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SERIES K: PROTECTION AGAINST INTERFERENCE

Installation of telecommunication equipment on utility poles

Recommendation ITU-T K.109

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Installation of telecommunication equipment on utility poles

Summary

Recommendation ITU-T K.109 provides guidelines for the installation of telecommunication equipment and/or antennas on utility poles. These guidelines cover the clearances from the power conductors, the requirements for insulation, earthing and bonding, and the protective procedures to avoid interference and damage from the electromagnetic fields generated by the nearby power conductors and lightning flashes. The power distribution lines considered are those operating in alternating or direct current, with nominal voltages up to 25 kV. These lines may be used for power distribution, street lighting, or electrified railways.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
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Keywords

Clearances, earthing, joint use of poles, power lines, telecommunication equipment, utility poles.

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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.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

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.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Installation of telecommunication equipment on utility poles

1 Scope

This Recommendation provides guidelines for the installation of telecommunication equipment and/or antennas on utility poles carrying power distribution lines. The power lines considered are those operating in alternating or direct current, with nominal voltages up to 25 kV. These lines may be used for power distribution, street lighting, or traction lines (electrified railways).

For the procedures regarding the joint use of poles between telecommunication lines and power lines, especially the prevention of accidental contacts between these lines (power-cross), the user shall refer to [b-ITU-T K.108].

For guidance on the installation of telecommunication equipment in towers of power transmission lines (above 25 kV), the user shall refer to [b-ITU-T K.57].

Some equipment used for smart-grid applications may contain telecommunication interfaces used for supervision and control of the electric power grid, which may be installed close to or on the energized power conductors. This type of equipment is outside the scope of this Recommendation.

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.45] Recommendation ITU-T K.45 (2015), *Resistibility of telecommunication equipment installed in the access and trunk networks to overvoltages and overcurrents*.

[ITU-T K.50] Recommendation ITU-T K.50 (2000), *Safe limits of operating voltages and currents for telecommunication systems powered over the network*.

[IEC 60060-1] IEC 60060-1 (2010), *High-voltage test techniques - Part 1: General definitions and test requirements*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 low-voltage: Voltage having a value below a conventionally adopted limit.

NOTE – For the distribution of AC electric power, the upper limit is generally accepted to be 1000 V. (IEC IEV 151-15-03 of [b-IEC IEV])

3.1.2 residual current device (RCD): A mechanical switching device designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions. (IEC IEV 442-05-02 of [b-IEC IEV]).

NOTE – A residual current device can be a combination of various separate elements designed to detect and evaluate the residual current and to make and break current.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AC Alternating Current

DC Direct Current

EBB Equipotential Bonding Bar

ESD Electrostatic Discharge

PEN Protective Earth and Neutral

RCD Residual Current Device

RF Radio-Frequency

SPD Surge Protective Device

V_N Nominal phase-to-phase Voltage (of the power line)

5 Conventions

None.

6 General considerations

Telecommunication operators that wish to install equipment on poles already used by power utilities are recommended, when national laws and regulations permit such an arrangement, to take the following general considerations into account:

– the economic and aesthetic advantages to be derived from installing telecommunication equipment on utility poles;
– the use of utility poles by telecommunication operators increases the likelihood of danger in comparison with that of an exclusive pole, both to staff and to the equipment. Special training of personnel working in such environments is highly desirable, especially when the nominal power line voltage is above 1 kV;
– special formal agreements are desirable between the telecommunication operator and the power utility in the case of such installation, in order to define responsibilities.

7 Resistibility requirements

Telecommunication equipment intended to be installed on utility poles shall comply with the resistibility requirements contained in [ITU-T K.45].

8 Minimum clearances

In order to reduce the likelihood of accidents due to the proximity between the telecommunication equipment and the energized power conductors, a minimum clearance shall be maintained:

– the minimum clearance between the telecommunication equipment (including its antenna) and the lighting fixture attached to the pole shall be 0.2 m;
– the minimum clearance between the telecommunication equipment (including its antenna) and a power line conductor, as a function of its nominal voltage (V_N) and insulation, is given in Table 1.

Table 1 – Minimum clearances between telecommunication equipment and power conductors

Nominal voltage (kV)		Minimum clearance (m)	
AC	DC	Insulated conductor	Bare conductor
$V_N \leq 1$[(1)]	$V_N \leq 1.5$[(1)]	0.5	1.0
$1 < V_N \leq 15$	$1.5 < V_N \leq 23$	1.0	1.5
$15 < V_N \leq 25$	$23 < V_N \leq 38$	1.5	2.0
[(1)] Low-voltage			

The minimum clearances for the installation of telecommunication equipment in low-voltage utility poles are shown in Figure 1. The upper limit shown in this figure shall be observed during the installation of the equipment, taking into account the height of its antenna.

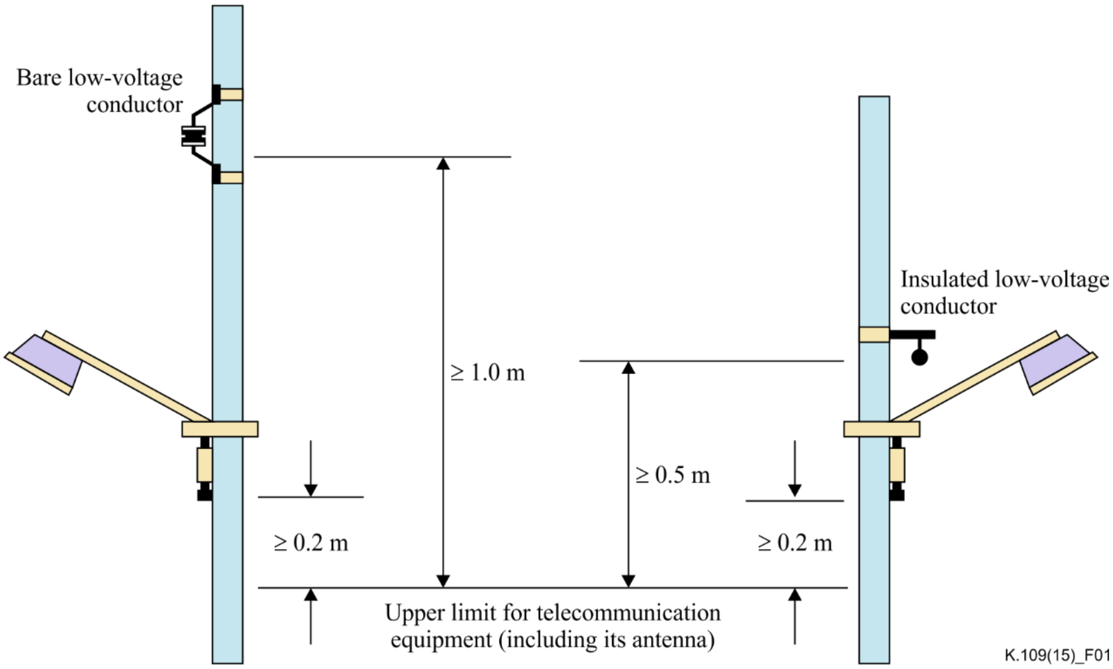

Figure 1 – Minimum clearances for telecommunication equipment in low-voltage utility poles

9 Installation of the equipment

The installation of telecommunication equipment on a utility pole depends on the type of pole considered. The utility poles can be classified as conductive or non-conductive. Conductive poles are those made of any metallic material (e.g., galvanized steel) or made of concrete with an internal steel reinforcement. Non-conductive poles are those made of wood, glass fibre, or any other composite material. Non-conductive poles carrying a bare earthing down-conductor of the power line shall be treated as a conductive pole.

If the equipment is installed on the surface of a non-conductive pole, no special treatment is required. In this case, the equipment can be attached directly to the pole using regular fittings.

If the telecommunication equipment is installed on the surface of a conductive pole, it may require additional protective procedures. This issue is currently under study.

10 Earthing and bonding

The earthing procedure applied to the telecommunication equipment may depend on the characteristics of the equipment enclosure. Any earthing procedure shall be agreed upon with the power utility and follow the applicable national rules.

If the equipment enclosure is plastic or made of other non-conducting material, the equipment does not need to be connected to an earthing system. In this case, the service personnel shall be aware of the existence of any accessible live parts inside of the equipment.

If the equipment enclosure is metallic, the following possibilities shall be considered:

– if the telecommunication operator and the power utility agree, the equipment enclosure shall be bonded to the utility's protective earth conductor (if available). This situation is illustrated in Figure 2, where the protective earth and neutral (PEN) conductor is bonded to the equipment metallic enclosure through an equipotential bonding bar (EBB);

– if the protective earth conductor is not available, the equipment shall be earthed by a dedicated down-conductor and an earthing electrode. In this case, the protection of the equipment against an internal short-circuit to the enclosure shall be provided by a residual current device (RCD), as shown in Figure 3;

– if the equipment is remotely powered through the telecommunication line according to [ITU-T K.50] or if it is self-powered by means of a low-voltage source (e.g., photovoltaic cell), then it does not need to be earthed.

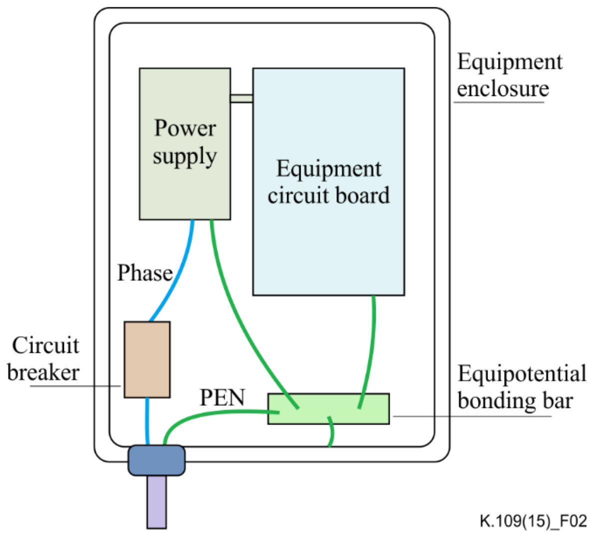

Figure 2 – Equipment earthing by the PEN conductor

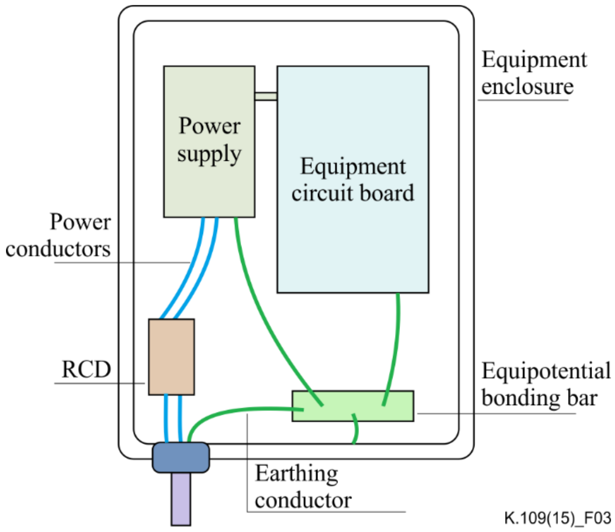

Figure 3 – Equipment earthing by a dedicated conductor

11 Protection against electromagnetic fields

When telecommunication equipment is installed on a utility pole, it is exposed to the electromagnetic fields generated by the power conductors. Damage to the equipment can be caused by the electric field generated by a power conductor, which can be installed on the same pole or on a nearby line. Field experience shows that the power-frequency electric fields from a nearby power conductor can damage the input radio-frequency (RF) circuit of certain types of radio transceivers.

This is usually the case of radio transceivers whose RF circuit is coupled to the antenna through a series capacitor. For the low-frequency inducing field, the stray capacitance between the power conductor and the antenna forms a capacitive voltage divider, resulting in a substantial voltage applied to the input capacitor. Depending on the capacitor characteristics, the voltage of the power conductor and the relative position between the antenna and the power conductor, the input capacitor may be damaged and put the transceiver out of service.

Even if there is no power line nearby, this type of transceiver can be damaged due to lightning flashes. The coupling process is similar to the one described before, but in this case the inducing electric field is generated by the lightning flash. Details about this mechanism and some protective measures can be found in [b-Barbosa].

In order to avoid this kind of damage, it is recommended that the radio transceiver used in utility poles has a shunt inductor between the RF circuit and the antenna. This inductor presents a short-circuit to the power-frequency and lightning electromagnetic fields, while presenting an open-circuit to the RF signal. There are several commercial transceivers that use this type of filter and this is a key aspect for providing reliable operation when attached to a utility pole. The shunt inductor also provides protection against electrostatic discharges (ESDs) and this is often the main reason for its installation. The RF circuits protected by shunt inductors are often referred as "DC earthed" or "DC grounded". Figure 4 shows a diagram with an RF circuit protected by a shunt inductor.

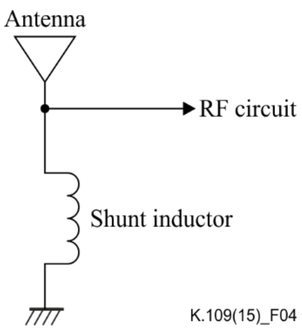

Figure 4 – RF circuit protected by a shunt inductor ("DC grounded")

The shunt inductor behaves as a high-pass filter, blocking the power-frequency energy as well as the energy from surges induced either by lightning flashes or by power line switching. The protective effect of this filter is described in detail in [b-ITU-T K.96], alongside with other types of filters. Figure 5, adapted from [b-ITU-T K.96], illustrates the action of the high-pass filter in protecting the frequency spectrum used by the RF signal from the potentially destructive energy coupled to the radio antenna by the power line and lightning flashes.

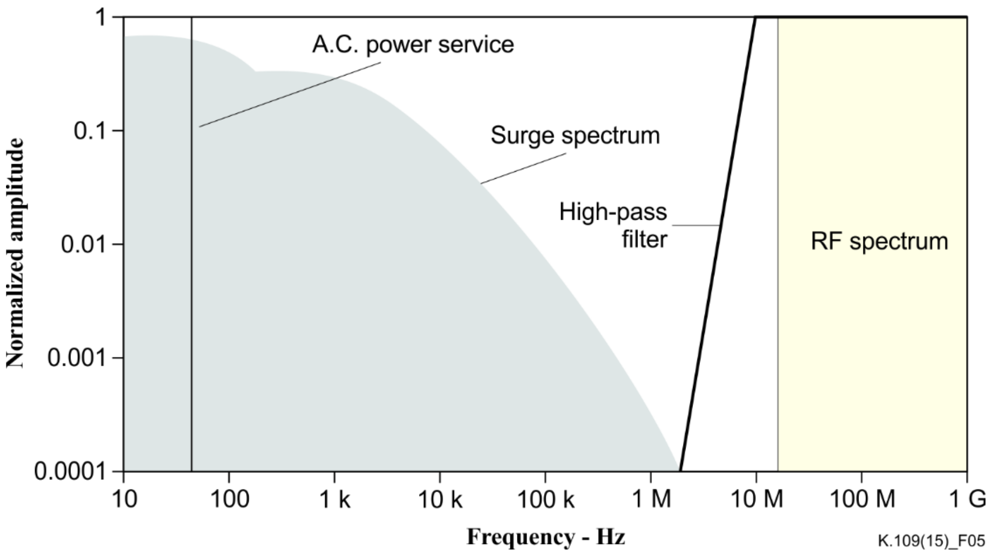

Figure 5 – Protective effect of the shunt inductor as a high-pass filter

Bibliography

[b-ITU-T K.57] Recommendation ITU-T K.57 (2003), *Protection measures for radio base stations sited on power line towers*.

[b-ITU-T K.96] Recommendation ITU-T K.96 (2014), *Surge protective components: Overview of surge mitigation functions and technologies*.

[b-ITU-T K.108] Recommendation ITU-T K.108 (2015), *Joint use of poles by telecommunication and solidly earthed power lines.*

[b-Barbosa] C.F. Barbosa and F.E. Nallin (2015), *Lightning protection of a smart grid sensor,* Electric Power Systems Research, Vol. 118, Jan; pp. 83-88.

[b-IEC IEV] IEC 60050, *International Electrotechnical Vocabulary (IEV)*.

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