This test need not be made on auxiliary circuits:

- which are protected by a short-circuit protective device with a rating not exceeding 16 A;
- if an electrical function test has been made previously at the rated operational voltage for which the auxiliary circuits are designed.

As an alternative for ASSEMBLIES with incoming protection rated up to 250 A the verification of insulation resistance may be by measurement using an insulation measuring device at a voltage of at least 500 V d.c.

In this case, the test is satisfactory if the insulation resistance between circuits and exposed conductive parts is at least 1 000 Ω/V per circuit referred to the supply voltage to earth of these circuits.

有下列情況時，本試驗不需在輔助電路上進行。

— 該輔助電路係受定額不超過 16 A 之短路保護性電路所保護。

— 若先前已在輔助電路所設計之額定操作電壓下進行電氣功能試驗。

作為內向保護額定在 250 A 以下之組裝品的替代方案，可在至少 500 V 直流電壓下使用絕緣量測裝置查證絕緣電阻。

在此情況中，若電路與暴露性導電性零件之間的絕緣電阻，依供應電壓至電路接地之電路至少為 1.000Ω/V 時，則試驗符合要求。

11.10 Wiring, operational performance and function

It shall be verified that the information and markings specified in Clause 6 are complete.

Depending on the complexity of the ASSEMBLY, it may be necessary to inspect the wiring and to carry out an electrical function test. The test procedure and the number of tests depend on whether or not the ASSEMBLY includes complicated interlocks, sequence control facilities, etc.

NOTE In some cases, it may be necessary to make or repeat this test on site before putting the installation into operation.

11.10 配線、操作性能及功能

應查證第 6 節所規定之資訊及標示為完整的。

依組裝品之複雜性而定，可能有必要檢驗配線，並進行電氣功能試驗。試驗程序及試驗次數取決於組裝品是否包括複雜之互鎖、順序控制設施(sequence control facility)等。

備考：在某些情況中，在安裝之設備投入操作之前，可能有必要在現場進行本試驗或重複進行本試驗。

Table 1 – Minimum clearances in air [a] (8.3.2)

Rated impulse withstand voltage U_{imp} kV	Minimum clearance mm
≤ 2,5	1,5
4,0	3,0
6,0	5,5
8,0	8,0
12,0	14,0

[a] Based on inhomogeneous field conditions and pollution degree 3.

表 1　空氣中之最小空間距離[a] (8.3.2)

額定衝擊耐電壓 U_{imp} kV	最小空間距離 mm
≤2.5	1.5
4.0	3.0
6.0	5.5
8.0	8.0
12.0	14.0
註[a]　依據非均勻電場條件及污染等級 3。	

Table 2 – Minimum creepage distances (8.3.3)

Rated insulation voltage U_i	Minimum creepage distance mm							
	Pollution degree							
	1	2			3			
	Material group[c]	Material group[c]			Material group[c]			
V[b]	All material groups	I	II	IIIa and IIIb	I	II	IIIa	IIIb
32	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
40	1,5	1,5	1,5	1,5	1,5	1,6	1,8	1,8
50	1,5	1,5	1,5	1,5	1,5	1,7	1,9	1,9
63	1,5	1,5	1,5	1,5	1,6	1,8	2	2
80	1,5	1,5	1,5	1,5	1,7	1,9	2,1	2,1
100	1,5	1,5	1,5	1,5	1,8	2	2,2	2,2
125	1,5	1,5	1,5	1,5	1,9	2,1	2,4	2,4
160	1,5	1,5	1,5	1,6	2	2,2	2,5	2,5
200	1,5	1,5	1,5	2	2,5	2,8	3,2	3,2
250	1,5	1,5	1,8	2,5	3,2	3,6	4	4
320	1,5	1,6	2,2	3,2	4	4,5	5	5
400	1,5	2	2,8	4	5	5,6	6,3	6,3
500	1,5	2,5	3,6	5	6,3	7,1	8,0	8,0
630	1,8	3,2	4,5	6,3	8	9	10	10
800	2,4	4	5,6	8	10	11	12,5	a
1 000	3,2	5	7,1	10	12,5	14	16	
1 250	4,2	6,3	9	12,5	16	18	20	
1 600	5,6	8	11	16	20	22	25	

NOTE 1 The CTI values refer to the values obtained in accordance with IEC 60112:2003, method A, for the insulating material used.

NOTE 2 Values taken from IEC 60664-1, but maintaining a minimum value of 1,5 mm.

a Insulation of material group IIIb is not recommended for use in pollution degree 3 above 630 V.

b As an exception, for rated insulation voltages 127, 208, 415, 440, 660/690 and 830 V, creepage distances corresponding to the lower values 125, 200, 400, 630 and 800 V may be used.

c Material groups are classified as follows, according to the range of values of the comparative tracking index (CTI) (see 3.6.16):

- Material group I　600 ≤ CTI
- Material group II　400 ≤ CTI < 600
- Material group IIIa　175 ≤ CTI < 400
- Material group IIIb　100 ≤ CTI < 175

表 2　最小沿面距離(8.3.3)

額定絕緣電壓 Ui	最小沿面距離 mm							
	污染等級							
	1	2			3			
	材料群組(c)	材料群組(c)			材料群組(c)			
Vb	所有材料群組	I	II	IIIa 及 IIIb	I	II	IIIa	IIIb
32	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
40	1.5	1.5	1.5	1.5	1.5	1.6	1.8	1.8
50	1.5	1.5	1.5	1.5	1.5	1.7	1.9	1.9
63	1.5	1.5	1.5	1.5	1.6	1.8	2	2
80	1.5	1.5	1.5	1.5	1.7	1.9	2.1	2.1
100	1.5	1.5	1.5	1.5	1.8	2	2.2	2.2
125	1.5	1.5	1.5	1.5	1.9	2.1	2.4	2.4
160	1.5	1.5	1.5	1.6	2	2.2	2.5	2.5
200	1.5	1.5	1.5	2	2.5	2.8	3.2	3.2
250	1.5	1.5	1.8	2.5	3.2	3.6	4	4
320	1.5	1.6	2.2	3.2	4	4.5	5	5
400	1.5	2	2.8	4	5	5.6	6.3	6.3
500	1.5	2.5	3.6	5	6.3	7.1	8.0	8.0
630	1.8	3.2	4.5	6.3	8	9	10	10
800	2.4	4	5.6	8	10	11	12.5	
1,000	3.2	5	7.1	10	12.5	14	16	a
1,250	4.2	6.3	9	12.5	16	18	20	
1,600	5.6	8	11	16	20	22	25	

備考 1.　對於所使用之絕緣材料，CTI 值涉及依 IEC 60112:2003 方法 A 所獲得之值。
備考 2.　值係來自 IEC 60664-1，但最小值維持 1.5 mm。

註(a) 超過 600 V 時，材料群組 IIIb 之絕緣，不建議使用在污染等級 3。
(b) 例外情形如下：對於額定絕緣電壓為 127 V、208 V、415 V、440 V、660 V /690 V 及 830 V，可使用相對應於較低值之 125 V、200 V、400 V、630 V 及 800 V 的沿面距離。
(c) 依比較電痕指數(CTI，參照 3.6.16)之範圍值，材料群組分類如下。
- 材料群組 I　　600 ≤ CTI
- 材料群組 II　　400 ≤ CTI < 600
- 材料群組 IIIa　　175 ≤ CTI < 400
- 材料群組 IIIb　　100 ≤ CTI < 175

Table 3 – Cross-sectional area of a copper protective conductor (8.4.3.2.2)

Rated operational current I_e A	Minimum cross-sectional area of a protective conductor mm²
$I_e \leq 20$	S^a
$20 < I_e \leq 25$	2,5
$25 < I_e \leq 32$	4
$32 < I_e \leq 63$	6
$63 < I_e$	10

[a] S is the cross-sectional area of the phase conductor (mm²).

表 3　銅保護性導體之截面積(8.4.3.2.2)

額定操作電流 Ie A	保護性導體之最小截面積 mm^2
$I_e \leq 20$	S (a)
$20 < I_e \leq 25$	2.5
$25 < I_e \leq 32$	4
$32 < I_e \leq 63$	6
$63 < I_e$	10

註(a)　S 為相導體之截面積(mm^2)。

Table 4 – Conductor selection and installation requirements (8.6.4)

Type of conductor	Requirements
Bare conductors or single-core conductors with basic insulation, for example cables according to IEC 60227-3	Mutual contact or contact with conductive parts shall be avoided, for example by use of spacers
Single-core conductors with basic insulation and a maximum permissible conductor operating temperature of at least 90 °C, for example cables according to IEC 60245-3, or heat-resistant thermo-plastic (PVC) insulated cables according to IEC 60227-3	Mutual contact or contact with conductive parts is permitted where there is no applied external pressure. Contact with sharp edges shall be avoided. These conductors may only be loaded such that an operating temperature of 80 % of the maximum permissible conductor operating temperature is not exceeded
Conductors with basic insulation, for example cables according to IEC 60227-3, having additional secondary insulation, for example individually covered cables with shrink sleeving or individually run cables in plastic conduits	No additional requirements
Conductors insulated with a very high mechanical strength material, for example Ethylene Tetrafluoro Ethylene (ETFE) insulation, or double-insulated conductors with an enhanced outer sheath rated for use up to 3 kV, for example cables according to IEC 60502	
Single or multi-core sheathed cables, for example cables according to IEC 60245-4 or IEC 60227-4	

表 4　導體之選擇及安裝要求(8.6.4)

導體之型式	要求
裸導體或具基本絕緣之單芯導體，例：IEC 60227-3 之電纜。	應避免互相接觸或與導電零件接觸，例：使用墊片(spacer)。
具基本絕緣且最高可容許之導體操作溫度至少為 90℃的單芯導體(例：IEC 60245-3 之電纜)，或 IEC 60227-3 之耐熱性熱塑性(PVC)絕緣之電纜。	當未施加外部壓力時，容許互相接觸或與導電零件接觸。應避免與尖銳邊緣接觸。可僅承載此等導體，使得操作溫度不超過最大可容許之導體操作溫度的 80 %。
具基本絕緣之導體，例：IEC 60227-3 之電纜其具有額外之二次絕緣，例：具收縮套管(shrink sleeving)之個別覆蓋電纜或塑膠導線管中之運行電纜(run cable)。	無額外要求
以機械強度極高之材料絕緣的導體，例：乙烯四氟乙烯(ethylene tetrafluoro ethylene)絕緣或具增強型外護套額定在 3 kV 以下之導體，例：IEC 60502 之電纜。	
單芯或多芯鎧裝電纜(sheathed cables)，例：IEC 60245-4 或 IEC 60227-4 之電纜。	

Table 5 – Minimum terminal capacity for copper protective conductors (PE, PEN) (8.8)

Cross-sectional area of phase conductors S mm²	Minimum cross-sectional area of the corresponding protective conductor (PE, PEN) S_p [a] mm²
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S \leq 400$	$S/2$
$400 < S \leq 800$	200
$800 < S$	$S/4$

[a] Current in the neutral may be influenced where there are significant harmonics in the load. See 8.6.1.

表 5　銅保護性導體之最小端子容量(PE, PEN) (8.8)

相導體之截面積 S mm^2	相對應保護性導體之最小截面積(PE, PEN) S_p [(a)] mm^2
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S \leq 400$	$S/2$
$400 < S \leq 800$	200
$800 < S$	$S/4$

註[(a)]　負載中有顯著諧波時，中性點之電流可能會受影響。參照 8.6.1。

Table 6 – Temperature-rise limits (9.2)

Parts of ASSEMBLIES	Temperature rise K
Built-in components [a]	In accordance with the relevant product standard requirements for the individual components or, in accordance with the component manufacturer's instructions [f], taking into consideration the temperature in the ASSEMBLY
Terminals for external insulated conductors	70 [b]
Busbars and conductors	Limited by [f]: – mechanical strength of conducting material [g]; – possible effect on adjacent equipment; – permissible temperature limit of the insulating materials in contact with the conductor; – effect of the temperature of the conductor on the apparatus connected to it; – for plug-in contacts, nature and surface treatment of the contact material
Manual operating means: – of metal – of insulating material	 15 [c] 25 [c]
Accessible external enclosures and covers: – metal surfaces – insulating surfaces	 30 [d] 40 [d]
Discrete arrangements of plug and socket-type connections	Determined by the limit for those components of the related equipment of which they form part [e]

NOTE 1　The 105 K relates to the temperature above which annealing of copper is likely to occur. Other materials may have a different maximum temperature rise.

NOTE 2　The temperature rise limits given in this table apply for a mean ambient air temperature up to 35 °C under service conditions (see 7.1). During verification a different ambient air temperature is permissible (see 10.10.2.3.4).

[a] The term "built-in components" means:
- conventional switchgear and controlgear;
- electronic sub-assemblies (e.g. rectifier bridge, printed circuit);
- parts of the equipment (e.g. regulator, stabilized power supply unit, operational amplifier).

[b] The temperature-rise limit of 70 K is a value based on the conventional test of 10.10. An ASSEMBLY used or tested under installation conditions may have connections, the type, nature and disposition of which will not be the same as those adopted for the test, and a different temperature rise of terminals may result and may be required or accepted. Where the terminals of the built-in component are also the terminals for external insulated conductors, the lower of the corresponding temperature-rise limits shall be applied. The temperature rise limit is the lower of the maximum temperature rise specified by the component manufacturer and 70 K. In the absence of manufacturer's instructions it is the limit specified by the built-in component product standard but not exceeding 70 K.

[c] Manual operating means within ASSEMBLIES which are only accessible after the ASSEMBLY has been opened, for example draw-out handles which are operated infrequently, are allowed to assume a 25 K increase on these temperature-rise limits.

[d] Unless otherwise specified, in the case of covers and enclosures, which are accessible but need not be touched during normal operation, a 10 K increase on these temperature-rise limits is permissible. External surfaces and parts over 2 m from the base of the ASSEMBLY are considered inaccessible.

[e] This allows a degree of flexibility in respect of equipment (e.g. electronic devices) which is subject to temperature-rise limits different from those normally associated with switchgear and controlgear.

[f] For temperature-rise tests according to 10.10, the temperature-rise limits have to be specified by the original manufacturer taking into account any additional measuring points and limits imposed by the component manufacturer.

[g] Assuming all other criteria listed are met a maximum temperature rise of 105 K for bare copper busbars and conductors shall not be exceeded.

表 6　溫升限制(9.2)

組裝品之零件	溫升 K
內建式組件(a)	考量組裝品中之溫度，依據個別組件之相關產品標準要求，或依據組件製造廠商之說明書。
外部絕緣導體用之端子	70 (b)
匯流排及導體	依下列限制(f)。 － 傳導性材料之機械強度(g)。 － 對鄰近設備之可能的影響。 － 與導體接觸之絕緣材料的可容許溫度限制。 － 導體溫度對連接至導體之設備的影響。 － 對於插入式(plug-in)接點，為接點材料之性質及表面處理。
手動操作裝置 － 金屬製 － 絕緣材料製	 15 (c) 25 (c)
可接近式外部箱體及蓋板 － 金屬表面 － 絕緣表面	 30 (d) 40 (d)
插頭式及插座式連接之不連接配置	由構成相關設備之零件的限制值決定(a)
備考 1. 105 K 與某溫度有關，超過該溫度時有可能發生銅退火。其他材料可具有不同之最高溫升。 備考 2. 本表所示之溫升限制，適用於使用條件(參照 7.1)下在 35℃以下之平均周圍空氣溫度。在查證期間，可容許不同之周圍空氣溫度(參照 10.10.2.3.4)。	

註(a)　〝內建式〞一詞係指下列意義。

－ 傳統開關裝置及控制裝置。

－ 電子半成品(例：整流橋(rectifier bridge)、印刷電路)。

－ 設備之零件(例：調節器、穩壓電源單元、運算放大器)。

(b) 溫升限制 70 K 係以 10.10 之傳統試驗為基礎之值。在安裝條件下所使用或進行試驗之組裝品，可具有不同之連接，其類型、性質及處置將不會與試驗時所採用者相同，並可能產生不同之端子溫升，且可能要求或接受不同之端子溫升。當內建式組件之端子亦為外部絕緣導體用之端子時，應適用相對應溫升限制之下限。溫升限制為組件製造廠商所規定之最高溫升的下限，且其為 70 K。若無製造廠商之說明書時，其為內建組件產品標準所規定之限制值，但不超過 70 K。

(c) 組裝品內之手動操作裝置僅在組裝品已開啟之後始可接近(例：不常操作之抽出式把手)，容許假定此等溫升限制之增量為 25 K。

(d) 除非另有規定，外蓋及箱體為可接近式，但在正常操作期間不需要接觸，可容許此等溫升限制之增量為 10 K。離組裝品基座 2 m 之外部表面及零件，視為不可接近。

(e) 關於遭受之溫升限制與正常連結至開關裝置及控制裝置者不同之設備，容許可撓性等級。

(f) 關於 10.10 之溫升試驗，考量組件製造廠商所施予之任何額外量測點及限制，溫升限制必須由原始製造廠商規定。

(g) 假定已符合所列之所有其他準則，則不應超過裸銅匯流排及導體之最高溫升 105 K。

Table 7 – Values for the factor *n* [a] (9.3.3)

r.m.s. value of short-circuit current kA	cos *φ*	*n*
$I \leq 5$	0,7	1,5
$5 < I \leq 10$	0,5	1,7
$10 < I \leq 20$	0,3	2
$20 < I \leq 50$	0,25	2,1
$50 < I$	0,2	2,2

[a] Values of this table represent the majority of applications. In special locations, for example in the vicinity of transformers or generators, lower values of power factor may be found, whereby the maximum prospective peak current may become the limiting value instead of the r.m.s. value of the short-circuit current.

表 7　因數 n [(a)]之值(9.3.3)

短路電流之均方根值 kA	cos <φ	*n*
$I \leq 5$	0.7	1.5
$5 < I \leq 10$	0.5	1.7
$10 < I \leq 20$	0.3	2
$20 < I \leq 50$	0.25	2.1
$50 < I$	0.2	2.2

註[(a)] 本表之值代表多數之應用，在特殊位置(例：在變壓器或發電機附近)，可找到功率因數下限值，藉此最高預期峰值電流可成為短路電流之限制值，而非均方根值。

Table 8 – Power-frequency withstand voltage for main circuits (10.9.2)

Rated insulation voltage U_i (line to line a.c. or d.c.) V	Dielectric test voltage a.c. r.m.s. V	Dielectric test voltage [b] d.c. V
$U_i \leq 60$	1 000	1 415
$60 < U_i \leq 300$	1 500	2 120
$300 < U_i \leq 690$	1 890	2 670
$690 < U_i \leq 800$	2 000	2 830
$800 < U_i \leq 1\,000$	2 200	3 110
$1\,000 < U_i \leq 1\,500$ [a]	-	3 820

[a] For d.c. only.

[b] Test voltages based on 6.1.3.4.1, fifth paragraph, of IEC 60664-1.

表 8　主電路之商頻耐電壓(10.9.2)

額定絕緣電壓 U_i (線對線交流或直流) V	電介質試驗電壓 交流、均方根 V	電介質試驗電壓[(b)] 直流 V
$U_i \leq 60$	1,000	1,415
$60 < U_i \leq 300$	1,500	2,120
$300 < U_i \leq 690$	1,890	2,670
$690 < U_i \leq 800$	2,000	2,830
$800 < U_i \leq 1{,}000$	2,200	3,110
$1{,}000 < U_i \leq 1{,}500$ [(a)]	—	3,820

註[(a)] 僅適用於直流。

[(b)] 依據 IEC 60664-1 之 6.1.3.4.1 第 4 段之試驗電壓。

Table 9 – Power-frequency withstand voltage for auxiliary and control circuits (10.9.2)

Rated insulation voltage U_i (line to line) V	Dielectric test voltage a.c. r.m.s. V
$U_i \leq 12$	250
$12 < U_i \leq 60$	500
$60 < U_i$	See Table 8

表 9　輔助及控制電路之商頻耐電壓(10.9.2)

額定絕緣電壓 U_i (線對線) V	電介質試驗電壓 交流、均方根 V
$U_i \leq 12$	250
$12 < U_i \leq 60$	500
$60 < U_i$	參照表 8

Table 10 – Impulse withstand test voltages (10.9.3)

Rated impulse withstand voltage U_{imp} kV	Test voltages and corresponding altitudes during test									
	$U_{1,2/50}$, a.c. peak and d.c. kV					a.c. r.m.s. kV				
	Sea level	200 m	500 m	1 000 m	2 000 m	Sea level	200 m	500 m	1 000 m	2 000 m
2,5	2,95	2,8	2,8	2,7	2,5	2,1	2,0	2,0	1,9	1,8
4,0	4,8	4,8	4,7	4,4	4,0	3,4	3,4	3,3	3,1	2,8
6,0	7,3	7,2	7,0	6,7	6,0	5,1	5,1	5,0	4,7	4,2
8,0	9,8	9,6	9,3	9,0	8,0	6,9	6,8	6,6	6,4	5,7
12,0	14,8	14,5	14,0	13,3	12,0	10,5	10,3	9,9	9,4	8,5

表 10　衝擊耐試驗電壓(10.9.3)

額定衝擊耐電壓 U_{imin} kV	試驗期間之試驗電壓及相對應之海拔									
	$I_{1.2/50'}$ 交流峰值及直流 kV					交流均方根 kV				
	海平面	200 m	500 m	1,000 m	2,000 m	海平面	200 m	500 m	1,000 m	2,000 m
2.5	2.95	2.8	2.8	2.7	2.5	2.1	2.0	2.0	1.9	1.8
4.0	4.8	4.8	4.7	4.4	4.0	3.4	3.4	3.3	3.1	2.8
6.0	7.3	7.2	7.0	6.7	6.0	5.1	5.1	5.0	4.7	4.2
8.0	9.8	9.6	9.3	9.0	8.0	6.9	6.8	6.6	6.4	5.7
12.0	14.8	14.5	14.0	13.3	12.0	10.5	10.3	9.9	9.4	8.5

Table 11 – Copper test conductors for rated currents up to 400 A inclusive (10.10.2.3.2)

Range of rated current [a] A		Conductor cross-sectional area [b, c]	
		mm^2	AWG/MCM
0	8	1,0	18
8	12	1,5	16
12	15	2,5	14
15	20	2,5	12
20	25	4,0	10
25	32	6,0	10
32	50	10	8
50	65	16	6
65	85	25	4
85	100	35	3
100	115	35	2
115	130	50	1
130	150	50	0
150	175	70	00
175	200	95	000
200	225	95	0000
225	250	120	250
250	275	150	300
275	300	185	350
300	350	185	400
350	400	240	500

[a] The value of the rated current shall be greater than the first value in the first column and less than or equal to the second value in that column.

[b] For convenience of testing and with the manufacturer's consent, smaller test conductors than those given for a stated rated current may be used.

[c] Either of the two conductors specified may be used.

表 11　額定電流在 400 A 以下之銅試驗導體(10.10.2.3.2)

額定電流範圍 (a) A		導體截面積 (b) (c)	
		mm^2	AWG/MCM
0	8	1.0	18
8	12	1.5	16
12	15	2.5	14
15	20	2.5	12
20	25	4.0	10
25	32	6.0	10
32	50	10	8
50	65	16	6
65	85	25	4
85	100	35	3
100	115	35	2
115	130	50	1
130	150	50	0
150	175	70	00
175	200	95	000
200	225	95	0000
225	250	120	250
250	275	150	300
275	300	185	350
300	350	185	400
350	400	240	500

註(a)　額定電流值應大於第 1 欄第 1 個值，且小於或等於該欄第 2 個值。

(b)　為了便於進行試驗且在製造廠商同意下，可使用比指定之額定電流的導體為小之試驗導體。

(c)　可使用所規定之 2 個導體之其中之一。

Table 12 – Copper test conductors for rated currents from 400 A to 4 000 A (10.10.2.3.2)

Range of rated current [a] A	Test conductors			
	Cables		Copper bars [b]	
	Quantity	Cross-sectional area mm^2	Quantity	Dimensions mm (W × D)
400 to 500	2	150	2	30 × 5
500 to 630	2	185	2	40 × 5
630 to 800	2	240	2	50 × 5
800 to 1 000			2	60 × 5
1 000 to 1 250			2	80 × 5
1 250 to 1 600			2	100 × 5
1 600 to 2 000			3	100 × 5
2 000 to 2 500			4	100 × 5
2 500 to 3 150			3	100 × 10
3 150 to 4 000			4	100 × 10

[a] The value of the rated current shall be greater than the first value and less than or equal to the second value.

[b] Bars are assumed to be arranged with their long faces (W) vertical. Arrangements with long faces horizontal may be used if specified by the manufacturer. Bars may be painted.

表 12　額定電流從 400 A 至 4,000 A 之銅試驗導體(10.10.2.3.2)

額定電流範圍 (a) A	試驗導體			
	電纜		銅排 (b)	
	數量	截面積 mm^2	數量	尺寸 mm (W×D)
400 至 500	2	150	2	30×5
500 至 630	2	185	2	40×5
630 至 800	2	240	2	50×5
800 至 1,000			2	60×5
1,000 至 1,250			2	80×5
1,250 至 1,600			2	100×5
1,600 至 2,000			3	100×5
2,000 至 2,500			4	100×5
2,500 至 3,150			3	100×10
3,150 至 4,000			4	100×10

註 (a)　額定電流值應大於第 1 個值，並小於或等於第 2 個值。

(b) 銅排係假定以長面(W)垂直之方式而配置。若製造廠商有規定時，可使用長面水平之方式配置。可將銅排印刷。

Table 13 – Short-circuit verification by comparison with a reference design: check list (10.5.3.3, 10.11.3 and 10.11.4)

Item No.	Requirements to be considered	YES	NO
1	Is the short-circuit withstand rating of each circuit of the ASSEMBLY to be assessed, less than or equal to, that of the reference design?		
2	Is the cross-sectional dimensions of the busbars and connections of each circuit of the ASSEMBLY to be assessed, greater than or equal to, those of the reference design?		
3	Is the center line spacing of the busbars and connections of each circuit of the ASSEMBLY to be assessed, greater than or equal to, those of the reference design?		
4	Are the busbar supports of each circuit of the ASSEMBLY to be assessed of the same type, shape and material and have, the same or smaller center line spacing, along the length of the busbar as the reference design? And is the mounting structure for the busbar supports of the same design and mechanical strength?		
5	Are the material and the material properties of the conductors of each circuit of the ASSEMBLY to be assessed the same as those of the reference design?		
6	Are the short-circuit protective devices of each circuit of the ASSEMBLY to be assessed equivalent, that is of the same make and series[a] with the same or better limitation characteristics (I^2t, I_{pk}) based on the device manufacturer's data, and with the same arrangement as the reference design?		
7	Is the length of unprotected live conductors, in accordance with 8.6.4, of each non-protected circuit of the ASSEMBLY to be assessed less than or equal to those of the reference design?		
8	If the ASSEMBLY to be assessed includes an enclosure, did the reference design include an enclosure when verified by test?		
9	Is the enclosure of the ASSEMBLY to be assessed of the same design, type and have at least the same dimensions to that of the reference design?		
10	Are the compartments of each circuit of the ASSEMBLY to be assessed of the same mechanical design and at least the same dimensions as those of the reference design?		
'YES' to all requirements – no further verification required. 'NO' to any one requirement – further verification is required.			
[a] Short-circuit protective devices of the same manufacturer but of a different series may be considered equivalent where the device manufacturer declares the performance characteristics to be the same or better in all relevant respects to the series used for verification, e.g. breaking capacity and limitation characteristics (I^2t, I_{pk}), and critical distances.			

表 13　藉由比較參考設計之方式查證短路：檢查表(10.5.3.3、10.11.3 及 10.11.4)

項目編號	須考量之要求	是	否
1	須評鑑之組裝品，其每一電路之短路耐受定額，是否小於或等於參考設計之短路耐受定額？		
2	須評鑑之組裝品，其每一電路之匯流排及連接之截面尺寸，是否大於或等於參考設計之截面尺寸？		
3	須評鑑之組裝品，其每一電路之匯流排及連接之中心線間隔，是否大於或等於參考設計之中心線間隔？		
4	須評鑑之組裝品，其每一電路之匯流排支撐物，是否相同型式、形狀及材料？且沿著匯流排之長，其是否具有與參考設計相同或較小之中心線間隔？		
5	須評鑑之組裝品，其每一電路之導體的材料及材料特性，是否與參考設計之材料及材料特性相同？		

6	須評鑑之組裝品，其每一電路之短路保護性裝置，是否大於或等於參考設計之中心線間隔？		
7	須評鑑之組裝品，其每一未受保護之電路的未受保護之帶電導體(依 8.6.4)的長度，是否小於或等於參考設計之長度？		
8	若須評鑑之組裝品包括箱體，則當以試驗進行查證時，參考設計是否包括箱體？		
9	須評鑑之組裝品，其箱體是否與參考設計具有相同設計、型式，並具有至少相同之尺寸？		
10	須評鑑之組裝品，其每一電路之分隔室是否與參考設計具有相同機械設計，並具有至少相同之尺寸？		
〝是〞係針對所有要求－不需要額外查證。 〝否〞係針對任何一項要求－不需要額外查證。			
註[(a)] 當裝置製造廠商宣告在查證時所使用之系列的所有方面，其性能特性相同或較佳，則相同製造廠商但不同系列之短路保護裝置，可視為等同，例：啟斷容量及限制特性(I^2t, I_{pk})，以及關鍵距離。			

Table 14 – Relationship between prospective fault current and diameter of copper wire

Diameter of copper wire mm	Prospective fault current in the fusible element circuit A
0,1	50
0,2	150
0,3	300
0,4	500
0,5	800
0,8	1 500

表 14　預期故障電流與銅線直徑之關係

銅線直徑 mm	可熔化之元件電路中之預期故障電流 A
0.1	50
0.2	150
0.3	300
0.4	500
0.5	800
0.8	1,500

Annex A
(normative)

Minimum and maximum cross-section of copper conductors suitable for connection to terminals for external conductors (see 8.8)

Table A.1 below applies for the connection of one copper cable per terminal.

附錄 A
(規定)

適合供外部導體連接至端子之銅導體的最小及最大截面

表 A.1 適用於每端子之 1 條銅電纜的連接。

Table A.1 – Cross-section of copper conductors suitable for connection to terminals for external conductors

Rated current	Solid or stranded conductors		Flexible conductors	
	Cross-sections		Cross-sections	
	min.	max.	min.	max.
A	mm^2		mm^2	
6	0,75	1,5	0,5	1,5
8	1	2,5	0,75	2,5
10	1	2,5	0,75	2,5
13	1	2,5	0,75	2,5
16	1,5	4	1	4
20	1,5	6	1	4
25	2,5	6	1,5	4
32	2,5	10	1,5	6
40	4	16	2,5	10
63	6	25	6	16
80	10	35	10	25
100	16	50	16	35
125	25	70	25	50
160	35	95	35	70
200	50	120	50	95
250	70	150	70	120
315	95	240	95	185

If the external conductors are connected directly to built-in apparatus, the cross-sections indicated in the relevant specifications are valid.

In cases where it is necessary to provide for conductors other than those specified in the table, special agreement shall be reached between the ASSEMBLY manufacturer and the user.

表 A.1　適合供外部導體連接至端子之銅導體的截面

額定電流	實心導體或絞線		可撓性導體	
	截面		截面	
	最小	最大	最小	最大
A	mm^2		mm^2	
6	0.75	1.5	0.5	1.5
8	1	2.5	0.75	2.5
10	1	2.5	0.75	2.5
13	1	2.5	0.75	2.5
16	1.5	4	1	4
20	1.5	6	1	4
25	2.5	6	1.5	4
32	2.5	10	1.5	6
40	4	16	2.5	10
63	6	25	6	16
80	10	35	10	25
100	16	50	16	35
125	25	70	25	50
160	35	95	35	70
200	50	120	50	95
250	70	150	70	120
315	95	240	95	185

若外部導體直接連接至內建式設備，則相關規範中所示之截面為有效的。

當有必要提供非本表所規定之導體時，組裝品製造廠商與使用者之間，應達成特殊協議。

Annex B
(normative)

Method of calculating the cross-sectional area of protective conductors with regard to thermal stresses due to currents of short duration

The following formula shall be used to calculate the cross-section of the protective conductors necessary to withstand the thermal stresses due to currents with a duration of the order of 0,2 s to 5 s.

$$S_{\mathrm{p}} = \frac{\sqrt{I^2 t}}{k}$$

where

S_{p} is the cross-sectional area, in square millimetres;

I is the value (r.m.s.) of a.c. fault current for a fault of negligible impedance which can flow through the protective device, in amperes;

t is the operating time of the disconnecting device, in seconds;

NOTE Account should be taken of the current-limiting effect of the circuit impedances and the limiting capability (Joule integral) of the protective device.

k is the factor dependent on the material of the protective conductor, the insulation and other parts and the initial and final temperatures, see Table B.1.

附錄 B

(規定)

關於因短持續時間電流所產生之熱應力方面，計算保護性導體截面積之方法

下列公式應使用於計算能耐受持續時間為 0.2 s至 0.5 s等級之電流所產生之熱應力所必要之保護性導體之截面積。

$$S_p = \frac{\sqrt{I^2 t}}{k}$$

式中，S_{p}：截面積(mm^2)。

I：可予以忽略之電阻的故障中，其可通過保護裝置之交流故障電流的均方根值(A)。

t：為切離裝置之操作時間(s)。

備考：宜考量電路阻抗之限流及保護裝置之限制能力(s)。

k：取決於保護性導體、絕緣及其他零件之材料及初始及最終溫度的因數，參照表 B.1。

Table B.1 – Values of *k* for insulated protective conductors not incorporated in cables, or bare protective conductors in contact with cable covering

	Insulation of protective conductor or cable covering		
	Thermo-plastic (PVC)	XLPE EPR Bare conductors	Butyl rubber
Final temperature	160 °C	250 °C	220 °C
	Factor *k*		
Material of conductor:			
Copper	143	176	166
Aluminium	95	116	110
Steel	52	64	60
The initial temperature of the conductor is assumed to be 30 °C.			

More detailed information is to be found in IEC 60364-5-54.

表 B.1　有關未合併於電纜之絕緣保護性導體或與電纜護套接觸之裸保護性導體的 k 值

	保護性導體或電纜護套之絕緣		
	熱塑性塑膠 (PVC)	交聯聚乙烯 EPR 裸導體	丁基橡膠
最終溫度	160℃	250℃	220℃
	因數 *k*		
導體之材料： 銅 鋁 鋼	 143 95 52	 176 116 64	 166 110 60
導體之最終溫度係假定為 30℃。			

有關更詳細之資訊，參照 IEC 60364-5-54。

Annex C
(informative)

User information template

This annex is intended as a template for the identification of items necessary for the ASSEMBLY manufacturer which is to be provided by the user.

It is intended to be used and developed in the relevant ASSEMBLY standards.

附錄 C
(參考)

使用者資訊樣板

本附錄係作為樣板，供組裝品製造廠商識別使用者所提供之必要項目。

此樣板係樣相關組裝品標準中使用及發展。

Table C.1 – Template

Characteristics	Reference clause or subclause	Default arrangement [b]	Options listed in standard	User requirement [a]
Electrical system				
Earthing system	5.6, 8.4.3.1, 8.4.3.2.3, 8.6.2, 10.5, 11.4	Manufacturer's standard, selected to suit local requirements	TT / TN-C / TN-C-S / IT, TN-S	
Nominal voltage (V)	3.8.9.1, 5.2.1, 8.5.3	Local, according to installation conditions	max 1 000 V a.c. or 1 500 V d.c.	
Transient overvoltages	5.2.4, 8.5.3, 9.1, Annex G	Determined by the electrical system	Overvoltage category I / II / III / IV	
Temporary overvoltages	9.1	Nominal system voltage + 1 200 V	None	
Rated frequency f_n (Hz)	3.8.12, 5.5, 8.5.3, 10.10.2.3, 10.11.5.4	According to local installation conditions	d.c./50 Hz/60 Hz	
Additional on site testing requirements: wiring, operational performance and function	11.10	Manufacturer's standard, according to application	None	
Short-circuit withstand capability				
Prospective short-circuit current at supply terminals I_{cp} (kA)	3.8.7	Determined by the electrical system	None	
Prospective short-circuit current in the neutral	10.11.5.3.5	Max. 60 % of phase values	None	
Prospective short-circuit current in the protective circuit	10.11.5.6	Max. 60 % of phase values	None	
SCPD in the incoming functional unit requirement	9.3.2	According to local installation conditions	Yes / No	
Co-ordination of short-circuit protective devices including external short-circuit protective device details.	9.3.4	According to local installation conditions	None	
Data associated with loads likely to contribute to the short-circuit current	9.3.2	No loads likely to make a significant contribution allowed for	None	
Protection of persons against electric shock in accordance with IEC 60364-4-41				

Type of protection against electric shock – Basic protection (protection against direct contact)	8.4.2	Basic protection	According to local installation regulations	
Type of protection against electric shock – Fault protection (protection against indirect contact)	8.4.3	According to local installation conditions	Automatic disconnection of supply / Electrical separation / Total insulation	
Installation environment				
Location type	3.5, 8.1.4, 8.2	Manufacturer's standard, according to application	Indoor / outdoor	
Protection against ingress of solid foreign bodies and ingress of water	8.2.2, 8.2.3	Indoor (enclosed): IP 2X Outdoor (min.): IP 23	IP 00, 2X, 3X, 4X, 5X, 6X After removal of removable parts: As for connected position / Reduced protection to manufacturer's standard	
External mechanical impact (IK)	8.2.1, 10.2.6	None	None	
Resistance to UV radiation (applies for outdoor assemblies only unless specified otherwise)	10.2.4	Indoor: Not applicable. Outdoor: Temperate climate	None	
Resistance to corrosion	10.2.2	Normal Indoor/Outdoor arrangements	None	
Ambient air temperature – Lower limit	7.1.1	Indoor: –5 °C Outdoor: –25 °C	None	
Ambient air temperature – Upper limit	7.1.1	40 °C	None	
Ambient air temperature – Daily average maximum	7.1.1, 9.2	35 °C	None	
Maximum relative humidity	7.1.2	Indoor: 50 % at 40 °C Outdoor: 100 % at 25 °C	None	
Pollution degree (of the installation environment)	7.1.3	Industrial: 3	1, 2, 3, 4	
Altitude	7.1.4	≤ 2 000 m	None	
EMC environment (A or B)	9.4, 10.12, Annex J	A/B	A/B	
Special service conditions (e.g. vibration, exceptional condensation, heavy pollution, corrosive environment, strong electric or magnetic fields, fungus, small creatures, explosion hazards, heavy vibration and shocks, earthquakes)	7.2, 8.5.4, 9.3.3 Table 7	No special service conditions	None	
Installation method				
Type	3.3, 5.6	Manufacturer's standard	Various e.g. floor standing / wall mounted	
Stationary/Movable	3.5	Stationary	Stationary / movable	

Maximum overall dimensions and weight	5.6, 6.2.1	Manufacturer's standard, according to application	None	
External conductor type(s)	8.8	Manufacturer's standard	Cable / Busbar Trunking System	
Direction(s) of external conductors	8.8	Manufacturer's standard	None	
External conductor material	8.8	Copper	Copper / aluminium	
External phase conductor, cross sections, and terminations	8.8	As defined within the standard	None	
External PE, N, PEN conductors cross sections, and terminations	8.8	As defined within the standard	None	
Special terminal identification requirements	8.8	Manufacturer's standard	None	
Storage and handling				
Maximum dimensions and weight of transport units	6.2.2, 10.2.5	Manufacturer's standard	None	
Methods of transport (e.g. forklift, crane)	6.2.2, 8.1.6	Manufacturer's standard	None	
Environmental conditions different from the service conditions	7.3	As service conditions	None	
Packing details	6.2.2	Manufacturer's standard	None	
Operating arrangements				
Access to manually operated devices	8.4		Authorized persons / Ordinary persons	
Location of manually operated devices	8.5.5	Easily accessible	None	
Isolation of load installation equipment items	8.4.2, 8.4.3.3, 8.4.6.2	Manufacturer's standard	Individual / groups / all	
Maintenance and upgrade capabilities				
Requirements related to accessibility in service by ordinary persons; requirement to operate devices or change components while the ASSEMBLY is energised	8.4.6.1	Basic protection	None	
Requirements related to accessibility for inspection and similar operations	8.4.6.2.2	No requirements for accessibility	None	
Requirements related to accessibility for maintenance in service by authorized persons	8.4.6.2.3	No requirements for accessibility	None	
Requirements related to accessibility for extension in service by authorized persons	8.4.6.2.4	No requirements for accessibility	None	
Method of functional units connection	8.5.1, 8.5.2	Manufacturer's standard	None	
Protection against direct contact with hazardous live internal parts during maintenance or upgrade (e.g. functional units, main busbars, distribution busbars)	8.4	No requirements for protection during maintenance or upgrade	None	
Current carrying capability				
Rated current of the ASSEMBLY I_{nA} (amps)	3.8.9.1, 5.3, 8.4.3.2.3, 8.5.3, 8.8, 10.10.2, 10.10.3, 10.11.5, Annex E	Manufacturer's standard, according to application	None	

Rated current of circuits I_{nc} (amps)	5.3.2	Manufacturer's standard, according to application	None	
Rated diversity factor	5.4, 10.10.2.3, Annex E	As defined within the standard	RDF for groups of circuits / RDF for whole ASSEMBLY	
Ratio of cross section of the neutral conductor to phase conductors: phase conductors up to and including 16 mm^2	8.6.1	100 %	None	
Ratio of cross section of the neutral conductor to phase conductors: phase conductors above 16 mm^2	8.6.1	50 % (min. 16 mm^2)	None	

a For exceptionally onerous applications, the user may need to specify more stringent requirements to those in the standard.

b In some cases information declared by the ASSEMBLY manufacturer may take the place of an agreement.

表 C.1　樣板

特性	參考節次	預設配置 (b)	標準所列之選項	使用者要求(a)
電氣系統				
接地系統	5.6、8.4.3.1、8.4.3.2.3、8.6.2、10.5、11.4	製造廠商之標準，並配合當地要求	TT/TN-C/TN-C-S / IT、TN-S	
標稱電壓(V)	3.8.9.1、5.2.1、8.5.3	當地要求，依安裝條件	最高 1,000 V(交流)或 1,500V(直流)	
暫態過電壓	附錄 G 之 5.2.4、8.5.3、9.1	由電氣系統決定	過電壓種類 I / II / III / IV	
暫時過電壓	9.1	標稱系統電壓 +1,200 V	無	
額定頻率 f_n (Hz)	3.8.12、5.5、8.5.3、10.10.2.3、10.11.5.4	依當地安裝條件	直流/50 Hz/60 Hz	
額外現場試驗要求：配線、操作性能及功能	11.10	製造廠商之標準，依據其應用	無	
短路耐電流能力				
於供應端子之預期短路電流 I_{cp}(kA)	3.8.7	由電氣系統決定	無	
中性點之預期短路電流	10.11.5.3.5	最高為相值之 60 %	無	
保護性電路之預期短路電流	10.11.5.6	最高為相值之 60 %	無	
內向功能性單元要求之短路保護裝置(SCPD)	9.3.2	依據當地安裝條件	是/否	
短路保護裝置之協	9.3.4	依據當地安裝	無	

調 ，包括外部短路包括裝置細節		條件		
與有可能產生短路電流有關聯之資料	9.3.2	無負載可能產生已考量到之顯著貢獻	無	
依 IEC 60364-4-41 對人員之防電擊保護				
防電擊之保護型式－基本保護(防電擊之保護)	8.4.2	基本保護	依據當地安裝法規	
防電擊之保護型式－故障保護(防電擊之保護)	8.4.3	依據當地安裝條件	電源自動切離/電氣隔離/總絕緣	
安裝環境				
位置型式	3.5、8.1.4、8.2	製造廠商之標準，依其應用	屋內/屋外	
防固體異物進入及防止水進入之保護	8.2.2、8.2.3	屋內(封閉)：IP 2X 屋外(最低)：IP 23	IP 00、2X、3X、4X、5X、6X 於移除可動零件之後： 至於連接之位置/對製造廠商標準之降級保護	
外部機械衝擊(IK)	8.2.1、10.2.6	無	無	
耐紫外線輻射(僅適用於屋外用組裝品，除非另有規定)	10.2.4	屋內：不適用。 屋外：溫帶氣候	無	
耐蝕	10.2.2	正常屋內用/屋外用配置	無	
周圍空氣溫度－下限	7.1.1	屋內：-5℃ 屋外：-25℃	無	
周圍空氣溫度－上限	7.1.1	40℃	無	
周圍空氣溫度－每日平均最高	7.1.1、9.2	35℃	無	
最高相對濕度	7.1.2	屋內：40℃時為 50 % 屋外：25℃時為 100 %	無	
(安裝環境之)污染等級	7.1.3	工業：3	1、2、3、4	
海拔	7.1.4	≤ 2,000 m	無	
EMC 環境(A 或 B)	附錄 J 之 9.4、10.12	A/B	A/B	
特殊使用條件(例：振	表 7 之 7.2、	無特殊使用條	無	

動、異常冷凝、重度污染、腐蝕環境、強電場或強磁場、菌類植物、小動物、爆炸危險、劇烈振動及衝擊、地震)	8.5.4、9.3.3	件		
安裝方法				
型式	3 3、5 6	製造廠商之標準	各種，例：落地式/壁掛式	
靜止/可動	3.5	靜止	靜止/可動	
最大總尺寸及總重量	5.6、6.2.1	製造廠商之標準，依其應用	無	
外部導體型式	8.8	製造廠商之標準	電纜/匯流排中繼系統	
外部導體之方向	8.8	製造廠商之標準	無	
外部導體材料	8.8	銅	銅/鋁	
外部相導體、橫截面及終端	8.8	如標準範圍內之定義	無	
外部 PE、N、PEN 導體橫截面及終端	8.8	如標準範圍內之定義	無	
特殊端子識別要求	8.8	製造廠商之標準	無	
儲存及搬運				
運送單元之最大尺寸及重量	6.2.2、10.2.5	製造廠商之標準	無	
運送方法(例：堆高機、起重機)	6.2.2、8.1.6	製造廠商之標準	無	
與使用條件不同之環境條件	7.3	如使用條件	無	
包裝細節	6.2.2	製造廠商之標準	無	
操作配置				
接近手動式操作裝置	8.4		獲授權之人員/一般人員	
手動式操作裝置之位置	8.5.5	容易接近	無	
負載安裝設備項目之隔離	8.4.2、8.4.3.3、8.4 6.2	製造廠商之標準	個別/群組/所有	
維護及升級能力				
有關一般人員使用中之可接近性的要求；當組裝品通電時，操作裝置或變更組件之要求	8.4.6.1	基本保護	無	

與檢驗及類似操作用之可接近性有關的要求	8.4.6.2.2	關於可接近性，無要求	無	
與獲授權人員使用中維持用之可接近性有關的要求	8.4.6.2.3	關於可接近性，無要求	無	
與獲授權人員使用中延伸用之可接近性有關的要求	8.4.6.2.4	關於可接近性，無要求	無	
功能性單元連接之方法	8.5.1、8.5.2	製造廠商之標準	無	
維護或升級期間，防止與危機帶電內部零件直接接觸之保護(例：功能性單元、主匯流排、配電匯流排)	8.4	關於維護或升級期間之保護，無要求	無	
電流承載能力				
組裝品之額定電流 I_{nA} (安培)	附錄 E 之 3.8.9.1、5.3、8.4.3.2.3、8.5.3、8.8、10.10.2、10.10.3、10.11.5	製造廠商之標準，依其應用	無	
電路之額定電流 I_{nc} (安培)	5.3.2	製造廠商之標準，依其應用	無	
額定多樣性因數	附錄 E 之 5.4、10.10.2.3	如標準範圍內之定義	電路群組之 RDF/整個組裝品之 RDF	
中性點導體與相導體之截面比例：相導體在 16 mm^2 以下	8.6.1	100 %	無	
中性點導體與相導體之截面比例：相導體大於 16 mm^2	8.6.1	50 % (最小 16 mm^2)	無	

註(a) 對於異常繁苛之應用，使用者可能需要針對本標準之要求，規定更嚴格之要求。

(b) 在某些情況中，組裝品製造廠商所宣告之資訊，可代替協議。

Annex D
(informative)

Design verification

Table D.1 – List of design verifications to be performed

No.	Characteristic to be verified	Clauses or subclauses	Verification options available		
			Testing	Comparison with a reference design	Assessment
1	Strength of material and parts:	10.2			
	Resistance to corrosion	10.2.2	YES	NO	NO
	Properties of insulating materials:	10.2.3			
	Thermal stability	10.2.3.1	YES	NO	NO
	Resistance to abnormal heat and fire due to internal electric effects	10.2.3.2	YES	NO	YES
	Resistance to ultra-violet (UV) radiation	10.2.4	YES	NO	YES
	Lifting	10.2.5	YES	NO	NO
	Mechanical impact	10.2.6	YES	NO	NO
	Marking	10.2.7	YES	NO	NO
2	Degree of protection of enclosures	10.3	YES	NO	YES
3	Clearances	10.4	YES	NO	NO
4	Creepage distances	10.4	YES	NO	NO
5	Protection against electric shock and integrity of protective circuits:	10.5			
	Effective continuity between the exposed conductive parts of the ASSEMBLY and the protective circuit	10.5.2	YES	NO	NO
	Short-circuit withstand strength of the protective circuit	10.5.3	YES	YES	NO
6	Incorporation of switching devices and components	10.6	NO	NO	YES
7	Internal electrical circuits and connections	10.7	NO	NO	YES
8	Terminals for external conductors	10.8	NO	NO	YES
9	Dielectric properties:	10.9			
	Power-frequency withstand voltage	10.9.2	YES	NO	NO
	Impulse withstand voltage	10.9.3	YES	NO	YES
10	Temperature-rise limits	10.10	YES	YES	YES
11	Short-circuit withstand strength	10.11	YES	YES	NO
12	Electromagnetic compatibility (EMC)	10.12	YES	NO	YES
13	Mechanical operation	10.13	YES	NO	NO

附錄 D

(參考)

設計驗證

表 D.1　須執行之設計驗證的清單

項次	須查證之特性	節次	可取得之查證選項		
			試驗	與參考設計之比較	評鑑
1	材料及零件之強度	10.2			
	耐蝕	10.2.2	是	否	否
	絕緣材料之特性	10.2.3			
	熱穩定性	10.2.3.1	是	否	是
	耐受因內部電效應產生之異常熱及火	10.2.3.2	是	否	是
	耐紫外線(UV)輻射	10.2.4	是	否	否
	吊運	10.2.5	是	否	否
	機械撞擊	10.2.6	是	否	否
	標示	10.2.7	是	否	否
2	箱體之保護等級	10.3	是	否	是
3	空間距離	10.4	是	否	否
4	沿面距離	10.4	是	否	否
5	防電擊之保護及保護性電路之完整性	10.5			
	於組裝品之暴露的導電零件與保護性電路之間的有效連續性	10.5.2	是	否	否
	保護性電路之短路耐受強度	10.5.3	是	是	否
6	開關操作裝置與組件之合併	10.6	否	否	是
7	內部電路及連接	10.7	否	否	是
8	外部導體用之端子	10.8	否	否	是
9	電介質特性	10.9			
	商頻耐電壓	10.9.2	是	否	否
	衝擊耐電壓	10.9.3	是	否	是
10	溫升限制	10.10	是	是	是
11	短路耐受強度	10.11	是	是	否
12	電磁相容(EMC)	10.12	是	否	是
13	機械操作	10.13	是	否	否

Annex E
(informative)

Rated diversity factor

附錄 E

(規定)

額定多樣性因數

E.1 General

All circuits within an ASSEMBLY are individually capable of carrying their rated current, in accordance with 5.3.2, continuously but, the current carrying capacity of any circuit may be influenced by adjacent circuits. Thermal interaction can result in heat being imported from, or exported to, circuits in close proximity. Cooling air available to a circuit may be at a temperature well in excess of the ambient due to the influence of other circuits.

In practise, not all circuits within an ASSEMBLY are normally required to carry rated current continuously and simultaneously. Within a typical application the type and nature of loads differ appreciably. Some circuits will be rated on the basis of inrush currents and intermittent or short duration loads. A number of circuits may be heavily loaded while others are lightly loaded or switched off.

To provide ASSEMBLIES in which all circuits can be operated at rated current continuously is therefore unnecessary and would be an inefficient use of materials and resources. This standard recognises the practical requirements of ASSEMBLIES through the assignment of a rated diversity factor as defined in 3.8.11.

By stating a rated diversity factor, the ASSEMBLY manufacturer is specifying the 'average' loading conditions for which the ASSEMBLY is designed. The rated diversity factor confirms the per unit value of rated current to which all the outgoing circuits, or a group of outgoing circuits, within the ASSEMBLY, can be continuously and simultaneously loaded. In ASSEMBLIES where the total of the rated currents of the outgoing circuits operating at rated diversity factor exceeds the capacity of the incoming circuit, the diversity factor applies to any combination of outgoing circuits used to distribute the incoming current.

E.1 一般

組裝品內之所有電路分別能連續承載其額定電流(依據 5.3.2)，但電路之電流承載容量可能會受鄰近電路之影響。熱交互作用會導致熱從附近電路輸入，或輸出至附近電路。由於其他電路之影響，電路可獲得之冷卻空氣，其溫度可能超過周圍之溫度。

實際上，非組裝品內之所有電路通常皆需要連續且同時承載額定電流。在典型應用中，負載之型式及種類明顯不同。當其他電路輕度承載或關閉時，一些電路可能會重度承載。

提供組裝品，若其內部之所有電路可在額定電流下連續操作，則此為非必要，且將是無效率使用材料及箱體。透過指定 3.8.11 所定義之額定多樣性因數，本標準認可組裝品之實際要求。

藉由敘明額定多樣性因數，針對組裝品所設計之條件，組裝品製造廠商規定〝平均承載條件〞。額定多樣性因數確認組裝品內所有外向電路或一群組外向電路所能連續且同時承載之額定電流的標么值。在組裝品中，當在額定多樣性因數下操作之外向電路的總額定電流超過內向電路之容量時，多樣性因數適用於分配內向電流所使用之外向電路的任何組合。

E.2 Rated diversity factor of an ASSEMBLY

The rated diversity factor of an ASSEMBLY is specified in 5.4. For the typical ASSEMBLY shown in Figure E.1, examples of the multitude of loading arrangements for a diversity factor of 0,8 are given in Table E.1 and shown in Figures E.2 to E.5.

E.3 Rated diversity factor of a group of outgoing circuits

In addition to stating the rated diversity factor for a complete ASSEMBLY, an ASSEMBLY manufacturer may specify a different diversity factor for a group of related circuits within an ASSEMBLY. Subclause 5.4 specifies the rated diversity factor for a group of outgoing circuits.

Tables E.2 and E.3 give examples of a diversity factor of 0,9 for a section and subdistribution board within the typical ASSEMBLY shown in Figure E.1.

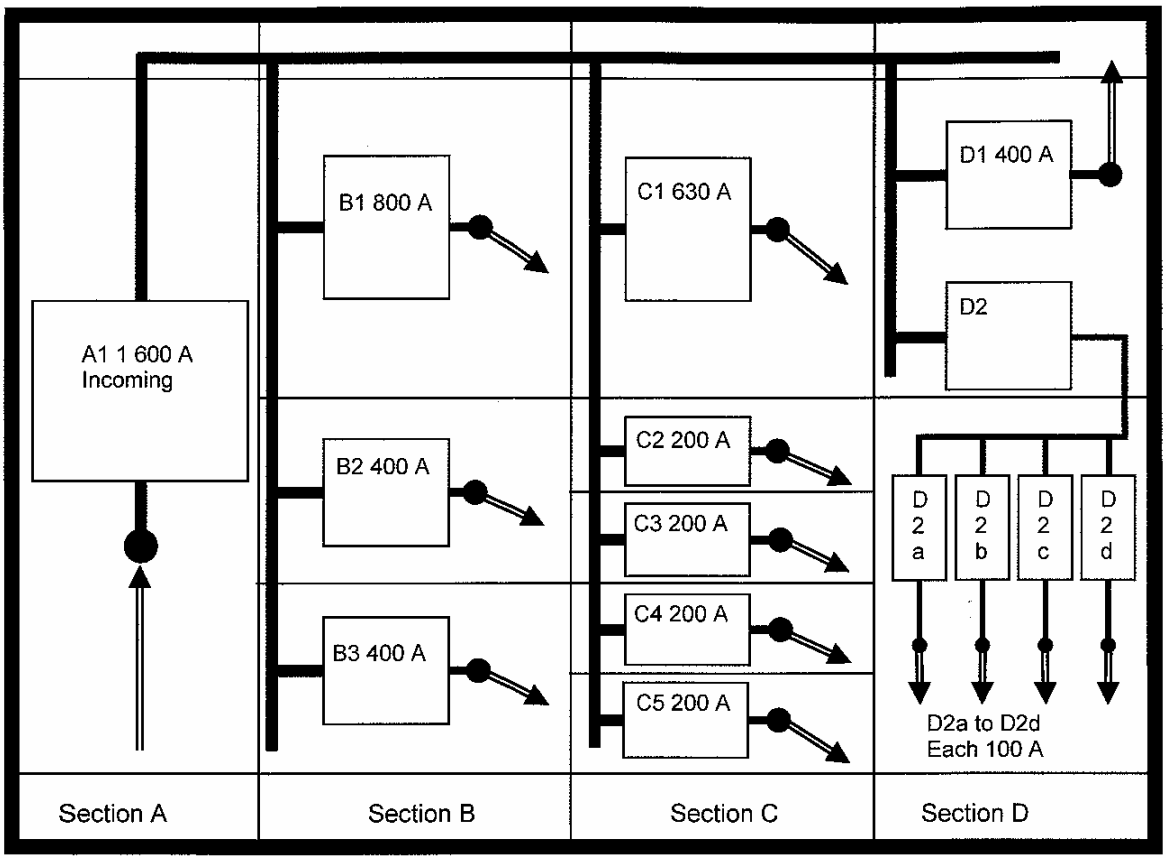
E.2 組裝品之額定多樣性因數

組裝品之額定多樣性因數規定於 5.4 中。對於圖 E.1 所示之典型組裝品，表 E.1 及圖 E.2 至圖 E.5 列出許多多樣性因數為 0.8 之負載配置的範例。

E.3 外向電路群組之額定多樣性因數

除了針對整組組裝品指定額定多樣性因數之外，針對組裝品內一群組相關電路，組裝品製造廠商可規定不同之多樣性因數。5.4 規定一群組外向電路之額定多樣性因數。

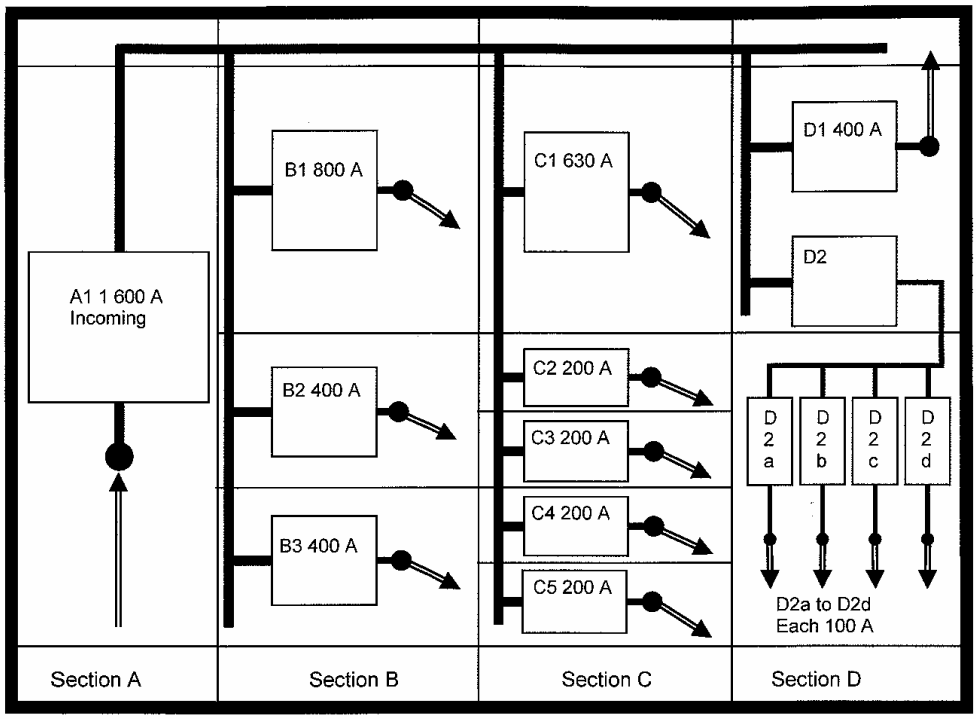
針對圖 E.1 所示之典型組裝品內之區段及次配電板，表 E.2 及表 E.3 提供多樣性因數為 0.9 之範例。



Functional unit – Rated current (I_n) shown [a]

[a] The rated current of the functional unit (the circuit) in the ASSEMBLY may be less than the rated current of the device.

Figure E.1 – Typical ASSEMBLY



功能性單元－所顯示之額定電流[a]

註[a]　組裝品中，功能性單元(電路)之額定電流可小於裝置之額定電流。

圖 E.1　典型組裝品

Table E.1 – Examples of loading for an ASSEMBLY with a rated diversity factor of 0,8

Functional unit		A1	B1	B2	B3	C1	C2	C3	C4	C5	D1	D2a	D2b	D2c	D2d
		Current (A)													
Functional unit - rated current (I_n) [b] (See Figure E.1)		1 600	800	400	400	630	200	200	200	200	400	100	100	100	100
Functional unit loading for an ASSEMBLY with a rated diversity factor of 0,8	Example 1 Figure E.2	1 600	640	320	320	0	160	160	0	0	0	0	0	0	0
	Example 2 Figure E.3	1 600	640	0	0	504	136[a]	0	0	0	320	0	0	0	0
	Example 3 Figure E.4	1 600	456[a]	0	0	504	160	160	160	160	0	0	0	0	0
	Example 4 Figure E.5	1 600	0	0	0	504	160	160	136[a]	0	320	80	80	80	80

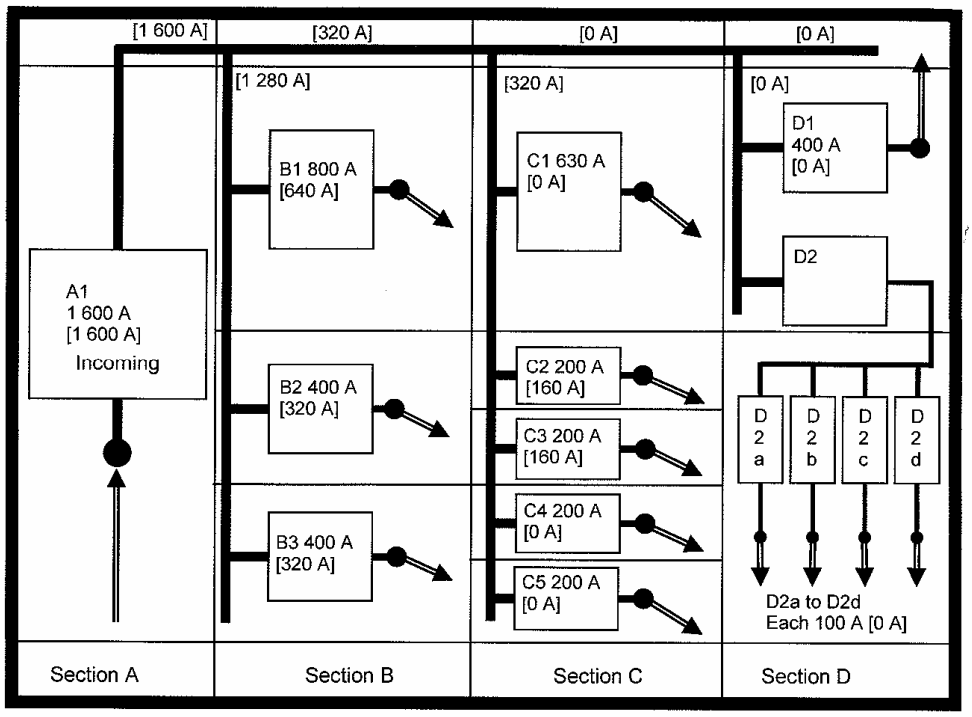
[a] Balance current to load incoming circuit to its rated current.
[b] The rated current of the functional unit (the circuit) in the ASSEMBLY may be less than the rated current of the device.

表 E.1　額定多樣性因數為 0.8 之組裝品的負載範例

功能性單元		A1	B1	B2	B3	C1	C2	C3	C4	C5	D1	D2a	D2b	D2c	D2d
		電流(A)													
功能性單元－額定電流 (I_n) [(b)] (參照圖 E.1)		1,600	800	400	400	630	200	200	200	200	400	100	100	100	100
額定多樣性因數為 0.8 之組裝品的負載範例	範例 1 圖 E.2	1,600	640	320	320	0	160	160	0	0	0	0	0	0	0
	範例 2 圖 E.3	1,600	640	0	0	504	136 (a)	0	0	0	320	0	0	0	0
	範例 3 圖 E.4	1,600	456 (a)	0	0	504	160	160	160	160	0	0	0	0	0
	範例 4 圖 E.5	1,600	0	0	0	504	160	160	136 (a)	0	320	80	80	80	80

註 [(a)] 使內向電流承載至其額定電流之平衡電流。

[(b)] 組裝品內之功能性單元(電路)的額定電流，可小於裝置之額定電流。



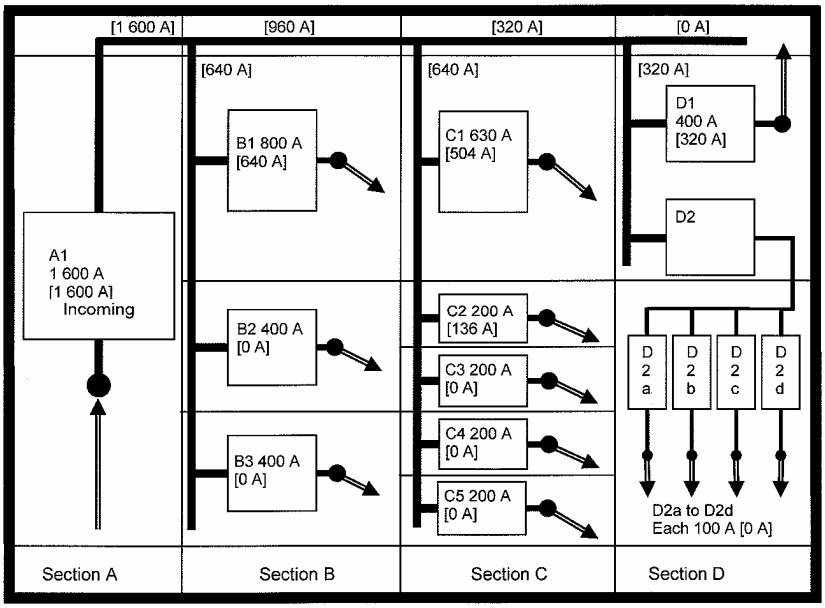
Actual loading is indicated by the figures in brackets e.g. [640 A].
Busbar section loading is indicated by the figure in brackets e.g. [320 A].

Figure E.2 – Example 1: Table E.1 – Functional unit loading for an ASSEMBLY with a rated diversity factor of 0,8

實際負載係以括號內之數字指示，例：[640 A]

匯流排部分負載係以括號內之數字指示，例：[320 A]

圖 E.2　範例 1：表 E.1－額定多樣性因數為 0.8 之組裝品的功能性單元負載



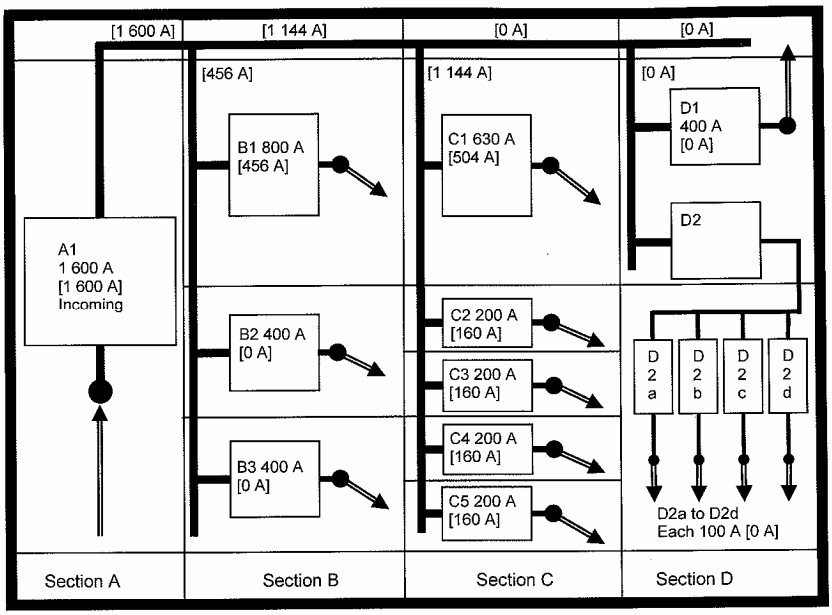
Actual loading is indicated by the figures in brackets e.g. [640 A].
Busbar section loading is indicated by the figure in brackets e.g. [320 A].

Figure E.3 – Example 2: Table E.1 – Functional unit loading for an ASSEMBLY with a rated diversity factor of 0,8

實際負載係以括號內之數字指示，例：[640 A]

匯流排部分負載係以括號內之數字指示，例：[320 A]

圖 E.3　範例 2：表 E.1－額定多樣性因數為 0.8 之組裝品的功能性單元負載



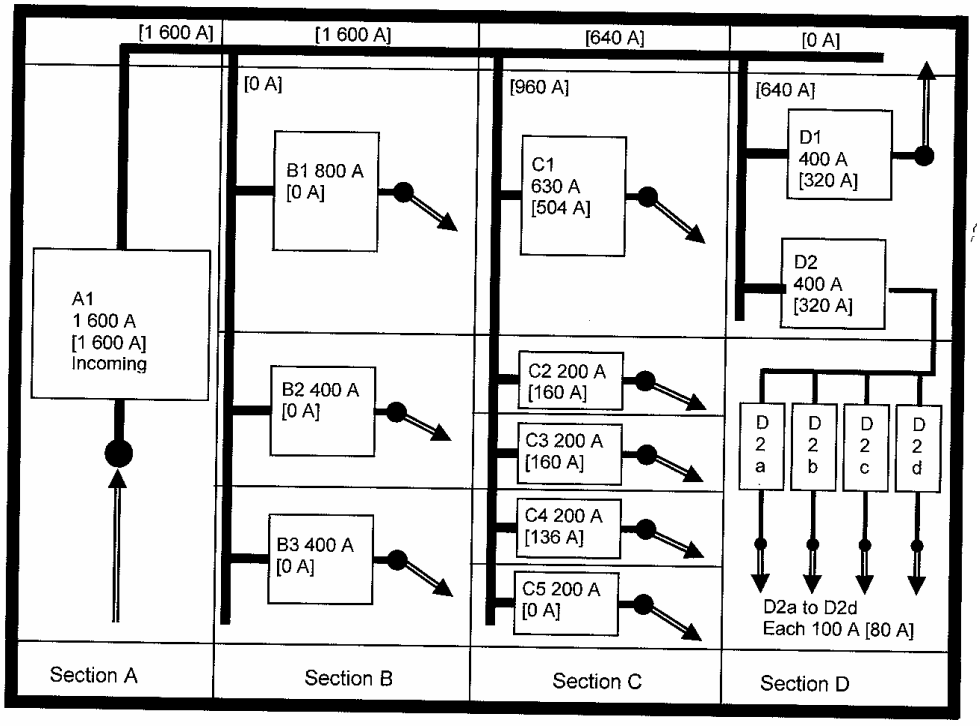
Actual loading is indicated by the figures in brackets e.g. [640 A].
Busbar section loading is indicated by the figure in brackets e.g. [320 A].

Figure E.4 – Example 3: Table E.1 – Functional unit loading for an ASSEMBLY with a rated diversity factor of 0,8

實際負載係以括號內之數字指示，例：[640 A]

匯流排部分負載係以括號內之數字指示，例：[320 A]

圖 E.4　範例 3：表 E.1－額定多樣性因數為 0.8 之組裝品的功能性單元負載



Actual loading is indicated by the figures in brackets e.g. [640 A].
Busbar section loading is indicated by the figure in brackets e.g. [320 A].

Figure E.5 – Example 4: Table E.1 – Functional unit loading for an ASSEMBLY with a rated diversity factor of 0,8

實際負載係以括號內之數字指示，例：[640 A]

匯流排部分負載係以括號內之數字指示，例：[320 A]

圖 E.5　範例 4：表 E.1－額定多樣性因數為 0.8 之組裝品的功能性單元負載

Table E.2 – Example of loading of a group of circuits (Section B – Figure E.1) with a rated diversity factor of 0,9

Functional unit	Distribution busbar Section B	B1	B2	B3
	Current (A)			
Functional unit – Rated current (I_n)	1 440 [a]	800	400	400
Loading – Group of circuits with a rated diversity factor of 0,9	1 440	720	360	360
[a] Minimum rated current to supply the connected functional units at the RDF (0,9).				

表 E.2　額定多樣性因數為 0.9 之電路群組(B 段－圖 E.1)的負載範例

功能性單元	配電匯流排 B 段	B1	B2	B3
	電流(A)			
功能性單元－額定電流(I_n)	1,440 [(a)]	800	400	400
負載－額定多樣性因數為 0.9 之電路群組	1,440	720	360	360
註[(a)]　額定多樣性因數為 0.9 時，供應已連接之功能性單元的最小額定電流。				

Table E.3 – Example of loading of a group of circuits (Sub-distribution board – Figure E.1) with a rated diversity factor of 0,9

Functional unit	D2	D2a	D2b	D2c	D2d
	Current (A)				
Functional unit – Rated current (I_n)	360 [a]	100	100	100	100
Loading – Group of circuits with a rated diversity factor of 0,9	360	90	90	90	90
[a] Minimum rated current to supply the connected functional units at the RDF (0,9).					

表 E.3　額定多樣性因數為 0.9 之電路群組(次配電板－圖 E.1)的負載範例

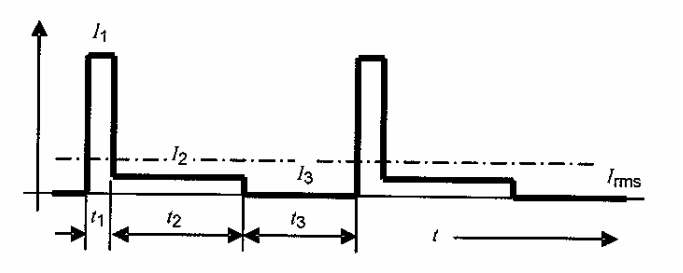
功能性單元	D2	D2a	D2b	D2c	D2d
	電流 (A)				
功能性單元－額定電流(I_n)	360 a	100	100	100	100
負載－額定多樣性因數為 0.9 之電路群組	360	90	90	90	90
註[(a)]　額定多樣性因數為 0.9 時，供應已連接之功能性單元的最小額定電流。					

E.4 Rated diversity factor and intermittent duty

The dissipated heat of circuits built from components with Joule losses is proportional to the true r.m.s value of the current. An equivalent r.m.s current representing the thermal effect of the real intermittent current can be calculated by the formula given below. This enables the thermal equivalent true r.m.s current (I_{eff}) in case of intermittent duty to be determined and thus the permissible load pattern for a given RDF. Care should be taken with ON-times > 30 min since small devices could already reach the thermal equilibrium.

E.4 額定多樣性因數及間歇任務

以具焦耳損失之組件建構之電路，其熱耗散與電流之真實均方根值成正比。等效均方根電流代表實際間歇電流之熱效應，可用下列公式計算而得。此可決定間歇任務之熱動等效實際均方根電流(I_{eff})及已知 RDF 之可容許負載模式。宜留意導通時間大於 30 min 之情況，因為小裝置可能已達到熱平衡。



$$I_{rms} = \sqrt{\frac{t_1^2 \times t_1 + t_2^2 \times t_2 + t_3^2 \times t_3}{t_1 + t_2 + t_3}}$$

$$I_{rms} = \sqrt{\frac{I_1^2 \times t_1 + I_2^2 \times t_2 + I_3^2 \times t_3}{t_1 + t_2 + t_3}}$$

t_1 Starting time at current I_1
t_2 Run time at current I_2
t_3 Interval time at $I_3 = 0$
$t_1 + t_2 + t_3$ Cycle time

IEC 1857/11

Figure E.6 – Example of average heating effect calculation

t_1 電流 I_1 之開始時間

t_2 電流 I_2 之運轉時間

t_3 電流 I_3=0 時之間隔時間

$t_1+t_2+t_3$ 循環時間

圖 E.6 平均加熱效應計算之範例

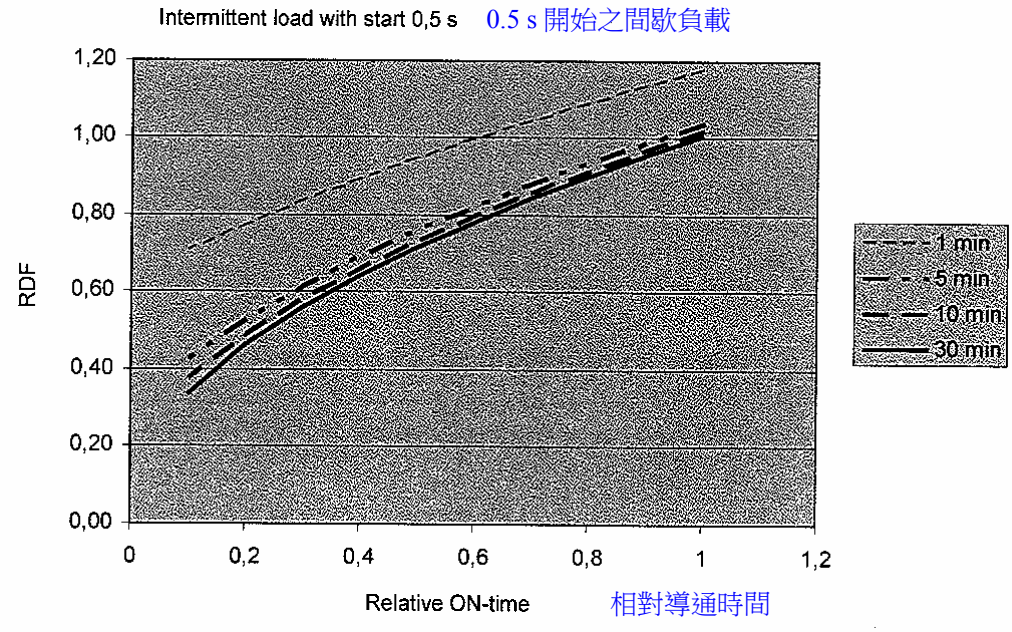


Figure E.7 – Example graph for the relation between the equivalent RDF and the parameters at intermittent duty at t_1 = 0,5 s, I_1 = 7*I_2 at different cycle times

圖 E.7 於間歇任務 t_1=0.5 s、I_1=7*I_2 不同循環次數下，等效 RDF 與參數之關係的範例圖

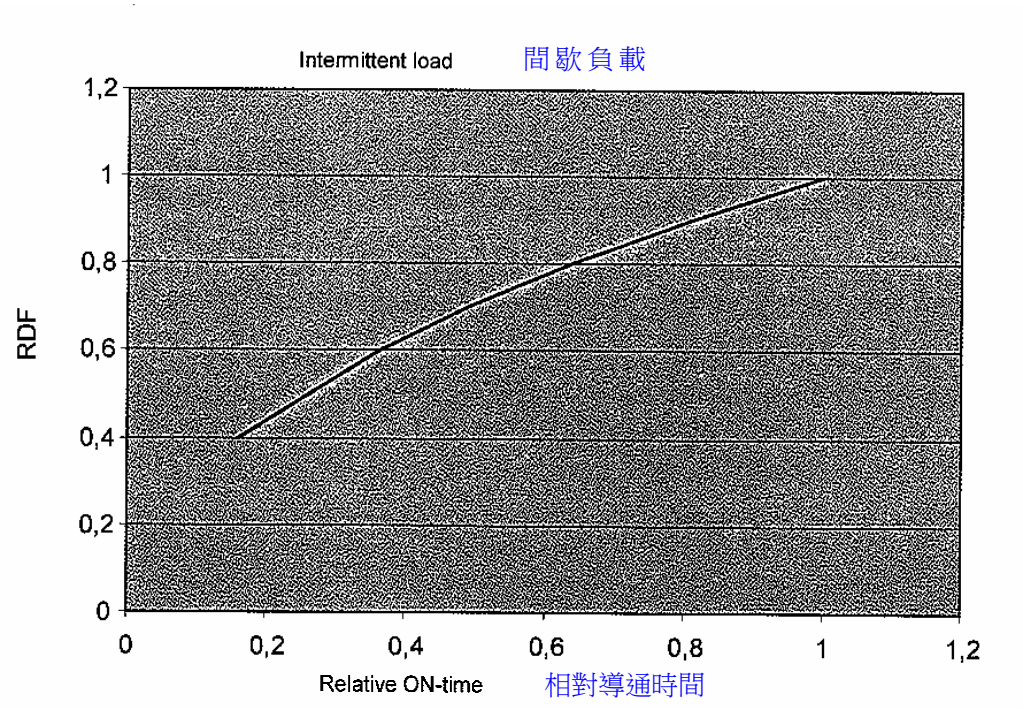


Figure E.8 – Example graph for the relation between the equivalent RDF and the parameters at intermittent duty at $I_1 = I_2$ (no starting overcurrent)

圖 E.8　於間歇任務 I_1=I_2 下，等效 RDF 與參數之關係的範例圖

附錄 F
(規定)
空間距離及沿面距離之量測(6)

Annex F
(normative)
Measurement of clearances and creepage distances 6

F.1 Basic principles

The width X of the grooves specified in the following examples 1 to 11 basically apply to all examples as a function of pollution as follows:

Table F.1 – Minimum width of grooves

Pollution degree	Minimum values of width X of grooves mm
1	0,25
2	1,0
3	1,5
4	2,5

6 This Annex F is based on IEC 60664-1:2007.

註(6)　本附錄係依據 IEC 60664-1:2007。

F.1 基本原理

下列範例 1 至範例 11 所規定之溝槽的寬度 X，基本上適用於所有範例，其為污染之函數。

表 F.1　溝槽之最小寬度

污染等級	溝槽之寬度 X 的最小值
1	0.25
2	1.0
3	1.5
4	2.5

If the associated clearance is less than 3 mm, the minimum groove width may be reduced to one-third of this clearance.

The methods of measuring clearances and creepage distances are indicated in examples 1 to 11. These examples do not differentiate between gaps and grooves or between types of insulation.

Furthermore:

- any corner is assumed to be bridged with an insulating link of X mm width moved into the most unfavourable position (see example 3);
- where the distance across the top of a groove is X mm or more, a creepage distance is measured along the contours of the grooves (see example 2);
- clearances and creepage distances measured between parts moving in relation to each other are measured when these parts are in their most unfavourable positions.

若相關聯之空間距離小於 3 mm，則最小溝槽寬度可降至此空間距離之 1/3。

有關量測空間距離及沿面距離之方法，如範例 1 至範例 11 所示。此等範例並未區分間隙與溝槽或絕緣型式。

此外，

－ 任何角隅係假定被移至最不利位置之 X mm 寬的絕緣鏈所橋接(參照範例 3)。

－ 當溝槽頂端之距離在 X mm 以上時，沿溝槽之輪廓量測沿面距離(參照範例 2)。

－ 可相對移動之零件在移至最不利的位置後，量測此等零件之間的沿面距離及空間距離。

F.2 Use of ribs

Because of their influence on contamination and their better drying-out effect, ribs considerably decrease the formation of leakage current. Creepage distances can therefore be reduced to 0,8 of the required value, provided the minimum height of the ribs is 2 mm, see Figure F.1.

F.2 肋之使用

由於肋在污染之影響及具有較佳之乾涸效果，肋大量減低洩漏電流之形成。因此，倘肋之最小高度為 2 mm，則沿面距離可降低至要求值之 0.8，參照圖 F.1。

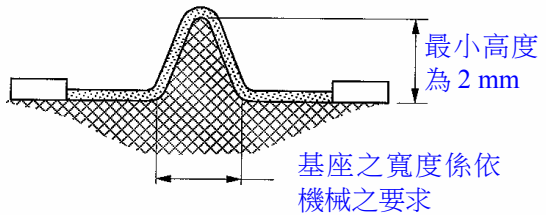


圖 F.1 (a)　肋之量測：範例

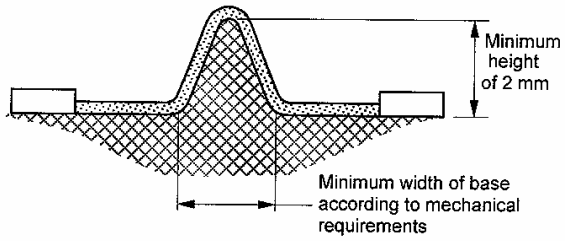
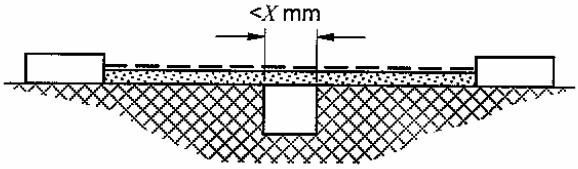


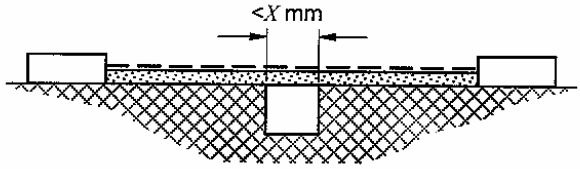
Figure F.1 a) – Measurement of ribs: examples



條件：此沿面距離路徑包括寬度小於 X mm 之任何深度的平行側或收斂側溝槽。

規則：直接從圖示之溝槽上方量測沿面距離及空間距離。

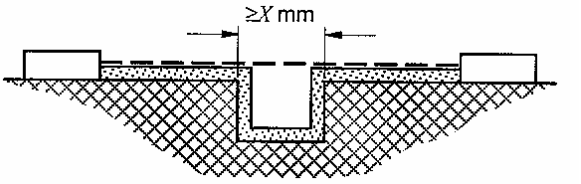
圖 F.1 (b)　範例 1



Condition: This creepage distance path includes a parallel- or converging-sided groove of any depth with a width less than *X* mm.

Rule: Creepage distance and clearances are measured directly across the groove as shown.

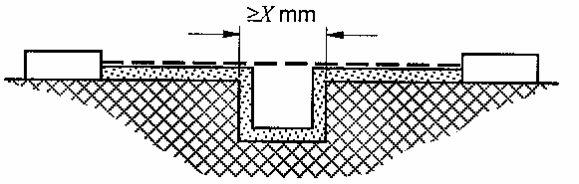
Figure F.1 b) – Example 1



條件：此沿面距離路徑包括寬度等於或大於 X mm 之任何深度的平行側溝槽。

規則：空間距離為〝視線〞距離。沿面距離路徑係沿著溝槽輪廓。

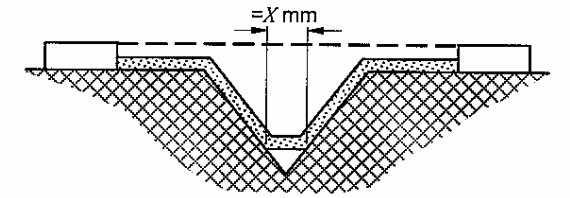
圖 F.1 (c)　範例 2



Condition: This creepage distance path includes a parallel-sided groove of any depth and equal to or more than *X* mm.

Rule: Clearance is the "line-of-sight" distance. Creepage distance path follows the contour of the groove.

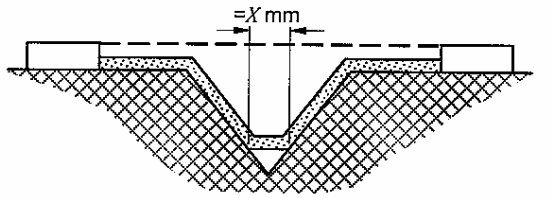
Figure F.1 c) – Example 2



條件：此沿面距離路徑包括寬度大於 X mm 之 V 形溝槽。

規則：空間距離為〝視線〞距離。沿面距離路徑係沿著溝槽輪廓，但以 X mm 之鏈將溝槽之底部予以〝短路〞。

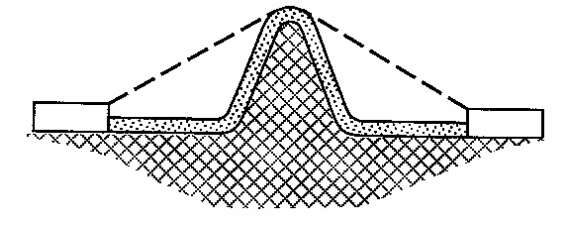
圖 F.1 (d)　範例 3



Condition: This creepage distance path includes a V-shaped groove with a width greater than *X* mm

Rule: Clearance is the "line-of-sight" distance. Creepage distance path follows the contour of the groove but "short-circuits" the bottom of the groove by *X* mm link.

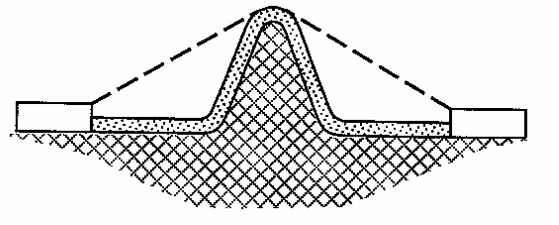
Figure F.1 d) – Example 3



條件：此沿面距離路徑包括肋。

規則：空間距離為肋上方之最短空氣路徑。沿面距離路徑係沿著肋之輪廓。

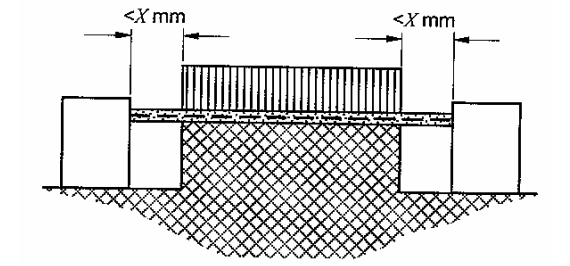
圖 F.1 (e)　範例 4



Condition: This creepage distance path includes a rib.

Rule: Clearance is the shortest air path over the top of the rib. Creepage path follows the contour of the rib.

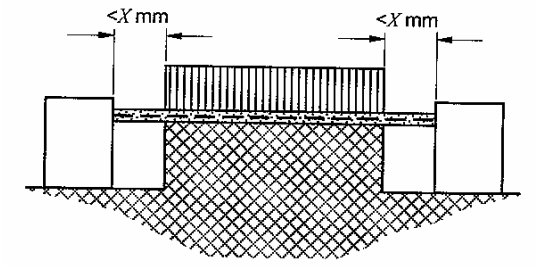
Figure F.1 e) – Example 4



條件：此沿面距離路徑包括未充填接合之接合處，其溝槽在每側之寬度小於 X mm。

規則：沿面距離及空間距離路徑為所示之〝視線〞距離。

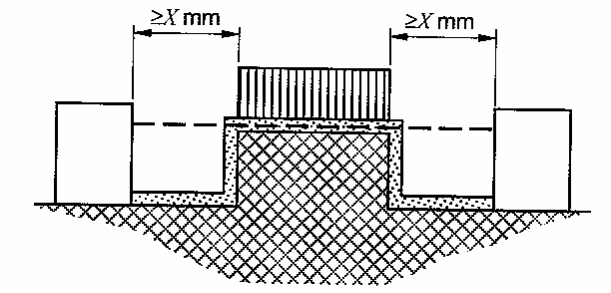
圖 F.1 (f)　範例 5



Condition: This creepage distance path includes an uncemented joint with grooves less than *X* mm wide on each side.

Rule: Creepage distance and clearance paths are the "line-of-sight" distance shown.

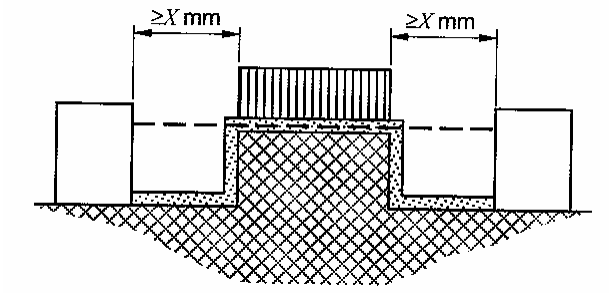
Figure F.1 f) – Example 5



條件：此沿面距離路徑包括未充填接合處，其溝槽在每側之寬度等於或大於 X mm。

規則：空間距離為〝視線〞距離。沿面距離路徑係沿著溝槽輪廓。

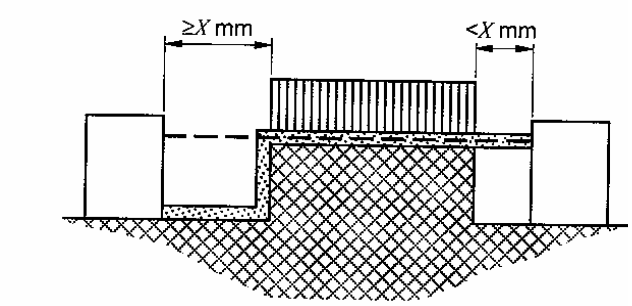
圖 F.1 (g)　範例 6



Condition: This creepage distance path includes an uncemented joint with grooves equal to or more than *X* mm wide on each side.

Rule: Clearance is the "line-of-sight" distance. Creepage distance path follows the contour of the grooves.

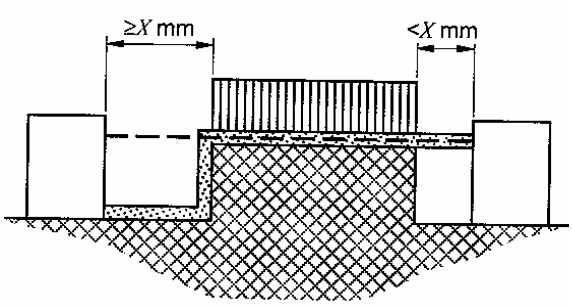
Figure F.1 g) – Example 6



條件：此沿面距離路徑包括未充填接合處，其溝槽在其中 1 側之寬度小於 X mm，且在其他側之寬度等於或大於 X mm。

規則：空間距離及沿面距離路徑如圖所示。

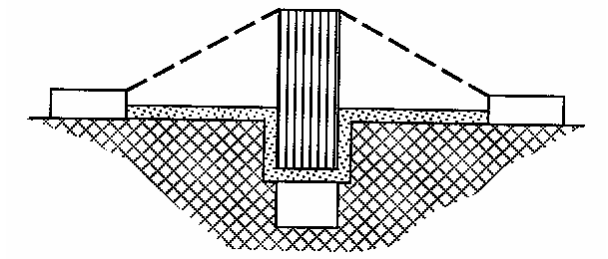
圖 F.1 (h)　範例 7



Condition: This creepage distance path includes an uncemented joint with a groove on one side less than *X* mm wide and the groove on the other side equal to or more than *X* mm wide.

Rule: Clearances and creepage distance paths are as shown.

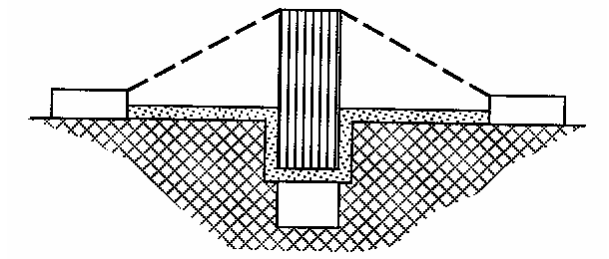
Figure F.1 h) – Example 7



條件：通過未充填接合處之沿面距離，小於障壁上方之沿面距離。

規則：空間距離為障壁上方之最短直接空氣路徑。

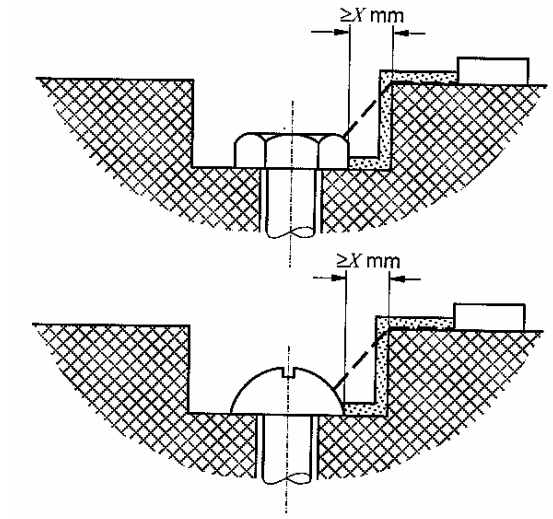
圖 F.1 (i)　範例 8



Condition: Creepage distance through uncemented joint is less than creepage distance over barrier.

Rule: Clearance is the shortest direct air path over the top of the barrier.

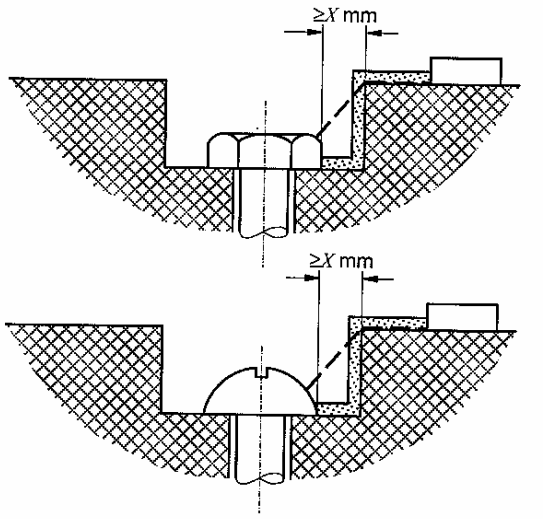
Figure F.1 i) – Example 8



條件：螺釘頭部與凹槽壁之間的間隙夠寬，須列入考量。

規則：空間距離及沿面距離路徑如圖所示。

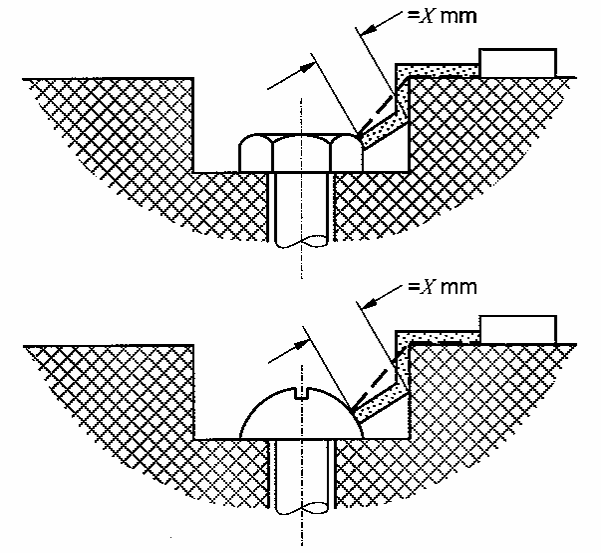
圖 F.1 (j)　範例 9



Condition: Gap between head of screw and wall of recess wide enough to be taken into account.

Rule: Clearances and creepage distance paths are as shown.

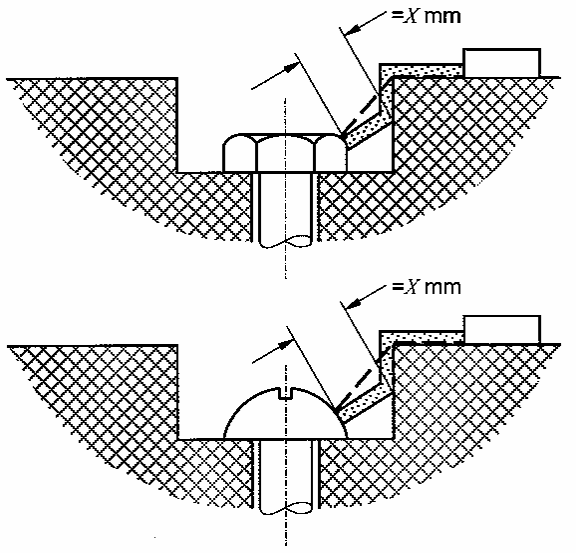
Figure F.1 j) – Example 9



條件：螺釘頭部與凹槽壁之間的間隙太窄，無須列入考量。

規則：當沿面距離等於 X mm 時，沿面距離之量測係從螺釘至壁。

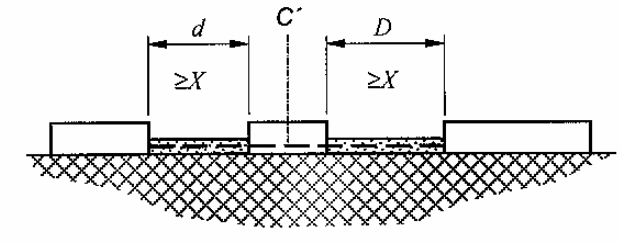
圖 F.1 (k)　範例 10



Condition: Gap between head of screw and wall of recess too narrow to be taken into account.

Rule: Measurement of creepage distance is from screw to wall when the distance is equal to *X* mm.

Figure F.1 k) – Example 10

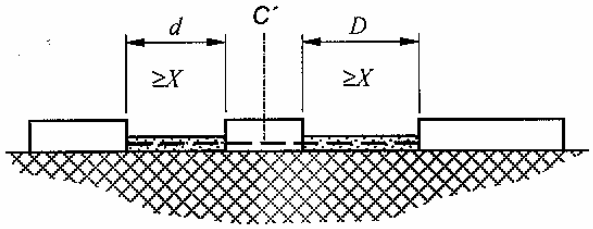


C’ 浮點

空間距離為 d+D

沿面距離亦為 d+D

圖 F.1 (l) 範例 11



C' Floating part

Clearance is the distance $d + D$

Creepage distance is also $d + D$

Figure F.1 l) – Example 11

空間距離

沿面距離

圖 F.1 肋之量測：範例

Clearance

Creepage distance

Figure F.1 – Measurement of ribs

Annex G
(normative)
Correlation between the nominal voltage of the supply system and the rated impulse withstand voltage of the equipment[7]

This annex is intended to give the necessary information concerning the choice of equipment for use in a circuit within an electrical system or part thereof.

Table G.1 provides examples of the correlation between nominal supply system voltages and the corresponding rated impulse withstand voltage of the equipment.

The values of rated impulse voltage given in Table G.1 are based on 4.3.3 of IEC 60664-1:2007. Further information about criteria for the selection of an appropriate overvoltage category and overvoltage protection (if necessary) is given in IEC 60364-4-44:2007, Clause 443.

It should be recognized that control of overvoltages with respect to the values in Table G.1 can also be achieved by conditions in the supply system such as the existence of a suitable impedance or cable feed.

7 This annex is based on Annex H of IEC 60947-1:2007.

附錄 G
(規定)
供電系統之標稱電壓與設備之額定衝擊耐電壓之間的關係 (7)

本附錄係提供有關選擇設備之必要資訊，以供在電氣系統或其零件內之電路所使用。

表 G.1 提供標稱電源系統電壓與相對應之設備額定衝擊電壓之關係的範例。

表 G.1 所示之額定衝擊電壓值係以 IEC 60664-1:2007 之 4.3.3 為基礎。有關選擇適當過電壓類別及過電壓保護(若有必要時)之準則的進一步資訊，如 IEC 60364-4-44:2007 第 443 節所示。

宜確認在表 G.1 之值方面之過電壓控制，亦可藉由電源系統(例：存在適合之阻抗或電纜饋送)中之條件來達成。

註(7) 本附錄係依據 IEC 60947-1:2007 之附錄 H。

Table G.1 – Correspondence between the nominal voltage of the supply system and the equipment rated impulse withstand voltage

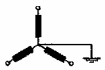
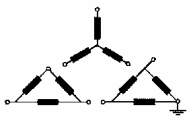
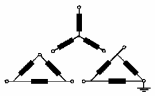
Maximum value of rated operational voltage to earth, a.c. r.m.s. or d.c. V	Nominal voltage of the supply system (≤ rated insulation voltage of the equipment) V				Preferred values of rated impulse withstand voltage (1,2/50 µs) at 2 000 m kV			
					Overvoltage category			
					IV	III	II	I
	 AC r.m.s.	 AC r.m.s.	AC r.m.s. or d.c.	 AC r.m.s. or d.c.	Origin of installation (service entrance) level	Distribution circuit level	Load (appliance, equipment) level	Specially protected level
50	–	–	12,5, 24, 25, 30, 42, 48		1,5	0,8	0,5	0,33
100	66/115	66	60	–	2,5	1,5	0,8	0,5
150	120/208 127/220	115, 120 127	110, 120	220-110, 240-120	4	2,5	1,5	0,8
300	220/380, 230/400 240/415, 260/440 277/480	220, 230 240, 260 277	220	440-220	6	4	2,5	1,5
600	347/600, 380/660 400/690, 415/720 480/830	347, 380, 400 415, 440, 480 500, 577, 600	480	960-480	8	6	4	2,5
1 000	–	660 690, 720 830, 1 000	1 000	–	12	8	6	4

表 G.1　電源系統及之標稱電壓與設備額定衝擊耐電壓之關係

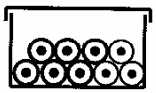
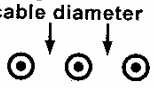
額定操作電壓至地之最大值直流均方根或直流 V	電源系統之標稱電壓 (≤設備之額定絕緣電壓)				於 2,000 m 時額定衝擊耐電壓(1.2 50 µs)之首選值			
					過電壓類別			
					IV	III	II	I
	 直流均方根	 直流均方根	直流均方根或直流	 直流均方根或直流	安裝設備之原點(使用入口位準)	配電電路位準	負載(電器、設備位準)	特別保護之位準
50	—	—	12.5, 24, 25, 30, 42, 48	—	1.5	0.8	0.5	0.33
100	66/115	66	60	—	2.5	1.5	0.8	0.5
150	120/208 127/220	115, 120 127	110, 120	220-110, 240-120	4	2.5	1.5	0.8
300	220/380 230/400 240/415 260/440 277/480	220 230 240 260 277	220	440-220	6	4	2.5	1.5
600	347/600 380/660 400/690 415/720 480/830	347, 380, 400 415, 440, 480 500, 577, 600	480	960-480	8	6	4	2.5
1,000	—	660 690,720 830, 1 000	1 000	"	12	8	6	4

Annex H
(informative)

Operating current and power loss of copper conductors

The following tables provide guidance values for conductor operating currents and power losses under ideal conditions within an ASSEMBLY. The calculation methods used to establish these values are given to enable values to be calculated for other conditions.

Table H.1 – Operating current and power loss of single-core copper cables with a permissible conductor temperature of 70 °C (ambient temperature inside the ASSEMBLY: 55 °C)

Conductor arrangement		 Single-core cables in a cable trunking on a wall, run horizontally. 6 of the cables (2 three-phase circuits) continuously loaded		 Single-core cables, touching free in air or on a perforated tray. 6 cables (2 three-phase circuits) continuously loaded		 Single-core cables, spaced horizontally in free air	
Cross-sectional area of conductor	Resistance of conductor at 20°C, R_{20} [a]	Max. operating current I_{max} [b]	Power-losses per conductor P_v	Max. operating current I_{max} [c]	Power-losses per conductor P_v	Max. operating current I_{max} [d]	Power-losses per conductor P_v
mm²	mΩ/m	A	W/m	A	W/m	A	W/m
1,5	12,1	8	0,8	9	1,3	15	3,2
2,5	7,41	10	0,9	13	1,5	21	3,7
4	4,61	14	1,0	18	1,7	28	4,2
6	3,08	18	1,1	23	2,0	36	4,7
10	1,83	24	1,3	32	2,3	50	5,4
16	1,15	33	1,5	44	2,7	67	6,2
25	0,727	43	1,6	59	3,0	89	6,9
35	0,524	54	1,8	74	3,4	110	7,7
50	0,387	65	2,0	90	3,7	134	8,3
70	0,268	83	2,2	116	4,3	171	9,4
95	0,193	101	2,4	142	4,7	208	10,0
120	0,153	117	2,5	165	5,0	242	10,7
150	0,124			191	5,4	278	11,5
185	0,099 1			220	5,7	318	12,0
240	0,075 4			260	6,1	375	12,7

a Values from IEC 60228:2004, Table 2 (stranded conductors).

b Current carrying capacity I_{30} for one three-phase circuit from IEC 60364-5-52:2009, Table B.52.4, col. 4 (Method of installation: item 6 in Table B.52.3). k_2=0,8 (item 1 in Table B.52.17, two circuits).

c Current carrying capacity I_{30} for one three-phase circuit from IEC 60364-5-52:2009, Table B.52.10, col. 5 (Method of installation: Item F in Table B.52.1). Values for cross-sections less than 25 mm² calculated following Annex D of IEC 60364-5-52:2009. k_2=0,88 (item 4 in Table B.52.17, two circuits).

d Current carrying capacity I_{30} for one three-phase circuit from IEC 60364-5-52, Table B.52.10, col. 7 (Method of installation: item G in Table B.52.1). Values for cross-sections less than 25 mm² calculated following Annex D of IEC 60364-5-52:2009. (k_2=1)

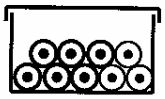
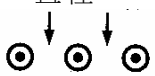
附錄 H

(規定)

銅導體之操作電流及功率損失

下列各表提供在組裝品內之理想條件下，有關導體操作電流及功率損失之指引值。本附錄提供用於建立此等值所使用之計算方法，以便能針對其他條件計算其值。

表 H.1　在可容許之導體溫度 70℃下(組裝品內部周圍溫度：55℃)，單芯銅電纜之操作電流及功率損失

導體配置						間隔至少 1 條電纜直徑 	
						單芯電纜，在自由空氣中水平間隔	
導體之截面積 mm²	20℃下導體之電阻 R_{20} [(a)] mΩ/m	最大操作電流 I_{max} [(b)] A	每個導體之功率損失 P_v W/m	最大操作電流 I_{max} [(c)] A	每個導體之功率損失 P_v W/m	最大操作電流 I_{max} [(d)] A	每個導體之功率損失 P_v W/m
1.5	12.1	8	0.8	9	1.3	15	3.2
2.5	7.41	10	0.9	13	1.5	21	3.7
4	4.61	14	1.0	18	1.7	28	4.2
6	3.08	18	1.1	23	2.0	36	4.7
10	1.83	24	1.3	32	2.3	50	5.4
16	1.15	33	1.5	44	2.7	67	6.2
25	0.727	43	1.6	59	3.0	89	6.9
35	0.524	54	1.8	74	3.4	110	7.7
50	0.387	65	2.0	90	3.7	134	8.3
70	0.268	83	2.2	116	4.3	171	9.4
95	0.193	101	2.4	142	4.7	208	10.0
120	0.153	117	2.5	165	5.0	242	10.7
150	0.124			191	5.4	278	11.5
185	0.0991			220	5.7	318	12.0
240	0.0754			260	6.1	375	12.7

註[(a)] 參照 IEC 60228:2004 表 2 之值(標準導體)。

[(b)] 三相電路之電流承載容量 I_{30}，其來自 IEC 60364-5-52:2009 表 B.52.4 第 4 欄(安裝方法：表 B.52.3 第 6 項)。k_2=0.8 (表 B.52.17 第 1 項，2 個電路)。

[(c)] 三相電路之電流承載容量 I_{30}，其來自 IEC 60364-5-52:2009 表 B.52.10 第 5 欄(安裝方法：表 B.52.1 第 F 項)。k_2=0.88 (表 B.52.17 第 4 項，2 個電路)。

[(d)] 三相電路之電流承載容量 I_{30}，其來自 IEC 60364-5-52 表 B.52.10 第 7 欄(安裝方法：表 B.52.1 第 G 項)。截面積值小於 25 mm²，係依 IEC 60364-5-52:2009 附錄 D 計算(k_2=1)。

$$I_{max} = I_{30} \times k_1 \times k_2 \qquad P_v = I_{max}^2 \times R_{20} \times [1 + \alpha \times (T_c - 20\,°C)]$$

where

k_1 reduction factor for air temperature inside the enclosure around the conductors (IEC 60364-5-52:2009, Table B.52.14)
k_1 = 0,61 for conductor temperature 70 °C, ambient temperature 55 °C
k_1 for other air temperatures: see Table H.2;

k_2 reduction factor for groups of more than one circuit (IEC 60364-5-52:2009, Table B.52.17) ;

α temperature coefficient of resistance, α = 0,004 K^{-1};

T_c conductor temperature.

Table H.2 – Reduction factor k_1 for cables with a permissible conductor temperature of 70 °C (extract from IEC 60364-5-52:2009, Table B.52.14)

Air temperature inside the enclosure around the conductors °C	Reduction factor k_1
20	1,12
25	1,06
30	1,00
35	0,94
40	0,87
45	0,79
50	0,71
55	0,61
60	0,50

NOTE If the operating current in Table H.1 is converted for other air temperatures using the reduction factor k_1, then also the corresponding power losses must be calculated using the formula given above.

$$I_{max} = I_{30} \times k_1 \times k_2 \qquad P_v = I_{max}^2 \times R_{20} \times [1 + \alpha \times (T_c - 20°C)]$$

式中，k_1，導體周圍之箱體內的空氣溫度之縮減因數(IEC 60364-5-52:2009 表 B.52.14)。導體溫度 70℃、周圍溫度 55℃時，k_1=0.61；有關其他空氣溫度時之 k_1，參照表 H.2。

k_2，超過 1 個電路之縮減因數(IEC 60364-5-52:2009 表 B.52.17)。

α，電阻之溫度係數，α=0.004 K^{-1}。

T_c，導體溫度。

表 H.2　可容許之導體溫度為 70℃的電纜之縮減因數 k_1(摘錄自 IEC 60364-5-52:2009 表 B.52.14)

導體周圍之箱體內的空氣溫度 ℃	縮減因數 k_1
20	1.12
25	1.06
30	1.00
35	0.94
40	0.87
45	0.79
50	0.71
55	0.61
60	0.50

備考：若使用縮減因數 k_1 針對其他溫度轉換表 H.1 之操作電流，則亦必須使用上述公式計算相對應之功率損失。

附錄 I

(空白)

Annex I

(Void)

附錄 J

(規定)

電磁相容(EMC)

Annex J
(normative)

Electromagnetic compatibility (EMC)

J.1 General

The subclause numbering within this annex aligns with that of the body of the standard.

J.1 一般

本附錄之節次編號，係配合標準內文之節次編號。

J.2 Terms and definitions

For the purposes of this annex, the following terms and definitions apply. (See Figure J.1)

J.2 用語及定義

適用下列用語及定義(參照圖 J.1)。

J.3.8.13.1
port
particular interface of the specified apparatus with external electromagnetic environment

J.3.8.13.1 埠(port)

特定設備與外部電磁環境之間的特殊介面。

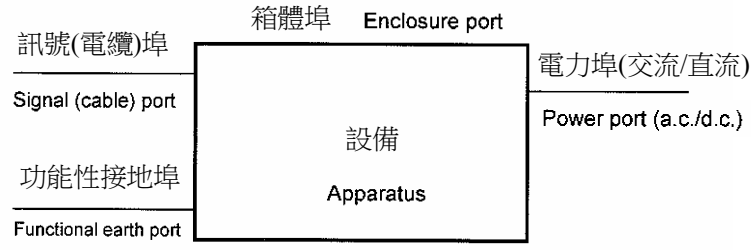


Figure J.1 – Examples of ports

圖 J.1 埠之範例

J.3.8.13.2
enclosure port
physical boundary of the apparatus through which electromagnetic fields may radiate or impinge on

J.3.8.13.2 箱體埠(enclosure port)

設備之實體邊界，透過此邊界可將電磁場輻射或照射出去。

J.3.8.13.3
functional earth port
port other than signal, control or power port, intended for connection to earth for purposes other than electrical safety

J.3.8.13.3 功能性接地埠(functional earth port)

訊號、控制或電力埠除外之埠，其係供電氣安全除外之用途，作為接地連接之用。

J.3.8.13.4
signal port
port at which a conductor or cable intended to carry signals is connected to the apparatus

NOTE Examples are analogue inputs, outputs and control lines; data busses; communication networks etc.

[3.4 of IEC 61000-6-1:2005]

J.3.8.13.4 訊號埠(signal port)

承載訊號之導體或電纜所連接至設備之埠。

備考：範例為類比輸入、輸出及控制線、數據線、通訊網路等。

[IEC 61000-6-1:2005 之 3.4]

J.3.8.13.5
power port
port at which a conductor or cable carrying the primary electrical power needed for the operation (functioning) of an apparatus or associated apparatus is connected to the apparatus

J.3.8.13.5 電力埠(power port)

承載設備或相關聯設備操作時所需之主要電力的導體或電纜所連接至設備之埠。

J.9.4 Performance requirements

J.9.4.1 General

For the majority of ASSEMBLIES applications falling within the scope of this standard, two sets of environmental conditions are considered and are referred to as

a) Environment A;
b) Environment B.

J.9.4 性能要求

J.9.4.1一般

本標準適用範圍內之大多數組裝品應用，考量 2 組環境條件，並歸類如下。

(a) 環境 A。

(b) 環境 B。

Environment A: relates to a power network supplied from a high or medium voltage transformer dedicated to the supply of an installation feeding manufacturing or similar plant, and intended to operate in or in proximity to industrial locations, as described below. This standard applies also to apparatus which is battery operated and intended to be used in industrial locations.

The environments encompassed are industrial, both indoor and outdoor.

Industrial locations are in addition characterised by the existence of one or more of the following examples:

- industrial, scientific and medical (ISM) apparatus (as defined in CISPR 11);
- heavy inductive or capacitive loads are frequently switched;
- currents and associated magnetic fields are high.

NOTE 1 Environment A is covered by the generic EMC standards IEC 61000-6-2 and IEC 61000-6-4.

環境 A：與由專門對安裝饋送製造或類似工廠供電之高電壓或中電壓變壓器供電之電力網路有關，且用於在如下所述之工業區中或附近操作。本標準亦適用於以電池操作且在工業區使用之設備。

所圍繞之環境為工業用，包括屋內及屋外兩者。

工業區另外係以下列 1 種或多種範例之存在描述其特性

－工業、科學及醫學(ISM)設備(如 CISPR 11 所定義)。

－重電感或電容負載頻繁切換。

－電流及相聯結之磁場高。

備考 1. 環境 A 包含於 IEC 61000-6-2 及 IEC 61000-6-4 等一般 EMC 標準中。

Environment B: relates to low-voltage public mains networks or apparatus connected to a dedicated DC source which is intended to interface between the apparatus and the low-voltage public mains network. It applies also to apparatus which is battery operated or is powered by a non-public, but non-industrial, low voltage power distribution system if this apparatus is intended to be used in the locations described below.

The environments encompassed are residential, commercial and light-industrial locations, both indoor and outdoor. The following list, although not comprehensive, gives an indication of locations which are included:

- residential properties, for example houses, apartments;
- retail outlets, for example shops, supermarkets;
- business premises, for example offices, banks;
- areas of public entertainment, for example cinemas, public bars, dance halls; outdoor locations, for example petrol stations, car parks, amusement and sports centres;
- light-industrial locations, for example workshops, laboratories, service centres.

Locations which are characterised by being supplied directly at low voltage from the public mains network are considered to be residential, commercial or light-industrial.

NOTE 2 Environment B is covered by the generic EMC standards IEC 61000-6-1 and IEC 61000-6-3.

The environmental condition A and/or B for which the ASSEMBLY is suitable shall be stated by the ASSEMBLY manufacturer.

環境 B：與連接至專用直流電源之低電壓公共電力網或設備有關，該直流電源成為設備與低電壓公共電力網之界面。其亦適用於電池操作式之設備，或當設備預定使用於下述場所時，適用於以非公共(但非工業)低電壓配電系統供電之設備。

所圍繞之環境為住宅、商業或輕工業，包括屋內及屋外兩者。下列為所包括之位置指示，雖然並非詳盡。

－ 住宅房舍，例：房子、公寓。

－ 零售商店，例：店鋪、超市。

－ 商業場所，例：辦公室、銀行。

－ 公共娛樂區，例：電影院、公共酒吧、舞廳；戶外場所，例：加油站、停車場、娛樂及運動中心。

－ 輕工業區，例：工作室、實驗室、服務中心。

以從公共電力網之低電壓直接供電描述特徵之場所，視為住宅、商業或輕工業。

備考 2. 環境 B 包含於 IEC 61000-6-1 及 IEC 61000-6-3 等一般 EMC 標準中。

組裝品所適合之環境條件 A 及/或環境條件 B，應由組裝品製造廠商指定。

J.9.4.2 Requirement for testing

ASSEMBLIES are in most cases manufactured or assembled on a one-off basis, incorporating a more or less random-combination of devices and components.

No EMC immunity or emission tests are required on final ASSEMBLIES if the following conditions are fulfilled:

a) the incorporated devices and components are in compliance with the requirements for EMC for the stated environment (see J.9.4.1) as required by the relevant product or generic EMC standard.

b) the internal installation and wiring is carried out in accordance with the devices and components manufacturer's instructions (arrangement with regard to mutual influences, cable, screening, earthing etc.)

In all other cases the EMC requirements are to be verified by tests as per J.10.12.

J.9.4.2試驗之要求

在多數情況中，組裝品係於離線基礎上製造或組裝，其含有或多或少之隨機組合裝置及組件。

若符合下列條件，則最終之組裝品不需要 EMC 抗擾度或發射試驗。

(a) 所包含之裝置及組件符合相關產品或一般 EMC 標準指定之環境的 EMC 要求(參照 J.9.4.1)。

(b) 依裝置及組件製造廠商之說明書，進行內部安裝及配線(關於相互影響、電纜、遮蔽、接地等之協議)。

在所有其他情況中，EMC 要求須依 J.10.12 之試驗查證。

J.9.4.3 Immunity

J.9.4.3.1 ASSEMBLIES not incorporating electronic circuits

Under normal service conditions, ASSEMBLIES not incorporating electronic circuits are not sensitive to electromagnetic disturbances and therefore no immunity tests are required.

J.9.4.3抗擾度

J.9.4.3.1 未含有電子電路之組裝品

於正常使用條件下，未含電子電路之組裝品對電磁干擾不敏感，因此不需要進行抗擾度試驗。

J.9.4.3.2 ASSEMBLIES incorporating electronic circuits

Electronic equipment incorporated in ASSEMBLIES shall comply with the immunity requirements of the relevant product or generic EMC standard and shall be suitable for the specified EMC environment stated by the ASSEMBLY manufacturer.

In all other cases the EMC requirements are to be verified by tests as per J.10.12.

Equipment utilizing electronic circuits in which all components are passive (for example diodes, resistors, varistors, capacitors, surge suppressors, inductors) are not required to be tested.

The ASSEMBLY manufacturer shall obtain from the device and or component manufacturer the specific performance criteria of the product based on the acceptance criteria given in the relevant product standard.

J.9.4.3.2 含有電子電路之組裝品

包含於組裝品內之電子設備，應符合相關產品或一般 EMC 標準之抗擾度要求，且應適合於組裝品製造廠商指定之特定 EMC 環境。

在所有其他情況中，EMC 要求須依 J.10.12 之試驗查證。

使用電子電路之設備，其內之所有組件為被動式(例：二極體、電阻器、壓敏電阻、電容器、突波抑制器、電感器)，該設備不需要進行試驗。

組裝品製造廠商應從裝置及/或組件製造廠商取得產品之特定性能準則，該準則係以相關產品標準所示之允收準則為基礎。

J.9.4.4 Emission

J.9.4.4.1 ASSEMBLIES not incorporating electronic circuits

For ASSEMBLIES not incorporating electronic circuits, electromagnetic disturbances can only be generated by equipment during occasional switching operations. The duration of the disturbances is of the order of milliseconds. The frequency, the level and the consequences of these emissions are considered as part of the normal electromagnetic environment of low-voltage installations. Therefore, the requirements for electromagnetic emission are deemed to be satisfied, and no verification is necessary.

J.9.4.4發射

J.9.4.4.1 未含有電子電路之組裝品

對於未含有電子電路之組裝品，電磁干擾僅能由偶發開關切換操作期間之設備產生。干擾之持續時間為數毫秒之等級。此等發射之頻率、位準及結果，視為低電壓裝備之正常電磁環境的一部分。因此，電磁發射之要求視為滿足，且不需要進行查證。

J.9.4.4.2 ASSEMBLIES incorporating electronic circuits

Electronic equipment incorporated in the ASSEMBLY shall comply with the emission requirements of the relevant product or generic EMC standard and shall be suitable for the specific EMC environment stated by the ASSEMBLY manufacturer.

ASSEMBLIES incorporating electronic circuits (such as switched mode power supplies, circuits incorporating microprocessors with high-frequency clocks) may generate continuous electromagnetic disturbances.

For such emissions, these shall not exceed the limits specified in the relevant product standard, or the requirements of IEC 61000-6-4 for environment A and/or IEC 61000-6-3 for environment B shall apply. Tests are to be carried out as detailed in the relevant product standard, if any, otherwise according to J.10.12.

J.9.4.4.2 含有電子電路之組裝品

包含於組裝品內之電子設備，應符合相關產品或一般 EMC 標準之發射要求，且應適合於組裝品製造廠商指定之特定 EMC 環境。

含有電子電路(例：開關切換模式電源、含有高頻時脈微處理器之電路)之組裝品，可產生連續電磁干擾。

關於此等發射，其不應超過相關標準所規定之限制，或應適用環境 A 用之 IEC 61000-6-4 要求及/或環境 B 用之 IEC 61000-6-3 要求。試驗須依相關產品標準(若有時)所述之方式進行，否則須依 J.10.12。

J.10.12 Tests for EMC

Functional units within ASSEMBLIES which do not fulfil the requirements of J.9.4.2 a) and b) shall be subjected to the following tests, as applicable.

The emission and immunity tests shall be carried out in accordance with the relevant EMC standard. However, the ASSEMBLY manufacturer shall specify any additional measures necessary to verify the criteria of performance for the ASSEMBLIES if necessary (e.g. application of dwell times).

J.10.12 EMC 之試驗

組裝品內之功能性單元不符合 J.9.4.2 (a)及(b)之要求，應進行下列適用之試驗。

發射及抗擾度試驗應依相關 EMC 標準進行試驗。然而，若有必要時，組裝品製造廠商應規定查證組裝品之性能準則所必要之任何措施(例：停留時間)。

J.10.12.1 Immunity tests

J.10.12.1.1 ASSEMBLIES not incorporating electronic circuits

No tests are necessary; see J.9.4.3.1.

J.10.12.1 抗擾度試驗

J.10.12.1.1 未含有電子電路之組裝品

不需要任何試驗。參照 J.9.4.4.1。

J.10.12.1.2 ASSEMBLIES incorporating electronic circuits

Tests shall be made according to the relevant environment A or B. The values are given in Tables J.1 and/or J.2 except where a different test level is given in the relevant specific product standard and justified by the electronic components manufacturer.

Performance criteria shall be stated by the ASSEMBLIES manufacturer based on the acceptance criteria in Table J.3.

J.10.12.1.2 含有電子電路之組裝品

應依相關環境 A 或 B 進行試驗。其值如表 J.1 及/或表 J.2 所示，相關特定產品標準所示及電子組件製造廠商所證明之不同試驗位準除外。

組裝品製造廠商應依表 J.3 之允收準則，聲明性能準則。

J.10.12.2 Emission tests

J.10.12.2.1 ASSEMBLIES not incorporating electronic circuits

No tests are necessary; see J.9.4.4.1.

J.10.12.2 發射試驗

J.10.12.1.1 未含有電子電路之組裝品

不需要任何試驗。參照 J.9.4.4.1。

J.10.12.2.2 ASSEMBLIES incorporating electronic circuits

The ASSEMBLIES manufacturer shall specify the test methods used; see J.9.4.4.2.

The emission limits for environment A are given in IEC 61000-6-4:2006, Table 1.

The emission limits for environment B are given in IEC 61000-6-3:2006, Table 1.

If the assembly incorporates telecommunication ports, the emission requirements of CISPR 22, relevant to that port and to the selected environment, shall apply.

J.10.12.1.2 含有電子電路之組裝品

組裝品製造廠商應規定使用之試驗法。參照 J.9.4.4.2。

有關環境 A 之發射限制，如 IEC 61000-6-4:2006 表 1 所示。

有關環境 B 之發射限制，如 IEC 61000-6-3:2006 表 1 所示。

若組裝品含有再驗信埠，應適用 CISPR 22 之發射要求，該要求與埠及所選擇之環境有關。

Table J.1 – Tests for EMC immunity for environment A
(see J.10.12.1)

Type of test	Test level required	Performance criterion [c]
Electrostatic discharge immunity test IEC 61000-4-2	± 8 kV / air discharge or ± 4 kV / contact discharge	B
Radiated radio-frequency electromagnetic field immunity test IEC 61000-4-3 at 80 MHz to 1 GHz and 1,4 GHz to 2 GHz	10 V/m on enclosure port	A
Electrical fast transient/burst immunity test IEC 61000-4-4	± 2 kV on power ports ± 1 kV on signal ports including auxiliary circuits and functional earth	B
1,2/50 µs and 8/20 µs surge immunity test IEC 61000-4-5 [a]	± 2 kV (line to earth) on power ports, ± 1 kV (line to line) on power ports, ± 1 kV (line to earth) on signal ports	B
Conducted radio-frequency immunity test IEC 61000-4-6 at 150 kHz to 80 MHz	10 V on power ports, signal ports and functional earth	A
Immunity to power-frequency magnetic fields IEC 61000-4-8	30 A/m [b] on enclosure port	A
Immunity to voltage dips and interruptions IEC 61000-4-11 [d]	30 % reduction for 0,5 cycles 60 % reduction for 5 and 50 cycles >95 % reduction for 250 cycles	B C C
Immunity to harmonics in the supply IEC 61000-4-13	No requirements	

[a] For equipment and/or input/output ports with a rated d.c. voltage of 24 V or less tests are not required.

[b] Applicable only to apparatus containing devices susceptible to magnetic fields.

[c] Performance criteria are independent of the environment. See Table J.3.

[d] Applicable only to mains input power ports.

表 J.1　環境 A 之電磁相容抗擾度試驗(參照 J.10.12.1)

試驗型式	所需要之試驗位準	性能準則(c)
靜電放電抗擾度試驗 IEC 61000-4-2	± 8 kV / 空氣放電 或 ± 4 kV / 接觸放電	B
輻射無線電頻率電磁場 抗擾度試驗 IEC 61000-4-3 於 80 MHz 至 1 GHz 及 1.4 GHz 至 2 GHz	於箱體埠 10 V/m	A
電氣快速暫態/脈衝抗擾度試驗 (burst immunity test) IEC 61000-4-4	於電力埠± 2 kV 於訊號埠(包括輔助電路及 功能性接地) ± 1 kV	B
1.2/50 µs 及 8/20 µs 突波抗擾度試驗 IEC 61000-4-5 (a)	於電力埠±2 kV (線對地) 於電力埠±1 kV (線對線) 於訊號埠±1 kV (線對地)	B
傳導性無線電頻率抗擾度試驗 IEC 61000-4-6 於 150 kHz 至 80 MHz	於電力埠、訊號埠及功能性 接地 10 V	A
商頻磁場之抗擾度 IEC 61000-4-8	於箱體埠 30 A/m (b)	A
電壓驟降及電壓中斷之抗擾度 IEC 61000-4-11 (d)	0.5 個循環降低 30 % 5 個及 50 個循環降低 60 % 250 個循環降低> 95 %	B C C
電源中，諧波之抗擾度 IEC 61000-4-13	無要求	

註(a) 對於額定直流電壓為 24 V 以下之設備及/或輸入/輸出埠，不需要進行試驗。
(b) 僅可適用於含有易受磁場影響之裝置的設備。
(c) 性能準則與環境無關。參照表 J.3。
(d) 僅可適用於主輸入電力埠。

Table J.2 – Tests for EMC immunity for environment B
(see J.10.12.1)

Type of test	Test level required	Performance criterion [c]
Electrostatic discharge immunity test IEC 61000-4-2	± 8 kV / air discharge or ± 4 kV / contact discharge	B
Radiated radio-frequency electromagnetic field immunity test IEC 61000-4-3 at 80 MHz to 1 GHz and 1,4 GHz to 2 GHz	3 V/m on enclosure port	A
Electrical fast transient/burst immunity test IEC 61000-4-4	± 1 kV on power ports ± 0,5 kV on signal ports including auxiliary circuits and functional earth	B
1,2/50 µs and 8/20 µs surge immunity test IEC 61000-4-5 [a]	± 0,5 kV (line to earth) for signal and power ports except for mains supply input port where ±1 kV applies (line to earth) ± 0,5 kV (line to line)	B
Conducted radio-frequency immunity test IEC 61000-4-6 at 150 kHz to 80 MHz	3 V on power ports, signal ports and functional earth	A
Immunity to power-frequency magnetic fields IEC 61000-4-8	3 A/m [b] on enclosure port	A
Immunity to voltage dips and interruptions IEC 61000-4-11 [d]	30 % reduction for 0,5 cycles 60 % reduction for 5 cycles >95 % reduction for 250 cycles	B C C
Immunity to harmonics in the supply IEC 61000-4-13	No requirements	

[a] For equipment and/or input/output ports with a rated d.c. voltage of 24 V or less tests are not required.

[b] Applicable only to apparatus containing devices susceptible to magnetic fields.

[c] Performance criteria are independent of the environment. See Table J.3.

[d] Applicable only to mains input power ports.

表 J.2　環境 B 之電磁相容抗擾度試驗(參照 J.10.12.1)

試驗型式	所需要之試驗位準	性能準則(c)
靜電放電抗擾度試驗 IEC 61000-4-2	± 8 kV / 空氣放電 或 ± 4 kV / 接觸放電	B
輻射無線電頻率電磁場 抗擾度試驗 IEC 61000-4-3 於 80 MHz 至 1 GHz 及 1.4 GHz 至 2 GHz	於箱體埠 3 V/m	A
電氣快速暫態/脈衝抗擾度試驗 (burst immunity test) IEC 61000-4-4	於電力埠± 1 kV 於訊號埠(包括輔助電路及功能性接地) ± 0.5 kV	B
1.2/50 µs 及 8/20 µs 突波抗擾度試驗 IEC 61000-4-5 (a)	於訊號埠及電力埠(適用±1 kV (線對地)之主電源輸入埠除外) ±0.5 kV (線對地) ±0.5 kV (線對地)	B
傳導性無線電頻率抗擾度試驗 IEC 61000-4-6 於 150 kHz 至 80 MHz	於電力埠、訊號埠及功能性接地 10 V	A
商頻磁場之抗擾度 IEC 61000-4-8	於箱體埠 30 A/m (b)	A
電壓驟降及電壓中斷之抗擾度 IEC 61000-4-11 (d)	0.5 個循環降低 30 % 5 個及 50 個循環降低 60 % 250 個循環降低> 95 %	B C C
電源中，諧波之抗擾度 IEC 61000-4-13	無要求	

註(a) 對於額定直流電壓為 24 V 以下之設備及/或輸入/輸出埠，不需要進行試驗。
(b) 僅可適用於含有易受磁場影響之裝置的設備。
(c) 性能準則與環境無關。參照表 J.3。
(d) 僅可適用於主輸入電力埠。

Table J.3 – Acceptance criteria when electromagnetic disturbances are present

Item	Acceptance criteria (performance criteria during tests)		
	A	B	C
Overall performance	No noticeable changes of the operating characteristic Operating as intended	Temporary degradation or loss of performance which is self-recoverable	Temporary degradation or loss of performance which requires operator intervention or system reset [a]
Operation of power and auxiliary circuits	No unwanted operation	Temporary degradation or loss of performance which is self-recoverable [a]	Temporary degradation or loss of performance which requires operator intervention or system reset [a]
Operation of displays and control panels	No changes to visible display information Only slight light intensity fluctuation of LEDs, or slight movement of characters	Temporary visible changes or loss of information Undesired LED illumination	Shut down or permanent loss of display. Wrong information and/or unpermitted operating mode, which should be apparent or an indication should be provided. Not self-recoverable
Information processing and sensing functions	Undisturbed communication and data interchange to external devices	Temporarily disturbed communication, with possible error reports of the internal and external devices	Erroneous processing of information Loss of data and/or information Errors in communication Not self-recoverable
[a] Specific requirements shall be detailed in the product standard.			

表 J.3　發生電磁擾動時之準則

項目	允收準則		
	A	B	C
整體性能	操作特性無顯著變化 依預期方式操作	可自行恢復之性能暫時降級或喪失	需要操作者介入或系統重置之性能暫時降級或喪失 (a)
電力及輔助電路之操作	無不需要之操作	可自行恢復之性能暫時降級或喪失	需要操作者介入或系統重置之性能暫時降級或喪失 (a)
顯示及控制面板之操作	可顯而易見之顯示資訊，無變化 LED 僅些微之光強度波動，或特性些微移動	資訊暫時顯而易見之變化或喪失 不需要之 LED 照明	關閉或永久喪失顯示。錯誤資訊及/或不容許之操作模式，其宜明顯或宜提供指示。 不可自行恢復
資訊處理及感測功能	未受干擾之通訊及與外部裝置之資料互換	暫時受干擾之通訊，內部及外部裝置可能有錯誤之回報	錯誤之資訊處理 資料及/或資訊之損失 通訊中之錯誤 不可自行恢復
註(a) 產品標準中應詳述特定之要求。			

附錄 K
(規定)
以電氣分隔方式之保護

Annex K
(normative)
Protection by electrical separation

K.1 General

Electrical separation is a protective measure in which:

- basic protection (protection against direct contact) is provided by basic insulation between hazardous live parts and exposed conductive parts of a separated circuit, and
- fault protection (protection against indirect contact) is provided:
  - by simple separation of the separated circuit from other circuits and from earth;
  - by an earth-free protective equipotential bonding interconnecting exposed equipment parts of the separated circuit where more than one item of equipment is connected to the separated circuit.

Intentional connection of exposed conductive parts to a protective conductor or to an earth conductor is not permitted.

K.1 一般

電氣分隔係一種保護措施。

- 基本保護(防止直接接觸之保護)係藉由分隔電路之危險帶電零件與暴露導電零件之間的基本絕緣提供。且
- 故障保護(防止直接接觸之保護)係藉由下列方式提供。
  - 使分離之電路與其他電路及地簡單分隔。
  - 以不接地之保護性等電位搭接互連分離之電路的暴露式設備零件，其設備超過 1 個項目連接至分離之電路。

不容許外露導電零件蓄意連接至保護性導體或連接至接地導體。

K.2 Electrical separation

K.2.1 General

Protection by electrical separation shall be ensured by compliance with all the requirements of K.2.2 to K.2.5.

K.2 電氣分隔

K.2.1 一般

應藉由符合 K.2.2 至 K.2.5 之所有要求，以確保電氣分隔之保護。

K.2.2 Supply source

The circuit shall be supplied through a source that provides separation i.e.

- an isolating transformer, or
- a source of current providing a degree of safety equivalent to that of the isolating transformer specified above, for example a motor generator with windings providing equivalent isolation.

K.2.2 電源

電路應透過可提供分隔之電源加以供電，亦即

- 隔離變壓器。或
- 提供等同於上述隔離變壓器安全等級之電源，例：具有提供等效隔離之繞組的電動發電機。

NOTE Ability to withstand a particularly high test voltage is recognized as a means of ensuring the necessary degree of isolation.

Mobile sources of supply connected to a supply system shall be selected in accordance with Clause K.3 (class II equipment or equivalent insulation).

Fixed sources of supply shall be either:

- selected in accordance with Clause K.3, or
- such that the output is separated from the input and from the enclosure by an insulation satisfying the conditions of Clause K.3; if such a source supplies several items of equipment, the exposed conductive parts of that equipment shall not be connected to the metallic enclosure of the source.

備考：耐受特殊包試驗電壓之能力，視為確保必要之隔離等級的方式。

連接至電源系統之行動式電源，應依 K.3 選擇(第 II 類設備或等效絕緣)。

固定式電源可如下。

- 依 K.3 選擇。或
- 使得輸出與輸入分隔，且以符合 K.3 之條件的絕緣使輸出與箱體分隔。若此電源對設備之數個項目供電，設備之外露導電零件不應連接至電源之金屬箱體。

K.2.3 Selection and installation of supply source

K.2.3.1 Voltage

The voltage of the electrically separated circuit shall not exceed 500 V.

K.2.3 電源之選擇及安裝

K.2.3.1 電壓

電氣分隔之電路，其電壓不應超過 500 V。

K.2.3.2 Installation

K.2.3.2.1 Live parts of the separated circuit shall not be connected at any point to another circuit or to earth.

To avoid the risk of a fault to earth, particular attention shall be given to the insulation of such parts from earth, especially for flexible cables and cords.

Arrangements shall ensure electrical separation not less than that between the input and output of an isolating transformer.

NOTE In particular the electrical separation is necessary between the live parts of electrical equipment such as relays, contactors, auxiliary switches and any part of another circuit.

K.2.3.2 安裝

K.2.3.2.1 分離之電路的帶電零件，在任何點不應連接至其他電路或連接至地。

為避免對地故障之風險，應特別留意此零件與地之絕緣，尤其是對於可撓性電纜及電線。

配置應確保電氣分隔不小於隔離變壓器之輸入及輸出之間的電氣分隔。

備考： 電氣設備帶電零件(例：電驛、接觸器、輔助開關及其他電路之任何零件)之間的電氣分隔尤其是有必要。

K.2.3.2.2 Flexible cables and cords shall be visible throughout any part of their length liable to mechanical damage.

K.2.3.2.2 在可撓性電纜及電線長度易受機械損壞之任何部位，應明顯可見。

K.2.3.2.3 For separated circuits, the use of separate wiring systems is necessary. If the use of conductors of the same wiring system for the separated circuits and other circuits is unavoidable, multi-conductor cables without metallic covering, or insulated conductors in insulating conduit, ducting or trunking shall be used, provided that their rated voltage is not less than the highest voltage likely to occur, and that each circuit is protected against overcurrent.

K.2.3.2.3 關於分離之電路，使用分離之配線系統係有必要的。對分隔之電路及其他電路，若無法避免使用相同配線系統之導體，倘若其額定電壓不小於有可能發生之最高電壓且每一電路係受防過電流保護，則應使用無金屬披覆之多導體電纜或在絕緣導管(conduit)、管道(ducting)或線槽(trunking)中之絕緣導體。

K.2.4 Supply of a single item of apparatus

Where a single item of apparatus is supplied, the exposed conductive parts of the separated circuit shall not be connected either to the protective conductor or exposed conductive parts of other circuits.

NOTE If the exposed conductive parts of the separated circuit are liable to come into contact, either intentionally or fortuitously, with the exposed conductive parts of other circuits, protection against electric shock no longer depends solely on protection by electrical separation but on the protective measures to which the latter exposed conductive parts are subject.

K.2.4 設備之單一項目 2k71 供電

當對設備之單一項目供電時，分隔之電路的外露導電零件不應連接至保護性導體或其他電路之外露導電零件。

備考： 若分隔之電路的外露導電零件容易接觸(無論蓄意或偶發)其他電路之外露導電零件，防止電擊之保護不再僅取決於以電氣分隔之保護，但取決於支配後者外露導電零件之保護措施。

K.2.5 Supply of more than one item of apparatus

If precautions are taken to protect the separated circuit from damage and insulation failure, a source of supply, complying with K.2.2, may supply more than one item of apparatus provided that all the following requirements are fulfilled.

a) The exposed-conductive-parts of the separated circuit shall be connected together by insulated non-earthed equipotential bonding conductors. Such conductors shall not be connected to the protective conductors or exposed-conductive-parts of other circuits or to any extraneous conductive parts.

NOTE If the exposed-conductive-parts of the separated circuit are liable to come into contact, either intentionally or fortuitously, with the exposed-conductive-parts of other circuits, protection against electric shock no longer depends solely on protection by electrical separation but on the protective measures to which the latter exposed- conductive-parts are subject.

K.2.5 設備之多個項目的供電

若採取預防措施以保護分隔之電路，防止損壞及絕緣失效，倘若符合所有下列要求，則符合 K.2.2 之電源可對設備之多個項目供電。

(a) 應以絕緣非接地之等電位搭接導體，將分隔之電路的外露導電零件連接在一起。此導體不應連接至保護性導體或其他電路之外露導電零件，或連接至任何外部導電零件。

備考： 若分隔之電路的外露導電零件容易接觸(無論蓄意或偶發)其他電路之外露導電零件，防止電擊之保護不再僅取決於以電氣分隔之保護，但取決於支配後者外露導電零件之保護措施。

b) All socket-outlets shall be provided with protective contacts which shall be connected to the equipotential bonding system provided in accordance with item a).

c) Except where supplying class II equipment, all flexible cables shall embody a protective conductor for use as an equipotential bonding conductor.

It shall be ensured that if two faults affecting two exposed conductive parts occur and these are fed by conductors of different polarity, a protective device shall disconnect the supply in a disconnecting time conforming to Table K.1.

(b) 所有插座應備有保護性接點，其應連接至依第(a)項準備之等電位搭接系統。

(c) 除對第 II 類設備供電者外，所有可撓性電纜應包含保護性導體，以作為等電位搭接導體之用。

應確保若影響 2 個外露導電零件之 2 個故障發生時，且其係以不同極性之導體饋送時，保護性電路應在表 K.1 之切離時間切離電源。

Table K.1 – Maximum disconnecting times for TN systems

U_0[a] V	Disconneting time s
120	0,8
230	0,4
277	0,4
400	0,2
>400	0,1
a Values based on IEC 60038.	

表 K.1　TN 系統之最大切離時間

U_0[a] V	切離時間 s
120	0.8
230	0.4
277	0.4
400	0.2
> 400	0.1
註(a)依據 IEC 60038 之值。	

For voltages which are within the tolerance band stated in IEC 60038, the disconnecting time appropriate to the nominal voltage applies.

For intermediate values of voltage, the next higher value in the above table is to be used.

關於 IEC 60038 所述之許可差頻帶內的電壓，適用適合於標稱電壓之切離時間。有關中間之電壓值，須使用上表中次一個較高之值。

K.3 Class II equipment or equivalent insulation

Protection shall be provided by electrical equipment of the following types:

- Electrical equipment having double or reinforced insulation (class II equipment)
- ASSEMBLIES having total insulation see 8.4.3.3.

This equipment is marked with the symbol ⧈

NOTE This measure is intended to prevent the appearance of dangerous voltage on the accessible parts of electrical equipment through a fault in the basic insulation.

K.3　第 II 類設備或同等絕緣

應以下列型式之電氣設備提供保護。

- 具有雙重或強化絕緣之電氣設備(第 II 類設備)
- 具有總絕緣之組裝品，參照 8.4.3.3。

以符號 ⧈ 標示此設備。

備考：此措施係為避免因為基本絕緣中之故障，而在電氣設備之可接近性零件上出現危險電壓。

Annex L
(informative)

Clearances and creepage distances for North American region

Table L.1 – Minimum clearances in air

Rated operational voltage V	Minimum clearances mm	
	Phase to phase	Phase to earth
(150) [a] 125 or less	12,7	12,7
(151) [a] 126-250	19,1	12,7
251-600	25,4	25,4
[a] Values in brackets are applicable in Mexico.		

Table L.2 – Minimum creepage distances

Rated operational voltage V	Minimum creepage distances mm	
	Phase to phase	Phase to earth
(150) [a] 125 or less	19,1	12,7
(151) [a] 126-250	31,8	12,7
251-600	50,8	25,4
[a] Values in brackets are applicable in Mexico.		

NOTE This is not a complete and exhaustive listing of all regulations that are specific to the North American marketplace.

附錄 L

(參考)

北美地區之空間距離及沿面距離

表 L.1 空氣中之最小空間距離

額定操作電壓 V	最小空間距離 mm	
	相對相	相對地
(150) (a) 125 以下	12.7	12.7
(151) (a) 126~250	19.1	12.7
251~600	25.4	25.4
註(a) 括號中之值可適用於墨西哥。		

表 L.2 最小沿面距離

額定操作電壓 V	最小沿面距離 mm	
	相對相	相對地
(150) (a) 125 以下	19.1	12.7
(151) (a) 126~250	31.8	12.7
251~600	50.8	25.4
註(a) 括號中之值可適用於墨西哥。		

備考：此表並非北美市場專用之所有規定的完整且詳細之清單。

Annex M
(informative)

North American temperature rise limits

The temperature rise limitation permitted in North America are based upon the allowable rises permitted for the devices connected (wire connectors, cables, circuit breakers, etc.). In order to maintain the proper and safe performance of the entire electrical system, these must be taken into account. These requirements are mandated by the National Electrical Code, NFPA 70, Article 110.14-C, "Temperature Limitations'. This document is published by the National Fire Protection Association, Quincy, Massachusetts, USA. In Mexico these requirements are mandated by NOM-001-SEDE.

Table M.1 – North American temperature rise limits

Parts of ASSEMBLIES	Temperature rise K
Unplated busbars	50
Plated busbars	65
Terminals except as covered below	50
Terminals for devices marked for use with 90 °C conductors, based upon 75 °C ampacity (current carrying capacity)	60
Terminals for devices rated 110 A and less, if marked for use with 75 °C conductors	65

附錄 M
(參考)
北美溫升限制

北美所容許之溫升限制，係以所連接之裝置(配線連接器、電纜、斷路器等)容許之可容許溫升為基礎。為維持整個電氣系統之適合且安全之性能，此等必須列入考量。此等要求係國家電氣法規 NFPA 70 第 110.14-C 章〝溫升限制〞所要求。此文件係由美國麻薩諸塞州昆西國家防火協會所發布。在墨西哥，此等要求係 NOM-001-SEDE 所要求。

表 M.1　北美溫升限制

組裝品之零件	溫升 K
非裝甲匯流排(unplated busbar)	50
裝甲匯流排(plated busbar)	65
下述範圍除外之端子	50
標示為與 90℃導體一同使用之裝置用的端子，其係以 75℃安培容量(電流承載容量)為基礎。	60
額定為 110 A 以下之裝置用的端子，若其標示為與 75℃導體一同使用時。	65

Annex N
(normative)

Operating current and power loss of bare copper bars

The following tables provide values for conductor operating currents and power losses under ideal conditions within an ASSEMBLY (see 10.10.2.2.3, 10.10.4.2.1 and 10.10.4.3.1). This annex does not apply to conductors verified by test.

The calculation methods used to establish these values are given to enable values to be calculated for other conditions.

Table N.1 – Operating current and power loss of bare copper bars with rectangular cross-section, run horizontally and arranged with their largest face vertical, frequency 50 Hz to 60 Hz (ambient temperature inside the ASSEMBLY: 55 °C, temperature of the conductor 70 °C)

Height x thickness of bars	Cross-sectional area of bar	One bar per phase			Two bars per phase (spacing = thickness of bars) 		
		k_3	Operating current	Power-losses per phase conductor P_v	k_3	Operating current	Power-losses per phase conductor P_v
mm × mm	mm²		A	W/m		A	W/m
12 × 2	23,5	1,00	70	4,5	1,01	118	6,4
15 × 2	29,5	1,00	83	5,0	1,01	138	7,0
15 × 3	44,5	1,01	105	5,4	1,02	183	8,3
20 × 2	39,5	1,01	105	6,1	1,01	172	8,1
20 × 3	59,5	1,01	133	6,4	1,02	226	9,4
20 × 5	99,1	1,02	178	7,0	1,04	325	11,9
20 × 10	199	1,03	278	8,5	1,07	536	16,6
25 × 5	124	1,02	213	8,0	1,05	381	13,2
30 × 5	149	1,03	246	9,0	1,06	437	14,5
30 × 10	299	1,05	372	10,4	1,11	689	18,9
40 × 5	199	1,03	313	10,9	1,07	543	17,0
40 × 10	399	1,07	465	12,4	1,15	839	21,7
50 × 5	249	1,04	379	12,9	1,09	646	19,6
50 × 10	499	1,08	554	14,2	1,18	982	24,4
60 × 5	299	1,05	447	15,0	1,10	748	22,0
60 × 10	599	1,10	640	16,1	1,21	1118	27,1
80 × 5	399	1,07	575	19,0	1,13	943	27,0
80 × 10	799	1,13	806	19,7	1,27	1372	32,0
100 × 5	499	1,10	702	23,3	1,17	1125	31,8
100 × 10	999	1,17	969	23,5	1,33	1612	37,1
120 × 10	1200	1,21	1131	27,6	1,41	1859	43,5

附錄 N
(規定)
裸銅排之操作電流及功率損失

下列表格提供在組裝品內之理想條件下，有關導體操作電流及功率損失之值參照 10.10.2.2.3、10.10.4.2.1 及 10.10.4.3.1。本附錄不適用於經試驗查證過之導體。

本附錄提供建立此等數值所使用之計算方法，以便使此等數值能供其他條件計算之用。

表 N.1　長方形截面、水平運轉並在其最大面為垂直情況下配置、頻率 50 Hz 至 60 Hz 之裸銅排的操作電流及功率損失(組裝品內之周圍溫度：55℃，導體溫度 70℃)

銅排之高度×厚度	銅排之截面積	每相之 1 個銅排 I			每相之 1 個銅排 (間隔=銅排之厚度) II		
		k_3	操作電流	每相導體之功率損失 P_v	k_3	操作電流	每相導體之功率損失 P_v
mm×mm	mm^2		A	W/m		A	W/m
12 ×2	23.5	1.00	70	4.5	1.01	118	6.4
15×2	29.5	1.00	83	5.0	1.01	138	7.0
15×3	44.5	1.01	105	5.4	1.02	183	8.3
20×2	39.5	1.01	105	6.1	1.01	172	8.1
20×3	59.5	1.01	133	6.4	1.02	226	9.4
20×5	99.1	1.02	178	7.0	1.04	325	11.9
20×10	199	1.03	278	8.5	1.07	536	16.6
25×5	124	1.02	213	8.0	1.05	381	13.2
30×5	149	1.03	246	9.0	1.06	437	14.5
30×10	299	1.05	372	10.4	1.11	689	18.9
40×5	199	1.03	313	10.9	1.07	543	17.0
40×10	399	1.07	465	12.4	1.15	839	21.7
50×5	249	1.04	379	12.9	1.09	646	19.6
50×10	499	1.08	554	14.2	1.18	982	24.4
60×5	299	1.05	447	15.0	1.10	748	22.0
60×10	599	1.10	640	16.1	1.21	1118	27.1
80×5	399	1.07	575	19.0	1.13	943	27.0
80×10	799	1.13	806	19.7	1.27	1372	32.0
100×5	499	1.10	702	23.3	1.17	1125	31.8
100×10	999	1.17	969	23.5	1.33	1612	37.1
120×10	1200	1.21	1131	27.6	1.41	1859	43.5

$$P_v = \frac{I^2 \times k_3}{\kappa \times A} \times \left[1 + \alpha \times (T_c - 20°C)\right]$$

where

P_v is the power loss per metre;

I is the operating current;

k_3 is the current displacement factor;

κ is the conductivity of copper, $\kappa = 56 \frac{m}{\Omega \times mm^2}$;

A is the cross-sectional area of bar;

α is the temperature coefficient of resistance, $\alpha = 0{,}004\ K^{-1}$;

T_c is the temperature of the conductor.

The operating currents may be converted for other ambient air temperatures inside the ASSEMBLY and/or for a conductor temperature of 90 °C by multiplying the values of Table N.1 by the corresponding factor k_4 from Table N.2. Then the power losses shall be calculated using the formula given above accordingly.

式中，P_v 每公尺之功率損失

I　操作電流

k_3 電流位移因數

κ 銅之導電率， $\kappa = 56 \frac{m}{\Omega \times mm^2}$

A 排之截面積

α 電阻之溫度係數， $\alpha = 0.004\ K^{-1}$

T_c 導體溫度

針對組裝品內之其他周圍空氣溫度及/或針對導體溫度 90℃，可將表 N.1 之值乘以表 N.2 相對應之因數 k_4，以轉換操作電流。因此，應使用上述公式計算功率損失。

Table N.2 – Factor k_4 for different temperatures of the air inside the ASSEMBLY and/or for the conductors

Air temperature inside the enclosure around the conductors °C	Factor k_4	
	Conductor temperature of 70 °C	Conductor temperature of 90 °C
20	2,08	2,49
25	1,94	2,37
30	1,82	2,26
35	1,69	2,14
40	1,54	2,03
45	1,35	1,91
50	1,18	1,77
55	1,00	1,62
60	0,77	1,48

表 N.2　組裝品內不同之空氣溫度及/或導體之因數 k_4

導體周圍之箱體內的空氣溫度 ℃	因數 k_4	
	導體溫度 70℃	導體溫度 90℃
20	2.08	2.49
25	1.94	2.37
30	1.82	2.26
35	1.69	2.14
40	1.54	2.03
45	1.35	1.91
50	1.18	1.77
55	1.00	1.62
60	0.77	1.48

It shall be considered that, dependent upon the design of the ASSEMBLY, quite different ambient and conductor temperatures can occur, especially with higher operating currents.

Verification of the actual temperature rise under these conditions shall be determined by test. The power losses may then be calculated by the same method as used for this Table N.2.

NOTE At higher currents additional eddy current losses may be significant which are not included in the values of Table N.1.

視組裝品之設計而定，應考量可能產生相當不同之周圍溫度及導體溫度，尤其是在高操作電流。

在此等條件下所進行之實際溫升的查證，應以試驗決定。功率損失可用表 N.2 所使用之相同方法計算。

備考：於較高之電流下，渦流損失可能非常重要，其未包括於表 N.1 之值中。

附錄 O
(參考)
溫升查證之指引

Annex O
(informative)
Guidance on temperature rise verification

O.1 General

All ASSEMBLIES generate heat in service. Assuming the heat dissipation capability of the ASSEMBLY for local areas within the ASSEMBLY and for the ASSEMBLY as a whole, when operating on full load, exceeds the total heat produced then thermal equilibrium will be established; temperature will stabilize at a temperature rise above the ambient temperature surrounding the ASSEMBLY.

The purpose of temperature rise verification is to ensure temperatures stabilize at a value that will not result in:

a) significant deterioration or ageing of the ASSEMBLY, or
b) excessive heat being transferred to external conductors, such that the service capability of the external conductors and any equipment to which they are connected, may be impaired, or,
c) people, operators or animals in the vicinity of an ASSEMBLY being burnt in normal operating circumstances.

O.1 一般

在使用中，所有組裝品產生熱。當組裝品在全載下操作時，在組裝品內之局部區域及整個組裝品內，假定組裝品之熱量消耗能力超過所產生之總熱量，則將建立熱平衡；溫度將穩定在超過圍繞在組裝品之周圍溫度的溫度。

溫升查證之目的係為了確保溫度穩定在不會產生下列情況之值。

(a) 組裝品明顯劣化或老化。或

(b) 過多熱量轉移至外部導體，使得外部導體及其可能連接之任何設備的使用能力可能損害。

(c) 在正常操作環境中，組裝品附近之人員、操作者或動物被燒傷。

O.2 Temperature-rise limits

It is the manufacture's responsibility to select the appropriate method for temperature rise verification. (See Figure O.1).

All the temperature rise limits given in the standard assume that the ASSEMBLY will be located in an environment where the daily average and peak ambient temperatures do not exceed 35 °C and 40 °C, respectively.

The standard also assumes that all outgoing circuits within an ASSEMBLY will not be loaded to their rated current at the same time. This recognition of the practical situation is defined by a 'rated diversity factor'. Subject to the loading of the incoming circuit not exceeding its rated current, diversity is the proportion of the individual rated currents that any combination of outgoing circuits can carry continuously and simultaneously, without the ASSEMBLY overheating. Diversity factor (assumed loading) is usually defined for the ASSEMBLY as a whole, but a manufacturer may choose to specify it for groups of circuits, for example the circuits in a section.

O.2 溫升限制

針對溫升查證選取適合之方法，係製造廠商之責任(參照圖 O.1)。

標準中所列之所有溫升限制，係假定組裝品將處於每日平均及峰值溫度分別不超過 35℃及 40℃之位置。

標準亦假定組裝品內之外向電路將不會同時承載其額定電流。此項對於實際情況

之認識，係以〝額定多樣性因數〞定義。在承受不超過其額定電流之內向電路的施載下，多樣性為組裝品不會過熱之情況下，任何組合之外向電路所能連續及同時承載之個別額定電流的比例。多樣性因數(假定施載)通常係針對整個組裝品所定義，但製造廠商可選擇針對電路群組(例：區段中之電路)規定其多樣性因數。

Temperature rise verification confirms two criteria, as follows:

a) that each type of circuit is capable of carrying its rated current when it is incorporated in the ASSEMBLY. This takes into account the way in which the circuit is connected and enclosed within the ASSEMBLY, but excludes any heating affects that may result from adjacent circuits carrying current.

b) the ASSEMBLY as a whole will not overheat when the incoming circuit is loaded to its rated current and, subject to the maximum current of the incoming circuit, any combination of outgoing circuits can be simultaneously and continuously loaded to their rated current multiplied by the rated diversity factor for the ASSEMBLY.

Temperature rise limits within the ASSEMBLY are the manufacturers' responsibility, they are essentially determined on the basis of operating temperature not exceeding the long term capability of the materials used within the ASSEMBLY. At interfaces between the ASSEMBLY and the 'wider world', for example, cable terminals and operating handles, the standard defines temperature rise limits (see Table 6).

Within boundaries defined in the standard, temperature rise verification can be undertaken by test, calculation or design rules. It is permissible to use one or a combination of the verification methods set out in the standard to verify temperature rise performance of an ASSEMBLY. This allows the manufacturer to choose the most appropriate method for the ASSEMBLY, or part of an ASSEMBLY, being considered, taking into consideration volumes, the construction, design flexibility, current rating and size of the ASSEMBLY.

In typical applications involving some adaptation of a standard design it is highly likely more than one method will be used to cover various elements of the ASSEMBLY design.

溫升查證確認下列 2 項準則。

(a) 每種型式之電路當合併於組裝品中時，能承載其額定電流。此係考量電路在組裝品內之連接及閉合方式，但排除任何可能從承載電流之鄰近電路所產生之發熱影響。

(b) 當內向電路承載其額定電流時，整個組裝品不會過熱，且在承受內向電路之最大電流情況下，外向電路之任何組合能同時且連續承載其額定電流乘上組裝品之額定多樣性因數。

組裝品內之溫升限制係屬製造廠商之責任，其實質上係依不超過組裝品內所使用之材料長期容量的操作溫度之基礎決定。在組裝品與〝廣闊世界(wider world)〞之間的介面，例：電纜端子及操作把手，標準定義其溫升限制(參照表 6)。

在標準所定義之邊界內，可藉由試驗、計算或設計規則進行溫升查證。可容許在標準中說明 1 種或組合之查證方法，以查證組裝品之溫升性能。此容許製造廠商在考量組裝品之體積、構造、設計靈活性、電流定額及大小之情況下，選取最適合組裝品或部分組裝品之方法。

在典型應用(包括標準設計之一些改編)中，將極有可能使用超過 1 種方法，以涵蓋組裝品設計之各種元件。

O.3 Test

O.3.1 General

In order to avoid unnecessary testing the standard provides guidance on selecting groups of comparable functional units. It then details how to select the critical variant from the group for test. Design rules are then applied to assign ratings to other circuits that are 'thermally similar' to the critical variant tested.

Three options for verification by test are offered in this standard.

O.3 試驗

O.3.1 一般

為避免不必要之試驗，標準提供有關選擇可比較之功能性單元群組的指引。其應詳細敘述如何從群組中選擇試驗用之關鍵變體。應採用設計規則，以對〝熱量類似〞於受試驗之關鍵變體的其他電路指定定額。

本標準提供 3 種以試驗進行查證之選項

O.3.2 Method a) – Verification of the complete ASSEMBLY (10.10.2.3.5)

If several or all circuits of an ASSEMBLY are loaded simultaneously then the same circuit is only able to carry its rated current multiplied with the rated diversity factor (see 5.4), due to the thermal influence of the other circuits. Thus to verify the rated currents of all circuits a separate test for each type of circuit is necessary. To verify the rated diversity factor one additional test with simultaneous load on all circuits has to be done (see methods b) and c)).

To avoid the large number of tests that may be necessary 10.10.2.3.5 describes a verification method where only one test is made with simultaneous load on all circuits. Because with only one test the rated currents and the rated diversity factor of the circuits cannot be verified separately, it is assumed that the diversity factor is one. In this case the load currents are equal to the rated currents.

This is a quick and conservative approach to achieving a result for a particular arrangement of ASSEMBLY. It proves the rating of the outgoing circuits and the ASSEMBLY in the same test. The incoming circuit and busbars are loaded to their rated current and as many outgoing circuits in a group as are necessary to distribute the incoming current, are loaded to their individual rated currents when installed in the ASSEMBLY. For most installations this is an unrealistic situation since outgoing circuits are not normally loaded to unity diversity. If the group of functional units tested does not include one of each of the different types of outgoing circuit incorporated in the ASSEMBLY, then further tests are carried out considering different groups of outgoing circuits until one of each type has been tested.

Testing in this manner requires the minimum number of temperature rise tests, but the test arrangement is more onerous than necessary and the result is not applicable to a range of ASSEMBLIES.

O.3.2 方法(a)－整個組裝品之查證(10.10.2.3.5)

若組裝品之數種或所有電路同時承載，則由於其他電路之熱影響，相同電路僅能承載其額定電流乘上額定多樣性因數(參照 5.4)。因此，為查證所有電路之額定電流，每型式之電路有需要獨立之試驗。為查證額定多樣性因數，必須於對所有電路同時施以負載之情況下，進行 1 個額外試驗(參照方法(b)及方法(c))。

為避免可能需要進行大量試驗，10.10.2.3.5 敘述 1 種查證法，其在同時對所有電路施以負載之情況下，僅進行 1 項試驗。因為僅 1 項試驗，無法分別查證電路之額定電流及額定多樣性因數，其係假定多樣性因數為 1。在此情況中，負載電流等於額定電流。

對於組裝品之特殊配置，此為獲得結果之快速且保守之方法。其證明在相同試驗中外向電路之定額。使內向電路及匯流排承載至其額定電流，且因為有必要以許多外向電路分配內向電流，當外向電路安裝在組裝品中，使其承載至其個節額定電流。對於多數安裝設備而言，此為不切實際之情況，因為外向電路通常並非承載至單一多樣性。若受試驗之功能性單元群組不包括合併在組裝品中之每一不同型式外向電路的其中之一時，則於考量不同群組之外向電路，進行進一步試驗，直到每型式之其中之一已進行試驗為止。

以此方式進行試驗，需要最少數量之試驗，但試驗配置較所必要之配置更為繁重，且結果不可適用於一系列之組裝品。

O.3.3 Method b) – Verification considering individual functional units separately and the complete ASSEMBLY (10.10.2.3.6)

With this arrangement of testing each critical variant of outgoing circuit is tested separately to confirm its rated current and then the ASSEMBLY as whole is tested with the incoming circuit loaded to its rated current and groups of outgoing circuits, as necessary to distribute the incoming current, loaded to their rated current multiplied by the diversity factor. The group tested should include one outgoing circuit of each critical variant to be incorporated in the ASSEMBLY. Where this is not practical, further groups are tested until all critical variants of outgoing circuit have been considered.

This test regime takes into account the diversity in the loading of outgoing circuits that is applicable in the majority of applications. However, as in method a) above, the result is only applicable to a specific arrangement of ASSEMBLY tested.

O.3.3 方法(b)－分別考量個別功能性單元及考量整個組裝品之查證(10.10.2.3.6)

以此種試驗配置，分別對外向電路之每一關鍵變體進行試驗，以確認其額定電流，且隨後在內向電路承載其額定電流及外向電路群組(因為有必要分配內向電流)承載其額定電流乘上多樣性因數之情況下，對整個組裝品進行試驗。受試驗之群組宜包括每個關鍵變體之 1 個外向電路，並合併於組裝品中。當不可行時，對另外之群組進行試驗，直到已考量外向電路之所有關鍵變體為止。

此試驗制度考量外向電路之負載的多樣性，其可適用於多數應用中。然而，如同上述方法(a)，結果僅可適用於受試驗之組裝品的特定配置。

O.3.4 Method c) – Verification considering individual functional units and the main and distribution busbars separately as well as the complete ASSEMBLY (10.10.2.3.7)

This test method enables modular systems to be temperature rise verified without the need to test every conceivable combination of circuits. Temperature rise tests are carried out separately to prove the rating of:

a) functional units,
b) main busbars,
c) distribution busbars,
d) complete ASSEMBLY.

To verify the performance of the ASSEMBLY as a whole, these tests are then complimented by a test on a representative ASSEMBLY in which the incoming circuit is loaded to its rated current and the outgoing circuits are loaded to their rated current multiplied by the diversity factor.

Whilst this approach requires more testing than methods a) and b) it has the advantage that the modular system rather than a specific arrangement of ASSEMBLY is verified.

O.3.4 方法(c)－考量個別功能性單元、分別考量配電匯流排及考量整個組裝品之查證(10.10.2.3.7)

此試驗法能使模組系統進行溫升查證，而不需要對可想到之每種電路組合進行試驗。分別進行溫升試驗，以證明下列項目之定額。

(a) 功能性單元。

(b) 主匯流排。

(c) 配電匯流排。

(d) 整組組裝品。

為查證整體組裝品之性能，隨後於代表性組裝品上進行試驗以補充此等試驗，在該代表性組裝品中，內向電路係承載至其額定電流，且外向電路係承載至其額定電流乘上多樣性因數。

雖然此方法較方法(a)及方法(b) 需要更多試驗，其優點是查證模組系統，而非查證組裝品之特定配置。

O.4 Calculation

O.4.1 General

Two methods of verifying temperature rise performance by calculation are included within the standard.

O.4.2 Single compartment assembly with a rated current not exceeding 630 A

A very simple method of temperature rise verification that requires confirmation that the total power loss of the components and conductors within the ASSEMBLY do not exceed the known power dissipation capability of the enclosure. The scope of this approach is very limited and in order that there are no difficulties with hot spots, all components must be de-rated to 80 % of their free air current rating.

O.4.3 assembly with rated currents not exceeding 1 600 A

Temperature rise verification is by calculation in accordance with IEC 60890 with additional margins. The scope of this approach is limited to 1 600 A, components are de-rated to 80 % of their free air rating or less and any horizontal partitions must have, as a minimum, a 50 % open area.

O.4 計算

O.4.1 一般

本標準內包括 2 種以計算方式查證溫升性能之方法。

O.4.2 額定電流不超過 630 A 之單一分隔室組裝品

查證溫極簡單之方法需要確認組裝品內之組件及導體的總功率損失不超過箱體之已之功率耗損能力。本方法之範圍極為受限且為了使熱點沒有困難，所有組件必須降額至其自由空氣電流定額之 80 %。

O.4.3 額定電流不超過 1,600 A 之組裝品

藉由 IEC 60890 之計算及額外邊際進行溫升查證。本方法之範圍受限至 1,600 A，組件降額至其自由空氣定額之 80 %以下，且任何水平隔板必須具有至少 50 %開放空間。

O.5 Design rules

The standard allows, in clearly defined circumstances, for the derivation of ratings from similar variants that have been verified by test. For example, if the current rating of a double lamination busbar has been established by test, it is acceptable to assign a rating equal to 50 % of the tested arrangement to a busbar comprising a single lamination with the same width and thickness as the tested laminations, when all other considerations are the same.

In addition, the rating of all circuits within a group of comparable functional units (all devices must be of the same frame size and belong to the same series) can be derived from a single temperature rise test on the critical variant within the group. An example of this may be to test a nominal 250 A outgoing circuit breaker and establish a rating for it in the ASSEMBLY. Then, assuming the same frame size breaker is being considered and other specified conditions are met, verify by calculation the rating of a nominal 160 A circuit breaker within the same enclosure.

Lastly, in respect of temperature rise, there are very strict design rules that permit the substitution of a device with a similar device from another series or even another make, without retesting. In this case, in addition to the physical arrangement being essentially the same, the power loss and terminal temperature rise of the substitute device, when it is tested in accordance with its own product standard, must not be higher than those of the original device.

NOTE When considering device substitution all other performance criteria, in particular that dealing with short circuit capability, should be considered and satisfied, in accordance with the standard, before an ASSEMBLY is deemed to be verified.

O.5 設計規則

在明確定義之情況中，本標準容許從已以試驗查證之類似變體之定額所產生之偏離。舉例而言，若已以試驗建立雙重層壓物匯流排之電流定額，當其他考量均相同情況下，可接受對包含與受試驗之層積板相同寬度及厚度之匯流排指定受試驗配置之定額之 50%

此外，在可比較之功能性單元群組(所有裝置必須為相同框架大小，且屬於相同系列)中，電路之定額可由在群組內關鍵變體上所進行之單一溫升試驗中推導而得。其範例為對標稱 250 A 外向電路斷路器進行試驗，並在組裝品中建立定額。因此，假定考量相同框架大小斷路器，且符合其他規定之條件，藉由計算相同箱體內標稱 160 A 斷路器之定額，以進行查證。

最後，在溫升方面，有極嚴格之設計規則，其容許由其他系列或甚至其他型式之類似裝置來替代裝置，而無需重新進行試驗。在此情況中，除了物理配置實質上相同之外，當替代裝置以其本身之產品標準進行試驗時，替代裝置之功率損失及端子溫度必須不高於原始裝置之值。

備考： 當考量裝置替代性時，在組裝品視為已查證過之前，所有其他性能準則，尤其是與短電路能力有關者，宜予以考量並滿足，使其符合標準。

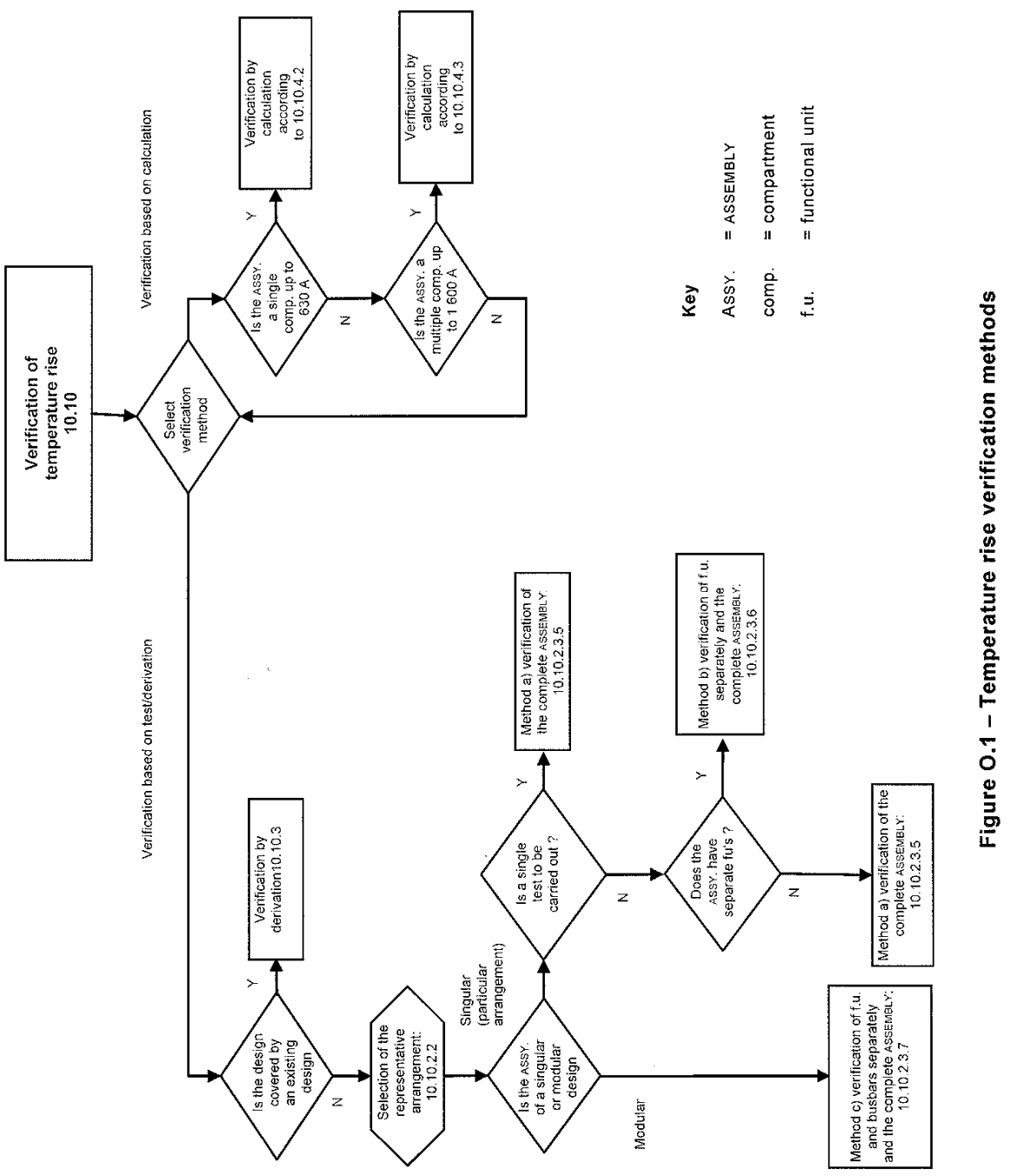


Figure O.1 – Temperature rise verification methods

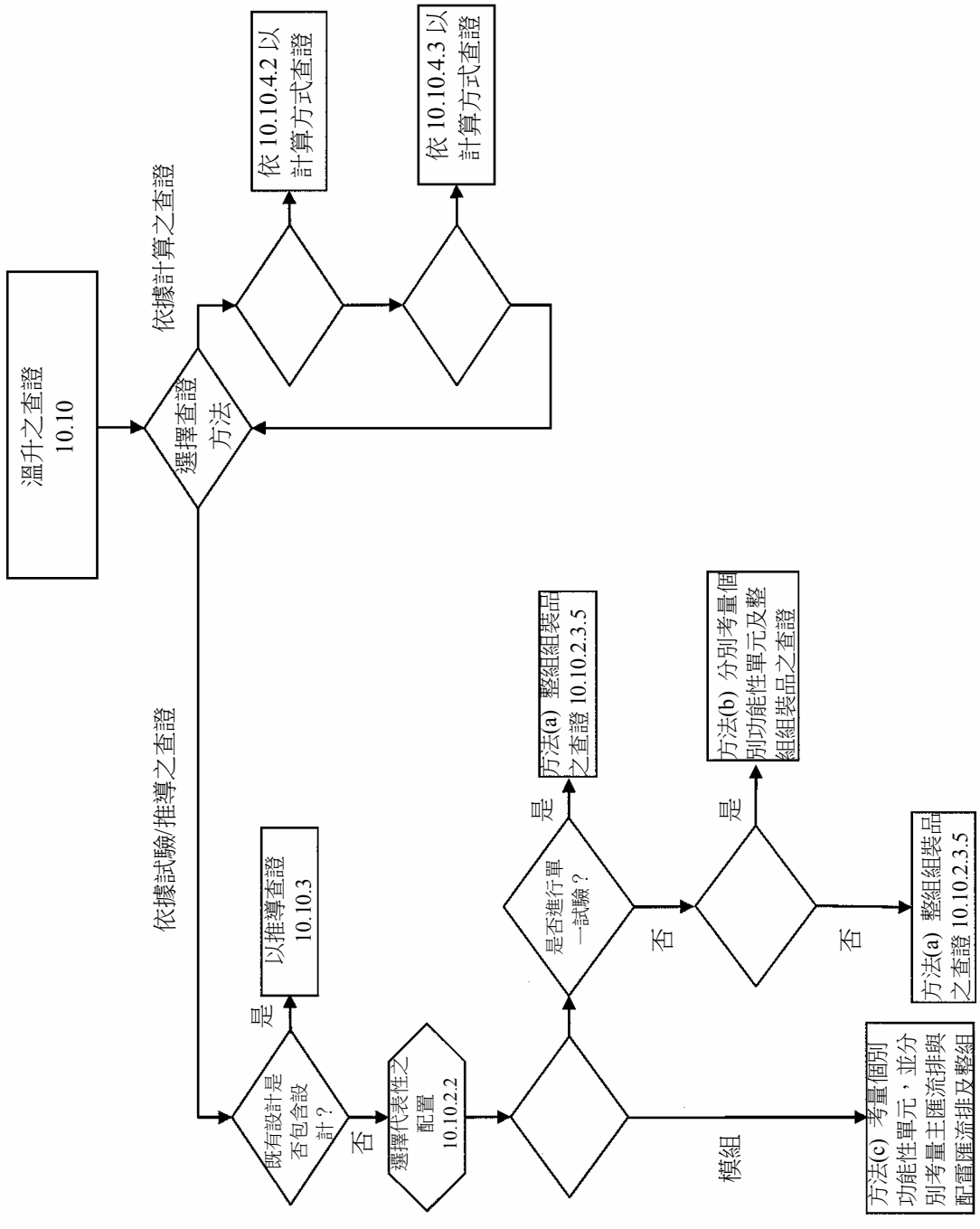

溫升之查證
10.10
選擇查證方法
依據計算之查證
依 10.10.4.2 以計算方式查證
依 10.10.4.3 以計算方式查證
依據試驗/推導之查證
既有設計是否包含設計？
是
以推導查證 10.10.3
否
選擇代表性之配置 10.10.2.2
是否進行單一試驗？
是
方法(a) 整組組裝品之查證 10.10.2.3.5
否
是
方法(b) 分別考量個別功能性單元及整組組裝品之查證
否
方法(a) 整組組裝品之查證 10.10.2.3.5
模組
方法(c) 考量個別功能性單元，並分別考量主匯流排與配電匯流排及整組

圖 O.1　溫升查證法

Annex P
(normative)
Verification of the short-circuit withstand strength of busbar structures by comparison with a tested reference design by calculation

附錄 P
(規定)
藉由計算方式比較受試驗之參考設計，查證匯流排結構之短路耐受強度

P.1 General

This annex describes a method for assessing the short-circuit withstand strength of busbar structures of an ASSEMBLY by a comparison of the ASSEMBLY to be assessed with an ASSEMBLY already verified by test (see 10.11.5).

P.1 一般

本附錄藉由比較待進行評鑑及已以試驗進行查證之組裝品，敘述評鑑組裝品之匯流排短路耐受強度的方法(參照 10.11.5)。

P.2 Terms and definitions

For the purposes of this annex, the following terms and definitions apply.

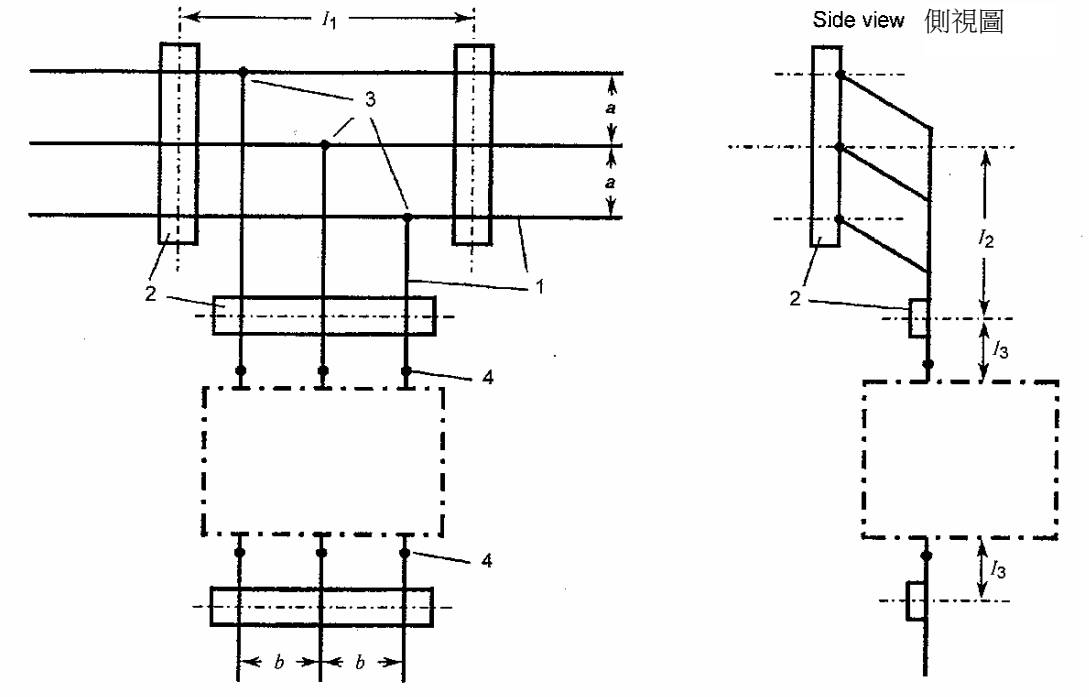
P.2 用語及定義

下列用語及定義，適用於本附錄。

P.2.1
tested busbar structure
TS
structure whose arrangement and equipment are documented by drawings, parts lists and descriptions in the test certificate (Figure P.1)

P.2.1 受試驗之匯流排結構 TS (tested busbar structure, TS)

係一種結構，其配置及設備係以圖面、零件清單及敘述記載於證書中(圖 P.1)。



Key

1	busbar
2	support
3	busbar connection
4	equipment connection
a, b, I	distances

Figure P.1 – Tested busbar structure (TS)

說明

1 匯流排

2 支撐物

3 匯流排連接

4 設備連接

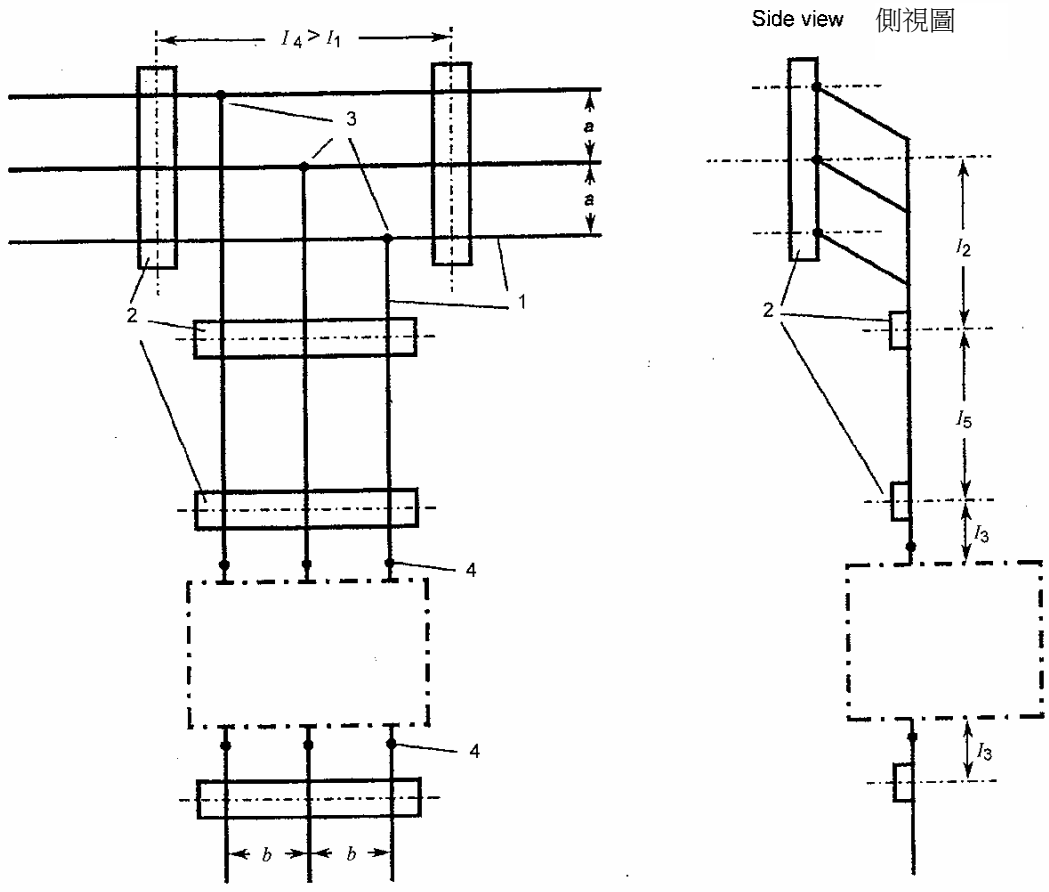
a, b, I 距離

圖 P.1 受試驗之匯流排結構(TS)

P.2.2
non tested busbar structure
NTS
structure which requires verification of short-circuit withstand strength (Figure P.2)

P.2.2 非受試驗之匯流排結構 NTS (non tested busbar structure, TS)

係一種結構，其需要查證短路耐受強度(圖 P.2)。



Key
1 busbar
2 support
3 busbar connection
4 equipment connection
a, b, l distances

Figure P.2 – Non tested busbar structure (NTS)

說明

1 匯流排

2 支撐物

3 匯流排連接

4 設備連接

a, b, I 距離

圖 P.2 非受試驗之匯流排結構(NTS)

P.3 Method of verification

The short-circuit withstand strength of a derived structure, i.e. an NTS, is verified from a tested structure (TS) by applying calculations according to IEC 60865-1 to both structures. The short-circuit withstand strength of the NTS is considered verified if the calculations show that the NTS does not have to withstand higher mechanical and thermal stresses than the tested structure.

P.3 查證法

依 IEC 60865-1 對衍生之及受試驗之組裝品進行計算，從受試驗之結構(TS)中查證衍生之結構(例：NTS)的短路耐受強度。若計算結果顯示 NTS 並未必須耐受較受試驗之結構為高之機械應力及熱動應力，則 NTS 之短路耐受強度視為已查證。

P.4 Conditions for application

P.4.1 General

Changes of parameters, such as busbar clearances, busbar material, busbar cross-section and busbar configuration shown to be necessary by the calculation in conformity with IEC 60865-1 are permissible only in so far as the following conditions are adhered to.

P.4 應用之條件

P.4.1 一般

僅在符合下列條件時，始可容許經依 IEC 60865-1 計算後為必要之參數之變化(例：匯流排空間距離、匯流排材料、匯流排截面積及匯流排架構)。

P.4.2 Peak short-circuit current

The short-circuit current may be changed only to lower values.

P.4.2 峰值短路電流

短路電流僅可變更至較低值。

P.4.3 Thermal short-circuit strength

The thermal short-circuit strength of an NTS shall be verified by calculations according to IEC 60865-1. The calculated temperature rise of the NTS shall not be higher than that of the TS.

P.4.3 熱動短路強度

應依 IEC 60865-1 之計算，查證 NTS 之熱動短路強度。所計算出之 NTS 溫升，不應高於 TS 溫升。

P.4.4 Busbar supports

Changes of material or shape of supports taken from an ASSEMBLY verified by test are not permitted. However, other supports may be used but they shall have been previously tested for the required mechanical strength.

P.4.4 匯流排支撐物

從以試驗查證過之組裝品中取出之支撐物，不容許其材料或形狀之變化。然而，可使用其他支撐物，但其先前應已針對所需要之機械強度進行試驗。

P.4.5 Busbar connections, equipment connections

The type of busbar and equipment connections shall have been previously verified by test.

P.4.5 匯流排連接、設備連接

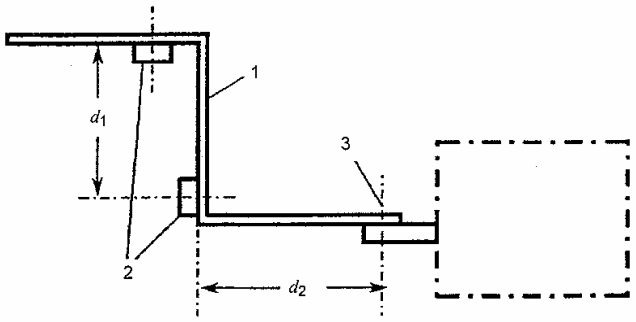
匯流排及設備連接之型式，應已以試驗查證。

P.4.6 Angular busbar configurations

IEC 60865-1 is applicable only to straight busbar configurations. Angular busbar configurations may be considered as a series of straight configurations when supports are provided at the corners (see Figure P.3).

P.4.6 角形匯流排(angular busbar)架構

IEC 60865-1 僅適用於直線形匯流排架構。當有在角落提供支撐物時，角形匯流排架構可視為一系列直線形架構(參照圖 P.3)。



Key

1	busbar
2	support
3	equipment connection
d	support distance

Figure P.3 – Angular busbar configuration with supports at the corners

說明

1 匯流排

2 支撐物

3 設備連接

d 支撐物距離

圖 P.3 於角落具有支撐物之角形匯流排

P.4.7 Calculations with special regard to conductor oscillation

For calculations in conformity with IEC 60865-1 on the tested structure (TS), the following values of the factors V_σ, $V_{\sigma s}$ and V_F shall be used:

$$V_\sigma = V_{\sigma s} = V_F = 1{,}0$$

where

V_σ is the ratio between dynamic and static main conductor stress;

$V_{\sigma s}$ is the ratio between dynamic and static sub-conductor stress;

V_F is the ratio between dynamic and static force on support.

For the NTS,

$$V_\sigma = V_{\sigma s} = 1{,}0 \text{ and}$$

V_F is found from calculations in accordance with IEC 60865-1, but $V_F < 1{,}0$ is to be replaced by $V_F = 1{,}0$.

P.4.7 特別關於導體振盪之計算

關於依照 IEC 60865-1 於受過試驗之結構(TS)上之計算，應使用下列 V_σ、$V_{\sigma s}$ 或 V_F 因數值。

$$V_\sigma = V_{\sigma s} = V_F = 1.0$$

式中，V_σ 為動態與靜態主導體應力之間的比率

$V_{\sigma s}$ 為動態與靜態次導體應力之間的比率

V_F 為支撐物上動態與靜態力量之間的比率

對於 NTS，

$$V_\sigma = V_{\sigma s} = 1.0\text{，且}$$

V_F 係依 IEC 60865-1 之計算取得，但 $V_F<1$，將以 $V_F=1$ 取代。

參考資料

IEC 60038	IEC standard voltages
IEC 60050-151:2001	International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices
IEC 60050-195:1998	International Electrotechnical Vocabulary – Part 195: Earthing and protection against electric shock
IEC 60050-441:1984	International Electrotechnical Vocabulary – Chapter 441: Switchgear, controlgear and fuses
IEC 60050-471:2007	International Electrotechnical Vocabulary – Part 471: Insulators
IEC 60050-601:1985	International Electrotechnical Vocabulary – Chapter 601: Generation, transmission and distribution of electricity – General
IEC 60050-604:1987	International Electrotechnical Vocabulary – Chapter 604: Generation, transmission and distribution of electricity – Operation
IEC 60050-826:2004	International Electrotechnical Vocabulary – Part 826: Electrical installations
IEC 60079 (all parts)	Explosive atmospheres
IEC 60092-302:1997	Electrical installations in ships – Part 302: Low-voltage switchgear and controlgear assemblies
IEC 60112:2003	Method for the determination of the proof and the comparative tracking indices of solid insulating materials
IEC 60204 (all parts)	Safety of machinery – Electrical equipment of machines
IEC 60204-1	Safety of machinery – Electrical equipment of machines – Part 1: General requirements
IEC 60227-4:1992	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 4: Sheathed cables for fixed wiring
IEC 60228:2004	Conductors of insulated cables
IEC 60417-SN:2011	Graphical symbols for use on equipment
IEC 60502-1:2004	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (U_m = 1.2 kV) up to 30 kV (U_m = 36 kV) – Part 1: Cables for rated voltages of 1 kV (U_m = 1.2 kV) and 3 kV (U_m = 3.6 kV)
IEC 60947 (all parts)	Low-voltage switchgear and controlgear
IEC 61000-3-2:2005	Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤16 A per phase)
IEC 61000-3-3	Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional

	connection
IEC 61000-3-5	Electromagnetic compatibility (EMC) – Part 3-5: Limits – Limitation of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than 75 A
IEC 61000-3-11	Electromagnetic compatibility (EMC) – Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤75 A and subjet to conditional connection
IEC 61000-3-12	Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤75 A per phase
IEC 61000-6-1	Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments
IEC 61000-6-3	Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments
IEC 61082 (all parts)	Preparation of documents used in electrotechnology
IEC/TR 61117:1992	A method for assessing the short-circuit withstand strength of partially type-tested assemblies (PITA)
IEC 61140:2001	Protection against electric shock – Common aspects for installation and equipment
IEC 61241(a!l parts)	Electrical apparatus for use in the presence of combustible dust
IEC/TR 61912-1:2007	Low-voltage switchgear and controlgear – Overcurrent protective devices – Part 1: Application of short-circuit ratings
IEC/TR 61912-2:2009	Low-voltage switchgear and controlgear – Over-current protective devices – Part 2: Selectivity under over-current conditions
DIN 43671:1975	Copper busbars; design for continuous current

相對應國際標準

IEC 61439-1:2011 High-voltage switchgear and controlgear − Part 1: Common specifications

正字標記簡介

正字標記驗證制度係爲推行中華民國國家標準，自民國 40 年起實施的產品驗證制度，是依據「標準法」及「正字標記管理規則」之規定，爲落實國家標準的實施而辦理的產品驗證標記。藉由正字標記之核發，可彰顯產品品質符合國家標準，且其生產製造工廠採用之品質管理系統，亦符合相關規定。生產廠商藉正字標記之信譽，可爭取顧客信賴以拓展市場，消費者亦可經由辨識正字標記圖式，簡易地購得合宜的優良產品，權益因此獲得保障。

正字標記圖式

由中華民國國家標準之英文代號「CNS」及中文符號「㊣」組成

正字標記核准要件

- 工廠品質管理經評鑑取得標準檢驗局指定品管制度之認可登錄。
- 產品經檢驗符合國家標準。

申請正字標記的益處

- **提升廠商競爭力**

  藉由正字標記信譽，爭取顧客信賴以拓展市場；透過與國外驗證標記之相互承認，促進正字標記國際化，進而掌握商機及拓展國內外市場，增加產業競爭力。

- **品牌加值行銷**

  在邁入品牌行銷的世代，產品品質符合國家標準是塑造獨有品牌專業形象的重要指標，也是企業奠定品牌知名度的基礎，以及追求永續穩定發展的最佳保證。取得正字標記，不僅可以提升您的產品形象，還可以加值行銷您的品牌價值，打造品牌屹立不搖的專業磐石。

■ 擴展宣傳管道

正字標記每年規劃系列推廣活動、標章教學、媒體廣告、記者會、文宣等，維持及增進和採購人員及社會大眾間的交流，讓正字標記成爲消費者與採購單位的信賴指標。因此當廠商產品取得正字標記後，在其產品或包裝上印製正字標記的圖式，即可讓品牌達到加乘效果，更易獲取顧客信賴，增加廠商產品之市場競爭力。

本局正字標記推廣宣導網站，提供取得正字標記的產品進行「產品訊息上架」，讓消費者及採購單位進行查詢、指定購買，免費提供正字標記產品宣傳的通路。

■ 政府採購利基

行政院公共工程委員會於 95 年 11 月發函通知各政府機關表示：「正字標記係我國推行國家標準品質保證之驗證標記，爲促進政府採購與公共工程品質之提升，本會鼓勵各機關以正字標記加註同等品作爲規格標示。本會 91 年 1 月 29 日工程企字第 09200044060 號函已明示『各機關如使用正字標記產品，其就該產品已依規定辦理之檢驗事項，機關得免重行檢驗。』」。

採購規格指定爲正字標記產品，可保障採購規格之妥善、週延性，驗收時只需查驗生產廠商所送交之產品是否具有正字標記證書即可，亦毋須逐項檢驗，可減少產品送驗之人力、物力、財力和時間。

相關資訊 Information

正字標記推廣網站（http://www.cnsmark.org.tw）

正字標記查詢系統（http://cnsmark.bsmi.gov.tw）

經濟部標準檢驗局（http://www.bsmi.gov.tw）