TELECOMMUNICATIONS INFRASTRUCTURE ADVISORY BOARD

Document Source:
Mike Gilmore, FIA

Date: 15th March 2010

SID-002

Standards Interpretation Document

EARTHING OF CABINETS, FRAMES AND RACKS

Foreword

This document is one a series of TIA-B Standards Interpretation Documents and is fr**ee** to TIA-B members of the following TIA-B host organisations:

- CMA Infrastructure Forum;
- Electrical Contractors Association - ITEC;
- Fibreoptic Industry Association.

Non-members are also able to purchase these documents either by contacting the relevant host.

Members and non-members unable to benefit from this service may receive the documents in hard-copy or diskette/CD ROM. However, the rapidly changing nature of our technology means that web-based documents can be amended and revised easily and it is the responsibility of the reader to ensure that the latest issue of a document is used.

The TIA-B web-site will indicate the issue status of each document and will have links to previous issues in order that changes made will be clear to readers.

Knowledge of the contents of this Standards Interpretation Document is no substitute for the possession, and understanding, of the standards to which this document refers. The complete text of the standards referred to by this document may contain specific additional requirements that apply under certain circumstances (for example, in relation to safe working practices in hazardous areas) which take precedence over the information in this document.

Table of contents

1 Introduction

The earthing of telecommunications infrastructures is handled in a number of standards, all of which are applicable in the United Kingdom, but most of these address the topic from a specific viewpoint and can appear contradictory.

With regard to the earthing of cabinets/frames/racks containing, or intended to contain, telecommunications equipment and cabling, installers need to have clear guidance based on accurate interpretation of these standards which is endorsed by the relevant standard bodies.

This Telecommunications Infrastructure Advisory Board SID contains interpretation of published standards covering the earthing arrangements for cabinets/frames/racks containing, or intended to contain, telecommunications equipment and cabling and:

- explains the circumstances under which earthing is required;
- provides guidance to the minimum requirements for protective earth conductors;
- allows users, consultants and installers to identify any potential or actual non-compliance with the published standards and act accordingly.

The specific standards subject to interpretation within the document are BS 6701:2010, BS EN 50174-2:2009 and BS EN 50310:2010 together with together with electrical system standard HD 60364-4-444 (which will form the basis of a future BS 7671 section 444 and provides some of the content for BS 6701:2010).

This document provides interpretation of published standards which is intended to be submitted to checking and endorsement by the BSI Technical Committee, or equivalent, responsible for the production of the standards that are subject to TIA-B interpretation.

2 Scope

This Telecommunications Infrastructure Advisory Board SID contains interpretation of published standards covering the earthing arrangements for telecommunication cabling infrastructures,

This Telecommunications Infrastructure Advisory Board SID contains interpretation of the following published standards covering earthing arrangements of cabinets/frames/racks containing, or intended to contain, telecommunications equipment and cabling:

- BS 6701:2010;
- BS EN 50174-2:2009;
- BS EN 50310:2010;
- CLC HD 60364-4-444:2010.

3 References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 6701:2010	*Telecommunications equipment and telecommunications cabling – Specification for installation, operation and maintenance*
BS 7671:2008	*Requirements for electrical installations – IEE Wiring Regulations – Seventeenth edition*
BS EN 50174-12009	*Information technology – Cabling installation – Installation specification and quality assurance*
BS EN 50174-2:2009	*Information technology – Cabling installation – Installation planning and practices inside buildings*
BS EN 50310:2010	*Application of equipotential bonding and earthing in buildings with technology equipment*
CLC HD 60364-4-444:2010	*Low-voltage electrical installations – Part 4-444: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*
CLC HD 60364-5-54:2007	*Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment - Earthing arrangements, protective conductors and protective bonding conductors*

4 Terms, definitions and abbreviations

4.1 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 6701, BS EN 50174 (all parts) and BS EN 50310 apply.

4.2 Abbreviations

For the purposes of this British Standard, the terms and abbreviations given in BS 6701, BS EN 50174 (all parts) and BS EN 50310 apply.

5 Background

The requirements for the protective earthing of cabinets, frames and racks are not considered in this document. They are contained within the relevant sections of BS 7671.

The objective of this document is to provide interpretation of the specific earthing requirements of those items in support of the effective operation of telecommunications cabling and equipment contained within them.

The primary standard in the UK covering the installation and operation of both telecommunications cabling and equipment is BS 6701. This standard simultaneously requires conformance with BS 7671 and BS EN 50174 documents both of which demand conformance with BS EN 50310.

The original editions of EN 50174-1 and EN 50174-2 have been substantially revised and were published as BS EN 50174-1 and BS EN 50174-2 in 2009.

At the time of publication of this document:

- BS 6701:2004 (published after, and in response to, the introduction of the original editions of BS EN 50174-1 and BS EN 50174-2) is now being revised, without major technical change, as BS 6701:2010;
- EN 50310 is being revised as Edition 3 and the revised BS EN 50310 will be published in 2010.

The revision of EN 50310 represents a major step forward in both clarity and usability of the standard for the following reasons:

1. BS EN 50310:2006 stated requirements for an ideal equipotential earthing system based on the presence of a protective earthing system in the form of a common bonded network. However, many premises do not have such a sophisticated protective earthing system and may instead feature star, ring or local mesh protective earthing networks or combinations of these.
2. The 2009 revisions of EN 50174-1 and EN 50174-1 have made EN 50310 a normative requirement (i.e. conformance to EN 50310 is automatically required in order to claim conformance to the EN 50174 documents). This forced the revision of BS EN 50310:2006 in order to ensure that it could be applied in all circumstances i.e. irrelevant of the protective earthing systems present in the premises.
3. As a result, BS EN 50310:2010 states requirements and recommendations for the improvement all types of protective earthing system in order to support the effective operation of telecommunications cabling and equipment within premises.

At the same time, CLC HD 60364-4-444 has been approved and awaits ratification (please note that this document is not a copy of IEC 60364-4-444 – there are some radical differences and IEC 60364-4-444 is irrelevant for the purposes of this document). Much of the content of CLC HD 60364-4-444 is founded on the contents of EN 50174:2009 documents and EN 50310.

> NOTE A CLC HD differs from a CLC EN in that an:
> a) an EN has to be published by all CENELEC (CLC) member countries “as is” and is supposed to be identical in all countries (albeit potentially suffering from risk of translation);
> b) a HD is the foundation of other national standards which, although not conflicting with the HD, may contain more stringent or additional requirements.

The majority of the content of HD 60364-4-444 will be reflected in a new section 444 of BS 7671. However, the section of HD 60364-4-444 addressing the earthing of cabinets, frames and racks does not appear to be panned for inclusion in BS 7671, section 444. As a result the intent of HD 60364-4-444 will be included in BS 6701:2010

6 Summary of requirements and recommendations

The future section 444 of BS 7671 entitled "Measures against electromagnetic disturbances" requires conformance to BS 6701, BS EN 50174 series and BS EN 50310, "where appropriate". It is assumed that the meaning of the words "where appropriate" are used not to be vague in terms of application but to indicate that the referenced standards only cover some areas of within the scope of section 444. Therefore, the requirements referenced in clause 7 and clause 8 of this document apply.

However, EN 50310:2010 will defer the need for equipotential bonding connections between the available protective earthing network and "all cabinets, frames and racks containing, or intended to contain, information technology equipment or metallic information technology cable" to the relevant national or local regulation based on HD 60364.

HD 60364-4-444 contains the statements related to the need to apply equipotential bonding to cabinets, frames and racks. In the UK this text (or equivalent) would normally be expected to be found in a future section 444 of BS 7671. However, the latest draft of the future section 444 of BS 7671 does not contain the relevant contents of HD 60364-4-444. As a result:

- BS 6701:2010 will contain the relevant text as described in clause 8.
- a national foreword to BS EN 50310 will direct the reader to BS 6701:2010 as the relevant text relating to the requirements in relation to HD 60364-4-444.

7 Requirements of EN 50310:2010

7.1 Bonding requirements and recommendations

Clause 7.1.6 of EN 50310:2010 specifies requirements and recommendations for the equipotential bonding connections between the earthing network and all cabinets, frames or racks containing, or intended to contain, information technology equipment or metallic information technology cable.

It begins by stating that the bonding connections shall be in accordance with the national or local regulation based on HD 60364, which for the UK will be present in BS 6701:2010 (see clause 8 of this document).

The design of the bonding conductors is also specified.

EN 50310 also recommends that, in addition to requirements for safety, any conductive items within a cabinet, frame or rack (e.g. doors, panels, shelves and cable organisers) should be bonded to reduce electromagnetic interference radiating from the cabinet, frame or rack.

7.2 Bonding conductors

EN 50310:2010 will require that "all protective earthing and equipotential bonding conductors shall comply with the safety requirements according to HD 60364-5-54". HD 60364-4-444:2010 and BS 6701:2010 contain a similar requirement by stating that "the cross sectional areas of the protective conductor shall be chosen according to HD 60364-5-54:2007, Section 543" but go on to add their own minimum requirements (see clause 8).

Whether or not single or multiple bonding conductors are required between the cabinet, frame or rack and the protective earthing network depends on the length of the required bonding conductors. The break-points in EN 50310:2010 are 6 metres and 3 metres. The design requirements for single or multiple bonding conductors are dependent on the type of protective earthing network at the location of cabinet, frame or rack.

EN 50310:2010 will state that:

> **In all cases** the conductor (independent of cross-sectional area or shape) shall either:
> a) be no greater than 6 m long, or;
> b) *n* conductors shall be installed where $n = L$ (m)/6 if the required length (L) of the conductor is greater than 6 m (due to the location of the points to be connected).

If the conductors are part of the recommended improvements to local or common mesh bonded networks then the conductor (independent of cross-sectional area or shape) shall either:

a) be no greater than 3 m long, or;

b) *n* conductors shall be installed where *n* = *L* (m)/3 if the required length (*L*) of the conductor is greater than 3 m (due to the location of the points to be connected).

Conductors in accordance with HD 60364-4-444 provide satisfactory d.c. performance (*this provision further links EN 50310 to HD 60364-4-444*).

There is a great deal of confusion about the cross-sectional areas of these conductors with "apocryphal" statements of length/width/thickness being promoted in many areas. EN 50310:2010 will provide clarity in this area based on the following:

- above lengths of 1 m the only relevant parameter of the conductor is its length, independent of cross-sectional dimensions or area. The critical factor is the inductance of the bonding conductor and this equates to approximately 1 uH per metre length.
- below 1 m, the cross-sectional dimensions and area are important and EN 50310:2010 will recommend that the length:width ratio of bonding conductors should not exceed 5:1. Such bonds are not implemented for the connections of cabinets, frames or racks to the protective earthing network depends but may be relevant inside the cabinets, frames or racks.

Equally confusing are the various assumptions regarding cross-sectional area of bonding conductors. EN 50310:2010 will provide clarity in this area based on the following:

- the effectiveness of an equipotential bonding conductor cannot be improved by increasing its cross-sectional area;
- instead multiple bonding conductors are required;
  This is the reason behind the statements in the bullets (b) in the text above which require the installation of n conductors if the lengths of the conductors exceed a specified value. This is similar to the effect of installation of parallel resistors.
- it is necessary to physically separate these "parallel" bonding conductors. Ideally they need to be separated by at least 150 mm over there entire length but this may be impractical.

As a result, EN 50310:2010 will state that "Where multiple bonding conductors are installed they shall be separated by at least 150 mm except where physical constraints (e.g. points of connection or routes through building structures) force a reduction of this separation. The lengths over which this separation is not provided shall be minimised."

8 Requirements of HD 60364-4-444 - deferred to BS 6701:2010

BS 6701:2010 contains a clause 5.2.2.4 entitled "Earthing of cabinets, frames and racks" which states that cabinets, frames and racks and their contents containing, or intended to contain, telecommunications equipment or metallic telecommunications cabling shall be bonded in accordance with BS EN 50310.

It then states the following additional requirements which are specifically stated to be a UK implementation of the relevant requirements of HD 60364-4-444.

Each cabinet, frame or rack shall be connected to the earthing network using a separate bonding conductor:

- having a cross sectional area in accordance with HD 60364-5-54:2007, Section 543 and not less than:
  - 4 mm^2 for a cabinet $\leq$ 21U;
  - 16 mm^2 for a cabinet $>$ 21U;
- that is neither coiled or doubled back on itself.

Multiple cabinets, frames or racks located within one area shall be connected to the earthing networking using a separate bonding conductor for each cabinet, frame or rack. The earthing network in that area shall be presented at an earthing bar which shall be:

- of a length sufficient for the immediate requirements and with at least a 20 % allowance for future growth;
- connected to the earthing network with a bonding conductor having a cross sectional area in accordance with HD 60364-5-54:2007, Section 543 and not less than 25 mm^2 and which is neither coiled or doubled back on itself.

NOTE: the earthing bar should be fitted with a disconnection/test point

Where screened cables are terminated within a cabinet, frame or rack, the point of screen termination shall be connected to the bonding connection point within the cabinet frame or rack. The connection shall be provided by one or both of the following:

- a bonding conductor of the following types
  - a PE conductor with outer insulation of green/yellow in accordance with BS EN 60446 and with a label or tag marked with the words “SAFETY/TELECOMMS EARTH DO NOT REMOVE” attached to conductor at all connection points;
  - an FE conductor with outer insulation of cream in colour and continuously marked with the words “TELECOMMS FUNCTIONAL EARTH.
- the conductive parts of the cabinet, frame or rack provided that these and their interconnections are specifically designed for this purpose and installed in accordance with manufacturers’/suppliers instructions.

276 # 9 Bibliography

Future section 444 of BS 7671 — *Measures against electromagnetic disturbances*

277