BS EN 62305:2011

Changes from the 2006 Edition

BS EN 62305:2011 parts 1, 3 and 4 were published in summer 2011. Part 2 was published on the 30 April 2013.

There are no significant changes to parts 1 (General Principles), 3 (Physical Damage to Structures and Life Hazard) and 4 (Electrical and Electronic Systems Within Structures) compared with the first published standard of 2006. There are some changes to part 2 (Risk Management) that may result in slightly different solutions and necessitate the need for a 'mark II' risk software.

BS EN 62305 parts 1, 3 and 4:2006 will be withdrawn on **27 May 2012**. BS EN 62305-2:2006 will be withdrawn on **31 January 2014**. Until that date, the existing BS EN 62305-2:2006 can be used in conjunction with the newly published parts 1, 3 and 4. This ATLAS guidance summarises the changes with a commentary where deemed necessary.

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BS EN 62305-1:2011

Introduction - New figure 1 "Connection between various parts of 62305"

- There has been a change in the nomenclature of a complete lightning protection system (LP), the structural side of a lightning protection system (LPS) and the LEMP protection measures (LPMS) and their associated mnemonics. The complete lightning protection system mnemonic is still LP; the "structural" protection is still LPS (62305-3) but the LEMP protection measures is now SPM (Surge Protection Measures) (62305-4).

- The following new definitions have been added:

    - 3.23 Line – "*Power line or telecommunication line connected to the structure to be protected"*
    - 3.24 Telecommunication Lines – "*Lines intended for communication between equipment that may be located in separate structures, such as a phone line or a data line"*
    - 3.25 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) electric mains"*.

- Definition 3.48 Shielding Wire and 3.54 Conventional Earthing Impedance have been deleted.

Clause 5.2 Damage to a service

- EN 62305-5 Services was deleted before the 2006 edition but there were still references to this section within other parts of the standard. The relevant clauses/paragraphs have now been deleted i.e. clauses 5.2, 5.2.1, 5.2.2 and 8.4.

- Table 4 – "Damages and loss in a service according to different points of strike of lightning" – has been deleted.

Clause 7.4 Protection measures to reduce failure of electrical and electronic systems

- Isolating interfaces have been added to the possible protection measures. This is defined as devices which are capable of reducing conducted surges on lines entering the lightning protection zone (LPZ). Typically these can be isolation transformers or fibre optic cables.

- A note has been added suggesting the use of storm detectors. The implication behind their use would be that advanced warning of a pending storm could be given and appropriate action taken to alleviate any potential damage to the electrical and electronic systems within the structure.

- Table E.2 has been expanded to table E.2 (surge over currents due to lightning flashes on LV systems) and table E.3 (surge over currents due to lightning flashes on telecommunication systems).

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Clause 4.2 Design of the LPS

The following sentence has been added in this normative section: *"The LPS should be designed and installed by well-trained and expert LPS designers and installers".*

Clause 5.2.1 General

The sentence that was in Annex A in the 2006 edition has been incorporated into the following normative clause: *"For all types of air terminals only the real physical dimensions of the metal air-termination systems shall be used for the determination of the volume protected".*

Clause 5.2.3 Air-terminations against flashes to the side of tall structures

Several paragraphs have been added in an attempt to clarify the ambiguous statements made in the 2006 edition.

Clause 5.2.3.1 Structures less than 60m tall

"Research indicates that the probability of low amplitude strikes to the vertical side of a structure of less than 60m in height are low enough that they need not be considered. Roofs and horizontal protrusions shall be protected in accordance with the class of LPS determined by the risk calculations of BS EN 62305-2."

Clause 5.2.3.2 Structures 60m in height or more

"On structures taller than 60m, flashes to the side may occur, especially to points, corners and edges of surfaces.

***"Note 1:** In general, the risk due to these flashes is low because only a few per cent of all flashes to tall structures will be to the side and moreover their parameters are significantly lower than those of flashes to the top of structures. However, electrical and electronic equipment on walls outside structures may be destroyed even by lightning flashes with low current peak values.*

"An air-termination system shall be installed to protect the upper part of tall structures (i.e. typically the topmost 20% of the height of the structure as far as this part exceeds 60m in height) and the equipment installed on it (see Annex A).

"The rules for positioning the air-termination systems on these upper parts of a structure shall meet at least the requirements for LPL IV with emphasis on the location of air-termination devices on corners, edges, and significant protrusions (such as balconies, viewing platforms etc.).

"The air-termination requirement for the side of a tall structure may be satisfied by the presence of external metallic materials such as metal cladding or metallic curtain walls provided they meet the minimum size requirements of Table 3. The air-termination requirement may also include the use of external down-conductors located on the vertical edges of the structure when not provided by natural external metallic conductors.

"The installed or naturally occurring air-terminations meeting these requirements may utilize installed down-conductors or be suitably interconnected with natural down-conductors such as the steel frame of the structure or the metal of electrically-continuous reinforced concrete meeting the requirements of 5.3.5.

*"**Note 2:** The use of suitable earth-termination and natural down-conductors is encouraged."*

Clause 5.3.4 Construction (Down Conductors)

The following sentence located within a note in the 2006 edition is now a normative statement: *"It is recommended that the down conductors be positioned such that a separation distance in accordance with 6.3 is provided between them and any doors and windows".*

Clause 5.4.2.2 Type B arrangement

A note has been added to clarify that, although 20% may not be in contact with the soil, the ring conductor must always be completely connected throughout its total length.

Clause 5.4.3 Installation of earth electrodes

A note has been added to clarify that if the type A earth electrode is positioned within an inspection housing which in turn is located in high resistance paving of adjoining concrete, then the 0.5m requirement can be disregarded.

Table 6 Materials

Air-termination and down conductors copper coated aluminium alloy (50 mm^2 solid round) and copper coated steel (50mm^2 solid round and tape) have been added to the table. More details can be found in the latest version of BS EN 62561-2 to be published in the first quarter of 2012.

Table 7 Materials – earth electrodes

Various earth electrode sizes have been updated.

Clause 6.2.1 General (Lightning equipotential bonding)

- An additional bullet point has been included to show that the use of isolating spark gaps (ISGs) can be used as an interconnecting means where direct connections with bonding conductors are not allowed.

- A note has been added to highlight that lightning equipotential bonding should be integrated and coordinated with other equipotential bonding within the structure.

Tables 8 and 9 Minimum dimension – bonding bars

The cross sectional areas (csa) of the conductors have been increased to reflect common obtainable sizes i.e. 6, 10, 16, 25 and 50mm^2.

Clause 6.2.3 Lightning equipotential bonding for external conductive parts

The information now refers to ISGs rather than SPDs and references it to EN 62561-3 (BS EN 50164-3) Lightning Protection Components (LPC) – Part 3 Requirements for isolating spark gaps.

Clause 6.3 Electrical insulation of the external LPS

- The separation distance(s) formula now has a more clearer definition as to what the length (l) is to be:

  "1 is the length, in metres, along the air termination and the down conductor from the point where the separation distance is to be considered, to the nearest equipotential bonding point or the earth termination (see E.6.3 of Annex E)".

- There is also a note advising that the length (l) along the air-termination can be disregarded in structures with continuous metal roof acting as a natural air-termination system.

- The separation distance calculation has been split with two additional sub clauses added to reflect:
  - 6.3.2 Simplified approach
  - 6.3.3 Detailed approach

  There is a clarification paragraph prior to these new-sub clauses that states:

  "The coefficient kc of the lightning current amongst the air-terminations/down-conductors depends on the class of LPS, on the overall number n, on the position of the down- conductors, on the interconnecting ring conductors and on the type of earth-termination system. The necessary separation distance depends on the voltage drop of the shortest path from the point where the separation distance is to be considered, to the ground electrode or the nearest equipotential bonding point."

  The simplified approach adopts the existing separation formula:

$$S = \frac{k_i \times k_c}{k_m} \times l \text{ (m)}$$

  The detailed approach examines the separation distance(s) when using air-termination system or interconnected ring conductors, as the conductors will have different values of current flowing down their lengths. This approach is suitable for the evaluation of the separation distance(s) in very large structures with complex shapes.

Clause 8.2 Protection measures against step voltages

- There is an additional statement that the hazard is reduced to a tolerable level if a system of at least 10 down conductors is employed.
- The contact resistance of the surface layer of the soil (within 3m of the down conductor) has been increased from the original 5kΩm to a value of 100kΩ.

Annex C - Figure C.5

A new figure has been added to show the values of the k_c in the case of a meshed air-termination system, with a multiple down conductor system.

Annex D - Additional information for LPS in the case of structures with a risk of explosion

This annex has been expanded to take into account factors such as maintenance and inspection, specifically related to structures with a risk of explosion. It states that:

- *"The LPS should be electrically tested every 12 (+ 2) months.*
- *"The DC resistance of any single object bonded to the LPS shall not exceed 0.2Ω."*

The reference to a minimum class II LPS requirement has been removed.

Annex E

- **Clause E. 4.3.1 General (Reinforced concrete structures)** - A note has been added (covering the continuity of reinforcing), confirming that if the continuity of a dedicated column cannot be tested from top to bottom, then individual tests can be carried out at each section/level. The total resistance of each section of rebar plus the resistance of their joints can then be calculated. The maximum overall resistance is still maintained at 0.2Ω.

- **Figure E5 Joining of reinforcing rods in concrete** - Several sketches have been added to clarify the various methods employed for the clamping of reinforcing bars.

- **E.4.3.4 Materials** - The following additional information has been provided particularly relevant to galvanized steel buried in concrete:

  "The following materials can be used as additional conductors installed in concrete for lightning protection purposes: steel, mild steel, galvanized steel, stainless steel, copper and copper coated steel.

  "The behaviour of a galvanized layer on steel in concrete is very complicated, particularly in concrete with chlorides, the zinc will corrode quickly on contact with the reinforcement, and can under certain conditions cause damage to the concrete. Galvanized steel should therefore not be used in coastal areas and where there may be salt in the ground water. As the use of galvanized steel in concrete requires evaluation of many external factors this material should be used only after careful analysis. With this in mind the use of the other mentioned materials is preferred over the use of galvanized steel."

- **Figure E.17 Protected volume of a rod on a sloped surface** - Figure E.17a and E.21 have been deleted.

- **Clause E.5.2.3 Air termination against flashes to the side on tall structures** - It is now stated that in structures higher than 60m, the topmost 20% of lateral surfaces should be equipped with air terminals (2006 edition stated structures higher than 120m).

A note has been added stating that for structures between 60m and 75m high, the area protected need not extend below 60m.

- **Clause E.5.2.4.2 Table E.1 Suggested fixing centres** - The error in the 2006 edition of 500mm fixing centres for tape and stranded conductors when using horizontal conductors on horizontal surfaces has been corrected to 1000m.

- **Clause E.5.2.4.2.4 Protection of flush mounted or protruding roof fixtures** - An additional paragraph has been included explaining that metal flush mounted roof fixtures not fulfilling the requirements of:
  - height above roof level 0.3m
  - total area of fixture 1.0m^2
  - length of fixture 2.0m

  and not being within the requirement for the separation distance according to 6.3 should be bonded to the air-termination system with at least one bonding conductor.

- **Figure E.31 Metallic roof fixture protected against direct lightning interception** - The figure has deleted the bonding joint to the conductive elements of the structure (No 7 in the 2006 edition).

- **Figure E.32 Examples of lightning protection of a house with a TV antenna** - Figure E.32a has been added: "*TV antenna mast and antennas protected with isolated air terminations planned according to the protection angle method".*

- **Clause E.5.3.3 Number of down conductors for non-isolated LPS –** The following additional information has been included:

  "As stated in 5.3.3, a down-conductor should be installed at each exposed corner of the structure, where this is possible. However an exposed corner does not need a down conductor if the distance between this exposed corner to the nearest down-conductors complies with the following conditions:
  - *the distance to both adjacent down-conductors is half the distance according to Tables 4 or smaller; or*
  - *the distance to one adjacent down-conductor is one-quarter of the distance according to Tables 4 or smaller. Inside corners can be disregarded."*

- **Clause E.5.3.4 "Isolated down conductors"** from the 2006 edition has been deleted.

- **Clause E.5.3.4.2 Non isolated down conductors** - The fourth paragraph has had the reference "do not fulfill the separation distance conditions" removed. The new paragraph reads:

  "All internal columns and all internal partition walls with conductive parts should be connected with the air-termination system and with the earth-termination system at suitable points."

  The following last paragraph has been added:

  "Direct installation of down-conductors within the external plaster is not recommended since the plaster may be damaged as a result of thermal expansion. Moreover, the plaster may be discoloured as a result of chemical reaction. Damage to the plaster is

particularly likely as a result of temperature rise and mechanical forces exerted by lightning current; PVC-covered conductors prevent staining".

- **Clause E.5.3.5 Natural components** - In the 2006 edition, the use of a metallic rainpipe, which satisfied the conditions for natural down conductors according to 5.3.5, could be used as a down conductor on structures with low protection requirements. This has been removed such that it is applicable to all protection requirements. The sentence now reads: *"A metallic rainpipe which satisfies the conditions for natural down conductors according to 5.3.5 may be used as a down conductor."*

- **Clause E.5.4.1 General (Earth termination system) –** The following new paragraph has been added:

  "The recommended value of the overall earth resistance of 10 ohms is fairly conservative in the case of structures in which direct equipotential bonding is applied. The resistance value should be as low as possible in every case but especially in the case of structures endangered by explosive material. Still the most important measure is equipotential bonding."

- **Clause E.5.4.2.1 Type A arrangement** - The last paragraph has an amendment clarifying the number of down conductors required: *"In a type A arrangement the minimum number of earth electrodes should be one for each down-conductor and at least two for the whole LPS."*

- **Clause E.6.3.1 General (Electrical isolation of the external LPS)** - All of E.6.1.1."Separation distance" has been moved to E.6.3.1.

  The reference to length (l) has some additional words to clarify that the reference is to the nearest earth termination i.e. *"The reference length, (l), for the calculation of the separation distances (see 6.3), should be the distance between the connection to the nearest equipotential bonding point or earth- termination network and the point of proximity along the down-conductor."*

  A clarification has been added relating to the separation distance being fulfilled for buildings lower than 30m. It reads: *"When bonding of installations to the LPS in buildings lower than 30 m is performed at the reference point and the furthest point, the separation distance is fulfilled along the whole path of the installation."*

- **E.6.3.2 Simplified approach (separation distance)** - A new clause has been added stating: *"The simplified approach according to 6.3.2 is possible, if the widest horizontal elongation of the structure (length or width) does not exceed four times the height."*

- **Clause E.7.1 Maintenance and inspection of the LPS** - Table E.2 Maximum period between inspections of an LPS

  A note (b) has been added as follows which qualifies the referenced categories to have a complete inspection every year regardless of whether it is I, II, III or IV protection level:

b) "Critical situations could include structures containing sensitive internal systems, office blocks, commercial buildings or places where a high number of people may be present."

- **Clause E.7.2.4 Testing** - The following paragraph has been inserted at the end of this clause:

  "SPDs without a visual indicator need to be tested, preferably using the guidelines or equipment provided by the manufacturer."

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The following new definitions have been added:

- 3.4 Lightning Protection LP – *"Complete system for the protection of structures and/or electrical and electronic systems in those structures from the effects of lightning, consisting of an LPS and SPM."*

- 3.5 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."*

- 3.24 Isolating Interfaces – *"Devices which are capable of reducing conducted surges on lines entering the LPZ*
  *"**Note 1**: These include isolation transformers with earthed screen between windings, metal-free fibre optic cables and opto-isolators.*
  *"**Note 2**: Insulation withstand characteristics of these devices are suitable for this application intrinsically or via SPD."*

Definition 3.6 lightning electromagnetic impulse LEMP has been expanded: all electromagnetic effects of lightning current via resistive, inductive and capacitive coupling which create surges and electromagnetic fields.

Clause 4.1 General (Design and installation of SPM)

A new paragraph has been added: *"The design of SPM should be carried out by experts in lightning and surge protection who possess a broad knowledge of EMC and installation practices."*

Clause 4.4 Basic Surge Protection Measures (SPM)

Isolating interfaces has been added to the existing measures of:
- earthing and bonding
- magnetic shielding and line routeing
- coordinated SPD system.

Table 1 – Minimum cross sections for bonding components

The cross sectional areas (csa) have been increased to reflect common obtainable sizes i.e. 1, 6, 10, 16, 25 and 50mm^2.

Clause 8 Isolating interfaces

This is a new clause that has been added as follows:

"Isolating interfaces may be used to reduce the effects of LEMP. Protection of such interfaces against overvoltages, where needed, may be achieved using SPDs. The withstand level of the isolating interface, and the voltage protection level of the SPD UP shall be coordinated with the overvoltage categories of IEC 60664-1.

*"**Note:** The scope of this part of IEC 62305 deals with protection of equipment within structures, and not protection of interconnected structures to which the isolation transformer may provide some benefit."*

Clause 9.3.1 General (Inspection on SPM)

The information is the same as per clause 8.2 of the 2006 edition but with the following additional note: *"Where no specific requirements are identified by the authority having jurisdiction, the values of Table E.2 of BS EN 62305-3:2006 are recommended."*

Clause 9.3.2.3 Measurements

The following note has been added to this clause:

"If an SPD does not have a visual indicator (flag), measurements shall be performed in accordance with the manufacturer's instructions to confirm its operating status, when so required."

Annex B Implementation of SPM for an existing structure

The following new clauses have been added:

- Clause B.1 General - *"For equipment within existing structures it is not always possible to follow the SPM outlined in this standard. This annex attempts to describe the main points for consideration and provides information on protection measures which are not mandatory but may help to improve the overall protection provided."*

- Clause B.3 Design of SPM for an existing structure - *"The first step in the design process is to work through the checklist in accordance with Clause B.2 and to conduct the risk assessment.*

  "If this analysis shows that SPM is required, then this should be implemented following the steps outlined in Figure B.1.

  "Assign suitable LPZs to all locations where equipment to be protected is located (see 4.3). The basis of the SPM shall be an internal screening and bonding network. This network should have mesh widths not exceeding 5 m in any direction. If the layout of the structure does not permit this screening and bonding network at least a ring conductor inside the outer wall of the structure on each floor should be installed. This ring conductor should be bonded to each down-conductor of the external LPS.

  *"**Note:** Retrofitting screening measures to an existing building is often impractical and uneconomic. Where this is the case, the use of SPDs provides an effective alternative."*

- B.4.1 Design of basic protection measures for LPZ 1 - *"The protection measures should be based on the internal screening and bonding network or the ring conductor inside the outer wall, which is normally the boundary of LPZ 1. If the outer wall is not the boundary of LPZ 1 and an internal screening and bonding network is not possible, a ring conductor should be installed at the boundary of LPZ 1. The ring conductor has to be connected to the ring conductor of the outer wall at least at two locations as far apart as possible."*

- B.4.2 Design of basic protection measures for LPZ 2 - *"The protection measures are based on the internal screening and bonding network or the ring conductor inside the outer wall. If an internal screening and bonding network is not possible, a ring conductor should be installed at the boundary of every LPZ 2. If an LPZ 2 is larger than 5m x 5m a subdivision has to be made creating meshes not exceeding 5m x 5m. The ring conductor has to be connected to the ring conductor of the surrounding LPZ 1 at two locations at least, and as far apart as possible."*

- B.4.3 Design of basic protection measures for LPZ 3 - *"The protection measures are based on the internal screening and bonding network or the ring conductor inside the LPZ 2. If an internal screening and bonding network is not possible, a ring conductor should be installed at the boundary of every LPZ 3. If an LPZ 3 is larger than 5m x 5m a subdivision has to be made creating meshes not exceeding 5m x 5m. The ring conductor has to be connected to the ring conductor of the surrounding LPZ 2 at two locations at least, and as far apart as possible."*

- B.5 Installation of a coordinated SPD system - *"A coordinated SPD system should be designed to protect the cables crossing borders of the different LPZs. Designing additional measures will greatly improve the protection by bonding and SPD systems. The design of cable trays, cable ladders and the like has to be improved to make them proper screens for the cables running in and/or over them. If possible, additional measures such as screening of walls, floors, ceilings etc should be considered to provide additional protection to that already applied (see Clause 6). Design measures to improve interconnections between the structure under consideration and other structures (see Clause B.11). In the case where new internal systems are installed in a structure already equipped with protection measures, the design process should be repeated for the location of those internal systems. The complete design process is illustrated in the flow chart (see Figure B.1)."*

- Clause B.14 Integration of new internal systems into existing structures - "*When adding new internal systems to an existing structure, the existing installation might restrict the protection measures that can be adopted. Figure B.8 shows an example where an existing installation is inter-connected to a new installation (not illustrated here).*"

Annex C Selection and installation of a coordinated SPD system

This annex replaces Annex D from the 2006 edition.

Annex D Factors to be considered in the selection of SPDs

This is a new annex which has been added.

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