



هيئة الكهرباء والماء
Electricity & Water Authority

Technical Guideline

Electricity Wiring Regulations for
Electric Vehicles Charging Systems

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List of Abbreviations

| | |
|------|--|
| A | Amps |
| AC | Alternating Current |
| BS | British Standards |
| DC | Direct Current |
| EDD | Electricity Distribution Directorate |
| EV | Electric Vehicle |
| EVSE | Electric Vehicle Supply Equipment |
| EWA | Electricity and Water Authority |
| IEC | International Electrotechnical Commission |
| IP | Ingress Protection |
| PV | Photovoltaics |
| RCBO | Residual Current Breaker with Over-Current |
| RCD | Residual-Current Device |
| V | Volts |

1 Introduction

a Referencing & Commencement

- 1 This document shall be treated as a continuous part of “Regulations for Electrical Installations” by Electricity & Water Authority (EWA), published under Resolution (2) of 2010.
- 2 This document sets the technical requirements for the installation of electric vehicle charging systems in the Kingdom of Bahrain.
- 3 This document shall be effective from 21st April 2022.

b Definitions

In addition to the definitions in this section, all listed definitions in Section 2, Definitions, of the Regulations for Electrical Installations, are also applicable:

- 1 Charging Modes: an operating mode in which energy transfer from a power source to the Electric Vehicle's (EV) battery; below are related definitions:
 - 1 Mode-1: connection of the EV to the AC supply network utilizing standardized socket-outlets not exceeding 16A and not exceeding a nominal supply Voltage of 230V AC single-phase or 400V AC three-phase, at the supply side, and utilizing the power and Circuit Earth Conductors (according to BS EN 61851-1). Mode-1 charging period is relatively long.
 - 2 Mode-2: connection of the EV to the AC supply network utilizing standardized socket-outlets not exceeding 32A and not exceeding a nominal Voltage of 230V AC single-phase or 400V AC three-phase, at the supply side, and utilizing the power and Circuit Earth Conductors together

with a Control Pilot function and system of personnel protection against electric shock (RCD) between the EV and the plug or as part of the In-Cable Control Box.

- 3 Mode-3: connection of the EV to the AC supply network utilizing dedicated EVSE and a charging cable assembly. The control pilot cable of the charging cable assembly allows communication between the EVSE and the On-Board Charger of an EV platform functions including verification of connection with the EV, continuous checking of Circuit Earth Conductor integrity, energization and de-energization of the supply and selection of charging rate. The charging equipment are typically in the form of charging posts or wall mounted charging units, and come in a variety of current ratings e.g. 13A, 16A, 32A and 250A.
- 4 Mode-4: connection of the EV to the AC supply network utilizing an Off-Board Charger where the Control Pilot function extends to control equipment permanently connected to the AC supply. In this Mode, Direct Current Electrical Power is delivered to the vehicle. In Mode-4 either a single-phase or three-phase AC is converted to DC within the EVSE. Such charging equipment units are considered not to be suitable for domestic Electrical Installations due to the higher Voltages and currents used (typically, 500V, 125A).
- 2 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.
- 3 Electric Vehicle (EV): any vehicle propelled by an electric motor drawing current from a rechargeable storage battery or from other portable energy

storage devices (rechargeable, using energy from a source off the vehicle such as a residential or public electricity services), which is manufactured primarily for use on public streets, roads or highways such as battery electric vehicles, hybrid vehicles, plug-in hybrid vehicles, and extended range electric vehicle.

- 4 Electric Vehicle Supply Equipment (EVSE): conductors, including the phase, neutral and Circuit 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.
- 5 In-Cable Control Box: a device incorporated in the charging cable assembly, which performs control functions and safety functions. Such functions include RCD, overcurrent, over-temperature, and protective Earth detection.
- 6 Off-Board Charger: charger connected to the Premises wiring of the AC supply network (mains) and designed to operate entirely off the vehicle. In this case, direct current electrical power is delivered to the vehicle (e.g. Mode-4).
- 7 On-Board Charger: charger mounted on the vehicle and designed to operate only on the vehicle.
- 8 Vehicle Coupler: means of enabling the manual connection of a flexible cable to an EV for the purpose of charging.
- 9 Vehicle Connector: part of a Vehicle Coupler integral with, or intended to be attached to, the flexible cable connected to the AC supply network (mains).
- 10 Vehicle Inlet: part of a Vehicle Coupler incorporated in, or fixed to, the EV or intended to be fixed to it.

Technical Requirements

a General Principles

- 1 This document applies to the installation of both AC and DC dedicated conductive charging equipment for charging of battery powered Electric Vehicles.
- 2 This document does not cover inductive charging equipment and Electrical Installations meant for scooters or similar vehicles of 10A and less.
- 3 The technical requirements set out in this document applies to all locations where such equipment may be required, such locations include but are not limited to domestic installations, on-street installations, public and private car parks, malls, offices, and single-level or multistory car parks.
- 4 The Electric Vehicle charging equipment, also known as the Electric Vehicle Supply Equipment (EVSE), are fixed Electrical Installations which are connected to the mains electrical supply and provide electrical energy to recharge the traction batteries of electrically propelled road vehicles.
- 5 EVSE shall be designed, installed, maintained and tested in accordance with the listed technical requirements of this document as well as all relevant requirements of the Regulations for Electrical Installations.
- 6 The design of EVSE shall be submitted to Electricity Distribution Directorate (EDD) for review and approval; noting that EVSE shall be inspected and tested by EDD prior to energization.
- 7 The designer of EVSE shall consider the potential risks during the installation, operation and maintenance of such equipment and systems.
- 8 The design should consider protection against vehicle impact, by which EVSE shall be installed in a position to minimize the likelihood of vehicle impact

damage; noting that in case the likelihood of vehicle impact damage cannot be minimized, the use of additional protection barriers shall be installed. A typical protection against mechanical stress impact for EVSE installed outdoors is IK10 in accordance with IEC 62262.

- 9 EVSE shall be installed in a position to avoid obstruction to public or private footpaths and it shall not be installed in such a position that causes unnecessary trip hazard; noting that electrical wiring shall be routed to avoid creating potential trip hazard, and suitably clipped or enclosed in a containment system.
- 10 EVSE shall be installed so as to minimize the distance between the Vehicle Inlet and the charging equipment.
- 11 EVSE shall not be installed in locations where potentially explosive atmosphere exists such as petrol stations. Where it is required to have EVSE equipment in such locations it must be installed outside the hazardous zone.
- 12 Precautions shall be made to ensure that live parts are either not accessible or cannot be touched during installation, operation and maintenance.
- 13 The design and installation of EVSE shall enable maintenance and service work to be carried out safely.
- 14 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 may be provided as a necessary; especially for outdoor installations.
- 15 EVSE shall be installed with sufficient space around it to allow for adequate ventilation and cooling of the equipment (e.g. DC charging equipment incorporating rectifiers); noting that it is strongly recommended that the designer and installer of the EV charging equipment electrical installation

refer to the manufacturer's installation and operational instructions supplied with the equipment for details.

- 16 EVSE and all associated equipment shall have an IP rating suitable for the installation location; for indoor locations a minimum ingress protection of IP44 shall be used; for outdoor locations a minimum ingress protection of IP55 shall be used.
- 17 For domestic usage (i.e. home charging), Mode-2 charging is recommend. The use of Mode-3 charging in homes may be allowed with a maximum rating of 32A and with the prior approval from EDD.
- 18 For areas accessed by the public only Mode-3 and Mode-4 can be used.
- 19 EVSE components shall comply with the relevant reference standards provided in the table below:

| Components | IEC/BS |
|--|--------------------------|
| EV conductive charging system | 61851-1, 21, 22, 23 & 24 |
| Plugs, socket-outlets, Vehicle Connectors and Vehicle Inlets | 62196-1, 2 & 3 |
| Degrees of protection provided by enclosures, IP code | 60529 |
| External mechanical impact protection | 62262 |

b Final Circuit

- 1 EVSE shall be supplied by a separate and a dedicated Radial Circuit that supplies no other loads except ventilation equipment intended for use with the EVSE where required. However, more than one EVSE can be fed from the same supply Circuit, provided that the combined current demand of the equipment does not exceed the rating of the supply Circuit; noting that for the purpose of these Regulations, EV charging loads are considered to be

continuous. It shall be considered that in normal use, each single charging point is used at its rated current.

- 2 Cables supplying EVSE shall be mechanically protected by means of metal sheath/ armored, or installed inside a rigid steel conduit, plastic or PVC conduit.
- 3 Each Final Circuit shall be sized to carry the rated current of the EVSE and with limited voltage drop as required by the Regulations for Electrical Installations, and the instructions of the EV charging equipment manufacturer.
- 4 Where the final circuit supplies more than one EVSE charging point, no diversity shall be allowed. The use of a diversity factor may be allowed for a dedicated distribution circuit supplying multiple EVSE charging points if load control is available.
- 5 Extension cord unit must not be used with the EV charging cable assembly.

c Sockets and Connectors

- 1 One socket-outlet or Vehicle Connector shall be used to charge only one EV.
- 2 EVSE shall be installed such that the main operating controls and any socket-outlet are between 0.75m and 1.2m above ground; noting that mounting height may be varied for special circumstances such as access for disabled persons or physical condition at the site.
- 3 The use of Mode-1 charging is not permitted under these Regulations due to the lack of safety measures associated with this mode of charging.
- 4 For Mode-2 charging, each AC charging point shall incorporate an interlocked socket-outlet complying with BS EN 60309. The rating of the

socket-outlet shall not exceed 32A; noting that Mode-2 charging cables must have an In-Cable Control Box typically provided by the EV manufacturer.

- 5 For Mode-3 charging, each AC charging point shall incorporate a Vehicle Connector or a type-2 socket-outlet complying with BS EN 62196-2.
- 6 For Mode-4 charging, a connector complying with IEC 62196 type-4 is to be used.
- 7 For Mode-3 and Mode-4, mechanical or electrical locking system shall be provided to prevent unintentional plugging or unplugging of the Vehicle Connector unless switched off from the supply.
- 8 EV manufacturers' instructions should be followed when determining the type of socket-outlet to be installed.
- 9 If different modes are combined on a single Vehicle Connector, IEC 62196-3 type 2 'Combo 2' connector shall be used.

d Isolation & Switching

- 1 A means of isolating the supply to the EVSE circuit shall be provided, in accordance with the Regulations for Electrical Installations. This isolating device shall be capable of being locked in the open position and also located in a position that is readily accessible for maintenance purposes and shall be suitably identified by marking and/or labelling.
- 2 Where an emergency switch is provided it shall be located in a position that is readily accessible and shall be suitably identified by marking and/or labelling and shall disconnect all live conductors including the neutral.
- 3 Requirement to install an external interface protection unit, as a further protection, may be required in some cases.

e Protection

- 1 EVSE and all associated equipment shall be selected and erected so as to minimize the risk of overloads, and short-circuits.
- 2 Each Final Circuit shall be individually protected against fault current by a suitably rated overcurrent Protective Devices.
- 3 Basic protection against electrical shock shall be provided by automatic disconnection of supply or electrical separation. Refer to Regulations for Electrical Installations.
- 4 Every charging point shall be individually protected by a 30mA RCD. The RCD shall disconnect all live conductors, including the neutral; noting that either an RCBO or RCD with characteristics of Type A is acceptable. If it is known that the DC component of the residual current exceeds 6mA then a Type B RCD complying with IEC 62423 shall be used.
- 5 The requirements of Earth Leakage Protection on Final Circuits must be met, along with the requirements for Earthed Equipotential Bonding and Supplementary Equipotential Bonding; noting that there should be discrimination between any RCD installed at the connecting point or incorporated in the charging equipment and the protection at the origin of the Circuit.

f Labelling Requirements

- 1 All labels must be clear, easily visible, constructed and affixed to remain legible for as long as the enclosure is in use and written both in English and Arabic.
- 2 An operation instruction for the charging facility including essential information of the rated voltage (V), frequency (Hz), current (A), and number of phases shall be displayed at a prominent location at each of the parking space with EVSE.
- 3 Directional signage inside and outside car park is recommended to direct EV drivers to designated parking spaces with EVSE.

g Inspection & Testing

- 1 Upon completing the installation of the EVSE and before energization, the installation shall be inspected and tested by a Licensed Contractor to verify that the installation complies with the manufacturer's instructions, all applicable standards as well as the Regulations for Electrical Installations.
- 2 Periodic inspections and testing shall be carried out in accordance with the Regulations for Electrical Installations, and the manufacturer recommendations.

h Metering

- 1 Each public EVSE shall have its dedicated meter for measuring the total supplied energy. Such meter shall be purchased from EWA by the applicant.

- 2 The meter may be utilized for controlling purposes; depending on requirements of EWA.