BS EN 62305:2011 Update

A summary of key changes to BS EN 62305:2006

The four parts of the British Standard for lightning protection, BS EN 62305:2006, have recently been subject to technical review to ensure their currency and relevance for best practice.

So far, this review has resulted in the update and republishing of three parts of the standard, as follows:

- BS EN 62305-1:2011 General principles
- BS EN 62305-3:2011 Physical damage to structures and life hazard
- BS EN 62305-4:2011 Electrical and electronic systems within structures

Whilst there have been no significant changes to parts 1, 3 and 4, the key additions or adjustment are provided below in this document.

Note, the 2006 Edition of these three parts will be withdrawn on 27th May 2012. Afterwards the 2011 Edition should be followed.

The update to part 2 of the standard (risk management) has not yet been published, although is expected in 2012.

Until this is published, risk assessment calculations for lightning protection should follow BS EN 62305-2:2006. Further information will be provided on part 2 once it is released.

Reference to Part 5 (Services)

BS EN 62305:2006 was originally intended as a five part set, with the fifth part being 'Services'.

This last part however was never actually published following the publishing of the other parts of the standard, which did contain a number of references to part 5.

Within this update, all such references have been removed.

New definitions within BS EN 62305:2011

Definitions have been added for 'Line', Telecommunication lines' and 'Power lines' within BS EN 62305-1:2011:

- **Line** - *'Power line or telecommunications line connected to the structure to be protected'* (3.23)
- **Telecommunications lines** - *'Lines intended for communication between equipment that may be located in separate structures, such as a phone line or a data line'* (3.24)
- **Power lines** - *'Distribution lines feeding electrical energy into a structure to power electrical and electronic equipment located there, such as low voltage (LV) or high voltage (HV) mains'* (3.25)

The definitions for 'Shielding wire' and 'Conventional earthing impedance' have been removed.

In addition, the following definitions have been introduced to BS EN 62305-4:2011:

- **Lightning protection LP** - '*complete system for protection of structures and/or electrical and electronic systems in those structures from the effects of lightning, consisting of an LPS and SPM'* (3.4) (for SPM - see below)
- **Lightning protection system LPS** - *'complete system used to reduce physical damage due to lightning flashes to a structure. Note it consists of both external and internal lightning protection systems'* (3.5)
- **Isolating interfaces** - *'devices which are capable of reducing conducted surges on lines entering the LPZ'* (3.24)

Furthermore, usage of 'LEMP protection measures system (LPMS)' as defined in BS EN 62305:2006 has now been updated to surge protection measures (SPM) in the 2011 Edition. Note however, that the definition for SPM (3.51 of BS EN 62305-1:2011) continues to use 'LEMP' and not 'Surge', though the intention from the acronym is clear.

Equally, the definition of LEMP (Lightning electromagnetic impulse) has also been expanded to include *'all electromagnetic effects of lightning current via resistive, inductive and capacitive coupling which create surges and electromagnetic fields'*.

Design and installation of LPS and SPM

The design and installation of LPS and SPM has now been qualified within BS EN 62305:2011, in that:

- LPS design and installation should be conducted by *well-trained and expert LPS designers and installers* (BS EN 62305-3, Clause 4.2), and
- Design of SPM should be conducted *by experts in lightning and surge protection who possess a broad knowledge of EMC and installation practices* (BS EN 62305-1, Clause 4.1)

These clauses serve to ensure competency in the complex planning & design processes, and the technical consultations when working on LPS and SPM.

Note, whilst there is no qualification for lightning protection, appropriate professional training is available for those looking to increase their understanding, including CPD-accredited seminars, as offered by Furse.

Structural lightning protection (BS EN 62305-3:2011)

The following amendments have been made to BS EN 62305-3:2011 which affect design of a structural LPS:

Air termination system and down conductor network

- **Protection against side flashes to tall structures (60 m or more)**

  The sides of structures lower than 60 m in height do not need to be considered as being at risk from side flashes (5.2.3.1). However, their lateral surfaces (roofs & horizontal protrusions) should still be protected to the appropriate Class of LPS as defined by BS EN 62305-2, using a suitable air termination system.

  Structures 60 m in height or more are considered at risk from side flashes. The topmost 20% of these structures, above 60 m, and any equipment installed thereon, should be protected against lightning through the installation of an air termination system and down conductors, in line with the structure's Class of LPS, with emphasis on covering corners, edges and significant protrusions (Clause 5.2.3.2).

  The use of natural components - external metallic conductors which form part of the fabric of the structure such as metal cladding - is encouraged, where possible, provided these components meet the requirements of Table 3 of BS EN 62305-3:2011.

- **Down conductor positioning within a non-isolated LPS**

  Down conductors where practicable should be installed at each exposed corner of a structure.

  Annex E of BS EN 62305-3 however now permits a variation, allowing the down conductor to be omitted in non-isolated LPS, if:

  - The distance to the two adjacent down conductors is half the distance or less, than that defined in Table 4 of BS EN 62305-3 (which defines the typical preferred values of the distance between down conductors according to Class of LPS)
  - The distance to one adjacent down conductor is one quarter the distance, or less than that defined in Table 4

  Inside corners can be disregarded (Clause E.5.3.3).

- **Down conductor spacing in a non-isolated LPS**

  The title of Table 4 in BS EN 62305-3 has now been updated to cover spacing of down conductors only and does not consider ring conductors.

  The application of ring conductors within an LPS should now be determined by other factors in BS EN 62305 including separation distance calculations.

- **Use of metallic rainpipes as a down conductor**

  The use of metallic rainpipes as down conductors is now permitted for all Classes of LPS, so long as these meet the requirements of Clause 5.3.5 of BS EN 62305-3 (E.5.3.5).

- **Installation of a down conductor into plaster**

  Installation of a down conductor directly into external plaster is not recommended (E.5.3.4.2). The plaster may be damaged by thermal expansion, or discoloured by chemical reaction where bare conductor is used (note, a PVC coating would prevent discolouration).

- **Calculation of separation distance**

  BS EN 62305-3:2011 introduces a simplified and detailed calculation method for separation distance.

  The simplified approach to separation distance (6.3.2) adopts the existing formula (Equation 4 in 6.3.1) and is suitable for straightforward structures, where the widest horizontal part of the structure does not exceed four times its height (E.6.3.2).

  The detailed approach to separation distance (6.3.3) applies for larger and more complex structures, which include a meshed air termination system or interconnected ring conductors.

  Note for calculations using the simplified approach, if a structure includes a continuous metal roof acting as a natural air termination system, the length (*l*) along the air termination can be disregarded (6.3.1).

- **Design considerations for achieving separation distance**

  BS EN 62305-3 now clarifies that down conductors should be suitably positioned to ensure a separation distance is provided between them and any doors and windows of the installation (5.3.4).

  Additionally, where a building is lower than 30 m in height, if installations are bonded to the LPS at the reference bonding point and the furthest point from it, then the separation distance can be considered fulfilled for the whole path of the installation (E.6.3.1).

- **Protection measures against step voltages**

  The conditions of Clause 8.2 have been clarified. So long as one of the following conditions is met, the risk from step voltages is considered reduced to a tolerable level:

  - There are no persons situated within 3 m of the down conductors during normal operations
  - There are at least 10 down conductors included in an LPS which meet the installation guidance of the standard, and
  - The contact resistance of the surface layer of the soil (within 3 m of the down conductor) is 100 kΩ (this has been increased from the figure of 5 kΩ stated in the 2006 Edition)

- **Size and material configuration of conductors and earth electrodes**

  Table 6 of BS EN 62305-3, relevant to air termination rods and conductors, down conductors and earth lead-in rods, now includes the additional materials copper coated aluminium alloy (50 mm^2 solid circular conductor) and copper coated steel (flat tape or 50 mm^2 solid circular conductor).

  Table 7 of BS EN 62305-3, relevant to earth electrodes, now includes adjusted sizings for various types of steel or stainless steel electrodes. Copper earth electrode sizes remain as per the 2006 Edition.

- **Fixing centres for horizontal flat tape and stranded conductors**

  Where installed on to horizontal surfaces, the fixing centres for horizontal flat tape and stranded conductors have been amended to 1000 mm (from 500 mm in the 2006 Edition).

- **Use of concrete reinforced rods (as down conductors and in foundation earthing)**

  The use of natural conductive components of a structure is encouraged in BS EN 62305-3. One instance where this applies is in using the structure's reinforcing rods as down conductors (or in foundation earthing arrangements).

  Where this is possible, the following materials can now be used for lightning protection purposes:

  - Steel
  - Mild steel
  - Stainless steel
  - Copper
  - Copper coated steel
  - Galvanized steel (with limitations)

  The use of galvanized steel reinforcing rods requires careful consideration (of local environmental conditions/external factors etc) as the zinc corrodes easily and can damage the concrete reinforcement.

  Therefore the use of the other materials stated above is preferred over galvanized steel (E.4.3.4). In all cases, the maximum overall earth resistance of reinforcing rods remains 0.2 Ohms.

- **Electrical continuity of concrete reinforced rods**

  To aid testing of the electrical continuity of reinforced rods, testing can now be undertaken at each level/section (i.e. periodically during installation) where it is not possible to test the rod completely from top to bottom.

  The total resistance of each section can then be calculated and the installation would be satisfactory as a lightning conductor if maximum resistance remains below 0.2 Ohms (E.4.3.1).

- **Maintenance and inspection of an LPS**

  A new note in Table E.2 defines that where an LPS is installed on a structure at risk from *'critical situations'*, for example a location which includes sensitive and critical electronic systems, or where a high number of people are present, a complete inspection of the LPS should be conducted every year regardless of the Class of LPS (E.7.1).

  Additionally, testing of surge protective devices (SPDs) which do not include visual status indication is now included in BS EN 62305-3 (E.7.2.4), preferably following manufacturer's instructions or through use of manufacturer's testing equipment.

- **Protection of structures with a risk of explosion**

  Annex D of BS EN 62305-3 (informative) provides guidance on protection of structures where there is a risk of explosion. The following amendments have been made:

  - There is no longer a requirement that such installations include a minimum of a Class II LPS, but should have an appropriate Class of LPS following risk assessment to BS EN 62305-2, or as deemed by the local authority having jurisdiction (D.1)
  - Clause D.6. now contains specific guidance on maintenance and inspection, in addition to those in Clause 7 of BS EN 62305-3, including maintenance by suitably qualified personnel, and electrical testing of the LPS every 12(+2) months
  - The DC resistance of any single object bonded to the LPS should not exceed 0.2 Ohms (D.6.5)

Earthing & bonding

- **Lightning equipotential bonding**

  The following considerations are now included for lightning equipotential bonding:

  - Lightning equipotential bonding should be integrated and coordinated with all other equipotential bonding in the structure (6.2.1)
  - For non-isolated down conductor networks, all internal columns and partition walls with conductive parts should be connected to the air termination and earth termination systems at appropriate points (E.5.3.4.2)
  - The minimum cross sectional area of conductors making connections between bonding bars, or from bonding bar to earth termination system, or from internal metal installations to bonding bar, have been revised to 6, 10, 16, 25 & 50 mm^2 (Tables 8 & 9)
  - Isolating spark gaps may now be used where direct connection with bonding conductors is not permitted, and should be used for bonding of external conductive parts (6.2.3)

- **Type A earthing arrangements**

  For Type A earthing arrangements, the minimum number of earth electrodes has been clarified to one per down conductor, and at least two for the entire LPS (E.5.4.2.1) (i.e. following the requirement in BS EN 62305-3 for a minimum of two down conductors in an LPS).

  Additionally for a Type A arrangement, a waiver to the requirement for earth electrode burial depth at least 0.5 m below ground level is now included.

  This 0.5 m requirement can be overlooked where an earth electrode is sited within an inspection pit which in turn is located in high resistance paving or adjoining concrete (5.4.3).

- **Type B earthing arrangements**

  BS EN 62305-3 now makes clear that, where a Type B earthing arrangement is employed, the ring earth electrode should be completely connected thoughout its entire length (5.4.2.2)

Electronic systems protection (BS EN 62305-4:2011)

The following important changes have been made to BS EN 62305-4:2011:

- **Design and installation of SPM**

  The distinction between the use of spatial shielding and surge protective devices (SPDs) is clarified in Clause 4.1:

  - Spatial shields and/or shielded wires, combined with shielded equipment enclosures, protect against risk from radiated electromagnetic fields which impinge directly on to equipment
  - SPDs, installed as a coordinated set, protect against the effects of conducted and induced surges on transmission lines (i.e. power or telecommunications lines)

  Note, for equipment which complies with relevant radio frequency and immunity EMC product standards, risk from electromagnetic fields which impinge directly on equipment is likely to be negligible, therefore installation of a coordinated set of SPDs should suffice to protect against the effects of LEMP.

- **Minimum cross sections of bonding components**

  The minimum cross sectional area of a number of bonding components have been increased, as per the conductors in BS EN 62305-3, to 6, 10, 16 & 25 mm^2 (Table 1).

- **Use of isolating interfaces**

  Isolating interfaces, such as isolating transformers or optical couplers, can now be applied to reduce the effects of LEMP on lines entering LPZ via conducted surges (4.4 & 8).

  The immunity withstand of isolating interfaces should be protected as appropriate against overvoltages through the use of a coordinated SPD with a suitably low voltage protection level (U_p) or let-through voltage.

- **Maintenance and inspection of SPM**

  Inspection of SPM should follow Table E.2 of BS EN 62305-3 (note the criteria defining risk from *'critical situations'*, above), where there is no other authority having jurisdiction in this matter.

  The operating status of any SPD which does not include visual status indication (e.g. an LED emitter) should be tested in accordance with the manufacturer's instructions (9.3.2.3).

- **Protection of electronic systems within existing structures**

  Annex B (informative) of BS EN 62305-4:2011 provides guidance on implementing SPM within existing structures.

  It now includes additional guidance on design of SPM for an existing structure (B.3), which first recommends conducting a risk assessment and a review of the structure following the checklists provided in Tables B1 - B4.

  This is the first step to defining whether SPM are required (following new Figure B.1).

Lightning Protection Zones (LPZs) should be defined for all locations within the structure. The provision of SPM in line with these LPZs should be through the internal screening and bonding network of the structure, or through installation of ring conductors, as follows:

- The screening and bonding network should include mesh widths not exceeding 5 x 5 m
- If this is not possible, where the boundary between LPZ 0 to LPZ 1 is the outer wall, this should include a ring conductor installed inside the outer wall on each floor of the structure, which is bonded to each down conductor of the external LPS
- If the outer wall is not the LPZ 1 boundary, an additional ring conductor should be installed at the LPZ 1 boundary and bonded to the ring conductor at the outer wall at a minimum of two points, as far apart as practicable
- For LPZ 2 & LPZ 3 (and any subsequent internal LPZs), where the LPZ is greater than 5 m x 5m, it should be sub-divided to ensure screening and bonding meshes not exceeding 5 x 5 m, or, at each LPZ boundary a ring conductor should be installed which is then bonded to the ring conductor of the preceding LPZ at a minimum of two points, as far apart as practicable

There is clear recognition within the Annex however that that retrofitting screening measures is often impractical and therefore the use of SPDs is seen as an effective alternative (B.5).

Cables crossing LPZ boundaries should be protected by a coordinated set of SPDs, with the design of cable trays, cable ladder etc improved where appropriate to ensure these provide effective cable screening.

Screening of walls, floors, ceilings etc should be assessed to see if additional protection can be provided.

The above information is provided by Furse as guidance on the new requirements for lightning protection in accordance with the BS EN 62305:2011 standard. The information provided herein is not intended to replace the content of the standard, and industry professionals are recommended to source and review the BS EN 62305 standard (available from the BSI online shop) when undertaking lightning and surge protection design and installation.

Furse is the market leading lightning protection brand from Thomas & Betts providing solutions worldwide for structural lightning protection, power earthing and electronic systems protection.

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