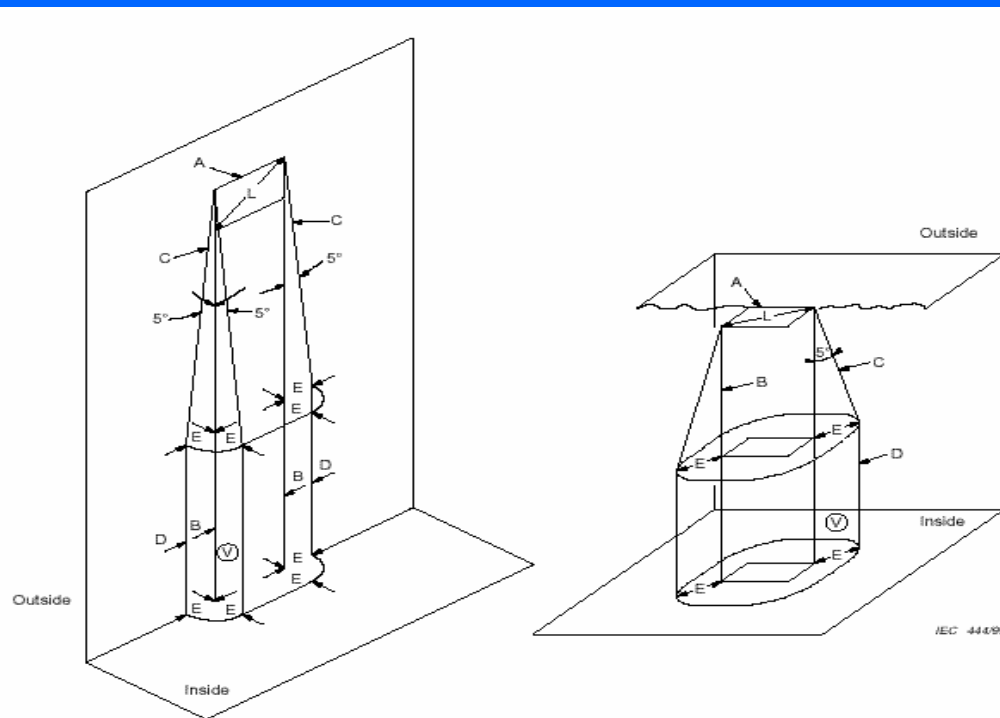
Figure 4C – Examples of louvre design



IEC/EN 60950-1:2001 介紹

5.3 設備外殼開孔規定 (continue)

Figure 4D – Enclosure openings



IEC 443/99

IEC 444/99

- A ENCLOSURE opening.
- B Vertical projection of the outer edges of the opening.
- C Inclined lines that project at a 5° angle from the edges of the opening to points located E distance from B.
- D Line which is projected straight downward in the same plane as the ENCLOSURE side wall.
- E Projection of the opening (not to be greater than L).
- L Maximum dimension of the ENCLOSURE opening.
- V Volume in which bare parts at HAZARDOUS VOLTAGE, or which are energy hazards (see 4.6.1), are not located.

IEC/EN 60950-1:2001 介紹

5.3 設備外殼開孔規定 (continue)

Figure 4F – Baffle plate construction

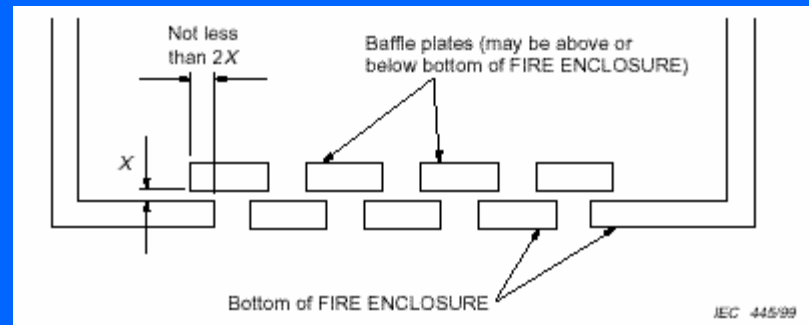


Table 4C – Size and spacing of openings in metal bottoms of fire enclosure

Applicable to circular holes			Applicable to other shaped openings	
Metal bottom minimum thickness	Maximum diameter of holes	Minimum spacing of holes centre to centre	Maximum area	Minimum spacing of openings border to border
mm	mm	mm	mm ²	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

IEC/EN 60950-1:2001 介紹

5.4 可攜式設備外殼開孔規定:

Transportable equipment的外殼開孔要求，是針對在運送過程中，防止一些細小的金屬物體，掉入設備內部，造成不符合**LPS**的導電零件短路，導致起火的危險，因此，其開孔的規定如下:

- 寬度在__**1**__mm內，長度則不限。 或者
- 以細目金屬網做屏蔽(**screen mesh**)，但網目大小不超過__**2**__mm×__**2**__mm，且織網金屬線之直徑不小於__**0.45**__mm。 或者
- 提供一_____ **內部擋牆** _____。

IEC/EN 60950-1:2001 介紹

5.4 可攜式設備外殼開孔規定: (continued)

並且，若設備的塑膠外殼或擋牆上的金屬部分，與內部功率大於 15 VA 的導電零件或電路間，距離小於 13 mm 時，則須符合下列其中之一的規定：

- 使用一細小的金屬物體，根據上述方式測試，不可掉入設備內部，即使該接觸的內部導電零件或電路之功率小於 15 VA。 或者
- 須有一 隔離物 在導電零件及外殼間。 或者
- 不正常測試模擬，短路該塑膠外殼或擋牆上的金屬部分，與內部功率大於 15 VA 的導電零件或電路。

IEC/EN 60950-1:2001 介紹

5.4 設備對於起火的防制有下述兩種方式:

1. 選擇能降低火焰外溢及燃燒的零件，線材及材料，如條款4.7.2及4.7.3的規定，一般而言，具有較多零件線材及材料的設備會選擇採用此方法。

2. 依照條款5.3.6模擬所有的失效情況，包括初次級電路的所有相關零件。

— 若設備內包含有下列零件者吾人視其為可促使火焰外溢及燃燒的零件因此該設備須要求裝有一防火外殼:

IEC/EN 60950-1:2001 介紹

5.4 設備對於起火的防制有下述兩種方式: (continued)

- a. 初級電路的零件。
- b. 次級電路的零件，且其電路的供應電源超過條款2.5的限值。
- c. 次級電路的零件，非裝在燃燒等級 V-1 的材料上，雖然其電路的供應電源符合條款2.5的限值。
- d. 絕緣線。
- e. 在具危險電壓或能量電路內，且會產生電弧，又無外殼蓋住的零件。

IEC/EN 60950-1:2001 介紹

5.4 若設備內包含有下列情況者吾人毋須要求該設備裝有一防火外殼:

1. 以PVC, TFE, PTFE, FEP, neoprene 或 polyimide 做為絕緣的線材或電纜。
2. 符合條款4.7.3.2的零件包含連接器完全填滿防火外殼的開孔。
正常 單一失效
3. 次級電路的連接器¹⁵，其電路的供應電源在_____或_____情況下被限制在_____VA以下。
4. 次級電路的連接器，其電路的供應電源符合條款2.5的限值。
5. 次級電路的其他零件^{V-1}，其電路的供應電源符合條款2.5的限值，且裝在燃燒等級_____的材料上。

IEC/EN 60950-1:2001 介紹

5.5 若設備內包含有下列情況者吾人毋須要求該設備裝有一防火外殼: (continued)

6. 電源線(power supply cord)或設備間連接線(interconnecting cable)上的插頭或連接器。

7. 馬達。

8. 次級電路的其他零件，其電路由內部或外來的供應電源，在正常 或 單一失效 情況下，其功率小於 15 VA，且裝在燃燒等級 HB 的材料上。

IEC/EN 60950-1:2001 介紹

5.6 零件，線材及材料的燃燒等級要求如下表4C所示：

Part		Requirement
防火外殼(FIRE ENCLOSURE 4.7.3.2)	MOVABLE EQUIPMENT >18Kg and stationary equipment	—5V —test A.1
		若離高熱零件的空氣間距離小於 13mm: HA1 (test A.3)
		若離高熱零件的空氣間距離小於 13mm: HW1 (test A.4)
	MOVABLE EQUIPMENT ≤18Kg	—V-1 —test A.2
		若離高熱零件的空氣間距離小於 13mm: HA1 (test A.3)
		若離高熱零件的空氣間距離小於 13mm: HW1 (test A.4)
	Parts which fill an opening	—V-1 —test A.2 —零件規章

Table 4C-Summary of material flammability requirements

IEC/EN 60950-1:2001 介紹

5.6 零件，線材及材料的燃燒等級要求: (continued)

Table 4C-Summary of material flammability requirements

機械或電氣外殼的內部零件但非為防火外殼要求者4.7.3.1及4.7.3.3	—HB —HBF —GWT550°C—IEC60695-2-1/1 對於連接器及例外情形參照4.7.3.3.
機械或電氣或防火外殼的內部零件4.7.3.4	—V-2 —HF-2 —test A.2 對於例外情形參照4.7.3.4.
空氣濾淨器(Air filter assemblies) 4.7.3.5	—V-2 —HF-2 對於例外情形參照4.7.3.5.
高壓零件(>4KV)	—V-2 —HF-2 —test of IEC60065, 14.4
HA: High Amp Ignition (also called High Current Arc Ignition). HWI: Hot Wire Ignition. GWT: Glow-Wire Test.	

IEC/EN 60950-1:2001 介紹

5.7 掛吊測試 (clause 4.2.10, wall or ceiling mounted test):

- 適用情形：所有具有掛吊結構，無論是在牆上或天花板上的設備。
- 使用設備：拉力計，或重量為 **50** N 的重物(如金屬塊)
- 測試步驟：
 1. 根據廠商所提供的裝設說明書，將設備掛吊妥當
 2. 然後將重量為至少 **50** N，或等於設備重量三倍的重物，掛吊在設備的幾何重心處，呈向下拉扯的方式；作 **一** 分鐘。
- 判定：上述測試後設備及其配件，均須維持穩固的固定掛吊狀態。

Hope : Give you a hand

● Thank you!