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SERIES K: PROTECTION AGAINST INTERFERENCE

Maintenance of protective measures

ITU-T Recommendation K.69

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Maintenance of protective measures

Summary

This Recommendation gives guidance on the maintenance of protective measures (protective devices and assemblies and their earthing) in telecommunication installations. It deals with the maintenance of the protection of telecommunication equipment, installations and cable plants exposed to the results of external sources of interference such as overvoltages and overcurrents due to lightning discharges or power induction.

The maintenance activity is achieved with visual and complete inspections during periodical controls defined by this Recommendation. The complete inspection includes the visual inspection and additional measurements or investigations.

The purpose of the maintenance activity is to control the effectiveness of the protective measures against overvoltages and overcurrents – to avoid or reduce hazard to people, damage to installations and disturbances to systems – taking into account the corrosion effects. The effectiveness of the protective measures against corrosion is also considered.

Source

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Keywords

Examining period, inspection, maintenance, protective measures.

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Maintenance of protective measures

1 Scope

Telecommunication networks can be endangered by atmospheric discharge, power induction, power line crossover and corrosion. The application of protective measures becomes necessary to:

- reduce the risk of injury for the user and the personnel;
- optimize the reliability of the network controlling:
  - the risk of damages of the telecommunications network;
  - the loss of function or the reduced performances of the telecommunications service.

This Recommendation gives an overview of the maintenance of these protective measures.

Maintenance of the protection measures and precautions against electrostatic phenomena are not subject of this Recommendation because they are set in general. Appendix III gives an overview how electrostatic protected areas or telecommunications systems have to be labelled.

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.5] ITU-T Recommendation K.5 (1988), *Joint use of poles for electricity distribution and for telecommunications*.

[ITU-T K.6] ITU-T Recommendation K.6 (1988), *Precautions at crossings*.

[ITU-T K.12] ITU-T Recommendation K.12 (2006), *Characteristics of gas discharge tubes for the protection of telecommunications installations*.

[ITU-T K.27] ITU-T Recommendation K.27 (1996), *Bonding configurations and earthing inside a telecommunication building*.

[ITU-T K.31] ITU-T Recommendation K.31 (1993), *Bonding configurations and earthing of telecommunication installations inside a subscriber's building*.

[ITU-T K.33] ITU-T Recommendation K.33 (1996), *Limits for people safety related to coupling into telecommunications systems from a.c. electric power and a.c. electrified railway installations in fault conditions*.

[ITU-T K.35] ITU-T Recommendation K.35 (1996), *Bonding configurations and earthing at remote electronic sites*.

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

[ITU-T K.53] ITU-T Recommendation K.53 (2000), *Values of induced voltages on telecommunication installations to establish telecom and a.c. power and railway operators responsibilities*.

[ITU-T K.66] ITU-T Recommendation K.66 (2004), *Protection of customer premises from overvoltages*.

[ITU-T K.68] ITU-T Recommendation K.68 (2006), *Management of electromagnetic interference on telecommunication systems due to power systems*.

[ITU-T Earthing] ITU-T Handbook (2003), *Earthing and Bonding*.

[ITU-T Directives VII] ITU-T Directives, volume VII (1989), *Protective measures and safety precautions*.

[IEC 62305-1] IEC 62305-1 (2006), *Protection against lightning – Part 1: General principles*.

[IEC 62305-3] IEC 62305-3 (2006), *Protection against lightning – Part 3: Physical damage to structures and life hazard*.

[IEC 62305-4] IEC 62305-4 (2006), *Protection against lightning – Part 4: Electrical and electronic systems within structures*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 maintenance: Combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function.

3.2.2 visual inspection: Action comprising careful scrutiny of an item carried out either without dismantling, or with the addition of partial dismantling as required.

3.2.3 complete inspection: Visual inspection, supplemented by means such as measurement, in order to arrive at a reliable conclusion as to the condition of an item.

3.2.4 repair: That part of a corrective maintenance in which manual actions are performed on the item to re-establish a required function.

3.2.5 examining period: Time period in years between the implementation of a protective measure and its first inspection or time period between two inspections.

3.2.6 active reduction system (ARS): An active reduction system uses a transformer to compensate for induced voltages in the telecommunication cable system. It operates on the basis that, via a transformer, a voltage with a phase shift by 180° but of the same amplitude, is coupled into the telecommunication cable to be protected. It consists of a coupling element (iron core with a primary winding, a control winding connected to a pilot conductor, a corresponding number of secondary windings) and an amplifier with a power supply.

3.2.7 passive reduction system (PRS): A passive reduction system uses a step-down transformer to compensate for induced voltages in the telecommunication cable system. It consists of an iron core with a primary winding (the grounded cable sheath or a pilot conductor) and a corresponding number of secondary windings. In general, the secondary windings are shielded telecommunication cables.

3.2.8 pilot conductor: Grounded wire, grounded on both sides of the influenced path to generate the steering voltage for the control winding of the ARS or PRS.

4 Abbreviations and acronyms

This Recommendations uses the following abbreviations and acronyms:

ARS Active Reduction System

EBB Equipotential Bonding Bar

EBP Earth Bonding Point

EPA Electrostatic Protected Area

ESD Electrostatic Discharge

GDT Gas Discharge Tube

LPS Lightning Protection System

MDF Main Distribution Frame

MET Main Earthing Terminal

NT Network Termination

PRS Passive Reduction System

RCD Residual Current Device

SPD Surge Protective Device

5 Maintenance of protective measures

5.1 General

5.1.1 General requirements

Protective measures of the telecommunication and signalling networks and/or of telecommunication structures (e.g., exchange building and remote sites) are the result of the protection need evaluation before construction or in the event of changes of plant, and they are integral part of a protected system.

All protective measures have to be documented to prove that they correspond to the obligation to exercise due care. Protective measures have to be inspected to ensure that they can perform a required function. All measuring results have to be documented and, together with the inspection protocols, are to be kept for as long as the protective measure exists. They have to be compared with the results of previous inspections (see Note 2). This proves if the results differ fundamentally from earlier values, then the reasons for the deviation need to be determined and solved.

NOTE 1 – The network operator might decide to have local identification at the plant, such as the marking of equipment and protective devices. An example of the marking of influencing systems in topographical maps and the local marking of influenced systems is given in Appendix III.

Subsequent protective measures or the inspection of the existing ones might become necessary in the following cases:

- repeated appearance of damage caused by electrical sources;
- later erection of exposed structures;
- later erection or changes to electric power plants/traction systems;
- change of the operating currents in existing power plants/traction systems;
- upon customer or authority request.

The maintenance of the interconnection of cable screens and the earthing of the screen at both ends including equipotentialization of the system is seen as the most effective protective measure of a telecommunication system and is assumed for all protective measures described below.

NOTE 2 – It has to be taken into account that measuring results may be influenced by the ambient conditions.

5.1.2 Maintenance responsibilities

The operator of the telecommunication network is responsible for the protection of his plant within the network.

The building owner is responsible for the overall safety of the installation within the building, providing a bonding terminal, EBB or access to the MET, to enable the earthing of the protective measures.

The customer is responsible for the protection of his (private) network in his property.

All parties are responsible for the effectiveness and documentation of the protective measures in their premises.

5.1.3 Safety precautions

The operating of the telecommunication network, including its earthing systems and protection measures, requires consistent compliance with the safety standards (accident prevention regulations).

5.2 Maintenance of earthing systems

The bonding configurations and earthing of telecommunication installations inside buildings is described in [ITU-T K.27], [ITU-T K.35] and [ITU-T K.31] for exchange buildings, remote sites and customers' buildings respectively.

Earthing plants have to be inspected in the course of the maintenance of the telecommunication plant. The examination covers control by inspection in accordance with the technical documents where the correct execution and the connection to the EBB or MET is described. Defects have to be corrected immediately.

5.2.1 Visual inspection

The following subjects are identified to be inspected:

- connections to the MET or EBB are available and intact for potential compensation;
- no loose connections or interruptions exist (as far as visible);
- no considerably corrosion-weakened system, or part of it (see Note);
- all lines and system components are duly fastened and parts which have a mechanical protection function are working.

NOTE – The extent of corrosion effects in the area of the earthing plant can only be checked by test digs (exposure of the earthing rod).

5.2.2 Complete inspection

The following subjects are identified to be checked by measuring:

- impedance of all earth connections and interconnections to the EBB or MET or shields (reference value < 1 Ohm);
- interconnection of the metal installations (cable screen, shield wires);

- the resistance of the earthing system;
- the earthing resistance of each single earthing rod should be investigated when there is a significant increment of the resistance value of the earthing system (e.g., for corrosion problem, see Note in clause 5.2.1).

5.2.3 Examining periods

Earthing plants as a part of protective measures have to be examined in the course of the maintenance work on these protective measures (see Table 1). For earthing systems with corrosion protection, see clause 5.7.

Table 1 – Inspection requirements for earthing systems

Item to be inspected	Visual inspection	Complete inspection
Connections to EBB, MET, shield wires, earthing rods etc., interconnections, mechanical status, corrosion status.	In general to be done during the maintenance of the telecommunication plant or the specific protective measure.	See clauses 5.3 to 5.7.

5.3 Maintenance of lightning protection measures for structures

The decision to protect a structure against lightning with an LPS, as well as the selection of the protection measures, shall be performed according to [IEC 62305-2].

The considered protection measures for structures include the structure itself and the installations inside the structure.

The objective of the maintenance is to ascertain that:

- the LPS conforms to the design based on the [IEC 62305-3] standard;
- there is no visible corrosion;
- any subsequent added services or constructions are incorporated into the LPS.

Inspections should be made as follows:

- during the construction of the structure, in order to check the natural components of the LPS (e.g., embedded electrodes), if any;
- after the installation of the LPS;
- after alterations or repairs, or when it is known that the structure has been struck by lightning.

The protection of structures does not include the protection of outside services connected to the structures, but it includes the protection measures on services (i.e., telecommunications and power installations) at the entrance of the structure as a result of the risk analysis for the structure; these protective measures are part of the maintenance program.

5.3.1 Visual inspection

The following subjects are identified to be checked:

- deterioration and corrosion of air-termination elements and down conductors;
- condition of joints, equipotential bonding and fixings.

5.3.2 Complete inspection

The complete inspection includes the visual inspection.

In addition, following measurements have to be carried out:

- resistance value for the earth-termination system;
- impedance of all earth connections and interconnections to the EBB, MET or shields;
- interconnection of the metal installations (cable screen, shield wires);
- functional performance of SPDs.

An example of SPD-testing equipment is shown in Appendix II.

5.3.3 Examining periods

The protective measures should be inspected periodically according to Table 2 as a function of the lightning protection level (LPL) associated to the class of LPS. For more information on maintenance and inspection of an LPS see clause E.7 of [IEC 62305-3].

Table 2 – Maximum period between inspections of lightning protection measures for structures

Lightning protection level	Visual inspection (years)	Complete inspection (years)
I and II	1	2
III and IV	2	4

5.4 Maintenance of lightning protective measures for telecommunication systems

Lightning protective measures for telecommunication systems can be:

- shielded cables;
- steel tubes;
- lightning protective cables;
- lightning protective cable ducts;
- shield wire(s);
- surge protective devices (SPDs).

These measures include the earthing systems and the continuity of the shields.

5.4.1 Visual inspection

The visual inspection includes the inspection of the earthing system (see clause 5.2).

In addition, the following inspections have to be carried out at accessible parts of the network:

- visible damage or indications of irreversible functions of SPDs;
- indications that the RCDs and SPDs are in working order;
- new installations added after the last inspection that might increase the risk (e.g., masts or antennas in the neighbourhood of the telecommunication system or supplied structures).

5.4.2 Complete inspection

The complete inspection includes the visual inspection.

In addition, the following inspections have to be carried out:

- functional performance of SPDs;
- for monitored SPDs (remote signalling), the functionality of the supervisory apparatus (e.g., remote control) has to be checked.

The function test of SPDs could be carried out as a field test, substituting the out of range SPDs, or by periodic replacement. An example for SPD-testing equipment is shown in Appendix II.

5.4.3 Examining periods

The protective measures should be inspected periodically according to Table 3.

Table 3 – Maximum period between inspections of lightning protective measures for telecommunication systems

Item to be inspected	Visual inspection (years)	Complete inspection (years)
Protective measures	3	6 (Note)
NOTE – Information on some network operators' experiences for reasonable examining periods for GDTs and on tests for field survey is given in Appendix I. The test of function of SPDs and the examining period could be subject to manufacturers' requests.		

5.5 Maintenance of power induction protection measures

The need of protective measures against electromagnetic interference produced by electric power systems and electrified traction systems on telecommunication systems is based on evaluation according to [ITU-T K.68] and [ITU-T Directives VII].

5.5.1 Visual inspection

The visual inspection includes the inspection of the earthing system (see clause 5.2).

In addition, the following inspections have to be carried out at accessible parts of the network:

- indication that the protective measures are in working order (i.e., ARS, PRS, isolating transformer, etc.);
- connections of the pilot conductor;
- connections of the compensation conductor;
- correct labelling of the influenced system, if any;
- up-to-date documentation of the interference situation; in particular, the construction and currents of the influencing electric power systems or electrified traction.

5.5.2 Complete inspection

The complete inspection includes the visual inspection.

In addition, the following inspections have to be carried out:

- functional performance of the protective measures;
- for monitored protective measures (remote signalling) the functionality of the supervisory apparatus (e.g., remote control) has to be checked;
- functional performance of SPDs.

NOTE – Measuring of the induced voltages could be included in the complete inspection programme. In this case, the measured voltages should be carefully extrapolated to the values under the worst induction conditions.

5.5.3 Examining periods

The protective measures should be inspected periodically according to Table 4.

Table 4 – Maximum period between inspections of power induction protection measures

Item to be inspected	Visual inspection (years)	Complete inspection (years)
ARS, PRS	1	3
Other protective measure (see [ITU-T Directives VII])	None	10
Induction protective cable compensation conductor	1	3
SPD	None	6

5.6 Maintenance of power line crossover protection measures

Due to the fact that, depending on network operator requirements or national regulations, different arrangements are in use, only general maintenance recommendations are appropriate.

Generally, the power line crossover protection of buried cables, e.g., the status of the insulating covering (plastic tubes or sheaths) cannot be inspected.

When joint construction methods are used, personnel with specific skills might be mandated by safety standards or by local accident prevention regulations.

5.6.1 Visual inspection

The objective of the inspections is to ascertain:

- compliance with the minimum vertical distance between the overhead telecommunication line and the power line;
- the status of common supports at the crossing-point;
- the status of the insulation or the reinforcement of the telecommunication line at the crossing point.

5.6.2 Complete inspection

The complete inspection includes the visual inspection.

In addition, the following inspections have to be carried out:

- status of the request for the crossing power line from the power-line operator;
- status of the formal agreements between the telecommunication network operator and the power-line operator, in the case of joint use of poles, in order to define responsibilities.

5.6.3 Examining periods

The protective measures should be inspected periodically according to Table 5.

Table 5 – Maximum period between inspections of power line crossover protection measures

Item to be inspected	Visual inspection (years)	Complete inspection (years)
See clauses 5.6.1 and 5.6.2	In general, to be done during the maintenance of the telecommunication line.	6

5.7 Maintenance of corrosion protection measures

This clause describes the maintenance of corrosion protection measures on outside telecommunication plant. However, it can also be used for the maintenance of structures such as tank plants. Special regulations for these areas might need to be taken into account and are not the subject of this clause.

All corrosion reactions in electrical circuits are potential-dependent. The rapidity of corrosion is a function of the anodic partial current, the so-called corrosion current density, related to the corrosion area. As direct measuring of this parameter is impossible, the range of potential values has to be measured in order to allow conclusions on the extent of endangering corrosion and on the effectiveness of the protection measures.

5.7.1 Visual inspection

The visual inspection of the bonding configurations and earthing has to be done during the general maintenance of the telecommunication plant (see clause 5.2).

5.7.2 Complete inspection

Any earthing systems relying on chemical methods should be checked at regular intervals, at least annually, by measuring. A complete inspection of the corrosion protection measure needs personnel with specific skills.

The extent of the inspection depends on the accepted risk of losing the required function of the:

– passive corrosion protection measures (e.g., insulation, spark gaps);
– active corrosion protection measures (e.g., galvanic anodes).

The following parameters have been identified to be evaluated by measuring:

– potentials, currents and voltages (see Note);
– the soil resistivity;
– the resistance of conductors and sheaths;
– the resistance of earthing interconnections (transition resistance);
– the resistance of railway tracks and of their joints;
– the conductivity of liquids;
– the pH value;
– soil analyses.

NOTE – This includes the risk of influence to neighbourhood systems due to stray currents from corrosion protection systems of the telecommunication plant.

5.7.3 Examining periods

The protective measures should be inspected periodically according to Table 6; shorter periods might be chosen due to network operators' decisions in special cases.

Table 6 – Maximum period between inspections of corrosion protection measures

Item to be inspected	Visual inspection	Complete inspection (years)	Complete inspection (Note) (years)
Connections to EBB	None	1	2
Active cathodic protection	None	1	2
Earth potential >80 mV	None	1	2
Earth potential 50-80 mV	None	2	4
Earth potential <50 mV	None	Not regularly	4
Insulation equipment	None	1	2
Spark gaps	None	1	2
SPD	None	6	6
NOTE – These examining periods should be selected after three failure-free complete inspections.			

5.8 Maintenance of protection measures on power systems (mains)

The installation of SPDs is the usual protective measure for the powering of telecommunication systems.

The SPDs are installed between live conductors and EBBs, which are connected to the earthing system, in order to achieve equipotentialization or equipment protection and might also be used as a protective measure against corrosion.

5.8.1 Visual inspection

The visual inspection includes the earthing system (see clause 5.2).

In addition, the following inspections have to be carried out at accessible parts of the network:

- visible damage or indications of irreversible functions of SPDs;
- indication that the RCDs and SPDs are in working order.

5.8.2 Complete inspection

The complete inspection includes the visual inspection.

In addition, following inspections have to be carried out:

- functional performance of SPDs (see Note);
- for monitored SPDs (remote signalling), the functionality of the supervisory apparatus (e.g., remote control) has to be checked.

The function test of SPDs should be carried out as a field test. An example for SPD-testing equipment is shown in Appendix II.

NOTE – Personnel with specific skills might be mandated by safety standards or by local accident prevention regulations.

5.8.3 Examining periods

The protective measures should be inspected periodically according to Table 7.

Table 7 – Maximum period between inspections of protection measures on power systems

Item to be inspected	Visual inspection (years)	Complete inspection (years)
Protective measures	3	6 (Note)
NOTE – The test of function of SPDs, and the examining period, could be subject to a manufacturer's request.		

6 Documentation

The aim of documentation with respect to protective measures is:

- to establish the correct planning of the protective measures against hazardous effects, damage or disturbance;
- to ensure that the function of the protective measures complies with the requirements checked during the periodic visits;
- to collect data for statistics and evaluations.

The documentation should include detailed and overview maps, topographical maps, technical information of the influencing and influenced systems, measuring reports, calculation results and further specific information. Typical information for different protection measures is listed below:

- Electrically influenced telecommunication system
  - reference influence distance calculation (see [ITU-T K.68]);
  - type of protective measure;
  - marked-out-route;
  - type of installation;
  - type of cable;
  - technical information on the reduction systems;
  - calculation parameters and results;
  - measuring results.
- Influencing electric power systems and electrified traction systems (see Note)
  - system overview;
  - marked-out-route;
  - current diagrams.

NOTE – An example of the marking of influencing systems in topographical maps is given in Appendix III.

- Lightning protective measures for telecommunication systems
  - risk calculation for the telecommunication service;
  - risk calculation for the exchange building;
  - risk calculation for served exposed buildings under the network operator's responsibility to assess the risk of loss of service;
  - information on structures that have an impact on risk calculation (masts, trees);
  - type of protective measure;

  - type of installation;
  - type of cable;
  - technical information on the SPD;
  - measuring results.
- Corrosion protective measures and corrosion protection systems of other parties
  - type of protective measure;
  - type of installation;
  - measuring results;
- General documentation
  - formal agreements or contracts between the network operator and third parties;
  - skill certificates;
  - calibration status of the measuring equipment.

Appendix I

Network operator experiences on maintenance of GDT

(This appendix does not form an integral part of this Recommendation)

I.1 France Telecom (FT)

FT carried out 2 experiments with the main goal of defining a replacement method for two-terminal GDTs with a nominal DC spark-over voltage of 250 V. This type represents 24'000'000 pieces in FT networks. Two experiments have been carried out on GDTs installed in 1965 which represent a total of 40'000 GDTs after 40 years of use.

I.1.1 Test results of the first measuring campaign

The first measuring campaign was carried out on 5'434 GDTs from 5 French areas. A minimum insulation resistance > 1 GΩ at 100 V was required for both campaigns.

a) DC spark-over voltage limits 220 < U < 280 V;
   out of range 1'134 of 5'434 (14-26%; average for all 5 regions 22%).

b) DC spark-over voltage limits 200 < U < 300 V;
   out of range 498 of 5'434 (4-12%; average for all 5 regions 9.2%).

I.1.2 Test results of the second measuring campaign

The second measuring campaign was carried out on 33'627 GDTs from 8 French areas.

a) DC spark-over voltage limits 224 < U < 276 V (manufacturer limits);
   out of range 12'776 of 33'627 (25-52%; average for all 8 regions 38%).

I.1.3 Estimation for FT limits based on the results of both measuring campaigns

a) DC spark-over voltage limits 220 < U < 280 V;
   out of range 7'838 of 33'627 (23%).

b) DC spark-over voltage limits 200 < U < 300 V;
   out of range 2'947 of 33'627 (8.7%).

I.1.4 Conclusion

Due to the lack of reliability of the method, FT decided not to retain it and to carry out regular tests every six years.

I.2 Deutsche Telekom (DT)

DT is carrying out regular tests every six years for all accessible GDTs, except at customer premises, out-of-range GDTs are substituted.

The results below are based on tests carried out on 79'500 pieces of two-terminal GDT with a nominal DC spark-over voltage of 230 V that were collected from the field.

a) DC spark-over voltage limits 184 < U < 288 V;
   out of range 1'144 of 79'500 (1.4%).

b) Impulse spark-over voltage limits <700V;
   out of range 794 of 79'500 (1%).

c) Insulation resistance <10 GΩ at 100 V;
   out of range 2'420 of 79'500 (3%).

d) Insulation resistance <1 GΩ at 100 V;
out of range 245 of 79'500 (0.3%).

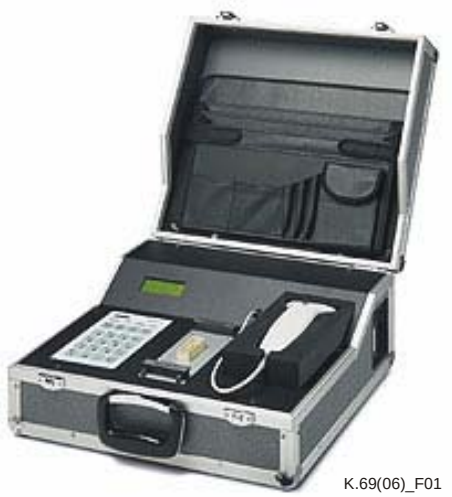
Appendix II

SPD-testing equipment

(This appendix does not form an integral part of this Recommendation)

There are portable test devices on the market to measure SPDs in the field:

- Battery-operated hand-held component test sets to measure the clamping voltage and DC breakdown voltage. They are suitable for GDTs, varistors, Zener diodes and thyristor devices as well as for complete SPDs.
- More complex automatic measurement equipment to measure the tolerance limits in detail, interruptions and short-circuits, giving visual and/or audible fault signals and software data for measurement reports. Figure II.1 below show test sets, supplied in cases, from two different manufacturers, for SPDs which are plugged in via adaptors.



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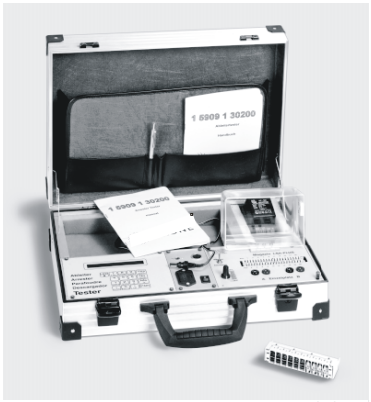

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Figure II.1 – Two examples of test equipment

Appendix III

Examples of documentation and local labelling

(This appendix does not form an integral part of this Recommendation)

III.1 Example of the marking of influencing systems in topographical maps

In a topographical map, e.g., scale, 1:25000, the influencing system is marked with colours and/or symbols.

Influencing systems	Marking
Electric power system ≥110 kV	Green
Transformer station or power plant ≥110 kV	Green (property borders)
Electrified traction system	Red
Transformer station for electrified traction system	Red (property borders)
Cathodic protected systems	Brown
Transmitting installations (radio broadcast)	Symbol  K.69(06)_F03

III.2 Example of local labelling of influenced systems

Local labelling is used to identify to staff accessible parts of the telecommunication system with a possible risk of high contact voltages due to electrical influence.

The label below is applied at switching components such as MDFs, NTs, distribution cabinets and active components of the access network.

K.69(06)_F04

III.3 Example of local labelling of corrosion protection systems

The label below is used to identify to staff active or passive corrosion protection systems, inviting them to exercise due care.

K.69(06)_F05

III.4 Examples of labelling ESD protected areas or equipment

The label below is used to identify to staff electrostatic protected areas, inviting them to exercise due care.

K.69(06)_F06

The label below is used to identify the equipment or parts of the system endangered by ESD.

K.69(06)_F07

The label below is used to identify earthing points for ESD protection of the equipment or system.

K.69(06)_F08

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* DIN German Institute for Standardization.

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