Technical Guidelines on Charging Facilities for Electric Vehicles

Introduction

1. This set of technical guidelines sets out the statutory requirements and general guidelines for installation of charging facilities for electric vehicles (EV) in Hong Kong.

2. This set of technical guidelines supersedes all previous technical guidelines on charging facilities for electric vehicles and shall apply to new charging facilities. Existing charging facilities conforming to previous technical guidelines may continue to be used unless such facilities are being altered, added or improved in which case this set of technical guidelines shall apply.

3. The terms and definitions used in this set of technical guidelines are listed in Annex A

Statutory Requirements

4. Electric vehicle charging facilities are fixed electrical installations and shall comply with the relevant requirements of the Electricity Ordinance (Cap. 406) and its subsidiary Regulations.

5. Electrical work on EV charging facilities including design, installation, commissioning, inspection, testing, maintenance, modification and repairing shall be carried out by registered electrical contractors and registered electrical workers of the appropriate grade.

International and National Standards

6. The International Electrotechnical Commission (IEC), Society of Automotive Engineers (SAE) of United States, and GuoBiao (GB) of China are the three most common conductive charging standards for EVs. In addition, CHAdeMO is a DC quick charging standard which was developed in Japan. IEC standard is adopted by most European EV

manufacturers while SAE by United States of America and Japan. GB is the national standard adopted by mainland EV manufacturers.

Standard	
IEC	IEC 61851
SAE	SAE J1772
GB	GB/T 20234
CHAdeMO	CHAdeMO

7. These standards define charging methods, communication signals as well as plug and socket designs. SAE and IEC standards share the same communication protocol between EV and charger, but have different designs for plug and socket interface. GB operates on a different communication protocol and hence is not compatible with SAE or IEC.

8. Where applicable, this set of technical guidelines makes reference to the IEC standard.

Modes of Charging

9. The four different modes of electric vehicle conductive charging specified in IEC 61851 are illustrated in Annex B.

Mode 1

10. For Mode 1 charging, an AC charging current is delivered via a standard socket outlet e.g. BS1363 13A and a charging cable without communication function to the on-board charger of the EV. The presence of a residual current device (RCD) is a must on the supply side of the fixed electrical installation. This mode of charging is suitable for longer period of charging at home or in office.

Mode 2

11. For Mode 2 charging, an in-cable control box is incorporated into the charging cable assembly. The provision of fixed electrical installation for charging facility is similar to that for Mode 1 except that the final circuit, protective device and socket outlet shall be of a suitable rating to cater for the higher level of charging current not exceeding 32A.

Mode 3

12. For mode 3 charging, a dedicated EV supply equipment (EVSE) and a charging cable assembly shall be employed. The control pilot cable of the charging cable assembly allows communication between the EVSE and the on-board charger of an EV to perform functions including verification of connection with the EV, continuous checking of protective earth conductor integrity, energization and de-energization of the supply, and selection of charging rate.

13. Dedicated charging plug, socket and coupler are required for Mode 3 charging, which are specially designed for EV charging.

14. Subject to the power rating of the on-board charger of an electric vehicle, Mode 3 charging can deliver a higher charging current (e.g. 220V/32A, 380V/32A, 380V/63A) and hence a shorter charging time.

15. Selection of EVSE shall depend on the charging protocol of the EV and on advice of the EV manufacturer.

Mode 4

16. Mode 4 charging employs the principle of using an off-board charger to deliver a DC current directly to the battery bypassing the on-board charger. DC quick charging can charge up an EV in a relatively short time as a substantially higher electrical power ranging from 20kW to 120kW is used.

Quick Charger

CHAdeMO

17. DC quick chargers typically of 50kW capacity in compliance with the Japanese CHAdeMO protocol (Mode 4 off-board charging) are currently available in Hong Kong.

Combined Charging System (CCS)

18. The CCS integrates one-phase AC charging, three-phase AC charging and DC charging into a single vehicle inlet. This universal charging system will allow EV owners to recharge at most existing charging stations regardless of power source.

19. There are two variants of the CCS. One is based on SAEJ1772 socket interface (equivalent to IEC Type 1 socket) and the other based on IEC Type 2 socket interface. They are called Combo 1 and Combo 2 respectively. The former is more commonly used in EVs from the U.S. while the latter is more so among EVs from European countries.

Multi-standard System

20. In recent market development, EV charger manufacturers have launched multi-standard products to enhance the versatility of EV chargers. There are various configurations of the multi-standard systems. The more common one incorporates two DC charging standards in one charger, e.g. CHAdeMO plus CCS or other combinations. Some chargers may also incorporate both AC and DC charging in a single charger, e.g. IEC plus CCS or IEC plus CCS and CHAdeMO etc.

General Guidelines on EV Charging Facilities

21. The requirements of the major components of EV charging facility are described below.

Final Circuit

21.1 Each final circuit of EV charging facility shall be installed as a separate radial circuit of the fixed electrical installation.

21.2 Electric cable for the final circuit shall be protected by means of metal sheath or armour, or installed in steel/plastic/PVC conduits.

21.3 The copper conductor size of electric cable for each final circuit shall be selected based on the design current of the EVSE and taking into account the constraint of voltage drop in the circuit in accordance with the relevant requirements of the latest Code of Practice for the Electricity (Wiring) Regulations. A larger size electric cable may be used to facilitate future upgrade. In connection with this, a conductor size suitable for carrying a minimum rated current of 32A is recommended.

Protective Device

21.4 Each final circuit shall be individually protected by a high breaking capacity (HBC) fuse or miniature circuit breaker (MCB) of suitable rating.

21.5 An earth leakage protective device shall be provided for each final circuit. Either a residual current operated circuit-breaker with integral over-current protection (RCBO) or residual current device (RCD) with characteristics of type A and residual operating current not exceeding 30mA is acceptable.

21.6 A current breaking device (an ON/OFF switch or others) shall be provided at the upstream of the socket outlet at the charging facility for switching on after plugging and switching off before unplugging the charging cable assembly.

Socket Outlet and Plug

21.7 For Mode 1 charging, the standard socket outlet for EV charging facility used in Hong Kong shall be a 13A socket outlet complying with BS 1363 and the associated plug used shall be a 13A non-rewirable plug also complying with BS 1363.

21.8 For Mode 2 charging, socket outlet and the associated plug used complying with IEC 60309 may be employed.

21.9 For Mode 3 charging, the type of socket outlet or vehicle connector required shall conform to the charging system protocol designed for the EV. At present, dedicated socket outlets conforming to IEC 62196 and SAE J1772 are becoming more common while socket outlets conforming to GB 20234 are also available.

21.10 EVSE or socket outlet shall, in general, be installed at a height of about 1.2m above finished floor level for easy access but the actual level may vary to suit EV user's need and site condition.

21.11 EVSE and socket outlet and associated electrical equipment shall be suitably protected from ingress of dust and water to an index of protection of IPX3 for use at indoor car park. An index of protection of IPX4 or higher is required for both plugged and no-plug conditions if the EV charging facility is installed and used in an outdoor environment. The use of a weatherproof enclosure to house both socket outlet and associated electrical equipment is acceptable.

21.12 Photos showing EV charging plug & socket, vehicle connectors and vehicle inlets adopting different standards are shown in Annex C for easy reference.

Extension Unit

21.13 No extension unit other than charging cable assembly designed for EV charging shall be used.

Type Test Certificate

21.14 EVSE shall be type tested for compliance with the relevant IEC, SAE, GB or CHAdeMO standard(s). In addition, if an EVSE is designed for outdoor use, test certificate for ingress protection rating in accordance with IEC 60529, e.g. IP 54 or above shall be available. EVSE suppliers shall be obliged to provide such test certificates.

Other Considerations

22. An operation instruction for the charging facility including essential information of the rated voltage (V), frequency (Hz), current (A), and number of phase shall be displayed at a prominent location at each of the parking space with EV charging facility.

23. For Mode 2 charging, a bracket or hanging device for supporting the weight of in-cable control box of the EV charging cable shall be provided as far as practicable to avoid excessive loading on the EV charging cable and plug.

24. Other advanced features for charging facility such as system energization, charging rate selection, vehicle connection verification, and circuit protective conductor integrity detection may be considered.

25. Directional signage inside and outside car park is recommended to direct EV drivers to designated parking spaces with EV charging facilities.

26. Occupancy sensors are useful devices giving indication to drivers on availability of EV charging facility in a public car park and may be considered by the owner of a public car park.

27. Means of preventing unauthorized usage of the charging facilities such as housing the socket outlet in a padlocked box or using an access card for energizing charging facility etc. may be provided as necessary.

28. The provision of an indicator light at the charging facility to indicate charging in progress may be provided.

29. For a car park with multiple charging facilities, provision of wired or wireless communication for group control of the charging facilities may be considered.

30. CCTV surveillance may be considered to improve security.

Inspection and Maintenance

31. Regular inspection of the charging facilities shall be carried out. If repair or maintenance is required, any electrical work shall be carried out by registered electrical contractor and registered electrical worker.

Useful Information

32. A summary table of different standards of sockets and plugs, RCBO and switch ratings, sizes of non-armoured PVC cables for different charging voltage and current levels for EV charging is shown in Annex D for reference.

Enquiries

33. For further enquiries on EV charging facilities, please call EMSD EV Hotline at telephone number 3757 6222.

Electrical and Mechanical Services Department
April 2015

Annex A

Terms and Definitions

For the purpose of this set of technical guidelines, the following terms and definitions shall apply.

Off-board charger
Charger connected to the premises wiring of the a.c. supply network (mains) and designed to operate entirely off the vehicle. In this case, direct current electrical power is delivered to the vehicle.

On-board charger
Charger mounted on the vehicle and designed to operate only on the vehicle.

Charging cable assembly
Piece of equipment used to establish the connection between the EV and socket-outlet or the fixed charger.

Control pilot
The control conductor in the charging cable assembly connecting the in-cable control box or the fixed part of the charging facilities, and the EV earth through the control circuitry on the vehicle. It may be used to perform several functions.

EV charging facility
Charging facilities are fixed electrical installations that include, but not limited to, switchboards, distribution boards, cabling, conduits, trunkings, socket outlets and EV supply equipment.

EV supply equipment (EVSE)
Conductors, including the phase, neutral and protective earth conductors, the EV couplers, attachment plugs, and all other accessories, devices, power outlets or apparatuses installed specifically for the purpose of delivering energy from the premises wiring to the EV and allowing communication between them if required. Example: wallbox unit and charging pole

In-cable control box
A device incorporated in the charging cable assembly, which performs control functions and safety functions.

Plug and socket-outlet
Means of enabling the manual connection of a flexible cable to fixed wiring

Plug
Part of a plug and socket-outlet integral with or intended to be attached to the flexible cable connected to the socket-outlet.

Socket-outlet
Part of a plug and socket-outlet intended to be installed with the fixed wiring.

Vehicle coupler
Means of enabling the manual connection of a flexible cable to an EV for the purpose of charging the traction batteries.

Vehicle connector
Part of a vehicle coupler integral with, or intended to be attached to, the flexible cable connected to the a.c. supply network (mains).

Vehicle inlet
Part of a vehicle coupler incorporated in, or fixed to, the EV or intended to be fixed to it.

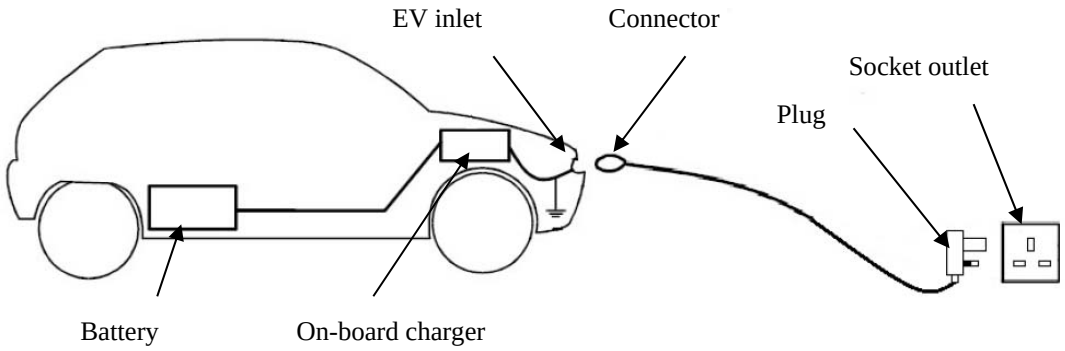
Annex B

Modes of Charging under IEC Standard

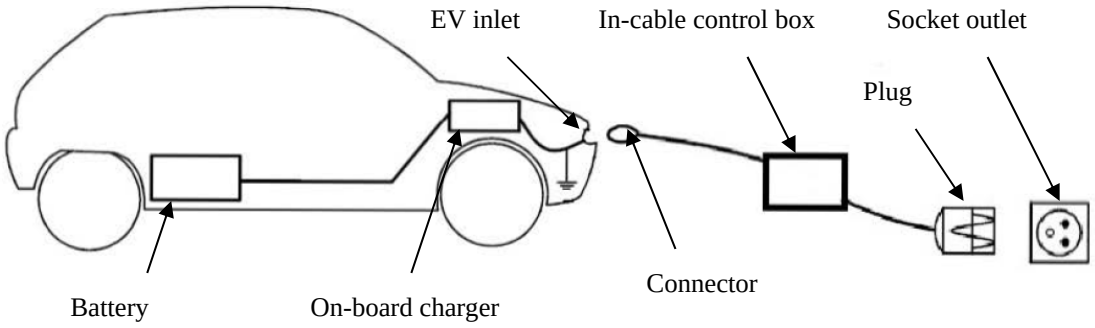
The four (4) different charging modes of EV are specified in the IEC 61851 on Electric Vehicle Conductive Charging System as follows:

Modes of Charging:

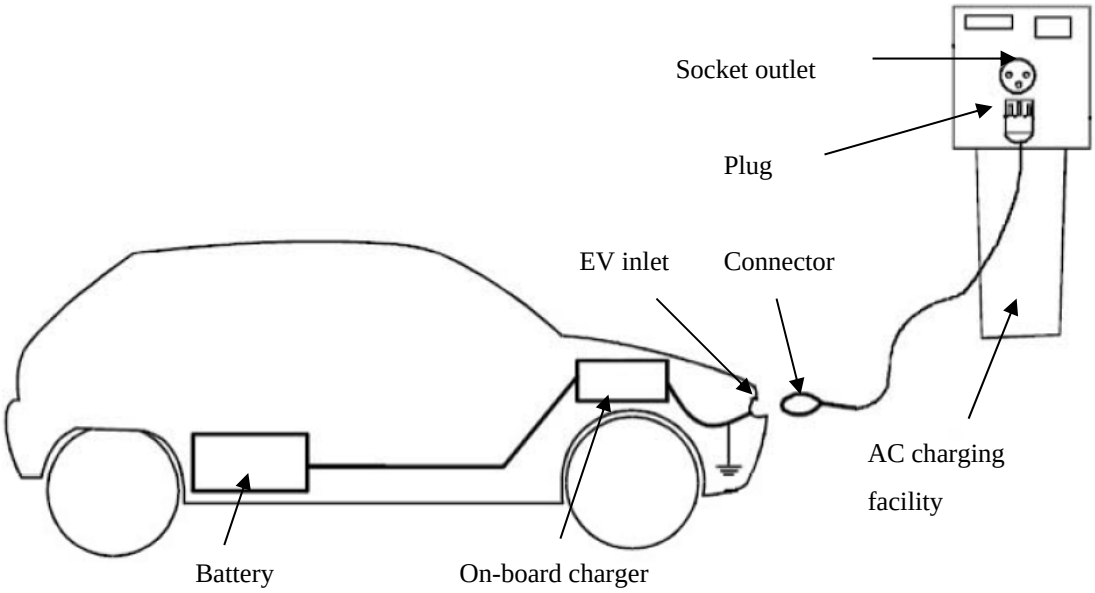
Mode 1 - Use of a standard socket outlet without communication and the presence of a residual current device (RCD) is a must on the supply side, rated up to 16A.



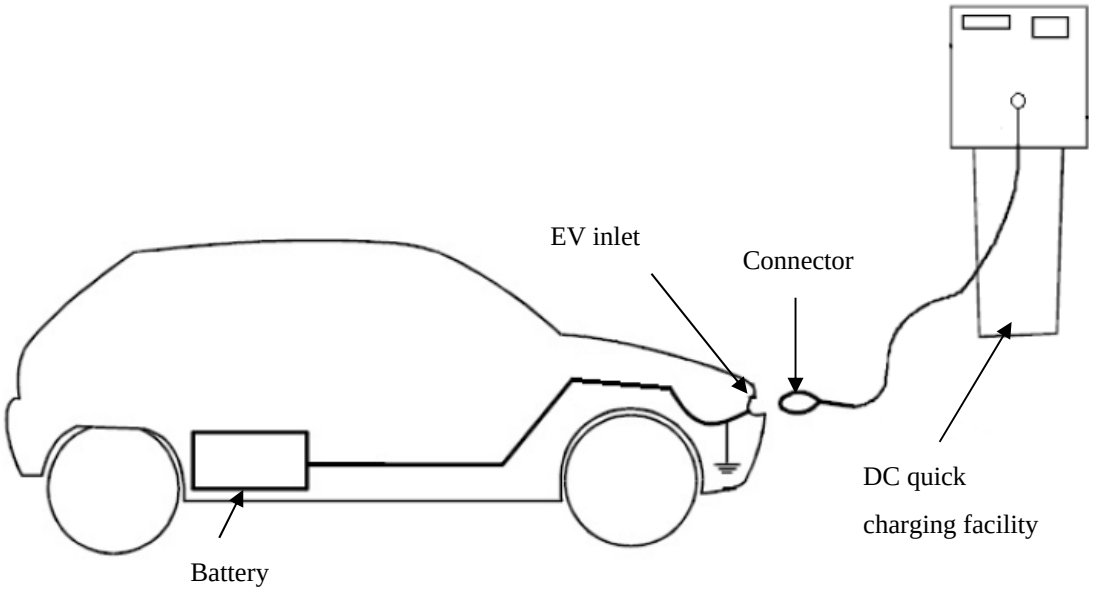
Mode 2 - Use of a standard socket not exceeding 32A outlet with in-cable or in-plug control pilot cable



Mode 3 - Use of a dedicated socket outlet where control pilot cable permanently connected to AC source



Mode 4 - Use of an off-board charger i.e. DC quick charger



Annex C

Photos of EV Charging Plug & Socket, Vehicle Connectors and Vehicle Inlets Adopting Different Standards

BS 1363 Non-rewirable Plug

BS 1363 Socket

IEC 62196 Type 2 Vehicle Connector

IEC 62196 Type 2 Vehicle Inlet

SAE J1772 Vehicle Connector

SAE J1772 Vehicle Inlet

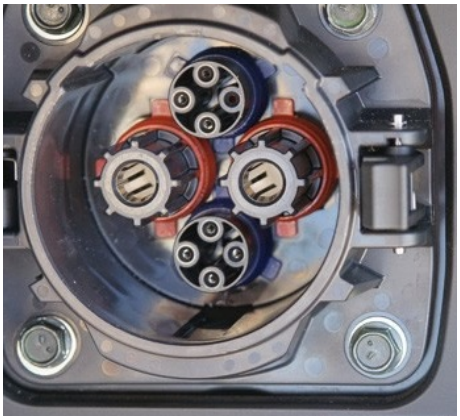
SAE DC Combo (Combo 1)

IEC DC Combo (Combo 2)

GB 20234.2 AC Vehicle Connector and Vehicle Inlet

GB 20234.3 DC Vehicle Connector and Vehicle Inlet

CHAdeMO Vehicle Connector



CHAdeMO Vehicle Inlet

Annex D

Summary Table of Different Charging Arrangements

The following summary table indicates various typical arrangements with different type of charging set up, charging time (for 18 kWh battery), protective device ratings and cable sizes for reference.

Charging Voltage	Charging Time Required	Minimum Cable Size	RCBO Rating	On/ Off Switch Rating	Standard
220V, 13A	6-7 hrs	2.5 mm^2	20A	20A	BS
220V, 16A	6 hrs	2.5 mm^2	20A	20A	IEC/SAE
220V, 32A	3 hrs	6 mm^2	32A	32A	IEC/SAE
380V, 32A	1 hr	6 mm^2	32A	32A	IEC
380V, 63A	30 mins	16 mm^2	63A	63A	IEC/GB