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SERIES K: PROTECTION AGAINST INTERFERENCE

Protection of radio base stations against lightning
discharges

Corrigendum 1

Recommendation ITU-T K.56 (2010) – Corrigendum 1

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Recommendation ITU-T K.56

Protection of radio base stations against lightning discharges

Corrigendum 1

Summary

Recommendation ITU-T K.56 presents the techniques applied to a telecommunication radio base station in order to protect it against lightning discharges. The need of protection is obtained from the methodology contained in IEC 62305-2, which is used to determine the relevant lightning protection level (LPL) for the installation. The protection techniques for the external area cover the lightning protection system (LPS), bonding procedures, earthing and the installation of surge protective devices (SPDs) at the power meter station. The protection techniques for the equipment building cover the feeder and lighting cables, the electric power conductors, the telecommunication cabling and the earthing/bonding procedures applied to cable trays and equipment frames. This Recommendation also provides guidelines in order to achieve adequate protection of the telecommunication equipment based on the coordination between equipment resistibility, SPD protection level and installation characteristics.

Corrigendum 1 to Recommendation ITU-T K.56 (2010) deletes the factor "2" in the denominator given in Equation 7 (clause 8.1).

History

Edition	Recommendation	Approval	Study Group	Unique ID*
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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T K.56

Protection of radio base stations against lightning discharges

Corrigendum 1

Editorial note: This is a complete-text publication. Modifications introduced by this corrigendum are shown in revision marks relative to Recommendation ITU-T K.56 (2010).

1 Scope and purpose

This Recommendation addresses radio base stations (RBSs) made of a shelter or small building to house the equipment and a nearby tower to hold the antennas. The purpose of this Recommendation is to provide a set of procedures to protect the RBS against lightning discharges. [ITU-T K.71] gives information on the protection of antenna installations in or on a customer building.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T K.12] Recommendation ITU-T K.12 (2006), *Characteristics of gas discharge tubes for the protection of telecommunications installations.*
- [ITU-T K.27] Recommendation ITU-T K.27 (1996), *Bonding configurations and earthing inside a telecommunication building.*
- [ITU-T K.35] Recommendation ITU-T K.35 (1996), *Bonding configurations and earthing at remote electronic sites.*
- [ITU-T K.44] Recommendation ITU-T K.44 (2008), *Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic Recommendation.*
- [ITU-T K.46] Recommendation ITU-T K.46 (2008), *Protection of telecommunication lines using metallic symmetric conductors against lightning-induced surges.*
- [ITU-T K.47] Recommendation ITU-T K.47 (2008), *Protection of telecommunication lines using metallic conductors against direct lightning discharges.*
- [ITU-T K.66] Recommendation ITU-T K.66 (2004), *Protection of customer premises from overvoltages.*
- [ITU-T K.71] Recommendation ITU-T K.71 (2007), *Protection of customer antenna installations.*
- [ITU-T K.72] Recommendation ITU-T K.72 (2008), *Protection of telecommunication lines using metallic conductors against lightning – Risk management.*
- [IEC 61643-1] IEC 61643-1 (2005), *Low-voltage surge protective devices – Part 1: Surge protective devices connected to low-voltage power distribution systems – Requirements and tests.*

- [IEC 61643-11] IEC 61643-11 (2004), *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power distribution systems – Performance requirements and testing methods.*
- [IEC 61643-12] IEC 61643-12 (2008), *Low-voltage surge protective devices – Part 12: Surge protective devices connected to low-voltage power distribution systems – Selection and application principles.*
- [IEC 61643-22] IEC 61643-22 (2004), *Low-voltage surge protective devices – Part 22: Surge protective devices connected to telecommunications and signalling networks – Selection and application principles.*
- [IEC 62305-1] IEC 62305-1 (2006), *Protection against lightning – Part 1: General principles.*
- [IEC 62305-2] IEC 62305-2 (2006), *Protection against lightning – Part 2: Risk management.*
- [IEC 62305-3] IEC 62305-3 (2006), *Protection against lightning – Part 3: Physical damage to structures and life hazard.*

3 Definitions

The definitions contained in the references apply to this Recommendation. Additional definitions needed for the protection of radio base stations (RBSs) are as follows:

- 3.1 cable tray:** Rigid structural system used to securely fasten or support cables.
- 3.2 feeder cable:** Wave-guide or coaxial cable that conducts signals to an antenna.
- 3.3 lightning protection system (LPS) rod:** Metallic rod that makes part of the LPS and is intended to intercept a lightning strike. It is also designated as "lightning air termination" or "lightning finial".
- 3.4 radio base station:** Installation intended to provide access to the telecommunication system by means of radio waves.
- 3.5 shielding factor:** Factor that represents the attenuation of the voltage or current in a conductor due to the presence of a nearby shielding conductor.
- 3.6 single-pulse peak current:** Rated maximum current value which may be applied for a single impulse of specified waveshape, without causing surge protective device (SPD) failure. Typically, this rating is defined using either an 8/20 or 10/350 impulse current waveshape.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

GDT	Gas Discharge Tube
LPL	Lightning Protection Level
LPS	Lightning Protection System
MEB	Main Earthing Bar
PE	Protective Earth
RBS	Radio Base Station
SPD	Surge Protective Device

5 Need of protection

The risk assessment of the RBS shall be performed according to [IEC 62305-2] in order to determine a lightning protection level (LPL) for the design of the protection procedures. Table 1 shows some lightning flash parameters associated with each LPL.

Table 1 – Lightning flash parameters from [IEC 62305-1]

Parameter	Unit	LPL			
		I	II	III	IV
Maximum peak current	kA	200	150	100	100
Maximum current rate of rise	kA/ μ s	200	150	100	100
Radius of electro-geometric sphere	m	20	30	45	60
Probability of flash	%	99	98	95	90

NOTE – The risk assessment may indicate an LPL for the design of the LPS that is different from the LPL considered for the design of the other protection procedures.

6 External area

Figure 1 shows the main earthing and bonding procedures applied to the external area. These procedures, as well as others not shown in the figure, are detailed in the subsequent clauses.

6.1 Lightning protection system (LPS)

In order to protect the antennas and auxiliary equipment from a direct strike, it may be necessary to install an LPS in the tower. If the nearby tower does not protect the shelter, it may be necessary to install an LPS in the shelter too. The assessment of the need for an LPS and the determination of its positioning shall be performed with the rolling sphere method described in [IEC 62305-3]. The following clauses give some procedures for the installation of the LPS.

6.1.1 Metallic tower

The LPS rod(s) shall be connected directly to the structure of the metallic tower. Therefore, the structure of the metallic tower will conduct the stroke current to ground and there is no need to install lightning down conductors.

NOTE – If the total cross-section of the tower structure is less than 125 mm², then the tower shall be treated as a non-metallic tower, as described in clause 6.1.2.

6.1.2 Non-metallic tower

If the structure that supports the antennas is not metallic (e.g., wood pole) or if it is metallic but its cross-section is less than 125 mm², it is necessary to install two down-conductors to earth the LPS rod(s). The down conductors shall not be insulated from the tower and they shall have a minimum cross-section of 50 mm² each. The down conductors shall be installed on opposite sides of the tower.

6.1.3 Building

In the majority of the cases, the nearby tower will protect the building against direct strikes. However, the need for an LPS in the building shall be investigated with the rolling sphere method described in [IEC 62305-3]. If the building requires an LPS, it shall be earthed in the earthing system of the RBS, which is described in clause 6.3.

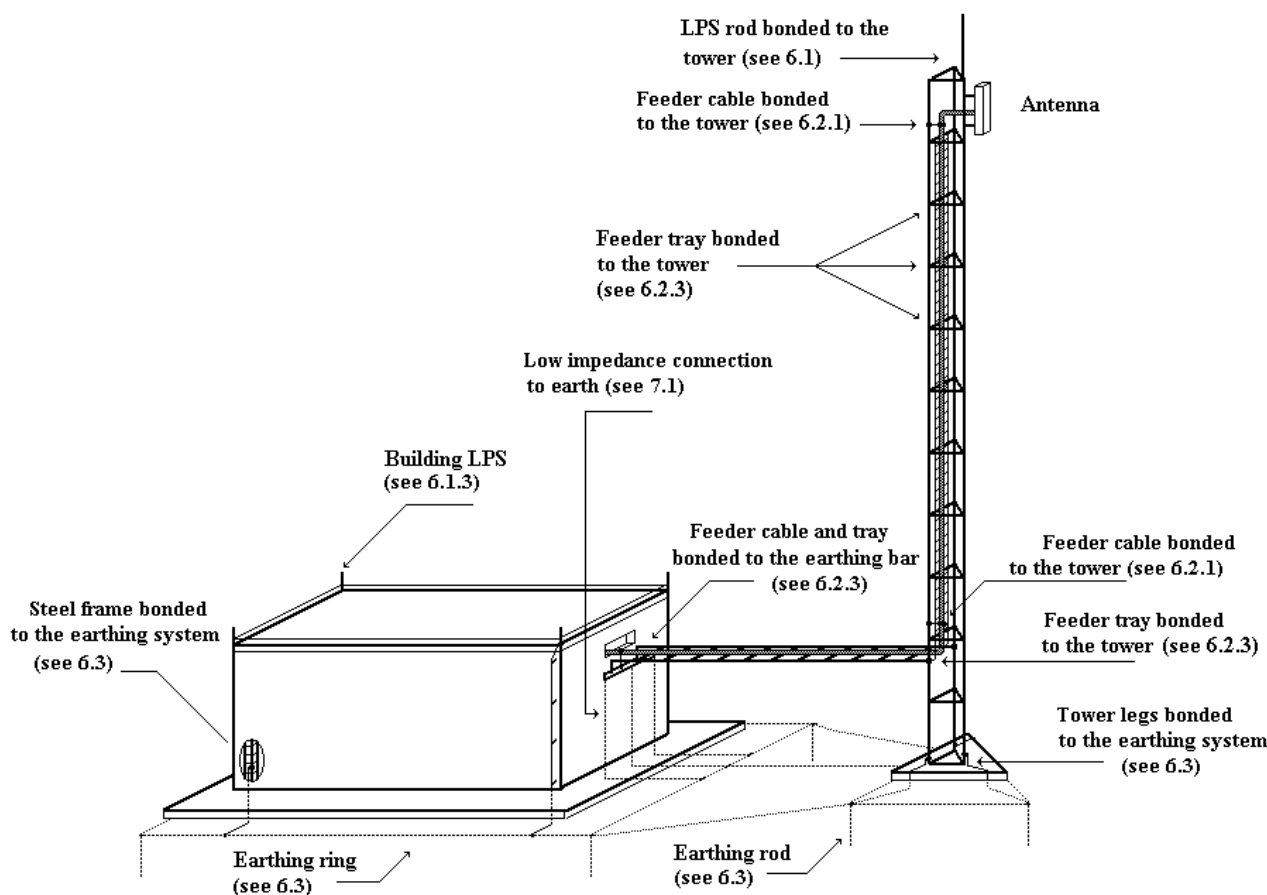


Figure 1 – General view of earthing and bonding procedures in the external area

6.2 Bonding in the tower

6.2.1 Feeder cables

The wave-guide and the external conductor of coaxial cables, henceforth referred as feeder cables, shall be bonded to the metallic tower (or to the feeder tray) near the antenna, as shown in Figure 1. A weatherproof connector shall make the connection to the feeder cable in order to avoid corrosion, and the connection to the tower (or feeder tray) structure shall also be protected to avoid ingress of moisture. Usually, the cable manufacturers provide appropriated earthing kits for these connections. The earthing kits shall have a connector to be attached on the bare outer surface of the feeder (the feeder plastic outer jacket shall be removed), another connector to be attached to the tower structure (paint shall be removed) and a conductor bonding the two connectors. The earthing kit shall also contain protective coatings to be applied on the connections. Figure 2 shows schematically the installation of an earthing kit before the application of the protective coating.

NOTE 1 – For non-metallic towers or metallic towers with a cross-section smaller than 125 mm², the bonding shall be made to the lightning down conductor.

NOTE 2 – Some types of antenna are inherently connected to the tower by design. In this case, it is not necessary to use an earthing kit to bond the feeder to the tower (or feeder tray), as it is already bonded through the antenna structure.

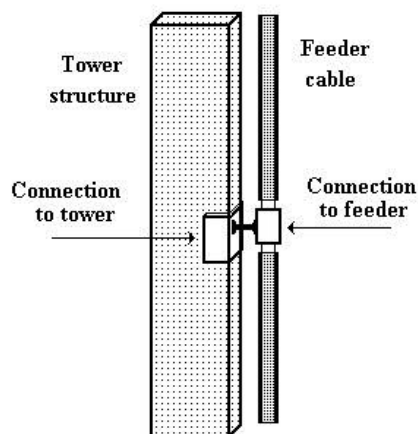


**Figure 2 – Example of installation of earthing kit on feeder cable
(protective coating not shown)**

Depending on the length of the horizontal section of the feeder tray (from the tower to the equipment building), it is recommended to bond the feeder cables to the tower (or to the feeder tray) at the point where they leave the tower (bending point). The minimum length of the horizontal section that requires this bonding is given in Table 2.

Table 2 – Minimum length of the horizontal section of the feeder tray that requires bonding of feeders at the bending point

LPL	I	II	III-IV
Feeder tray length	10 m	15 m	20 m

NOTE – Regardless of the bonding at the bending point, the feeder cables shall always be bonded to the bonding bar installed near the feed-through window, as described in clause 6.2.3.

6.2.2 Cable supplying power to the tower lights

The cable used for supplying power to the lights of the tower shall be protected from the lightning current by one of the options described in this clause. When the power to the lights is supplied by an equipment (e.g., AC/DC converter), an SPD set may be required close to this equipment, in addition to the protection measures described in the following.

6.2.2.1 Metallic duct

An unshielded cable should be installed inside a metallic duct and this duct shall be electrically continuous for its entire length. The duct shall be bonded to the tower at least at its upper end. The length of cable that may run outside the metallic duct shall be as short as possible. Preferably, the cable should run inside the metallic duct up to the lighting hardware. The metallic duct can be made of galvanized steel and shall have a cross-section area not less than 16 mm². The openings in the duct shall be adequately sealed in order to prevent the ingress of moisture. The metallic duct shall also be bonded to the earthing bar installed near the feed-through window.

6.2.2.2 Shielded cable

A shielded cable can be installed directly along the tower, i.e., without a metallic duct. The shield of the cable shall be electrically continuous for its entire length and shall be bonded to the tower at its upper end. The shield shall be terminated as close as possible to the lighting hardware and shall be bonded to the earthing bar installed near the feed-through window.

6.2.2.3 Unshielded cable

The use of unshielded cable installed without a metallic duct requires the installation of adequate SPDs close to the lighting hardware and connected between the conductors and the tower structure. Another set of SPDs is also required at the point where the lighting conductors enters the building and these SPDs shall be bonded to the earthing bar installed below the feed-through window. Requirements for these SPDs are given in clause 7.1.2.

6.2.3 Feeder tray

The feeder cables are supported by a metallic structure, here designated as a feeder tray. The feeder tray shall be kept continuous in its trajectory along the tower and it shall be bonded to the tower by its supporting hardware (i.e., screws, clamps or welding). In the upper side of the tower, the feeders shall leave the feeder tray as close as possible to the antennas.

The feeder tray shall be continuous when it leaves the tower towards the building, preferably using a curved section as shown in Figure 3. In the trajectory between the building and the tower, the feeder tray shall be continuous and bonded to the tower and to the earthing bar located near the feed-through window of the building. The objective of this bonding is to provide a path to the lightning current in parallel to the feeders, which reduces significantly the current carried by the feeders. The bonding shall be made at least in the two sides of the tray, as shown in Figure 4. On the tower side, the bonding between the feeder and the tower frame is normally achieved by mounting clamps or bolts. On the building side, it is necessary to install bonding conductors between the feeder tray and the earthing bar.

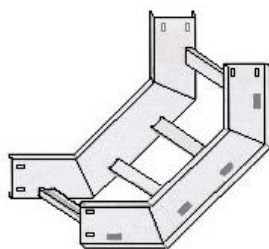


Figure 3 – Curved section used to maintain the continuity of the feeder tray

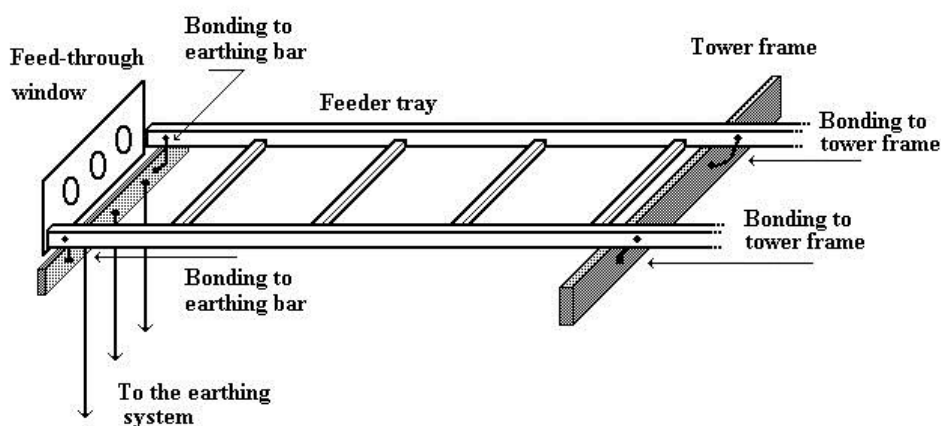


Figure 4 – Feeder tray bonded at both ends