



《電動車輛充電設施的電力安全》

2022年12月21日

機電工程署
EMSD



背景

- 政府於2021年3月公布首份《香港電動車普及化路線圖》
 - ✓ 闡述未來在香港推動使用電動車及其所需配套的長遠政策目標及計劃
 - ✓ 引領香港在2025年前達致車輛零排放的未來路向

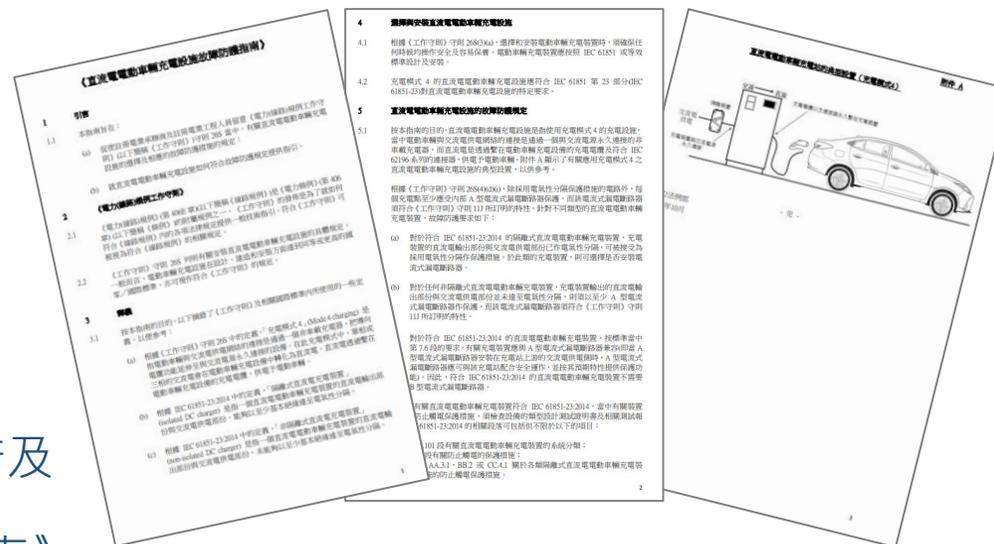
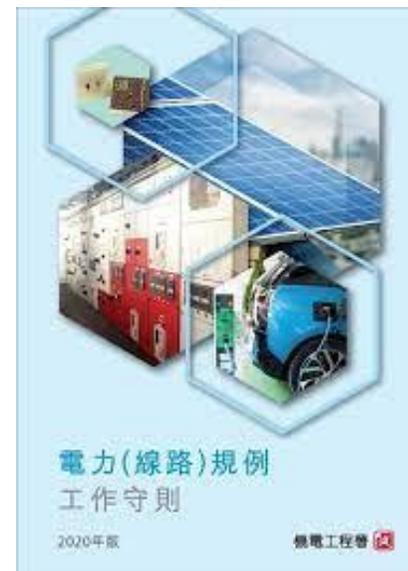
➤ 為推動電動車在香港的發展

- 《電力(線路)規例工作守則》(2020年版)

- 檢討守則26S並新增有關安裝電動車輛充電設施的具體規定
- 已於2021年12月31日全面實施

- 《直流電電動車輛充電設施故障防護指南》

- 有見直流電電動車輛充電設施(俗稱快速充電站)的日漸普及
- 於2022年10月推出《直流電電動車輛充電設施故障防護指南》
- 就直流電電動車輛充電設施如何符合故障防護規定提供進一步的指引



26S 電動車輛的充電設施

(4) 安全保護措施

(d) 故障防護

- (i) 除採用電氣性分隔保護措施的電路外，每個充電點至少應受內部 A 型電流式漏電斷路器保護，而該電流式漏電斷路器須符合守則 11J 所訂明的特性。
- (ii) 除非是由電動車輛充電設備提供保護措施，每個帶有充電插座或連接器（符合 IEC 62196 系列）的充電點，均應採取針對直流故障電流的保護措施。每個連接點均應採取以下的適當措施：
 - B 型電流式漏電斷路器；或
 - A 型電流式漏電斷路器及合適的設備，當直流故障電流超過 6mA 時可將電源截斷。

守則26S - 充電模式 3 的故障防護

26S 電動車輛的充電設施

(3) 選擇與安裝裝置

(b) 插座及連接器

(i) 插座及連接器須符合以下標準或等效標準：

- 充電模式 1 — BS 1363；
- 充電模式 2 — IEC 60309 是用作聯鎖和分類，以防可觸及的插座觸點帶電；
- 充電模式 3 — IEC 62196；

(4) 安全保護措施

(d) 故障防護

(i) 除採用電氣性分隔保護措施的電路外，每個充電點至少應受內部 A 型電流式漏電斷路器保護，而該電流式漏電斷路器須符合守則 11J 所訂明的特性。

(ii) 除非是由電動車輛充電設備提供保護措施，每個帶有充電插座或連接器（符合 IEC 62196 系列）的充電點，均應採取針對直流故障電流的保護措施。每個連接點均應採取以下的適當措施：

- B 型電流式漏電斷路器；或
- A 型電流式漏電斷路器及合適的設備，當直流故障電流超過 6mA 時可將電源截斷。



守則26S - 充電模式 3 的故障防護

- 在安裝充電模式3的電動車輛充電設施時，每個連接點均須採取針對直流故障電流的保護措施，下列為適當的措施：

- B 型電流式漏電斷路器 (RCD Type B)



IEC 62423

- A 型電流式漏電斷路器及合適的設備，當直流故障電流超過 6mA 時可將電源截斷 (RCD Type A + RDC-DD*)



IEC 61008



IEC 62955

商品目錄常見描述：

protection device type

Residual direct current detection device (RDC-DD) - 6 mA

Residual current device (RCD) - 30 mA type A-SI (Super Immunised)

*RDC-DD: Residual direct current detecting device

充電模式 3 - 確認故障防護措施的方法 (測試儀器)

- 能夠施加直流漏電測試電流的電流式漏電斷路器測試器
- 適用於測試B型電流式漏電斷路器及RDC-DD
- ✓ 模擬直流接地故障的情況

- 適用於相關電動車輛充電插座的測試轉接器
- ✓ 模擬電動車輛的充電狀態
- ✓ 連接電流式漏電斷路器測試器以進行測試



RCD
 (1) Mains input voltage range: 100V – 260V 50/ 60Hz
 For Type AC and A RCDs rated at 100mA or higher: 190 – 260V
 (2) Accuracy

Mode	RCD Type	Rated residual operating current (mA) (I _{Δn})	Test current		Duration		
			Current value (mA) rms	Accuracy @230V	Measuring time	Accuracy	
×1/2	AC	G	10/30/100/300/500/1000	I _{Δn} ×1/2	-8% to -2% VAR: -10% to 0%	2000ms	
		S	10/30/100/300/500				
	A/F	G	10/30/100/300/500	I _{Δn} ×0.35	-10% to 0%		
		S	10/30/100/300/500				
	B	G	10/30/100/300	I _{Δn} ×1/2	-10% to 0%		
		S	10/30/100/300				
×1	AC	G	10/30/100/300/500/1000	I _{Δn}	+2% to +8% VAR: 0% to +10%	G: 550ms S: 1000ms	Trip Time ±(1%+2ms) Measuring time ±3% of FS
		S	10/30/100/300/500				
	A/F	G	10/30/100/300/500	10mA: I _{Δn} ×2 Other currents: I _{Δn} ×1.4	0% to +10%		
		S	10/30/100/300/500				
	B	G	10/30/100/300	I _{Δn} ×2	0% to +10%		
		S	10/30/100/300				
EV		6	I _{Δn}	0% to +10%	10.5s		
×5	AC	G	10/30/100	I _{Δn} ×5	+2% to +8% VAR: 0% to +10%	410ms	
		S	10/30/100				
	A/F	G	10/30/100	I _{Δn} ×5×1.4	0% to +10%		
		S	10/30/100				
	B	G	10/30	I _{Δn} ×2×5	0% to +10%		
		S	10/30				
Ramp 20% to 110% (EV 30% to 100%)	AC	G	10/30/100/300/500	I _{Δn}	-4% to +4%	by 10% G: 300ms S: 500ms	Measuring time ±3% of FS
		S	10/30/100/300/500				
	A/F	G	10/30/100/300/500	10mA: I _{Δn} ×2 Other currents: I _{Δn} ×1.4	-10% to +10%		
		S	10/30/100/300/500				
	B	G	10/30/100/300	I _{Δn} ×2	-10% to +10%		
		S	10/30/100/300				
EV		6	I _{Δn}	-10% to +10%	by 2% 500ms (10s is kept only at 100%)		

• AUTO-TEST : X1/2(0°)→X1/2(180°)→X1(0°)→X1(180°)→X5(0°)→X5(180°)
 The test of "X5" will be skipped when a current is 100mA or higher.
 At the auto-test for Type EV, additional 6 mA DC test is performed.

Current waveform of KEW 6516/6516BT

- Type AC: Test current is sine wave.
- Type A and F: Test current is half sine wave.
- Type B and EV: Direct current.



充電模式 3 - 確認故障防護措施的方法 (測試設置)



充電模式 3 - 確認故障防護措施的方法 (直流故障電流保護措施的啟動特性)

- 符合IEC 62423標準的B型電流式漏電斷路器
- 若直流漏電電流量達至或超過於額定餘差啟動電流的兩倍
 - 則應在少於0.3秒的時間內啟動並截斷電流



- 符合IEC 62955標準的RDC-DD

- 若直流漏電電流量達至或超過6mA
 - 則應在少於10秒的時間內啟動保護裝置並截斷電流
- 若直流漏電電流量達至或超過60mA
 - 則應在少於0.3秒的時間內啟動保護裝置並截斷電流



商品目錄常見描述：

protection device type

Residual direct current detection device (RDC-DD) - 6 mA

Residual current device (RCD) - 30 mA type A-SI (Super Immunised)



守則26S - 充電模式 4 (直流電電動車輛充電設施)

- 充電模式4的直流電電動車輛充電設施

- 應符合IEC 61851第23部分(IEC 61851-23)針對直流電電動車輛充電設施的特定要求
- 電動車輛與交流電供電網絡的連接是通過一個與交流電源永久連接的非車載充電器
- 直流電是透過繫在電動車輛充電設備的充電電纜及符合 IEC 62196 系列的連接器，供電予電動車輛



守則26S - 充電模式 4 的故障防護

- 符合IEC 61851-23:2014標準的直流電電動車輛充電裝置可分為兩類型：

(1) 隔離式直流電電動車輛充電裝置 (isolated DC charger)

➤ 充電裝置的直流電輸出部份與交流電供電部份已作電氣性分隔

(2) 非隔離式直流電電動車輛充電裝置 (non-isolated DC charger)

➤ 充電裝置的直流電輸出部份與交流電供電部份並未達至電氣性分隔



26S 電動車輛的充電設施

(4) 安全保護措施

(d) 故障防護

- (i) 除採用電氣性分隔保護措施的電路外，每個充電點至少應受內部 A 型電流式漏電斷路器保護，而該電流式漏電斷路器須符合守則 11J 所訂明的特性。
- (ii) 除非是由電動車輛充電設備提供保護措施，每個帶有充電插座或連接器（符合 IEC 62196 系列）的充電點，均應採取針對直流故障電流的保護措施。每個連接點均應採取以下的適當措施：
 - B 型電流式漏電斷路器；或
 - A 型電流式漏電斷路器及合適的設備，當直流故障電流超過 6mA 時可將電源截斷。

守則26S - 充電模式 4 的故障防護

- 符合IEC 61851-23:2014標準的直流電電動車輛充電裝置可分為兩類型，相關故障防護要求如下：

(1) 隔離式直流電電動車輛充電裝置 (isolated DC charger)

➤ 充電裝置的直流電輸出部份與交流電供電部份已作電氣性分隔

✓ 可被接受為採用電氣性分隔作保護措施，可選擇是否安裝電流式漏電斷路器。

(2) 非隔離式直流電電動車輛充電裝置 (non-isolated DC charger)

➤ 充電裝置的直流電輸出部份與交流電供電部份並未達至電氣性分隔

□ 則須以至少A型電流式漏電斷路器作保護

- 符合 IEC 61851-23:2014的直流電電動車輛充電裝置，按標準當中第 7.6 段的要求
 - 有關充電裝置應與 A 型電流式漏電斷路器兼容
 - 不需要B 型電流式漏電斷路器



充電模式 4 - 確認故障防護措施的方法

- 確認有關直流電電動車輛充電裝置符合IEC 61851-23:2014，當中有關裝置分類及防止觸電保護措施
- 註冊電業工程人員須檢查設備的類型設計測試證明書及相關測試報告
- 檢查相關測試報告時，需注意IEC 61851-23:2014的相關段落及要求，當中可包括但不限於以下的項目：
 - 1) 第6.101段有關直流電電動車輛充電裝置的系統分類
 - 2) 第7段有關防止觸電的保護措施
 - 3) 附件 AA.3.1、BB.2 或 CC.4.1 關於各類隔離式直流電電動車輛充電裝置系統的防止觸電保護措施

(Sample)

Certificate



Certificate no. 1-234567

License Holder: EV Charger Supplier ABC Co. Ltd. Address Line 1 Address Line 2 Address Line 3	Manufacturing Plant: Factory XYZ Co. Ltd. Address Line 1 Address Line 2 Address Line 3
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Test report no.:
Tested to: IEC 61851-1:2017
IEC 61851-23:2014 ←

Client Reference:

Certified Product: Accessory Charging Station License Fee - Units 7

Model Designation: AB-XXX-YZ ←

Rated Voltage: DC 1600V
Rated Current: 425A
Protection Class: I
Rated Operating Temperature: -30°C to 50°C
Output Ratings: DC 1000V, 425A

Special Remarks: To be installed according to the licensee's installation instructions.
Solely assessed to standards listed above.

Appendix: 1, 1-10

Licensed Test mark:  61851-1
61851-23
www.tuv.com
D 28070030

Date of Issue (day/month/year)

TUV Rheinland of North America, Inc. 12 Commerce Road, Newbury, CT 06470, Tel: (203) 426-6888 Fax: (203) 426-4600

充電模式 4 - 確認故障防護措施的方法 (檢查相關測試報告)

- 1) 第6.101段有關直流電電動車輛充電裝置的系統分類
- 2) 第7段有關防止觸電的保護措施
- 3) 附件 AA.3.1、BB.2 或 CC.4.1 關於各類隔離式直流電電動車輛充電裝置系統的防止觸電保護措施

6.101	Classification		P
6.101.1	Category	Class II	---
6.101.1.1	According to system structure:		---
	- isolated d.c. EV charging station, according to the type of insulation between input and output:	<input type="checkbox"/> basic insulation <input checked="" type="checkbox"/> reinforced insulation <input type="checkbox"/> double insulation	P
	- non-isolated d.c. EV charging station.		N/A



充電模式 4 - 確認故障防護措施的方法 (檢查相關測試報告)

- 1) 第6.101段有關直流電電動車輛充電裝置的系統分類
- 2) 第7段有關防止觸電的保護措施
- 3) 附件 AA.3.1、BB.2 或 CC.4.1 關於各類隔離式直流電電動車輛充電裝置系統的防止觸電保護措施

7.5	Protective measures for d.c. EV charging stations		P
	The types of d.c. EV charging stations covered by these requirements, including all accessible conductive parts on the equipment shall have the following protective measures.		P
	– protective measures by automatic disconnection of supply by connecting all exposed conductive-parts to a protective conductor during battery charging, unless protective measure by reinforced or double insulation or protective measure by electrical separation is used for the d.c. EV charging stations.		P
7.5.101	Requirements of the isolated d.c. EV charging station		P
	Requirements for the isolated d.c. EV charging station for protection against electric shock are defined for each system in AA.3.1, BB.2 or CC.4.1.		---
	In addition, if the d.c. EV charging station has multiple d.c. outputs designed for simultaneous operation, each output circuit shall be isolated from each other by basic insulation or reinforced insulation.		P

7.5.102	Requirements of the non-isolated d.c. EV charging station		N/A
	under consideration.		N/A
7.5.103	Protective conductor dimension cross-sectional area		N/A
	Protective conductor shall be of sufficient cross-sectional area to satisfy the requirements of IEC 60364-5-54.		N/A

7.6	Additional requirements		P
	The d.c. EV charging station shall be compatible with RCD Type A in the installation, i.e. a.c. supply network (mains).		P
	Class II chargers may have a lead- through protective conductor for earthing the EV chassis.		P



充電模式 4 - 確認故障防護措施的方法 (檢查相關測試報告)

- 1) 第6.101段有關直流電電動車輛充電裝置的系統分類
- 2) 第7段有關防止觸電的保護措施
- 3) 附件 AA.3.1、BB.2 或 CC.4.1 關於各類隔離式直流電電動車輛充電裝置系統的防止觸電保護措施

6.101.1.5	According to the system used	<input checked="" type="checkbox"/> system A (see Annex AA), <input type="checkbox"/> system B (see Annex BB), <input type="checkbox"/> system C (see Annex CC)	---
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System A (CHAdeMO)

Annex AA	DC EV CHARGING STATION OF SYSTEM A	P
AA.3	Specific safety requirements	P
AA.3.1	Fault protection in the secondary circuit	P
AA.3.1.1	General	P
	For fault protection in the secondary circuit, system A station shall have the following measures: a) reinforced isolating transformer; b) earth leakage current measurement using a grounding resistor between the d.c. power lines DC+/DC- and earth (enclosure and chassis); c) automatic disconnection of supply to d.c. power circuit at the first d.c. earth fault; d) charging cable consisting of line conductors that are individually insulated.	P
	When PE forms part of a charging cable, the cross-sectional area of PE shall be determined by the formula in 543.1.2 of IEC 60364-5-54:2011.	P

AA.3.1.2	Automatic disconnection and earth fault monitoring	P
	System A station shall measure the earth leakage current between the secondary circuit and its enclosure, or between the secondary circuit and the vehicle chassis.	P
	When an earth fault is detected during charging, the station shall reduce the d.c. output current to 5A or less.	P
	Then, the switch d1 shall be open in order to prevent the vehicle to close EV contactor. The line-to-line voltage of d.c. output V _{dc} shall be reduced to less than 60 V The automatic disconnection process shall be accomplished within 5 s from the detection of earth fault.	P
	A method to detect a d.c. fault current is required for the first earth fault.	P

充電模式 4 - 確認故障防護措施的方法 (檢查相關測試報告)

- 1) 第6.101段有關直流電電動車輛充電裝置的系統分類
- 2) 第7段有關防止觸電的保護措施
- 3) 附件 AA.3.1、BB.2 或 CC.4.1 關於各類隔離式直流電電動車輛充電裝置系統的防止觸電保護措施

System C (CCS)

CC.4	Safety measures		
CC.4.1	IT (isolated terra) system requirements		
	The secondary circuit (output side) of the d.c. supply shall be designed as an IT system and protection measures in accordance with 411 of IEC 60364-4-41:2005 shall be applied.		P
	In case of using an insulation monitoring device (IMD), it shall comply with IEC 61557-8 or equivalent. The d.c. supply shall perform insulation monitoring between DC+ and PE and DC and PE during the supply process and communicate the current state (Invalid, Valid, Warning, Fault) of the system periodically to the EV.		P
	Prior to each supply cycle the following tests shall be performed. During these tests the d.c. output voltage shall not exceed 500 V at vehicle connector.		P
	a) A self-test of the insulation monitoring function of the d.c. supply shall be done by applying a defined fault resistor between d.c. output rail and equipotential bonding (e.g. PE). At least one of the following three possibilities for time management of self-test shall be applied:		P

1) directly prior to supply cycle with vehicle connector plugged into vehicle inlet; 2) at regular intervals with maximum period of 1 h; 3) after self-test has successfully been performed the station may stay in Valid state for a maximum time of 1 h and during supply session under normal conditions.	Prior to supply cycle	P
b) An insulation check of the system according to 6.4.3.106, e.g. by IMD shall be performed:		P
1) vehicle connector not plugged into vehicle inlet: system comprises station, cable and vehicle connector, or		N/A
2) vehicle connector plugged into vehicle inlet: system comprises station, charging cable, vehicle connector, vehicle inlet and vehicle cables.		P
The insulation states of the system are defined as follows: invalid state, valid state, warning state, fault state, no IMD state.		P

詳情載於 《直流電電動車輛充電設施故障防護指南》

- 上載於機電署網頁供免費下載參考
 - www.emsd.gov.hk → 電力安全 → 刊物 → 指南 / 指引



《直流電電動車輛充電設施故障防護指南》下載:



電力裝置	
1	電動車輛充電設施技術指引 (2015年4月發出) [PDF 格式 (545KB)]
2	可再生能源發電系統與電網連接技術指引 (2016年版) [PDF 格式 (14.03MB)]
3	電力線路測試紀錄表樣本 (可填寫) [PDF 格式 (117KB)]
4	商堂洗衣處所內商用電動乾衣機及電力裝置指南 (2022年1月) [PDF 格式 (1.68B)] * 有關商業樓宇內的燃氣乾衣機, 請參考工作守則: (1) 以煤氣作為燃料的商業樓宇內的燃氣乾衣機 [PDF 格式 (672KB)] (2) 以石油氣作為燃料的商業樓宇內的燃氣乾衣機 [PDF 格式 (672KB)]
5	註冊電業承辦商須知
6	註冊電業工程人員須知
7	B級電業工程人員註冊考試簡介
8	C級電業工程人員註冊考試簡介
9	固定電力裝置定期檢測的工作程序 [PDF 格式 (1.45MB)]
10	電力工作的停電安排 [PDF 格式 (4.79MB)]
11	檢查和測試泳池和噴水池電力裝置的附加核對表 [PDF 格式 (963KB)]
12	使用組裝合成建築法項目的固定電力裝置指南 (2019年6月) [PDF 格式 (190KB)]
13	直流電電動車輛充電設施故障防護指南 (2022年10月) [PDF 格式 (381KB)]

多謝！

