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**GB 50601-2010**

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**Code for construction and quality acceptance for lightning  
protection engineering of structures**

建筑物防雷工程施工与质量验收规范

**Issued on: July 15, 2010**

**Implemented on: February 01, 2011**

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**Issued by: Ministry of Housing and Urban-Rural Development of PRC.**

**General Administration of Quality Supervision, Inspection and  
Quarantine of PRC.**

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## **3 Basic requirement**

### **3.1 Quality management of construction site**

**3.1.1** The quality management of lightning protection project construction sites shall have corresponding construction technical standards, a sound quality management system, a construction quality inspection system, a comprehensive construction quality level judgment and assessment system. The chief supervisory engineer or the project leader of the construction organization shall inspect and fill in Table A.0.1 of Appendix A of this Code item by item.

**3.1.2** Construction personnel, qualifications, measuring instruments shall meet the following requirements:

- 1** All types of craftsmen and technical personnel, that are involved in construction, shall have corresponding qualifications and hold certificates to work.
- 2** The construction organization shall have corresponding construction qualifications.
- 3** Various measuring instruments, which are used in installation and commissioning, shall be certified by the statutory metrology certification agency AND shall be used within the validity period of the certification.

### **3.2 Requirements of construction quality control**

**3.2.1** The mobilization inspection conclusions of the main equipment, materials, finished products, semi-finished products, which are used in lightning protection projects, shall be recorded. They shall be used in construction, after confirming that they comply with the provisions of this Code. For mobilization acceptance of new equipment, appliances, materials, which are approved to enter the market in accordance with legal procedures, suppliers shall also provide technical documents, such as installation, use, maintenance, testing requirements. For the mobilization acceptance of imported equipment, appliances, materials, suppliers shall also provide commercial inspection (or domestic testing agency) certificates and quality certification documents in Chinese, specifications, models, performance inspection reports, as well as the technical documents on the installation, use, maintenance, testing requirements in Chinese.

Where there are objections to the main equipment, materials, finished products, semi-finished products, which are used in lightning protection projects, sampling testing shall be carried out, by the laboratory of the statutory testing agency; meanwhile a testing report shall be issued.

## 4 Subdivision work of earth-termination system

### 4.1 Installation of earth-termination system

4.1.1 The dominant items shall comply with the following requirements:

- 1 For the natural earth electrode, that uses the steel bars in the pile foundation, beams, columns of the building as the earth-termination system, AND the artificial earth electrode specially buried for earthing needs, it shall provide connection plate aboveground in accordance with requirements, which is used for measurement, connection to the artificial earth electrode, equipotential bonding.
- 2 The earthing resistance value of the earth-termination system shall comply with the requirements of the design document.
- 3 Within 3 m of the connection -- between the down-conductor and the earth electrode, where people outside the building can pass or stay, it shall use one or more methods to prevent step voltage from causing harm to personnel, as follows:
  - 1) Lay a 5 cm thick asphalt layer or a 15 cm thick gravel layer, so that the ground resistivity is not less than 50 k $\Omega$ ·m.
  - 2) Set up guardrails or warning signs, to prevent people from entering.
  - 3) Lay the earth electrode into a horizontal grid.
- 4 When the engineering design document designates the earth-termination system of first category of lightning protection building as independent earthing, the separation distance -- BETWEEN the independent earth electrode and the building foundation ground network AND the pipes, cables, other metal objects associated with it -- shall comply with the provisions of Article 4.2.1 in the current national standard "Design code for protection of structures against lightning" GB 50057-2010.

4.1.2 General items shall comply with the following requirements:

- 1 When there is no requirement in the design, the burial depth of the top surface of the earth-termination system shall not be less than 0.5 m. Earth electrode, such as angle steel, steel pipes, copper rods, copper pipes, shall be arranged vertically. The length of artificial vertical earth electrode should be 2.5 m; the spacing between artificial vertical earth electrodes should not be less than 5 m. The horizontal distance -- between the artificial earth electrode and the building's exterior wall or foundation -- should not be less than 1 m.
- 2 The following methods can be used, to reduce the earthing resistance:

- 2) When the conductors are copper and copper or copper and steel, the connection process shall be exothermic welding. The fusion joint shall completely enclose the connected conductor in the joint. It shall ensure that the metal at the connection part is completely melted AND the welding joint shall be connected firmly.
- 5 The earthing conductor connection requirements and measures to prevent mechanical damage and chemical corrosion shall comply with the provisions of Article 3.2.7, Article 3.3.1, Article 3.3.3 of the current national standard "Code for construction and acceptance of grounding connection electric equipment installation engineering" GB 50169-2006.
- 6 For the construction diagram of the connection between the earth-termination system and the down-conductor at the ground level AND the earthing construction diagram of building foundations with different foundations, see Figure D.0.1-1 ~ Figure D.0.1-3 in Appendix D of this Code.
- 7 When the earth electrode laid in the soil is connected to the steel in the concrete foundation, it should use copper or stainless steel.

## **4.2 Installation procedures of earth-termination system**

**4.2.1** After the laying of the steel bars on the bottom plate of the natural earth electrode is completed, the earthing construction shall be carried out according to the design requirements. The formwork or concrete pouring shall be carried out, after inspection and confirmation and taking the acceptance record of the concealed work.

**4.2.2** For the artificial earth electrode, it shall open trenches at locations according to the design requirements and drive in the artificial vertical earth electrode, OR lay metal earthing modules (tubes) and use artificial horizontal earth electrode for electrical connections. This shall be inspected and confirmed and a concealed work acceptance record shall be made.

**4.2.3** The concealed earth-termination system shall be inspected and accepted, before being backfilled with soil.

## 5 Subdivision work of down-conductor system

### 5.1 Installation of down-conductor system

5.1.1 The dominant items shall comply with the following requirements:

- 1 The installation layout of down-conductors shall comply with the relevant provisions of the current national standard "Design code for protection of structures against lightning" GB 50057. The number of dedicated down-conductors for the first, second, third categories of lightning protection buildings shall not be less than 2, which shall be evenly distributed around the building; their average spacing shall not be greater than 12 m, 18 m, 25 m, respectively.
- 2 The dedicated down-conductors for open laying shall be fixed in sections; they shall be laid to the earth electrode via the shortest path. The laying shall be smooth and straight without sharp bends. The welds fixed by welding shall be full and without omissions. The bolts shall have anti-loosening parts (washers). The anti-corrosion of the welded parts shall be complete.
- 3 **When the down-conductor outside the building is laid in an area, where people can stay or pass by, one or more of the following methods shall be used, to prevent contact voltage and side flashover voltage from causing harm to personnel:**
  - 1) **The part of the exposed down-conductor, which is below 2.7 m in height, shall be worn through a cross-linked polyethylene pipe, which has a thickness of not less than 3 mm. The cross-linked polyethylene pipe shall be able to withstand 100 kV impulse voltage (1.2/50  $\mu$ s waveform).**
  - 2) **Guardrails or warning signs shall be set up, to prevent people from entering. The horizontal distance between guardrails and down-conductors shall not be less than 3 m.**
- 4 Both ends of the down-conductor shall be reliably electrically connected to the air-termination device and the earth-termination system, respectively.
- 5 There shall be no other electrical lines attached to the down-conductor. When laying electrical lines on communication towers or other metal objects, that serve as lightning connections on tall metal structures, the lines shall use armored cables directly buried in the soil OR conductors passing through metal conduits. The metal sheath or metal conduit of the cable shall be grounded at both ends; the length buried in the soil shall not be less than 10 m.
- 6 **The distance -- between the down-conductor installation and the wall or wall**

## 6 Subdivision work of air-termination system

### 6.1 Installation of air-termination system

6.1.1 The dominant items shall comply with the following requirements:

- 1 The air-termination systems on the top of the building and on the exterior walls must be equipotentially connected to the building railings, flagpoles, crane beams, pipes, equipment, solar water heaters, doors and windows, curtain wall brackets, and other exposed metal objects.**
- 2 The installation layout of the air-termination system shall comply with the requirements of the engineering design documents, as well as the requirements for the layout of air-termination systems in different category of lightning-protected buildings in the current national standard "Design code for protection of structures against lightning" GB 50057.
- 3 The air-termination conductor, which is located at the top of the building, can be concealed in the concrete parapet or concrete roof, according to the requirements of the engineering design documents. When concealed laying is used, the construction of steel bars, which are used as air-termination conductors, shall comply with the provisions of Chapter 5 of the current national standard "Code for acceptance of constructional quality of concrete structures" GB 50204-2002. Air-termination system in high-rise buildings shall be exposed. In areas with frequent lightning, short lightning rods should be installed at the corners of the roof.
- 4 The special air-termination rod shall be able to withstand the basic wind pressure of  $0.7 \text{ kN/m}^2$ . In areas where typhoons and winds greater than level 11 occur frequently, it should increase the size of the air-termination rod.
- 5 There shall be no other electrical lines or communication lines or signal lines attached to the air-termination system. Where there are other electrical lines and communication lines, which are laid on the communication tower, as requested in the design document, they shall comply with the provisions of item 5 of Article 5.1.1 of this Code.

6.1.2 General items shall comply with the following requirements:

- 1 When metal objects such as metal roofs of buildings, flagpoles, iron towers, etc. are used as air-termination systems, the materials and specifications of metal objects, such as metal roofs of buildings, flagpoles, iron towers, etc., shall comply with the relevant provisions of Appendix B of this Code.
- 2 The position of the special air-termination rod shall be correct; the welds fixed by



## 7 Subdivision work of equipotential bonding

### 7.1 Installation of equipotential bonding

7.1.1 The dominant items shall comply with the following requirements:

- 1 In addition to complying with the provisions of item 1 of Article 6.1.1 of this Code, the metal pipelines entering and exiting the building shall be subject to equipotential bonding, in accordance with the current national standard "Design code for protection of structures against lightning" GB 50057, regarding various categories of lightning protection buildings.
- 2 A general equipotential bonding shall be made at the entrance to the building. There shall be no less than 2 direct connections -- between the building's equipotential bonding trunk line and the earth-termination system.
- 3 For the bridging of long metal objects, such as metal pipes, frames and cable metal sheaths inside and outside of category I lightning-protected buildings and category II lightning-protected buildings with explosion hazard locations in Zone 1, Zone 2, Zone 21, Zone 22, it shall comply with the relevant provisions of the current national standard "Design code for protection of structures against lightning" GB 50057.

7.1.2 General items shall comply with the following requirements:

- 1 Equipotential bonding can be welding, screw or bolt connection, etc. When welding is used, it shall comply with the provisions of item 4 of Article 4.1.2 of this Code.
- 2 The equipotential bonding at the interface of the subsequent lightning protection zone of the building shall comply with the relevant provisions of the current national standard "Design code for protection of structures against lightning" GB 50057.
- 3 The equipotential bonding in the electronic system equipment room shall adopt star structure (S type) or mesh structure (M type), according to the operating frequency of the electronic system. For analog lines, which have an operating frequency less than 300 kHz, it may use equipotential bonding network in a star structure. For digital lines, which have a frequency of megahertz (MHz) level, it shall use equipotential bonding network in a mesh structure.
- 4 The equipotential bonding at the entrance of the building and the equipotential bonding of the roof metal pipe at the entrance can be carried out, according to Figure D.0.2-5, Figure D.0.3-3, Figure D.0.4-1 ~ Figure D.0.4-5 in Appendix D of

## 8 Subdivision work of shielding

### 8.1 Installation of shielding device

**8.1.1** The dominant items shall comply with the following requirements:

- 1 When the engineering design documents require shielding measures to prevent damage or interference to indoor electronic equipment, which are caused by electromagnetic pulses due to lightning strikes, the construction of the shielding engineering shall comply with the engineering design documents and the relevant provisions of current national standard "Code for construction and acceptance of electronic information system room" GB 50462.
- 2 When the engineering design documents include a special shielding room for lightning protection, the installation of shielding shells, shielding doors, various filters, cut-off ventilation guide windows, shielding glass windows, shielding shadow boxes shall comply with the requirements of the engineering design documents. The equipotential bonding of the shielding room shall comply with the provisions of item 3 of Article 7.1.2 of this Code.

**8.1.2** General items shall comply with the following requirements:

- 1 For a machine room equipped with an electromagnetic shielding room, the building structure shall meet the load requirements of the shielding structure.
- 2 A maintenance channel should be reserved, between the electromagnetic shielding room and the inner wall of the building.

### 8.2 Installation procedures of shielding device

**8.2.1** The installation process of the building's grid-shaped large space shielding work shall comply with the following requirements:

- 1 Metal conductors shall be selected and laid on the hexahedron of the building, in accordance with the requirements of the engineering design documents. The size of the grid, which is formed by the metal conductor itself or the steel bars in the building, shall be inspected and confirmed, before electrical connection is made.
- 2 When setting up formwork or performing interior decoration, the shielding grid shall be buried in concrete or decoration materials.

**8.2.2** The installation process of the special shielding room shall comply with the following requirements:

## 9 Subdivision work of generic cabling

### 9.1 Installation of generic cabling

**9.1.1** The dominant items shall comply with the following requirements:

- 1** Single-core cables of low-voltage distribution lines (three-phase or single-phase) shall not be laid alone in metal conduits.
- 2** AC and DC wires of different circuits and different voltage levels shall not be laid in the same metal conduit. Wires of the same AC circuit shall be laid in the same metal conduit. There shall be no joints in the wires in the conduit.
- 3** The rated withstanding voltage of wires (cables), which are used in explosion-risk locations, shall not be less than 750 V; they shall be laid in metal conduit.

**9.1.2** General items shall comply with the following requirements:

- 1** The general cabling construction of the transmission network in the building shall comply with the relevant provisions of the current national standard "Code for engineering acceptance of generic cabling system for building and campus" GB 50312.
- 2** When information technology cables and power supply and distribution cables belong to the same cable management system and the same route, their cabling shall comply with the following requirements:
  - 1) All exposed conductive parts of the cabling system shall be equipotentially bonded, in accordance with the requirements of Article 7.1 of this Code.
  - 2) When the length of the parallel laying -- of information technology cables and power supply and distribution cables from the junction box -- is greater than 35 m, isolation measures shall be taken within 20 m from the junction box; however, it shall also maintain a gap of more than 30 mm between the two cables, OR add metal plates in the trough box to separate them.
  - 3) When conditions permit, multi-layer cabling trough boxes should be used. The strong and weak current lines should be laid in layers.
- 3** The color code of wires in the low-voltage power distribution system shall meet the requirements of using yellow, green, red for phase wires, using light blue for neutral wires, using green/yellow two-color wires for protective wires.

## 10 Subdivision work of surge protective device

### 10.1 Installation of surge protective device

**10.1.1** The dominant items shall comply with the following provisions:

- 1** The installation arrangement of SPD in low-voltage power distribution systems shall comply with the requirements of the engineering design documents. It shall also comply with the relevant provisions of the current national standard "Electrical installations of buildings - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control - Section 534: Devices for protection against overvoltage" GB 16895.22, "Surge protective devices connected to low-voltage power distribution systems - Part 12: Selection and application principles" GB/T 18802.12, "Design code for protection of structures against lightning" GB 50057.
- 2** The installation arrangement of SPD in electronic system signal networks shall comply with the requirements of engineering design documents. It shall also comply with the relevant provisions of current national standard "Low-voltage surge protective devices - Part 22: Surge protective devices connected to telecommunications and signaling networks - Selection and application principles" GB/T 18802.22 and "Design code for protection of structures against lightning" GB 50057.
- 3** When there is an external lightning protection system on the building, OR when the building is not equipped with an external lightning protection system, but the adjacent building has an external lightning protection system and there is an electrical connection between the two buildings, THEN, the SPD installed on the main distribution cabinet in buildings with external lightning protection system and buildings with electrical connections, shall comply with the following requirements:
  - 1) It shall use the SPD of Class I classification test.
  - 2) The main performance parameters of the SPD of the low-voltage distribution system: the impulse current shall not be less than 12.5 kA (10/350  $\mu$ s); the voltage protection level shall not be greater than 2.5 kV; the maximum continuous operating voltage shall be selected, according to the earthing type of the low-voltage distribution system.
- 4** Where there is no thermal trip device designed inside the SPD, for the SPD whose failure state is short-circuit type, it shall install a fuse, thermal melt coil or circuit breaker on the front end, for backup overcurrent protection.

**10.1.2** General items shall comply with the following requirements:

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