IEC 61643-312

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Components for low-voltage surge protective devices –
Part 312: Selection and application principles for gas discharge tubes

Composants pour parafoudres basse tension –
Partie 312: Principes de choix et d'application pour les tubes à décharge de gaz

IEC 61643-312:2013

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMPONENTS FOR LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 312: Selection and application principles for gas discharge tubes

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61643-312 has been prepared by subcommittee 37B: Specific components for surge arresters and surge protective devices, of IEC technical committee 37: Surge arresters.

The text of this standard is based on the following documents:

FDIS	Report on voting
37B/114/FDIS	37B/120/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above Table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 61643 series, under the general title *Components for low-voltage surge protective devices* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The contents of the corrigendum of July 2013 have been included in this copy.

COMPONENTS FOR LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 312: Selection and application principles for gas discharge tubes

1 Scope

This part of IEC 61643 is applicable to gas discharge tubes (GDT) used for overvoltage protection in telecommunications, signalling and low-voltage power distribution networks with nominal system voltages up to 1 000 V (r.m.s.) a.c. and 1 500 V d.c. They are defined as a gap, or several gaps with two or three metal electrodes hermetically sealed so that gas mixture and pressure are under control. They are designed to protect apparatus or personnel, or both, from high transient voltages. This standard provides information about the characteristics and circuit applications of GDTs having two or three electrodes. This standard does not specify requirements applicable to complete surge protective devices, nor does it specify total requirements for GDTs employed within electronic devices, where precise coordination between GDT performance and surge protective device withstand capability is highly critical.

This part of IEC 61643

– does not deal with mountings and their effect on GDT characteristics. Characteristics given apply solely to GDTs mounted in the ways described for the tests;
– does not deal with mechanical dimensions;
– does not deal with quality assurance requirements;
– may not be sufficient for GDTs used on high-frequency (>30 MHz);
– does not deal with electrostatic voltages;
– does not deal with hybrid overvoltage protection components or composite GDT devices.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 61643-311, *Components for low-voltage surge protective devices – Part 311: Specification for gas discharge tubes (GDT)*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

3.1.1
arc current
current that flows after sparkover when the circuit impedance allows a current to flow that exceeds the glow-to-arc transition current

3.1.2
arc voltage
arc mode voltage
voltage drop across the GDT during arc current flow

Note 1 to entry: See Figure 1a, region A.

3.1.3
arc-to-glow transition current
current required for the GDT to pass from the arc mode into the glow mode

3.1.4
current turn-off time
time required for the GDT to restore itself to a non-conducting state following a period of conduction.

Note 1 to entry: This applies only to a condition where the GDT is exposed to a continuous d.c. potential (see d.c. holdover).

3.1.5
d.c. sparkover voltage
d.c. breakdown voltage
voltage at which the GDT transitions from a high-impedance off to a conduction state when a slowly rising d.c. voltage up to 2 kV/s is applied

Note 1 to entry: The rate of rise for d.c. sparkover voltage measurements is usually equal or less 2 000 V/s.

3.1.6
d.c. holdover
state in which a GDT continues to conduct after it is subjected to an impulse sufficient to cause breakdown

Note 1 to entry: In applications where a d.c. voltage exists on a line. Factors that affect the time required to recover from the conducting state (current turn-off time) include the d.c. voltage and the d.c. current

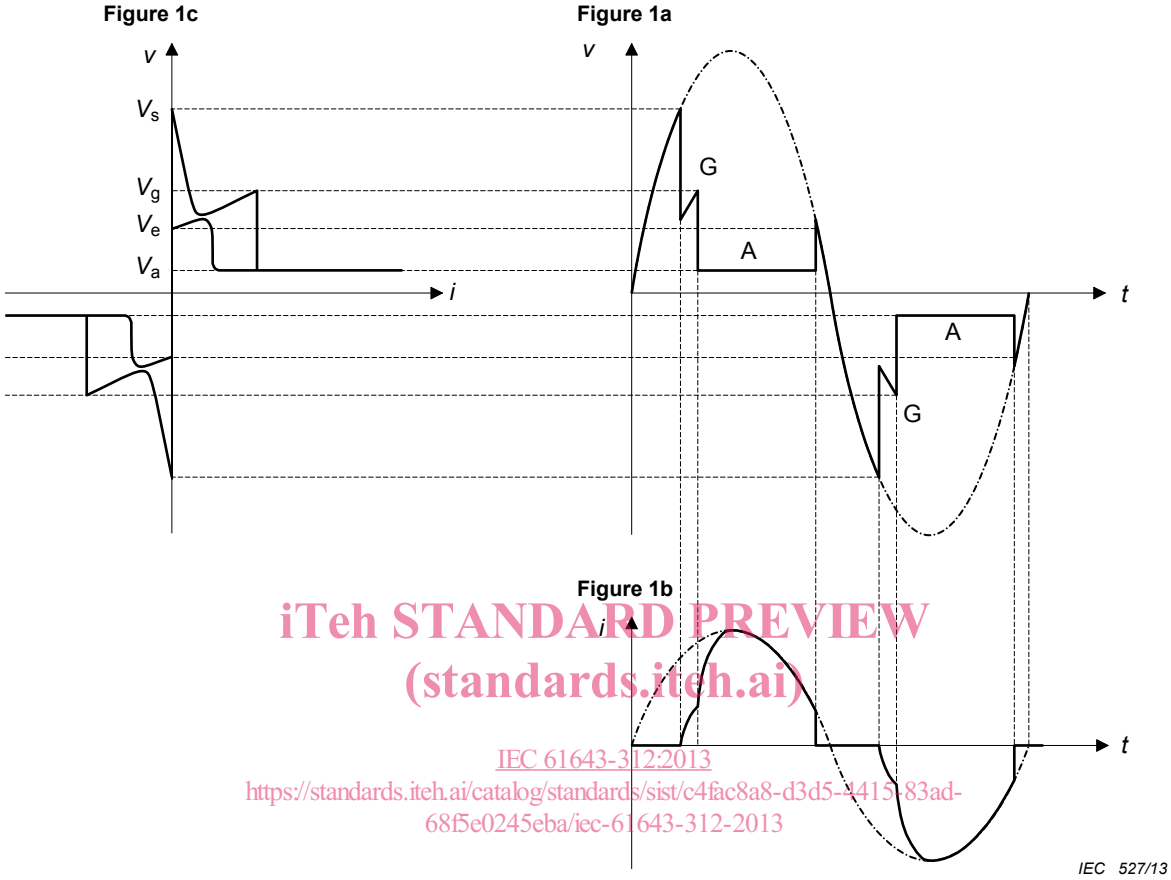
3.1.7
d.c. holdover voltage
maximum d.c. voltage across the terminals of a gas discharge tube under which it may be expected to clear and to return to the high-impedance state after the passage of a surge, under specified circuit conditions

3.1.8
discharge current
current that flows through a GDT after sparkover occurs

Note 1 to entry: In the event that the current passing through the GDT is alternating current, it will be r.m.s. value. In instances where the current passing through the GDT is an impulse current, the value will be the peak value.

3.1.9
discharge voltage
residual voltage of an arrester
peak value of voltage that appears across the terminals of a GDT during the passage of GDT discharge current

3.1.10
discharge voltage current characteristic
V/I characteristic
variation of peak values of discharge voltage with respect to GDT discharge current



Legend

V_s	spark-over voltage	V_a	arc voltage	G	glow mode range
V_{gl}	glow voltage	V_e	extinction voltage	A	arc mode range

Figure 1a – Voltage at a GDT as a function of time when limiting a sinusoidal voltage

Figure 1b – Current at a GDT as a function of time when limiting a sinusoidal voltage

Figure 1c – V/I characteristic of a GDT obtained by combining the graphs of voltage and current

Figure 1 – Voltage and current characteristics of a GDT

3.1.11
extinction voltage
voltage at which discharge (current flow) ceases

3.1.12
fail-short
failsafe
thermally-activated external shorting mechanism

3.1.13
follow (on) current
current that the GDT conducts from a connected power source after sparkover

Note 1 to entry: The GDT is expected to extinguish after sparkover to avoid overheating

3.1.14
gas discharge tube
GDT
gap, or several gaps with two or three metal electrodes hermetically sealed so that gas mixture and pressure are under control, designed to protect apparatus or personnel, or both, from high transient voltages

3.1.15
glow current
glow mode current
current that flows after breakdown when the circuit impedance limits the follow current to a value less than the glow-to-arc transition current

Note 1 to entry: See Figure 1a region G.

3.1.16
glow-to-arc transition current
current required for the GDT to pass from the glow mode into the arc mode

Note 1 to entry: See Figure 1a region G.

3.1.17
glow voltage
glow mode voltage
peak value of voltage drop across the GDT when a glow current is flowing

Note 1 to entry: See Figure 1a, region G.

3.1.18
impulse sparkover voltage
highest value of voltage attained by an impulse of a designated voltage rate-of-rise and polarity applied across the terminals of a GDT prior to the flow of the discharge current

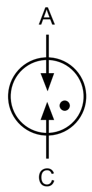
3.1.19
nominal d.c. sparkover voltage
voltage specified by the manufacturer to indicate the target value of sparkover voltages of a particular type of GDT products

Note 1 to entry: The nominal value is generally a rounded number such as: 75 V, 90 V, 150 V, 200 V, 230 V, 250 V, 300 V, 350 V, 420 V, 500 V, 600 V, 800 V, 1 000 V, 1 200 V, 1 400 V, 1 800 V, 2 100 V, 2 700 V, 3 000 V, 3 600 V, 4 000 V et 4 500 V

Note 2 to entry: Values in between should be agreed jointly between the manufacturer and the user.

3.1.20
sparkover
breakdown
abrupt transition of the gap resistance from practically infinite value to a relatively low value

3.2 Symbols



IEC 528/13

Figure 2 – Symbol for a two-electrode GDT

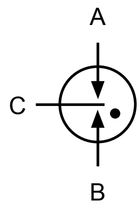


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Figure 3 – Symbol for a three-electrode GDT

Figures 2 and 3 show the symbols for two- and three-electrode GDTs.

4 Service conditions

4.1 General

The basic GDT is relatively insensitive to temperature, air pressure and humidity. GDTs fitted with a fail-short mechanism have a lower high temperature rating due to the thermal nature of the fail-short. Manufacturer's guidelines shall be followed when soldering fail-short mechanism GDTs to avoid premature operation of the shorting mechanism. For reference, standardised values and ranges of temperature, air pressure and humidity are given in Subclauses 4.2 to 4.5.

4.2 Low temperature

GDT shall be capable of withstanding IEC 60068-2-1, test Aa –40 °C, duration 2 h, without damage. While at –40 °C, the GDT shall meet the d.c. and impulse sparkover requirements of Table 1.

4.3 Air pressure and altitude

Air pressure is 80 kPa to 106 kPa.

These values represent an altitude of +2 000 m to –500 m respectively.

4.4 Ambient temperature

For the purposes of Subclause 4.4, the ambient temperature is the temperature of the air or other media, in the immediate vicinity of the component.

operating range (GDTs without failsafe): –40 °C to +90 °C

operating range (GDTs with failsafe): –40 °C to +70 °C

NOTE This corresponds to class 3K7 in IEC 60721-3-3.

storage range (GDTs without failsafe): –40 °C to +90 °C

storage range (GDTs with failsafe): –40 °C to +40 °C

4.5 Relative humidity

In this clause the relative humidity is expressed as a percentage, being the ratio of actual partial vapour pressure to the saturation vapour pressure at any given temperature, 4.4, and pressure, 4.3.

normal range: 5 % to 95 %

NOTE This corresponds to code AB4 in IEC 60364-5-51.

5 Mechanical requirements and materials

5.1 General

Clause 5 lists standardised requirements for terminations, solderability, radiation and marking. The radiation requirement is a key item to check as GDTs containing radio active elements are still manufactured.

5.2 Robustness of terminations

If applicable, the user shall specify a suitable test from IEC 60068-2-21.

5.3 Solderability

Solder terminations shall meet the requirements of IEC 60068-2-20, test Ta, method 1.

5.4 Radiation

Gas discharge tubes shall not contain radioactive material.

5.5 Marking

Legible and permanent marking shall be applied to the GDT as necessary to ensure that the user can determine the following information by inspection:

Each GDT shall be marked with the following information

– nominal d.c. sparkover voltage
– date of manufacture or batch number
– manufacturer name or trademark
– part number
– safety approval markings

NOTE 1 The necessary information can also be coded.

When the space is not sufficient for printing this data, it should be provided in the technical documentation after agreement between the manufacturer and the purchaser.

6 General

Due to the high complexity of the gas discharge physics on which the functioning of the GDTs is based, the performance of the GDTs depends very much on the technical expertise of the manufacturer. Thus the electrical properties and characteristics (tolerances, ignition values, etc.) are varying.