Safety of Measuring Equipments

EN 61010 之安規簡介 (2010 版)

Cerpass Technology Corporation

Version Note

- EN 61010-1:2010 and EN 61010-2-030:2010:
  - dop: 2011-07-01
  - dow: 2013-10-01
- EN 61010-2-033:2012
  - dop: 2013-02-09
  - dow: 2015-05-09
- EN 61010-2-032:2012
  - dop: 2013-07-31
  - dow: 2015-10-31

Version Note

- For equipment with testing and measuring circuit, -2-030 should be used.
- If -2-032 is applicable, no -2-030 is needed.
- For meters that measuring the mains circuit, -2-033 should be used.
- But for a hand-held clamp meter with V/COM terminals, both -2-033 and -2-032 are needed.

Marking 要求

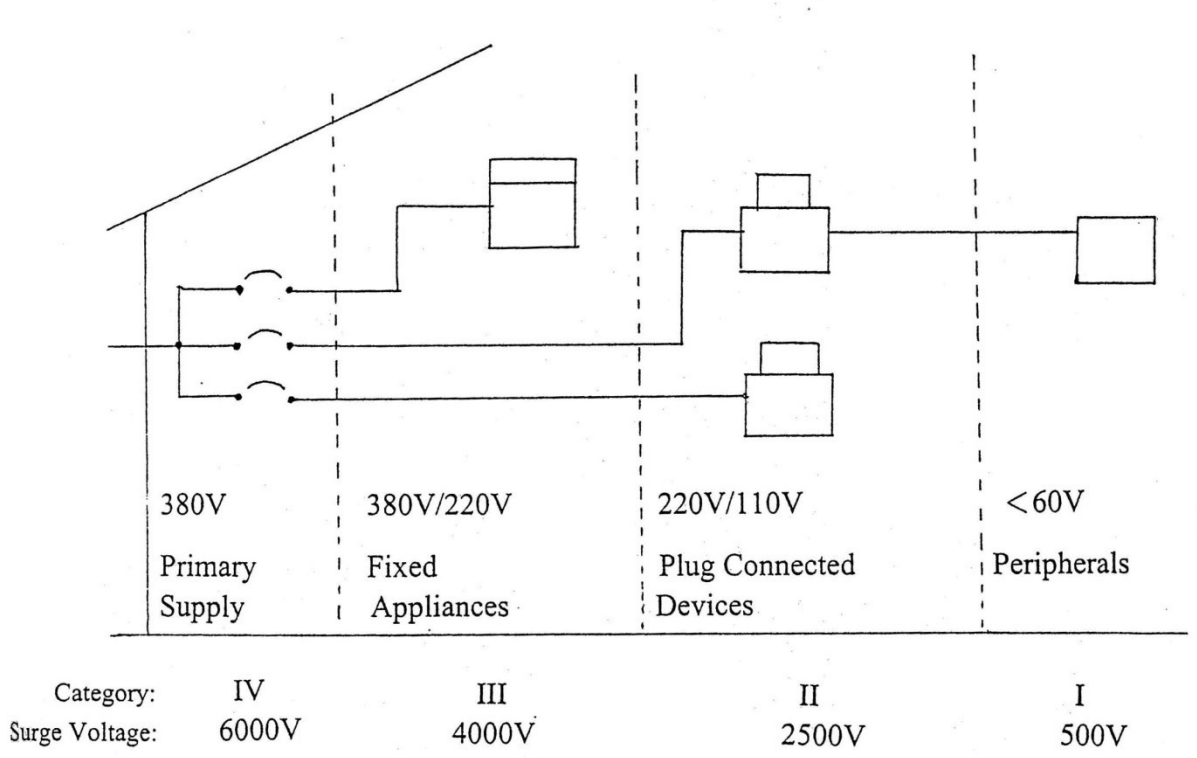
- 在產品的本體上須標示：
  - 商標
  - 型號
  - 電氣規格 (如: 100-120 / 220-240 V ~, 50/60 Hz, 100 W, 110 VA)
    - 註1: 可以只標W值、A值或VA值
    - 註2: 實測的W值、A值或VA值不能大於額定值的110%
    - 註3: 電池操作的產品不必標示W值、A值或VA值
    - 註4:若額定電壓是一個範圍，在電壓上限及下限實測到的W值若大於W中值20%，則須分開標示W值。

Marking 要求

- 量測端子須標示其CAT值、電壓值及交直流符號。
  - 註1: CAT為Measurement (Installation) Category的縮寫，請參照附圖
  - 註2: 若量測對象是限在50Vac或120Vdc以下或量測對象是不能在活電狀況下，則不必標示CAT值，亦不鼓勵
  - 註3: 對於勾表，其勾部亦須加標CAT值、電壓值及交直流符號。
- 量測端子須標示符號Symbol 14。(-2-030)
- 其他安全警語，如將所有Test Leads移除再進行保養、清潔或更換Fuse及Battery。若空間不夠，可只標Symbol 14，而另在manual 警示。

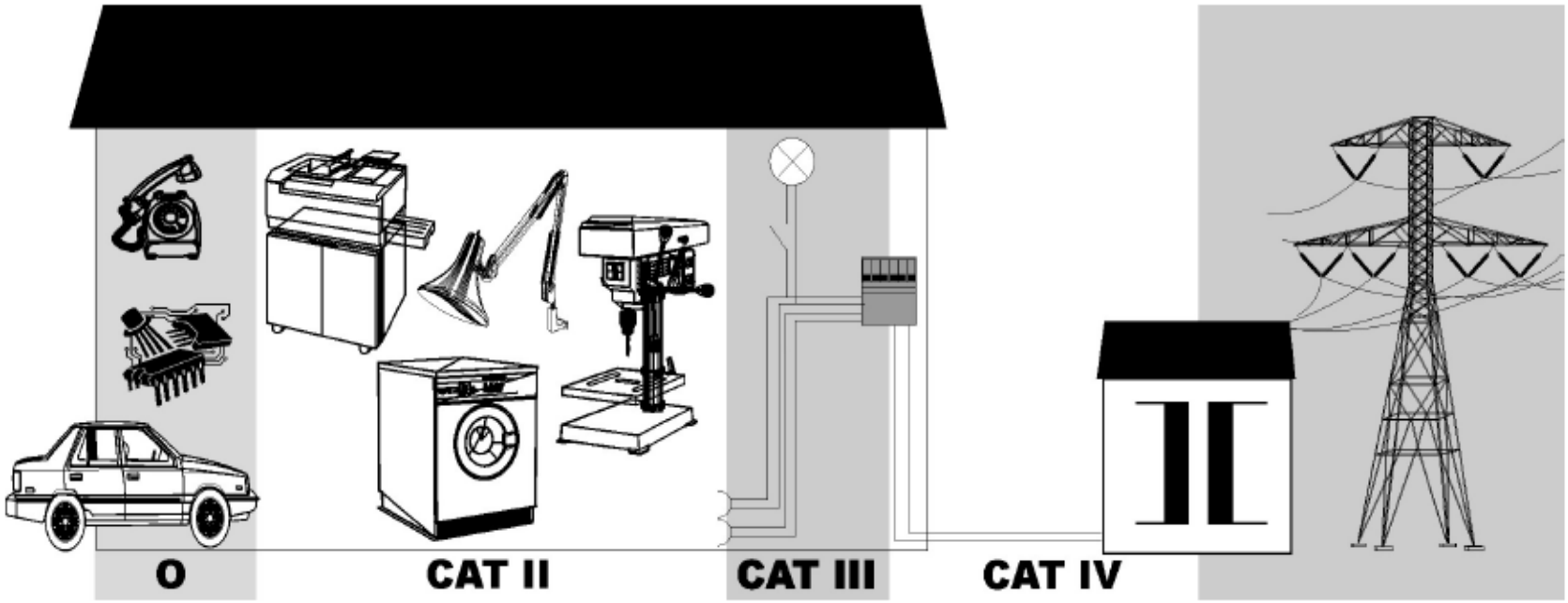
Marking 要求

- Installation Category (CAT)



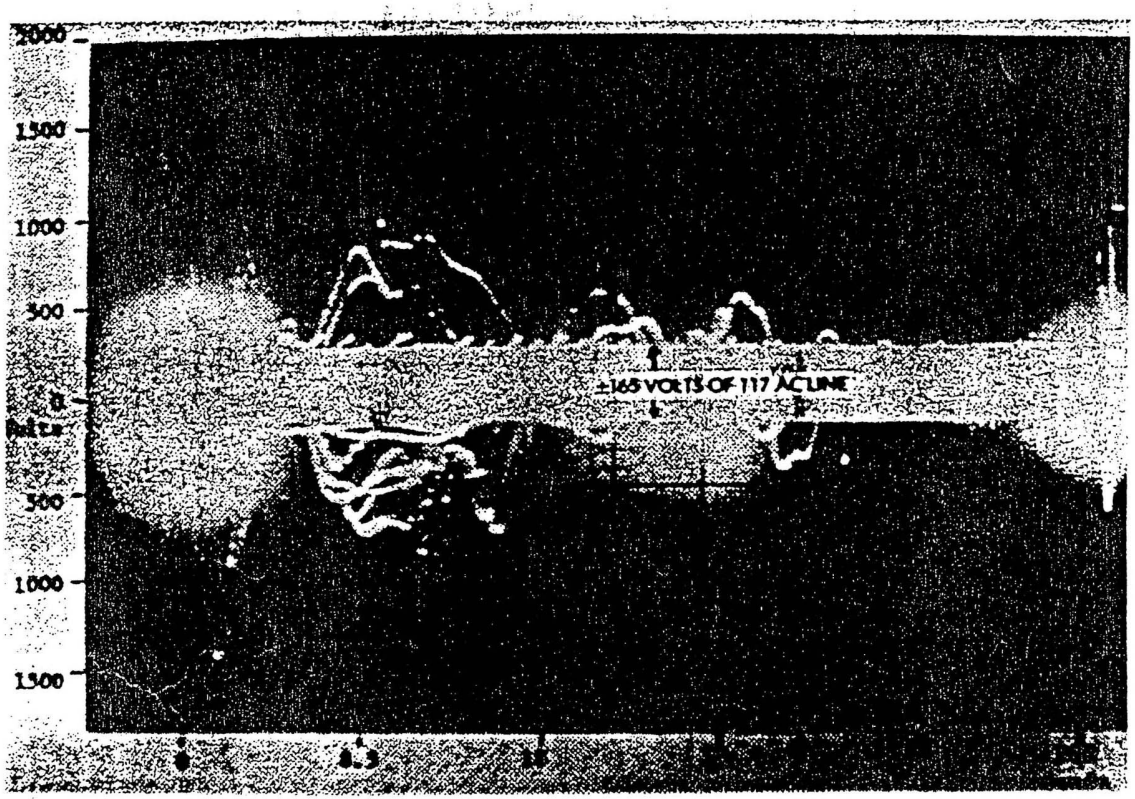
Marking 要求

- Installation Category (CAT) (-2-030)



Marking 要求

- Installation Category (CAT)



Typical surge voltages on residential power line; recordings taken over 24-hour period *(Photography courtesy F. Martzloff, General Electric Company)*

Marking 要求

- Installation Category (CAT)
  - MEASUREMENT CATEGORY I has changed. In EN 61010-2-030, it is termed “not rated for measurements within MEASUREMENT CATEGORIES II, III, or IV”. (From -2-030)

Marking 要求

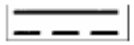
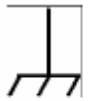
- 紅鈕只能用於急停或危險的開關 (Ed:2010)
- 適用的標示Symbol，請見附表。
  - 註1: 若有Inlet，Symbol 6可以不標
  - 註2: Symbol 7適用於示波器或耐電壓測試儀等負端可能接大地的儀器
  - 註3: 若輸出電壓大於1kVrms或1.5kVdc，則要標示Symbol 12

Marking 要求

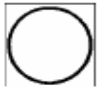
- 註4: Symbol 9及10 僅能用在電源開關，而Push-Push Switch則用Symbols 9/15 及10/16來表示
- 註5: Symbol高度須為2.75mm以上，警告文字須為1.5mm以上
- 註6: Symbol及警告文字若用刻模時，均須2mm以上；若無色差，則須凸出或凹入0.5mm以上
- 註7: 對於勾表，其勾部須加標 
- 註8:電源開關不能只以指示燈標示開關狀態
- 註9: Symbol 8, 等電位符號(Equipotentiality)已取消。(Ed.2010)

Marking Symbol

Table 1 – Symbols

Number	Symbol	Reference	Description
1		IEC 60417-5031 (2002-10)	Direct current
2		IEC 60417-5032 (2002-10)	Alternating current
3		IEC 60417-5033 (2002-10)	Both direct and alternating current
4		IEC 60417-5032-1 (2002-10)	Three-phase alternating current
5		IEC 60417-5017 (2006-08)	Earth (ground) TERMINAL
6		IEC 60417-5019 (2006-08)	PROTECTIVE CONDUCTOR TERMINAL
7		IEC 60417-5020 (2002-10)	Frame or chassis TERMINAL
8			Not used

Marking Symbol

9		IEC 60417-5007 (2009-02)	On (Power)
10		IEC 60417-5008 (2009-02)	Off (Power)
11		IEC 60417-5172 (2003-02)	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION
12			Caution, possibility of electric shock
13		IEC 60417-5041 (2002-10)	Caution, hot surface
14		ISO 7000-0434B (2004-01)	Caution [a]
15		IEC 60417-5268 (2002-10)	In position of a bi-stable push control
16		IEC 60417-5269 (2002-10)	Out position of a bi-stable push control
17		ISO 361	Ionizing radiation

Manual 要 求

- 在手冊上須標示：
  - 產品用途
  - 技術規格 (含所有輸入及輸出的規格)
  - 操作方法
  - 清潔方式
  - 耗材(如電池或保險絲等)的規格及其更換方法
  - 維修中心或銷售商的名字及地址

Manual 要求

- 安全注意事項
- 產品的環境規格，如下:
  - Indoor Use
  - Altitude: 2000 m
  - Temperature: 5℃ to 40℃
  - Humidity: Maximum 80%RH at 31℃ decreasing to 50%RH at 40℃
  - Transient overvoltage at Mains Supply: 2500V
  - Pollution Degree: 2
- Manual可只用電子方式(如光碟)提供，但安全注意事項一定要有紙本 (Ed:2010)
- 所有產品上的標示

Manual 要求

- CAT 的相關解釋 (當產品有標CAT值時)， 如：
  - CAT IV – Is for measurements performed at the source of the low-voltage installation.
  - CAT III – Is for measurements performed in the building installation.
  - CAT II – Is for measurement performed on circuits directly connected to the low voltage installation.
  - CAT I – Is for measurement performed on circuits not directly connected to mains.

Manual 要求

- 若產品只適用於CAT I 的量測，則須標示:
  - “This equipment is not for measurements performed for CAT II, III, and IV”
  - “Not to use this equipment for measurements on mains circuits.” (From -2-030)
- Symbol的解釋，如Symbol的附表。
- Manual shall indicate the CAT and V of the probe assemblies to be used for MAINS measurements. (From -2-033)

Manual 要求

- 對於勾表，須加入以下文字：
  - Individual protective equipment must be used if hazardous live parts in the installation where measurement is to be carried out could be accessible.
  - The barrier on the JAW is indicating the limit of safe access of the hand-held part, do not over the barrier when in normal use.
  - Do not use a flexible current sensor if the inner contrasting color of the insulation of the flexible cord is visible.
  - If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

外 殼 要 求

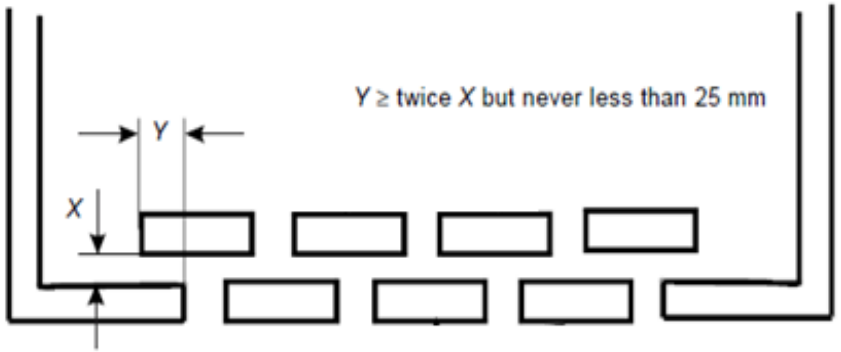
- 外殼的開孔不能使Test Finger 可以觸及活電部位。
  - 註 1: Locking Type 及 Screw-Held Type 的量測端子不在此限
  - 註 2: 須由使用者更換的耗材，其外蓋須有警語且須用工具方能打開
  - 註 3: 若某線路電壓的小於安全電壓(33Vrms、46.7Vp或70Vdc)，但和Mains circuit沒有足夠的絕緣，該線路亦視為危險線路，不得觸及。
  - 註 4:即便和 Mains circuit 有足夠的絕緣，若電壓大於33Vrms、46.7Vp 或 70Vdc，該線路亦視為危險線路，不得觸及。

外 殼 要 求

- 上蓋的開孔，其寬度不能大於4mm。
- 下蓋最好不要有開孔。
- 若下蓋要開孔，須符合以下其一:

Acceptable perforation of the bottom of an ENCLOSURE

Minimum thickness mm	Maximum diameter of holes mm	Minimum spacing of holes centre to centre mm
0,66	1,14	1,70 (233 holes/645 mm^2)
0,66	1,19	2,36
0,76	1.15	1,70
0,76	1,19	2,36
0,81	1,91	3,18 (72 holes/645 mm^2)
0,89	1,90	3,18
0,91	1,60	2,77
0,91	1,98	3,18
1,00	1,60	2,77
1,00	2,00	3,00

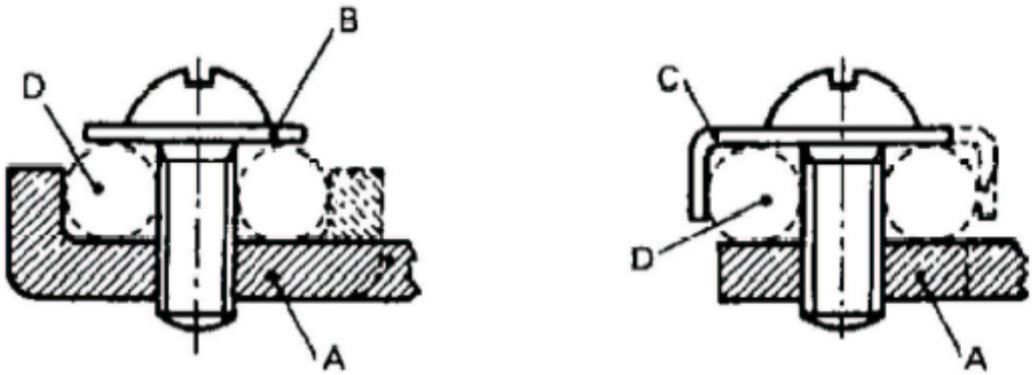


外 殼 要 求

- 桌上式產品，其外殼須承受三次5 J的撞擊(用500g的鋼球由1m高度落下)，勾部亦同。
- 手持式產品，須進行1m的落下測試。
- 塑膠外殼須為V-1等級或以上。
- 把手須能承受產品4倍的重量達1分鐘。
- 超過18kg的產品須提供把手，或在說明書內說明搬移方式。

Grounding 要求

- Green-Yellow wires should be used for all grounding and bonding.
- If the PROTECTIVE CONDUCTOR TERMINAL is a binding screw assembly, it shall be thread size no smaller than 4,0 mm, with at least three turns of the screw engaged. (Ed: 2010)



A fixed part
B washer or clamping plate
C anti-spread device
D conductor space

面板要求

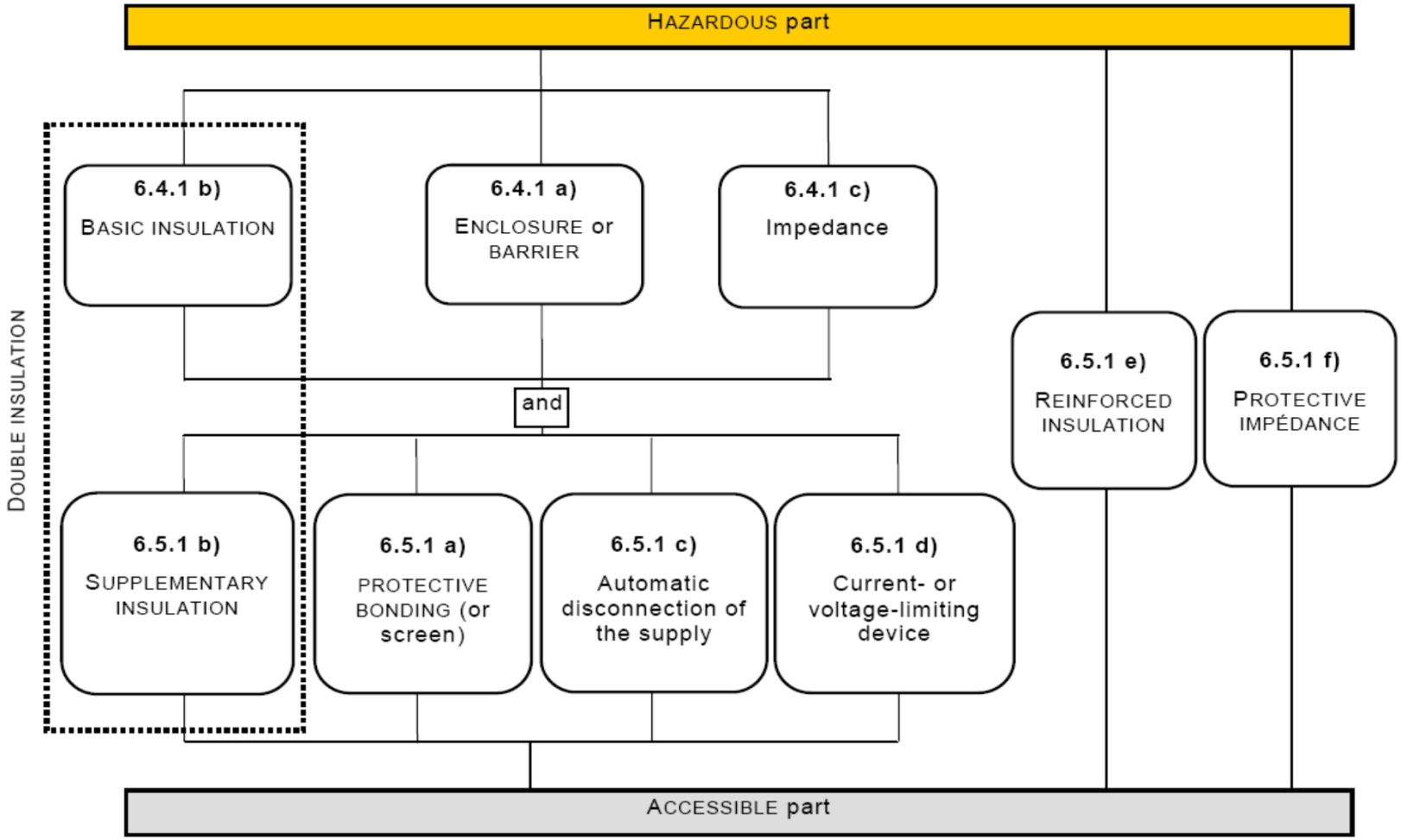
- 當量測輸入值大於量測範圍(Range)時，其Display須有Over-range 的顯示。

- 當功能選擇鈕錯誤操作時，不能導致危險。

絕 緣 要 求

- 基本絕緣 (Basic Insulation)、補充絕緣(Supplementary Insulation) 和 雙重/強化絕緣 (Double/Reinforced Insulation) 的概念。
- 基本絕緣+補充絕緣=雙重絕緣
- 強化絕緣=雙重絕緣
- Class I、 II、 III 的概念。
- Mains Circuit、Signal Circuit 及 Measuring Circuit 之間的絕緣要求。
- 空間距離(Clearance)和沿面距離(Creepage Distance)的概念。

絕緣要求



- From Ed. 2010

電源線路之距離

TABLE 4 – CLEARANCES and CREEPAGE DISTANCES for MAINS CIRCUITS of OVERVOLTAGE CATEGORY II up to 300 V

Voltage line-to-neutral a.c. r.m.s. or d.c.	Values for CLEARANCE	Values for CREEPAGE DISTANCE								
		Printed wiring board material		Other insulating material						
		POLLUTION DEGREE 1	POLLUTION DEGREE 2	POLLUTION DEGREE 1	POLLUTION DEGREE 2			POLLUTION DEGREE 3		
		All material groups	Material groups I, II, IIIa	All material groups	Material group I	Material group II	Material group III	Material group I	Material group II	Material group III
V	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
≤150	0,5	0,5	0,5	0,5	0,8	1,1	1,6	2,0	2,2	2,5
>150 ≤ 300	1,5	1,5	1,5	1,5	1,5	2,1	3,0	3,8	4,1	4,7

- Ed: 2010

電源線路之距離

- Material Group 和 UL 的CTI比對如下:

Material Group	I	II	IIIa	IIIb
CTI	0	1	2-3	4

Plastics - Component

See General Information for Plastics - Component

CHI MEI CORPORATION E56070

59-1 SAN CHIA

									H	D	
		Min.		H	H	R T I			V	4	C
		Thk	Flame	W	A	Elec	Mech		T	9	T
Material Dsg	Color	mm	Class	I	I		Imp	Str	R	5	I
PA-765B(+)	ALL	1.5	V-2	4	0	80	65	80	2	7	0
		2.1	V-2	2	0	80	65	80			
		2.5	V-0, 5VB	2	0	80	65	80			
		3.0	V-0, 5VA	2	0	80	75	80			

電源線路之距離

Component - Plastics E56070

CHI MEI CORPORATION

59-1 SAN CHIA, JEN TE, TAINAN HSIEN 717 TW

PA-765B(+)

Acrylonitrile Butadiene Styrene (ABS), "Polylac", furnished as pellets

Color	Min Thk (mm)	Flame Class	HWI	HAI	RTI Elec	RTI Imp	RTI Str
ALL	1.5	V-2	4	0	80	65	80
	2.1	V-2	2	0	80	65	80
	2.5	V-0, 5VB	2	0	80	65	80
	3.0	V-0, 5VA	2	0	80	75	80

Comparative Tracking Index (CTI): 0

Inclined Plane Tracking (IPT): -

Dielectric Strength (kV/mm): -

Volume Resistivity (10^x ohm-cm) : -

High-Voltage Arc Tracking Rate (HVTR): 2

High Volt, Low Current Arc Resis (D495): 7

Dimensional Stability (%): -

Secondary 線路之距離(沿面)

Table 7 – CREEPAGE DISTANCES for secondary circuits

Secondary WORKING VOLTAGE a.c. r.m.s. or d.c.	Printed wiring board material		Other insulating material						
	POLLUTION DEGREE 1	POLLUTION DEGREE 2	POLLUTION DEGREE 1	POLLUTION DEGREE 2			POLLUTION DEGREE 3		
	All material groups	Material groups I, II or IIIa	All material groups	Material group I	Material group II	Material group III	Material group I	Material group II	Material group III[b]
V	mm	mm	mm	mm	mm	mm	mm	mm	mm
250	0,56	1,0	0,56	1,25	1,8	2,5	3,2	3,6	4,0
320	0,75	1,6	0,75	1,60	2,2	3,2	4,0	4,5	5,0
400	1,0	2,0	1,0	2,0	2,8	4,0	5,0	5,6	6,3
500	1,3	2,5	1,3	2,5	3,6	5,0	6,3	7,1	8,0
630	1,8	3,2	1,8	3,2	4,5	6,3	8,0	9,0	10,0
800	2,4	4,0	2,4	4,0	5,6	8,0	10,0	11	12,5
1 000	3,2 [a]	5,0 [a]	3,2	5,0	7,1	10,0	12,5	14	16
1 250			4,2	6,3	9,0	12,5	16	18	20
1 600			5,6	8,0	11	16	20	22	25
2 000			7,5	10,0	14	20	25	28	32
2 500			10,0	12,5	18	25	32	36	40
3 200			12,5	16	22	32	40	45	50
4 000			16	20	28	40	50	56	63
5 000			20	25	36	50	63	71	80
6 300			25	32	45	63	80	90	100
8 000			32	40	56	80	100	110	125
10 000			40	50	71	100	125	140	160

- Ed: 2010

Secondary 線 路 之 距 離(空間)

Table 6 – CLEARANCES and test voltages for secondary circuits derived from MAINS CIRCUITS of OVERVOLTAGE CATEGORY II up to 300 V

Secondary WORKING VOLTAGE		MAINS voltage, line-to-neutral, OVERVOLTAGE CATEGORY II			
		≤ 150 V a.c. r.m.s.		> 150 V ≤ 300 V a.c. r.m.s.	
a.c. r.m.s. V	d.c. or a.c. peak V	CLEARANCE mm	Test voltage V a.c. r.m.s.	CLEARANCE mm	Test voltage V a.c. r.m.s.
16	22,6	0,10	500	0,50	840
33	46,7	0,11	510	0,52	850
50	70	0,12	520	0,53	860
100	140	0,13	540	0,61	900
150	210	0,16	580	0,69	940
300	420	0,39	770	0,94	1 040
600	840	1,01	1 070	1,61	1 450
1 000	1 400	1,92	1 630	2,52	1 970
1 250	1 750	2,50	1 960	3,16	2 280
1 600	2 240	3,39	2 390	4,11	2 730
2 000	2 800	4,49	2 890	5,30	3 230
2 500	3 500	6,02	3 520	6,91	3 850
3 200	4 480	8,37	4 390	9,16	4 660
4 000	5 600	10,9	5 320	11,6	5 610
5 000	7 000	14,0	6 590	14,9	6 960
6 300	8 820	18,2	8 270	19,1	8 620
8 000	11 200	23,9	10 400	24,7	10 700
10 000	14 000	30,7	12 900	31,6	13 300

- Ed: 2010

量測 Terminals之距離

- Spacing for terminals:
  - Unmated position and test by test finger (-2-030 and -2-032)

Voltage on conductive parts of TERMINAL		CLEARANCE and CREEPAGE DISTANCE
V a.c. r.m.s.	V d.c.	mm
≥33 ≤ 300	≥70 ≤ 414	0,8
>300 ≤ 600	>414 ≤ 848	1,0
>600 ≤ 1 000	>848 ≤ 1 414	2,6
NOTE Values are determined by calculation for REINFORCED INSULATION. Transients are not taken into account.		

量測 Terminals之距離

- Spacing for terminals:
  - Components, sensors, and devices intended to be connected to specialized measuring circuit TERMINALS shall not be ACCESSIBLE. Examples of specialized TERMINALS are semiconductor measuring terminal, capacitance measurements terminal, or thermocouple sockets. (From -2-033)

量測線路之沿面距離

Secondary WORKING VOLTAGE a.c. r.m.s. or d.c.	Printed wiring board material		Other insulating material						
	POLLUTION DEGREE 1	POLLUTION DEGREE 2	POLLUTION DEGREE 1	POLLUTION DEGREE 2			POLLUTION DEGREE 3		
	All material groups	Material group I, II or IIIa	All material groups	Material group I	Material group II	Material group III	Material group I	Material group II	Material group III [b]
V	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	0,025	0,04	0,08	0,40	0,40	0,40	1,00	1,00	1,00
12,5	0,025	0,04	0,09	0,42	0,42	0,42	1,05	1,05	1,05
16	0,025	0,04	0,10	0,45	0,45	0,45	1,10	1,10	1,10
20	0,025	0,04	0,11	0,48	0,48	0,48	1,20	1,20	1,20
25	0,025	0,04	0,125	0,50	0,50	0,50	1,25	1,25	1,25
32	0,025	0,04	0,14	0,53	0,53	0,53	1,3	1,3	1,3
40	0,025	0,04	0,16	0,56	0,80	1,10	1,4	1,6	1,8
50	0,025	0,04	0,18	0,60	0,85	1,20	1,5	1,7	1,9
63	0,040	0,063	0,20	0,63	0,90	1,25	1,6	1,8	2,0
80	0,063	0,10	0,22	0,67	0,95	1,3	1,7	1,9	2,1
100	0,10	0,16	0,25	0,71	1,00	1,4	1,8	2,0	2,2
125	0,16	0,25	0,28	0,75	1,05	1,5	1,9	2,1	2,4
160	0,25	0,40	0,32	0,80	1,1	1,6	2,0	2,2	2,5
200	0,40	0,63	0,42	1,00	1,4	2,0	2,5	2,8	3,2
250	0,56	1,0	0,56	1,25	1,8	2,5	3,2	3,6	4,0
320	0,75	1,6	0,75	1,60	2,2	3,2	4,0	4,5	5,0
400	1,0	2,0	1,0	2,0	2,8	4,0	5,0	5,6	6,3
500	1,3	2,5	1,3	2,5	3,6	5,0	6,3	7,1	8,0
630	1,8	3,2	1,8	3,2	4,5	6,3	8,0	9,0	10,0
800	2,4	4,0	2,4	4,0	5,6	8,0	10,0	11	12,5
1 000	3,2 [a]	5,0 [a]	3,2	5,0	7,1	10,0	12,5	14	16
1 250			4,2	6,3	9,0	12,5	16	18	20

註1: 此表僅為Basic Insulation, 而Double Insulation則將表值乘2倍。

註 2: 沿面距離不得小於空間距離。

註 3:此表等同 Creepage for Secondary circuit(Table 7)

量測線路之空間距離

- For CAT II, III and IV Measuring Circuits

Table 8 – CLEARANCES for measurement categories II, III and IV

Nominal a.c. or d.c. line-to-neutral voltage of MAINS supply	BASIC INSULATION or SUPPLEMENTARY INSULATION			DOUBLE INSULATION or REINFORCED INSULATION		
	Measurement category			Measurement category		
	II	III	IV	II	III	IV
V	mm	mm	mm	mm	mm	mm
≤50	0,04	0,1	0,5	0,1	0,3	1,5
>50 ≤100	0,1	0,5	1,5	0,3	1,5	3,0
>100 ≤150	0,5	1,5	3,0	1,5	3,0	6,0
>150 ≤300	1,5	3,0	5,5	3,0	5,9	10,5
>300 ≤600	3,0	5,5	8	5,9	10,5	14,3
>600 ≤1 000	5,5	8	14	10,5	14,3	24,3

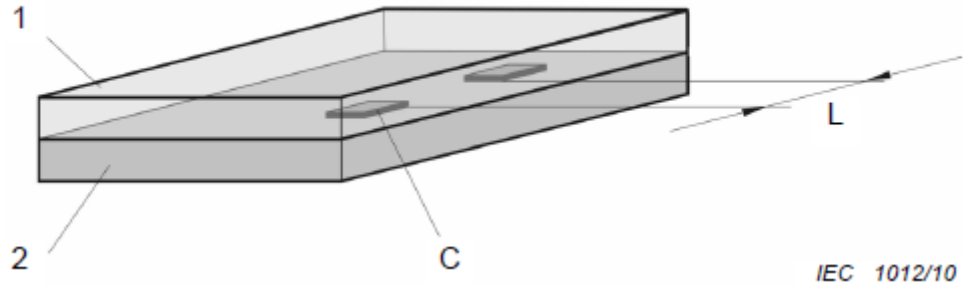
量測線路之空間距離

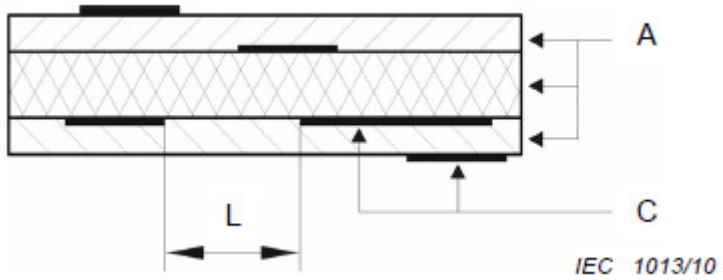
- For CAT I Measuring Circuit

Table K.15 – CLEARANCE values for the calculation of K.3.2

Maximum voltage U_m	CLEARANCE D_1	Maximum voltage U_m	CLEARANCE D_1
V	mm	V	mm
14,1 to 266	0,010	4 000	2,93
283	0,010	4 530	3,53
330	0,010	5 660	4,92
354	0,013	6 000	5,37
453	0,027	7 070	6,86
500	0,036	8 000	8,25
566	0,052	8 910	9,69
707	0,081	11 300	12,9
800	0,099	14 100	16,7
891	0,12	17 700	21,8
1 130	0,19	22 600	29,0
1 410	0,38	28 300	37,8
1 500	0,45	35 400	49,1
1 770	0,75	45 300	65,5
2 260	1,25	56 600	85,0
2 500	1,45	70 700	110
2 830	1,74	89 100	145
3 540	2,44	100 000	165
Linear interpolation is allowed.			

Solid Insulation Requirement



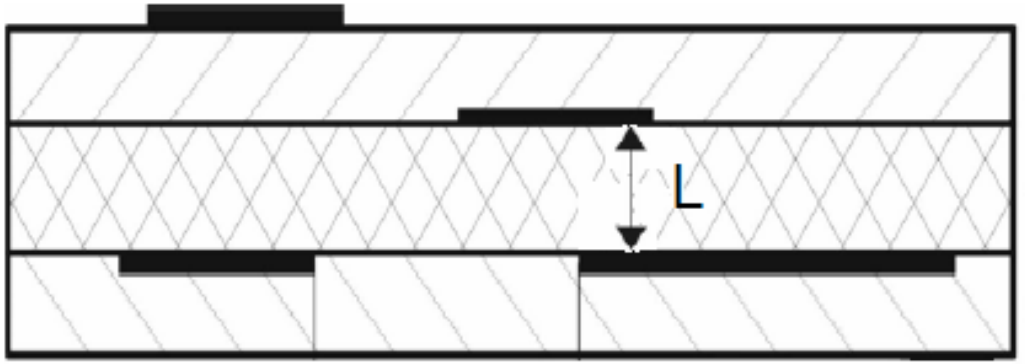


L is 0.4mm min. (for B/I, S/I and R/I)

(for both potted parts or multi-layer PCB)

From Ed:2010

Solid Insulation Requirement

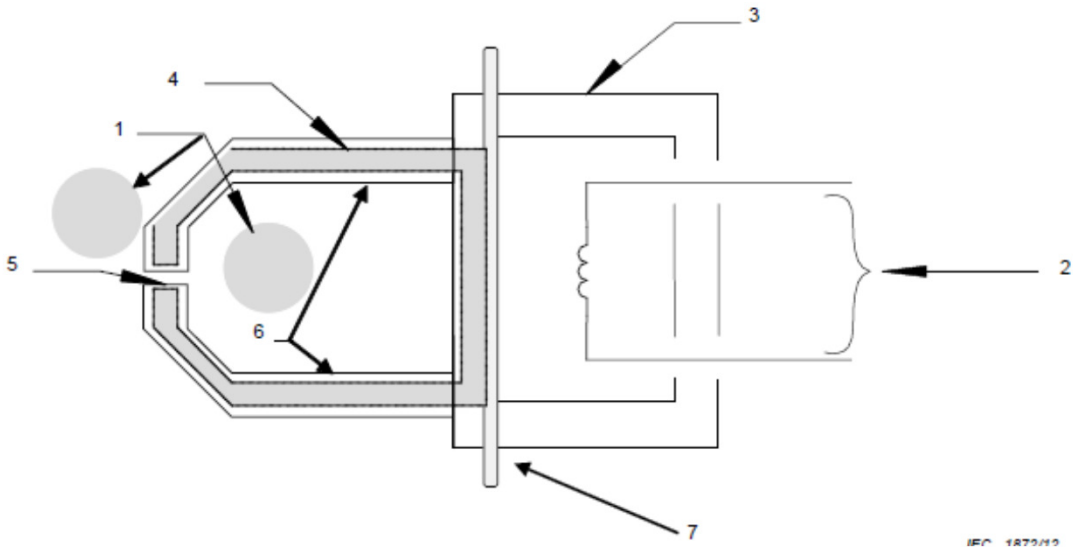


L is 0.4mm min. if only single layer is used for R/I.

If two layers are used for R/I, no thickness requirement.

From Ed:2010

Clamp Meter Insulation Requirement



Current sensor	Insulation between							
	1 and 2	1 and 3	1 and 4 [a]	2 and 3 [b]	2 and 5	2 and 6 [b]	3 and 5	4 and 6
Type A	D	D	B	D	D	D	D	B
Type B	D	-	B	D	D	D	-	B
Type C	D	-	B	D	-	D	-	B
Type D	NA	NA	NA	D	B	D	-	-

Over current Protection

- Fuse or other OCP should be located at Line side of three phase equipment.
- Fuse should be provided in portable appliances.
- If certified OCP is used as the protective device for the measuring terminal, only hipot test (2xUn) is required. (-2-030) (*Also apply to the traces under the fuse*)
- If uncertified OCP is used as the protective device for the measuring terminal, reinforced insulation between its terminals is required. (-2-030)

Over current Protection

- The a.c. and d.c. RATED voltages of the OCP device shall be at least as high as, respectively, the highest a.c. and d.c. RATED voltages of any measuring TERMINAL on the equipment. (-2-030)

- The a.c. and d.c. rated breaking capacities of the OCP need not exceed the table below:

MEASUREMENT CATEGORY	Short-circuit current (typical) kA
II	10
III	50
IV	50

Other Requirement

- The power cord for portable equipment should be less than 3m long.
- For measuring circuits that include one or more FUNCTIONAL EARTH TERMINALS, a HAZARD may result if the equipment is operated with a disconnected PE terminal and if the operator unintentionally connects a FUNCTIONAL EARTH TERMINAL to any RATED voltage for any other TERMINAL. (-2-030)

Other Requirement

- Oscilloscopes and spectrum analyzers are examples of equipment that often include FUNCTIONAL EARTH TERMINALS in the measuring circuit. In many cases, the OPERATOR will disconnect the PROTECTIVE CONDUCTOR TERMINAL so that the FUNCTIONAL EARTH TERMINAL can float above earth potential. This allows the OPERATOR to make a floating measurement, but introduces a HAZARD. If the OPERATOR should inadvertently connect the FUNCTIONAL EARTH TERMINAL to a HAZARDOUS LIVE voltage, then the chassis of the measuring equipment may also be connected to the HAZARDOUS LIVE voltage, and the OPERATOR or a bystander could receive an electric shock from the chassis. (-2-030)

Other Requirement

- MAINS voltage measurement shall be rated > 300 V a.c. r.m.s. to earth, and minimum CAT III.

  (From -2-033)

  (we accept to mark with CAT III 300V and CAT II 600V at the same time)

- The output leads of current clamp should be Reinforced insulated and having the CAT and V not less than the ratings of the current clamp, or CAT II/300V, whichever is higher. (From -2-032)

耐壓測試

- Correction factor to test site altitude

Table 10 – Correction factors according to test site altitude for test voltages for CLEARANCES

	Correction factors			
Test voltage peak	≥327 V < 600 V	≥600 V < 3 500 V	≥3 500 V < 25 kV	≥25 kV
Test voltage r.m.s.	≥231 V < 424 V	≥424 V < 2 475 V	≥2 475 V < 17,7 kV	≥17,7 kV
Test site altitude m				
0	1,08	1,16	1,22	1,24
500	1,06	1,12	1,16	1,17
1 000	1,04	1,08	1,11	1,12
2 000	1,00	1,00	1,00	1,00
3 000	0,96	0,92	0,89	0,88
4 000	0,92	0,85	0,80	0,79
5 000	0,88	0,78	0,71	0,70
Linear interpolation is allowed.				

耐壓測試

- For Mains (Primary) circuit, test with:
- AC voltage test for 60s for AC mains circuit (Ed:2010)
- DC voltage test for 60s for DC mains circuit (Ed:2010)

耐壓測試

Table 5 – Test voltages for solid insulation in MAINS CIRCUITS of OVERVOLTAGE CATEGORY II up to 300 V

Voltage line-to-neutral a.c. r.m.s. or d.c.	1 min a.c. test voltage		1 min d.c. test voltage	
	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION
V	V	V	V	V
≤ 150	1 350	2 700	1 900	3 800
>150 ≤ 300	1 500	3 000	2 100	4 200

From Ed:2010

耐壓測試

- For secondary circuit, test with:
  - AC voltage for 5s, or
  - DC voltage for 60s
  - Times 1.6 for DI/RI

From Ed:2010

耐壓測試

Table 6 – CLEARANCES and test voltages for secondary circuits derived from MAINS CIRCUITS of OVERVOLTAGE CATEGORY II up to 300 V

Secondary WORKING VOLTAGE		MAINS voltage, line-to-neutral, OVERVOLTAGE CATEGORY II			
		≤ 150 V a.c. r.m.s.		> 150 V ≤ 300 V a.c. r.m.s.	
a.c. r.m.s. V	d.c. or a.c. peak V	CLEARANCE mm	Test voltage V a.c. r.m.s.	CLEARANCE mm	Test voltage V a.c. r.m.s.
16	22,6	0,10	500	0,50	840
33	46,7	0,11	510	0,52	850
50	70	0,12	520	0,53	860
100	140	0,13	540	0,61	900
150	210	0,16	580	0,69	940
300	420	0,39	770	0,94	1 040
600	840	1,01	1 070	1,61	1 450
1 000	1 400	1,92	1 630	2,52	1 970
1 250	1 750	2,50	1 960	3,16	2 280
1 600	2 240	3,39	2 390	4,11	2 730
2 000	2 800	4,49	2 890	5,30	3 230
2 500	3 500	6,02	3 520	6,91	3 850
3 200	4 480	8,37	4 390	9,16	4 660
4 000	5 600	10,9	5 320	11,6	5 610
5 000	7 000	14,0	6 590	14,9	6 960
6 300	8 820	18,2	8 270	19,1	8 620
8 000	11 200	23,9	10 400	24,7	10 700
10 000	14 000	30,7	12 900	31,6	13 300

耐壓測試

- For CAT I Measuring Circuit
  - Test for 5s.
  - Clearance based on Table K.15
  - D/I = 2 x B/I (in mm)
  - Min. 0.2mm for Pollution Degree 2
  - Min. 0.8mm for Pollution Degree 3

Table K.16 – Test voltages based on CLEARANCES

Required CLEARANCE	Test voltage	
	Impulse 1,2/50 µs	a.c. r.m.s. 50/60 Hz
mm	V peak	V r.m.s.
0,010	330	230
0,025	440	310
0,040	520	370
0,063	600	420
0,1	810	500
0,2	1 150	620
0,3	1 310	710
0,5	1 550	840
1,0	1 950	1 060
1,5	2 560	1 390
2,0	3 090	1 680
2,5	3 600	1 960
3,0	4 070	2 210
4,0	4 930	2 680
4,5	5 330	2 900
5,0	5 720	3 110
6,0	6 460	3 510
8,0	7 840	4 260
10,0	9 100	4 950
12,0	10 600	5 780
15,0	12 900	7 000

耐壓測試

- For CAT II, III and IV Measuring Circuit (-2-030)

Nominal voltage line-to-neutral a.c. r.m.s. or d.c. of MAINS being measured V	Test voltage 5 s a.c. test					
	CAT II V a.c. r.m.s.		CAT III V a.c. r.m.s.		CAT IV V a.c. r.m.s.	
	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION
≤150	1 350	2 700	1 390	2 210	2 210	3 510
>150 ≤ 300	1 500	3 000	2 210	3 510	3 310	5 400
>300 ≤ 600	2 210	3 510	3 310	5 400	4 260	7 400
>600 ≤ 1 000	3 310	5 400	4 260	7 400	6 600	11 940

Grounding Test

- Test with twice the rated current but not less than 25A.
- Test for 1 minute.
- Max. 0.2 Ω for equipment has a non-detachable power cord. (Ed: 2010)
- Max. 0.1 Ω for other equipment.
- For permanently connected equipment, test with twice the rated current of protective device and the limit is 10V.

溫 昇 測 試

- 以額定電壓之90%及110%為輸入，在滿載條件下，測至溫度穩定為止

- 溫度限制為(以室溫40°C或更高的額定室溫為基準):

  - 線繞: 105°C(Class A) / 130°C(Class B) / 120°C(Class E)

溫 昇 測 試

Table 19 – Surface temperature limits in NORMAL CONDITION

Part	Limit °C
1 Outer surface of ENCLOSURE (unintentional contact)	
a) metal, uncoated or anodized	65
b) metal, coated (paint, non metallic)	80
c) plastics	85
d) glass and ceramics	80
e) small areas (<2 cm^2) that are not likely to be touched in NORMAL USE	100
2 Knobs and handles (NORMAL USE contact)	
a) metal	55
b) plastics	70
c) glass and ceramics	65
d) non-metallic parts that in NORMAL USE are held only for short periods (1 s – 4 s)	70

From Ed:2010

Abnormal Test

- Block opening if filter is provided.
- Lock fan or motor.
- Continuous operating for short time equipment
- Single component fault
- Short output

Abnormal Test

- Abnormal (Over) Input voltages (61010-2-033):
  - < 600 V a.c. r.m.s., multiplied by 1.90 but < 920 V a.c. r.m.s.;
  - 600 to 1, 000 V a.c. r.m.s., the voltage applied is 1 ,100 V a.c. r.m.s.;
  - > 1 ,000 V a.c. r.m.s., multiplied by 1.1;
  - for d.c. voltage, multiplied by 1.1
  - METER shall continue to be able to indicate the presence of HAZARDOUS LIVE voltages.

Impulse Test

- Modified at Ed:2010 and -2-030.
- Test at measuring terminals with voltage limiting devices
- Also test at each pair of MAINS supply TERMINALS of the equipment where voltage limiting devices are present.
- 5 positive and 5 negative impulses, spaced up to 1 min apart
- Open-circuit voltage of 1,2/50 µs, a short-circuit current of 8/20 µs.
- The output impedance is 12 Ω for CAT II and 2 Ω for CAT III to IV.

Impulse Test

- If a rupture occurs, no part of the component shall bridge safety-relevant insulation.
- If the component overheats, it shall not heat other materials to their self-ignition points.
- Tripping the circuit breaker of the MAINS supply is an indication of failure.
- EMC : L-N: 1kV (2Ω)
  L-G: 2kV(12Ω)
  N-G: 2kV(12Ω)

For mains terminals

Line-to-neutral MAINS voltage V r.m.s. or d.c.	Impulse withstand voltage V
≤50	500
>50 ≤ 100	800
>100 ≤ 150	1 500
>150 ≤ 300	2 500
>300 ≤ 600	4 000
>600 ≤ 1 000	6 000

Impulse Test

For measuring terminals:

Nominal a.c. or d.c. line-to-neutral voltage of MAINS being measured V	Impulse withstand voltage V		
	MEASUREMENT CATEGORY II	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV
≤50	500	800	1 500
>50 ≤ 100	800	1 500	2 500
>100 ≤ 150	1 500	2 500	4 000
>150 ≤ 300	2 500	4 000	6 000
>300 ≤ 600	4 000	6 000	8 000
>600 ≤ 1 000	6 000	8 000	12 000

Discharge Test

- If plug pins of cord-connected equipment receive a charge from an internal capacitor, the pins shall not be HAZARDOUS LIVE 5 s after disconnection of the supply.

Indirect Bonding Test

- If varistor is connected between live part and PE, test by shorting the varistor while the equipment is connected to the MAINS supply as in NORMAL USE.
- The voltage between the ACCESSIBLE conductive parts and the PE terminal shall not exceed the relevant levels below for more than 0,2 s:
  - 55 V r.m.s.,
  - 78 V peak
  - 140 Vd.c.

Impact Test

- Not for hand-held or direct plug-in equipment
- Test with 5J (500g steel ball drop from 1m high)
- Unless higher IK code (IEC 62262) is marked (Ed:2010)
  - IK08: 5J
  - IK09: 10J
  - IK10: 20J

Drop Test

- For hand-held or direct plug-in equipment
- Drop once through a distance of 1 m onto a 50 mm thick hardwood board.

外 殼 耐 溫 測 試

- The equipment not energized, is stored for 7 h at 70 ˚C ± 2 ˚C, or at 10 ˚C ± 2 ˚C above the temperature measured during the normal heating test, whichever is higher
- The Insulating material of JAWS surrounding a magnetic material shall complied with ball pressure test of at least 105 ˚C . (from -2-032)

勾 部 測 試

- 磨沙測試(Pre-treatment)
  - 沙紙規格: 50mm x 450mm, 2mm thick, 120grit(雙面)
  - 測來回15遍，行程200mm，用勾部本身的夾力

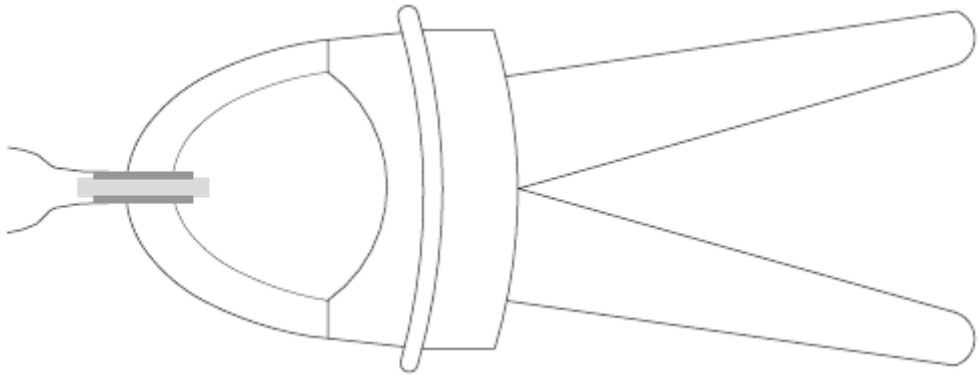
- 勾部閉合時，Jaw End不能被觸及且須符合 Basic Insulation 的耐壓測試。

勾 部 測 試

- 勾部張開時，須符合耐壓測試:

Table 105 – Thickness of the test probe of Figure 106 and test voltages

Rated a.c. r.m.s. or d.c voltage of the jaws V	Thickness X of the test probe [a] mm	Test voltage [b]	
		1 min a.c. test V r.m.s.	1 min d.c. test V d.c.
≤ 150	6	350	450
> 150 ≤ 300	10	650	900
> 300 ≤ 600	15	1 300	1 850
> 600 ≤ 1 000	25	2 200	3 100



……. thanks !