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Characteristics of gas discharge tubes for the protection of telecommunications installations

Recommendation ITU-T K.12



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Characteristics of gas discharge tubes for the protection of telecommunications installations

Summary

Recommendation ITU-T K.12 defines the basic characteristics to be met by gas discharge tubes for the protection of exchange and outdoor equipment, subscriber or customer equipment and telecommunication lines from surges. It is intended to be used for the harmonization of existing or future specifications issued by gas discharge tube manufacturers, telecommunication equipment manufacturers, administrations or network operators.

History

Edition	Recommendation	Approval	Study Group
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Keywords

Electrical characteristics and test methods, gas discharge tube (GDT).

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.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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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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Recommendation ITU-T K.12

Characteristics of gas discharge tubes for the protection of telecommunications installations

1 Scope

This Recommendation:

- a) gives the characteristics of gas discharge tubes used in accordance with [b-ITU-T K.11] and [b-ITU-T K.46] for the protection of exchange and outdoor equipment, subscriber or customer equipment and telecommunication lines against overvoltages;
- b) deals with gas discharge tubes having two or three electrodes;
- c) does not deal with mountings and their effect on tube characteristics (see [ITU-T K.65]); characteristics apply to gas discharge tubes as a component, mounted only in the ways described for the tests;
- d) does not deal with mechanical dimensions;
- e) does not deal with quality assurance requirements;
- f) does not deal with gas discharge tubes which are connected to electrical power systems.

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.65] Recommendation ITU-T K.65 (2004), *Overvoltage and overcurrent requirements for termination modules with contacts for test ports or SPDs*.
- [IEC 60060] IEC 60060-1 and IEC 60060-2 (1989/1994), *High voltage test techniques – Part 1: General definitions and test requirements and Part 2: Measuring systems*.
- [IEC 60068-2-1] IEC 60068-2-1 (2007), *Environmental testing – Part 2-1: Tests – Test A: Cold*.
- [IEC 60068-2-6] IEC 60068-2-6 (2007), *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*.
- [IEC 60068-2-17] IEC 60068-2-17 (1994), *Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*.
- [IEC 60068-2-20] IEC 60068-2-20 (2008), *Environmental testing – Part 2-20: Test – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*.
- [IEC 60068-2-21] IEC 60068-2-21 (2006), *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*.
- [IEC 60068-2-30] IEC 60068-2-30 (2005), *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*.

3 Definitions

This Recommendation defines the following terms:

3.1 arc mode: The lowest impedance or on-state of a gas discharge tube during normal operation (Figure 6).

3.2 arc voltage: The voltage measured across the tube while in lowest impedance state or arc mode (Figure 6).

3.3 breakdown: See "spark-over".

3.4 current turn-off time: The time required for the gas discharge tube to return itself to a non-conducting state following a period of conduction.

3.5 d.c. holdover voltage: The maximum d.c. voltage across the terminals of a gas discharge tube under which it may be expected to clear and to return to the high impedance state after the passage of a surge, under specified circuit conditions.

3.6 destruction characteristic: The relationship between the value of the discharge current and the time of flow until the gas discharge tube is mechanically destroyed (break, electrode short-circuit). For periods of time between 1 μ s and some ms, it is based on impulse discharge currents, and for periods of time of 0.1 s and greater, it is based on alternating discharge currents.

3.7 discharge current: The current that passes through a gas discharge tube when spark-over occurs.

- **discharge current, alternating:** The r.m.s. value of an approximately sinusoidal alternating current passing through the gas discharge tube.
- **discharge current, impulse:** The peak value of the impulse current passing through the gas discharge tube.

3.8 discharge voltage: The voltage that appears across the terminals of a gas discharge tube during the passage of discharge current.

3.9 gas discharge tube: A gap, or several gaps, in an enclosed discharge medium, other than air at atmospheric pressure, designed to protect apparatus or personnel, or both, from high transient voltages; see clause 9 for the electrical characteristics of GDT also referred to as "gas tube surge arrester".

3.10 glow mode: This is a semi on-state in the area of the V/I curve where only a limited glow-current flows and the device has not yet turned on or reached the lowest impedance arc-mode (Figure 6).

3.11 glow current: The current which flows after spark-over when circuit impedance limits the discharge current to a value less than the glow-to-arc transition current.

3.12 glow voltage: The peak value of the voltage drop across the GDT when a glow current is flowing. It is sometimes called the glow-mode voltage (Figure 6).

3.13 glow-to-arc (transition) current: The current required for the gas discharge tube to pass from the glow-mode into the arc mode.

3.14 impulse waveshape: An impulse waveform designated as x/y has a rise time of x μ s and a decay time to half value of y μ s as standardized in [IEC 60060].

3.15 nominal alternating discharge current: For currents with a frequency of 15 Hz to 62 Hz, the alternating discharge current which the gas discharge tube is designed to carry for a defined time.

3.16 nominal d.c. spark-over voltage: The voltage specified by the manufacturer to designate the gas discharge tube (type designation) and to indicate its application with respect to the service conditions of the installation to be protected. Tolerance limits of the d.c. spark-over voltage are also referred to the nominal d.c. spark-over voltage.

3.17 nominal impulse discharge current: The peak value of the impulse current with a defined wave-shape with respect to time for which the gas discharge tube is rated.

3.18 residual voltage: See "discharge voltage".

3.19 spark-over: An electrical breakdown of the discharge gap of a gas discharge tube. Also referred to as "breakdown".

3.20 spark-over voltage: The voltage which causes spark-over when applied across the terminals of a gas discharge tube (Figure 6).

- **spark-over voltage, d.c.:** The voltage at which the gas discharge tube sparks over when a slowly rising d.c. voltage up to 2 kV/s is applied.
- **spark-over voltage, impulse:** The highest voltage which appears across the terminals of a gas discharge tube in the period between the application of an impulse of given wave-shape and the time when current begins to flow.

3.21 transverse voltage: For a gas discharge tube with several gaps, the difference of the discharge voltages of the gaps assigned to the two conductors of a telecommunications circuit during the passage of discharge current.

4 Abbreviations

This Recommendation uses the following abbreviations:

GDT Gas Discharge Tube

ISDN Integrated Services Digital Network

xDSL Digital Subscriber Line

5 Storage conditions

Gas discharge tubes shall be capable of withstanding the following conditions without damage:

- Temperature: –40 to +70°C;
- Relative humidity: up to 95%.

See also clauses 8.6 and 8.8 for environmental conditions.

6 Electrical requirements

Gas discharge tubes should have the following characteristics when tested in accordance with clause 7. Clauses 6.1 to 6.5 apply to virgin gas discharge tubes and also, where quoted in clause 6.6, to tubes subjected to life tests.

NOTE – Using GDTs in circuits protecting certain systems can cause secondary effects like oscillations. This behaviour is dependent on certain circuit combinations like impedance and inductance in connection with certain GDT parameters like glow-to-arc transition current, etc.

This phenomenon has not been studied adequately at this time and will be added to future work of ITU-T.