Testing Charge Points for Electric Vehicles: A Step-by-Step Guide

Megger

IMPORTANT

This guide is intended to assist engineers and technicians with testing charge points for electric vehicles (EVs). However, only competent and suitably qualified persons with experience in electrical installation testing should perform this testing. The information and guidance presented here are not substitutes for proper training in electrical safety and the correct use of electrical test equipment.

Additionally, all testing of EV charge points must align with locally applicable standards and regulations. These standards and regulations always take precedence over statements made in this guide if conflicts arise.

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Introduction

The number of electric vehicles (EVs) in use is rapidly increasing worldwide, creating a growing demand for safe recharging facilities. This presents an excellent business opportunity for electrical contractors skilled in charge point installation, commissioning, and testing. This guide aims to fill the gaps, particularly in relation to testing.

Before proceeding, consider the following points:

1. EV Charger Scope

This guide covers chargers for electric vehicles (EVs) and hybrids driven by an electric motor powered by a high voltage battery. It does not address the charging of low voltage batteries in vehicles powered by petrol or diesel engines.

2. Terminology

The equipment used for charging electric vehicles is commonly referred to as 'charge points,' 'EV chargers,' or 'EV charge points.' Technically, these terms are incorrect as the charger itself is often within the vehicle. A more accurate term is 'electric vehicle supply equipment' (EVSE), but for simplicity, 'charge point' is used throughout this document.

3. Charger Modes

Charge points are classified into four 'Modes':

Mode 1: Connects a domestic power outlet to the car with a simple lead. This mode lacks safety features and is illegal in many countries.

Mode 2: In-line modules with basic control and protection capabilities, often provided by car manufacturers.

Mode 3: The most common type, fixed equipment providing a single- or three-phase AC supply to the vehicle.

Mode 4: DC chargers used for high-power fast charging, requiring specialized equipment for testing and outside the scope of this document.

4. Installation and Testing Standards

The circuit feeding the charge point must be installed and tested according to international standards like IEC 60364 or local regulations such as BS 7671 in the UK before the charge point is connected.

5. Testing Equipment

This guide assumes the use of dedicated test equipment designed for charge points, including an electrical installation multi-function tester (MFT) and a charge point adaptor.

Equipment for Testing Charge points

To test charge points (excluding Mode 4), you need:

1. Electrical Test Instrument

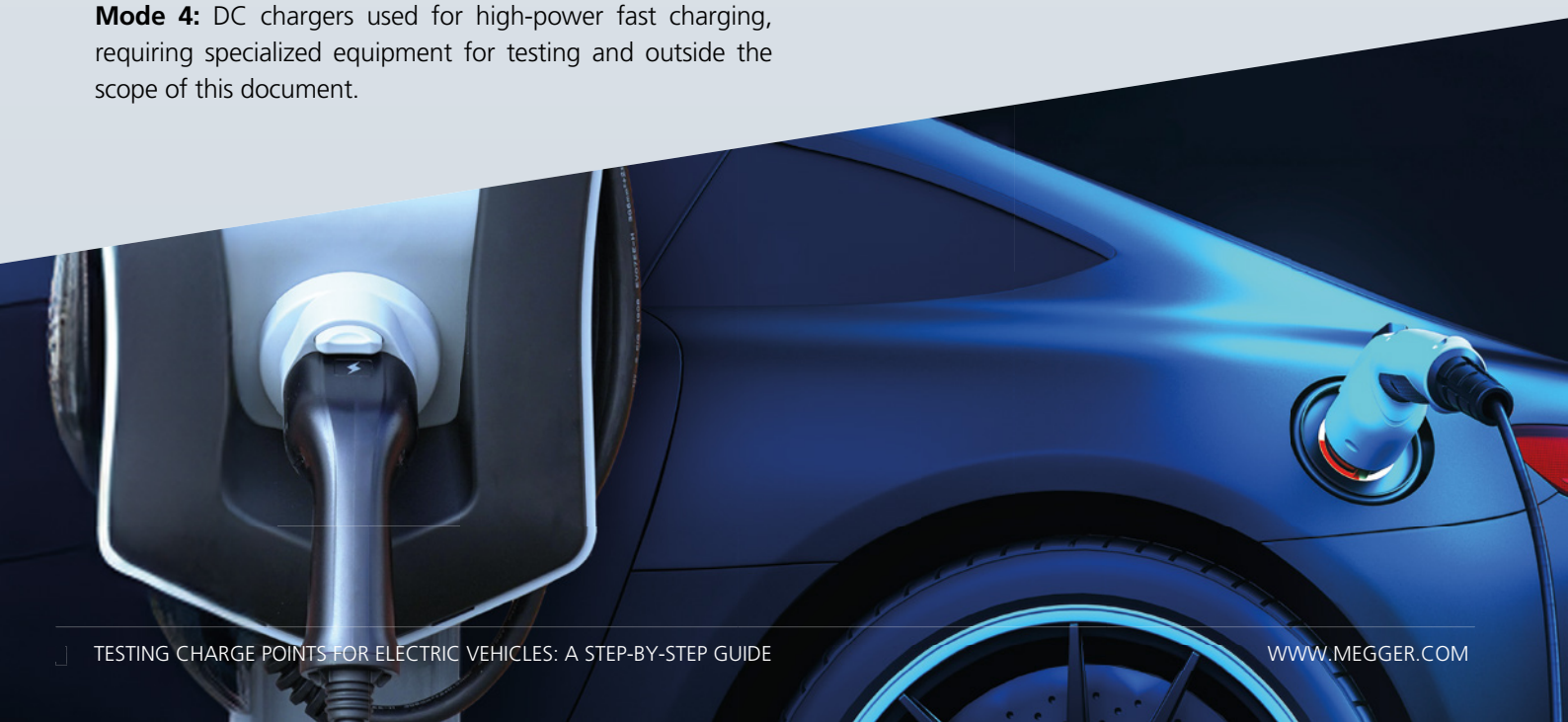
Used for general testing on electrical installations with extra features for testing unique protective devices in charge points, such as an electrical installation multi-function tester.

2. Charge point Adaptor:

Mimics a vehicle's connection to the charger, offering basic safety tests like earthing checks and error condition simulations.

A self-contained charge point checker can be used for post-installation testing and maintenance to verify the functionality and basic safety of the a charge point.

However, these checkers do not offer the full range of functionality of the MFT and adaptor. Consequently, they are unsuitable for initial verification of a newly installed charge point, but they are ideal for post-installation testing



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and maintenance. A separate step-by-step guide covering the use of this kind of checker is available. The remainder of this document assumes that tests are being carried out using an MFT plus a charge point adaptor

The MFT should be able to provide, as a minimum, these control and test functions:

- **Proximity Pilot control**
- **Control Pilot control**
- **Protective Earth (PE) continuity**
- **Protective conductor resistance measurement (RPE)**
- **Voltage drop**
- **Continuity**
- **Insulation resistance**
- **Polarity**
- **Phase rotation (for three-phase charge points)**
- **RCD (GCFI) operation**
- **RDC operation**
- **Earth (ground) loop impedance**

Control Signals

Two control signals – Proximity Pilot (PP) and Control Pilot (CP) – are used for communication between the vehicle and the charge point. The PP signal indicates a vehicle connection and ensures the EV doesn't drive off while charging. The CP signal provides information about the charging process status. Test equipment should simulate these CP states:

- **State A:** No vehicle connected
- **State B:** Vehicle connected but not ready to charge
- **State C:** Vehicle connected and ready to charge, ventilation not required
- **State D:** Vehicle connected and ready to charge, ventilation required

Testing Step-by-Step

Part 1 – Charge point Supply Connection Inspection and Testing

1. **Visual Inspection and Testing:** Inspect and test the installation up to the point of connection of the charge point, ensuring compliance with local regulations. Essential tests include loop impedance, voltage drop, continuity of bonding conductor, cable insulation, and polarity (phase sequence for three-phase chargers), and RCD testing.

Part 2 – Charge point Test Adaptor Connection

1. **Visual Inspection:** Inspect the charge point for physical damage. Replace or repair damaged items before proceeding.

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2. **Initial Connection:** Set the CP selector on the charge point test adaptor to State A and the PP selector to NC. Connect the charge point test adaptor using the correct connector type.
3. **PE Pre-Test:** Place a bare finger on the adaptor's PE pre-test button. If the PE pre-test LED lights up, stop testing and investigate the hazardous voltage present on the PE conductor.

Part 3 – Tests with the Multifunction Electrical Tester (MFT)

1. **Live Circuit Tests:** Connect the charge point test adaptor to the MFT. Set the CP to State C or D and the PP to any current.
2. **Phase Voltage and Polarity:** Check with the MFT set to the voltage range. For three-phase chargers, check the phase rotation.
3. **Earth Loop Impedance:** Measure the impedance from phase to neutral and phase to earth. Ensure results are low enough for correct operation of protective devices in case of a fault.
4. **Voltage Drop:** Measure or calculate voltage drop, particularly important as charge points load circuits to their maximum capacity.
5. **Protective Device Testing:** Test RCDs and RDC-DDs using the appropriate MFT settings. Perform tests at different tripping currents and polarities.

Certification and Calibration

- **Certification:** In some markets, certification may be required to show compliance with relevant standards and regulations. Professional record-keeping and documentation are highly recommended.
- **Calibration:** Use instruments with up-to-date traceable calibration for certifying new installations. While not essential for routine checking, calibrated instruments ensure result accuracy.

An important note about resetting chargers

Some of the tests described will make the charger trip out because of simulated fault conditions, while others will necessarily cause protective devices to trip. Before proceeding, check carefully that it will be possible to reset the charger or protective device after tripping. Chargers used in non-domestic applications are frequently networked and supervisor-level access to the network may be needed to reset them. In some cases, however, the charger may offer a maintenance mode to permit local resetting during testing. If this mode is available, it should be used. It is also recommended that in new installations electrical testing should be completed, if possible, before connecting chargers to the network. A further issue relates to protective devices. These are often external to the charger and may even be in another building. It is therefore important to know the location of the devices, and to be sure that access is available to reset them.

Conclusion

Testing charge points for electric vehicles is a detailed process requiring specific equipment and adherence to safety standards. By following this guide, electricians can ensure EV chargers are installed and functioning correctly, providing safe and reliable charging facilities.

For more detailed information and step-by-step guides on using charge point checkers, visit our website

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