BS 7671 IET Wiring Regulations Amendment 1 and implications for Electric Vehicle Charge points

Amendment 1 of BS 7671:2018 has been released sooner than is usual for a wiring regulations amendment and solely addresses changes to section 722 Electric Vehicle Charging Installations, but includes alterations to Part 2 (Definitions), Section 700 (General), Appendix 1 and the Index. The reason for the amendment is to allow the use of technologies which weren't available at the time of the original publication, with regards to Electric Vehicle Charge Point (EVCP) installations. Due to the rapidity in deployment of EVCP's needed to satisfy the growing market for electric vehicles, waiting until the original planned release of Amendment 1 (2022) could have stifled installation numbers.

For installation of an EV charge point installation on a single phase PME system in accordance with the first edition of BS 7671:2018, there were essentially 3 options:

- Creating a TT system for the charge point or for the entire building (722.411.4.1 (ii))
- Installation of a device providing electrical isolation- (which wasn't readily available) (722.411.4.1 (iii))
- Using an isolation transformer for electrical separation (722.413.1.2)

(the exact wording is within regulation 722 and the options above are a simplified interpretation)

There are implications for all of the above although they do remain as options for the installation:

TT systems

Firstly, the creation of a TT system is onerous. Installing multiple earth electrodes needed to achieve a low earth resistance is time consuming and may cause disruption to underground services which are rarely mapped. These can include:

- electrical supply cables
- gas supply
- water
- sewerage pipes

Disturbance and damage to these may cause any number of issues, including fatality.

Installers also need to be aware of their insurance limitations, which may only allow for groundwork to 1 m depth.

(Note: Guidance on Earth electrode resistance remains in Annex A722.3)

Device providing electrical isolation (the unicorn device)

The third option - often referred to as the 'unicorn device' (often sought after but never found), didn't exist. It monitors the voltage differential between the CPC and true Earth, activating if the value exceeds 70 V rms. Although there are now solutions on the market, these rely on an earth reference ground electrode, thereby still requiring an element of ground-work, with the potential issues attached.

Isolation Transformers

The use of an isolation transformer, although a good method of electrical separation, can add significant cost to the installation. There is also the issue of the size and mass of the isolation transformer and the need for additional space for the equipment.

Changes in Amendment 1

722.411.4.1 (iii) Amended

Regulation 722.411.4.1 (iii) has been amended from the original 'unicorn' device and now specifically refers to protecting against a broken PEN conductor in the LV network. (A PEN conductor is the Protective Earth and Neutral conductor, which is present in the most common electrical connections to our buildings from the electricity network TN-C-S. It combines the function of the Earth and Neutral into one single conductor- back to the substation.) It states that:

> *Protection against electric shock is provided by a device which electrically disconnects the vehicle from the live conductors of the supply and from protective earth in accordance with Regulation 543.3.3.101(ii) within 5 s in the event of the voltage between the circuit protective conductor and Earth exceeding 70 V rms due to an open-circuit fault in the PEN conductor of the low voltage network.*

In order to monitor the voltage difference between the CPC (circuit protective conductor) and Earth, this type of device requires an Earth electrode to be installed (for Earth reference) or through a 'virtual' reference point derived from line conductors of a 3-phase system. The device shall provide isolation, not reset or close until within the parameters and may be included within the charging equipment.

Annex 722.4

Annex 722.4 gives guidance on the device mentioned in 722.411.4.1 (iii), including minimum and recommended separation distances of electrodes.

722.411.4.1 (iv) The New Option

This gives an option specifically for protection against electric shock in **a single-phase installation**, by using a device which:

> *electrically disconnects the vehicle from the live conductors of the supply and from the protective earth within 5 seconds, in the event of the utilisation voltage at the charging point, between the line and neutral conductors, being greater than 253V rms or less than 207 V rms. The device shall provide isolation and be selected in accordance with Table 537.4.'*

Essentially this device ensures that the supply remains within +/- 10% nominal Voltage and as soon as it is outside of these parameters, the device will disconnect. The device is only permitted to close or reset once the voltage is within required parameters.

This equipment may stand alone in series with the Electric Vehicle Charge Point or the equivalent may be incorporated within the charging equipment.

This now gives the option for the electrical contractor to provide an Electric Vehicle Charge Point installation, conforming to the requirements of BS 7671:2018 Amendment 1, in a single phase PME environment, ***without*** having to undertake groundwork, nor installing an expensive and heavy isolation transformer.

722.411.4.1 (v) Alternative (Future) Devices

722.411.4.1 (v) is a new additional regulation which gives the opportunity for industry to develop alternative devices to those listed in 722.411.4.1 (iii) and 722.411.4.1 (iv), which will provide protection against electric shock which does not result in a lesser degree of safety than those of (iii) and (iv).

This removes the necessity for updating the regulations in the advent of new technologies coming through and should encourage innovation in this sector.

Minor Changes

There are also a number of minor changes which are worth highlighting.

722.311 - Maximum demand and diversity

This has been updated and now states that:

> *Load curtailment, including load reduction or disconnection, either automatically or manually, may be taken into account when determining maximum demand of the installation or part thereof.*

It should be noted that the reference to diversity has been removed. Now the option is given for load control, smart charging capabilities etc. to be considered in the design of the circuit.

722.312.2.1

A simplified statement now exists:

> *A circuit supplying charging equipment for electric vehicles shall not include a PEN conductor.* (previously final circuit)

722.512.2.203 Impact (AG)

The classification for equipment installed in public and car park sites has moved up a category from AG2 to AG3 (both medium severity). It also follows that the equipment shall comply with a degree of external mechanical impact protection to IK08 (previously IK07).

722.531.3.101 (RCDs)

This was previously 722.531.2.101 and has been rewritten for clarity.

It now gives the additional option of Type F RCDs which can detect and respond as per type A, but additionally to high frequency residual current. Some vehicle manufacturers may specify the use of these.

This regulation also introduces the RDC-DD - a Residual Direct Current Detecting Device.

An RDC-DD is for permanently connected AC EV charging stations (mode 3) whose purpose is to remove or initiate removal of the supply to EV in cases where a smooth residual direct current equal to or above 6 mA is detected.

RDC-DDs are available as either:

- RDC-MD (residual direct current **monitoring** device) which is mechanically coupled with a separate protective device
- RDC-PD (residual direct current **protective** device) an all in one device which is suitable for isolation

These may also be incorporated within the EVCP.

722.551.7.2

This now houses the statement that socket outlets and vehicle connectors need to comply with BS EN 62196 series.

Annex A722

Annex A722 (informative) has a number of formulae within it that have been re-arranged, to reflect a more coherent way of understanding ‘taught’ formulae.

Neutral current of a three-phase installation is now presented as:

$$I_m = \sqrt{I_{L1}^2 + I_{L2}^2 + I_{L3}^2 - I_{L1}I_{L2} - I_{L1}I_3 - I_{L2}}$$

There now exists in A722.5 an example of the arrangement of a separated system- isolating transformer. There is also a note regarding the consideration that they may have high inrush currents and for the overprotective devices in the primary circuit to be selected accordingly to prevent nuisance-tripping.

Amendment 1 was released on 3rd February 2020 and is free to view and download from the IET website, although a printable version will cost £5.

Visit: https://electrical.theiet.org/bs-7671/updates-to-18th-edition/