

INTERNATIONAL STANDARD

IEC 60099-4

Edition 1.2
2001-12

Edition 1:1991 consolidated with amendments 1:1998 and 2:2001

Surge arresters –

Part 4: Metal-oxide surge arresters without gaps for a.c. systems

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



Reference number
IEC 60099-4:1991+A1:1998+A2:2001(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

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IEC 60099-4:1991

<https://standards.iteh.ai/catalog/standards/iec/279675b3-0c23-4f46-a328-aeb0817852a1/iec-60099-4-1991>

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SURGE ARRESTERS –

Part 4: Metal-oxide surge arresters without gaps for a.c. systems

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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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This International Standard has been prepared by IEC technical committee 37: Surge arresters.

This consolidated version of IEC 60099-4 is based on the first edition (1991) [documents 37(CO)38 and 37(CO)45], its amendment 1 (1998) [documents 37/192/FDIS and 37/198/RVD] and its amendment 2 (2001) [documents 37/268/FDIS and 37/270/RVD].

It bears the edition number 1.2.

A vertical line in the margin shows where the base publication has been modified by amendments 1 and 2.

Annexes A, B, C, D, F and N form an integral part of this standard.

Annexes E, G, H, J, K, L, M and O are for information only.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until 2003. At this date, the publication will be

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- withdrawn;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

INTRODUCTION

This International Standard presents the minimum criteria for the requirements and testing of gapless metal-oxide surge arresters that are applied to a.c. power systems.

Arresters covered by this standard are commonly applied to live/front overhead installations in place of the non-linear resistor type gapped arresters covered in IEC 60099-1. Protection of low-voltage circuits, below 3 kV, is under consideration.

An accelerated ageing procedure is incorporated in the standard to simulate the long-term effects of voltage and temperature on the metal-oxide arrester. This is necessary since the arrester's resistor elements will have system power frequency voltage continuously applied across them during the arrester's time in service.

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SURGE ARRESTERS –

Part 4: Metal-oxide surge arresters without gaps for a.c. systems

SECTION 1: GENERAL

1.1 Scope

This International Standard applies to non-linear metal-oxide resistor type surge arresters without spark gaps designed to limit voltage surges on a.c. power circuits.

1.2 Normative references

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

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-2-11:1981, *Environmental testing – Part 2: Tests. Test Ka: Salt mist*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests. Test N: Change of temperature*

IEC 60068-2-17:1994, *Basic environmental testing procedures – Part 2: Tests – Test Q: Sealing*

IEC 60068-2-42:1982, *Environmental testing – Part 2: Tests. Test Kc: Sulphur dioxide test for contacts and connections*

IEC 60071: *Insulation co-ordination*

IEC 60071-2:1976, *Insulation co-ordination – Part 2: Application guide*

IEC 60071-2:1996, *Insulation co-ordination – Part 2: Application guide*

IEC 60099-1:1991, *Surge arresters – Part 1: Non-linear resistor type gapped arresters for a.c. systems*

IEC 60099-3:1990, *Surge arresters – Part 3: Artificial pollution testing of surge arresters*

IEC 60270:1981, *Partial discharge measurements*

IEC 60298:1990, *A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV to and up to and including 52 kV*

IEC 60507:1991, *Artificial pollution tests on high-voltage insulators to be used in a.c. systems*

IEC 60517:1990, *Gas-insulated metal-enclosed switchgear for rated voltages of 72,5 kV and above*

IEC 60694:1996, *Common specifications for high-voltage switchgear and controlgear standards*

IEC 60721-3-2:1997, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 2: Transportation*

IEC 60815:1986, *Guide for the selection of insulators in respect of polluted conditions*

IEC 61109:1992, *Composite insulators for a.c. overhead lines with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria*

IEC 61166:1993, *High-voltage alternating current circuit-breakers – Guide for seismic qualification of high-voltage alternating current circuit-breakers*

IEC 61330:1995, *High-voltage/low voltage prefabricated substations*

IEEE C62.11:1999, *Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits*

SECTION 2: DEFINITIONS

For the purpose of this International Standard, the following definitions apply.

2.1

metal-oxide surge arrester without gaps

an arrester having non-linear metal-oxide resistors connected in series and/or in parallel without any integrated series or parallel spark gaps

2.2

non-linear metal-oxide resistor

the part of the surge arrester which by its non-linear voltage versus current characteristics acts as a low resistance to overvoltages, thus limiting the voltage across the arrester terminals, and as a high resistance at normal power frequency voltage

2.3

internal grading system of an arrester

grading impedances, in particular grading capacitors connected in parallel to one single or to a group of non-linear metal-oxide resistors, to control the voltage distribution along the metal-oxide resistor stack

2.4

grading ring of an arrester

a metal part, usually circular in shape, mounted to modify electrostatically the voltage distribution along the arrester

2.5

section of an arrester

a complete, suitably assembled part of an arrester necessary to represent the behaviour of a complete arrester with respect to a particular test. A section of an arrester is not necessarily a unit of an arrester

2.6**unit of an arrester**

a completely housed part of an arrester which may be connected in series and/or in parallel with other units to construct an arrester of higher voltage and/or current rating. A unit of an arrester is not necessarily a section of an arrester

2.7**pressure relief device of an arrester**

means for relieving internal pressure in an arrester and preventing violent shattering of the housing following prolonged passage of fault current or internal flashover of the arrester

2.8**rated voltage of an arrester (U_r)**

the maximum permissible r.m.s. value of power frequency voltage between its terminals at which it is designed to operate correctly under temporary overvoltage conditions as established in the operating duty tests, see 7.5. The rated voltage is used as a reference parameter for the specification of operating characteristics

NOTE The rated voltage as defined in this document is the 10 s power frequency voltage used in the operating duty test after high current or long duration impulses. Tests used to establish the voltage rating in IEC 60099-1, as well as some National Standards, involve the application of repetitive impulses at nominal current with power frequency voltage applied. Attention is drawn to the fact that these two methods used to establish rating do not necessarily produce equivalent values. (A resolution to this discrepancy is under consideration.)

2.9**continuous operating voltage of an arrester (U_c)**

the continuous operating voltage is the designated permissible r.m.s. value of power frequency voltage that may be applied continuously between the arrester terminals in accordance with 7.5

2.10**rated frequency of an arrester**

the frequency of the power system on which the arrester is designed to be used

2.11**disruptive discharge**

the phenomena associated with the failure of insulation under electric stress, which include a collapse of voltage and the passage of current. The term applies to electrical breakdowns in solid, liquid and gaseous dielectric, and combinations of these

NOTE A disruptive discharge in a solid dielectric produces permanent loss of electric strength. In a liquid or gaseous dielectric the loss may be only temporary.

2.12**puncture (breakdown)**

a disruptive discharge through a solid.

2.13**flashover**

a disruptive discharge over a solid surface

2.14**impulse**

a unidirectional wave of voltage or current which without appreciable oscillations rises rapidly to a maximum value and falls – usually less rapidly – to zero with small, if any, excursions of opposite polarity

The parameters which define a voltage or current impulse are polarity, peak value, front time and time to half value on the tail.

2.15**designation of an impulse shape**

a combination of two numbers, the first representing the virtual front time (T_1) and the second the virtual time to half value on the tail (T_2). It is written as T_1/T_2 , both in microseconds, the sign "/" having no mathematical meaning

2.16**steep current impulse**

a current impulse with a virtual front time of 1 μs with limits in the adjustment of equipment such that the measured values are from 0,9 μs to 1,1 μs . The virtual time to half value on the tail shall be not longer than 20 μs

NOTE The time to half value on the tail is not critical and may have any tolerance during the residual voltage type tests, see 7.3.

2.17**lightning current impulse**

an 8/20 current impulse with limits on the adjustment of equipment such that the measured values are from 7 μs to 9 μs for the virtual front time and from 18 μs to 22 μs for the time to half value on the tail

NOTE The time to half value on the tail is not critical and may have any tolerance during the residual voltage type tests, see 7.3.

2.18**long duration current impulse**

a rectangular impulse which rises rapidly to maximum value, remains substantially constant for a specified period and then falls rapidly to zero. The parameters which define a rectangular impulse are polarity, peak value, virtual duration of the peak and virtual total duration

2.19**peak (crest) value of an impulse**

the maximum value of a voltage or current impulse. Superimposed oscillations may be disregarded, see 7.4.2c and 7.5.4.2e

2.20**front of an impulse**

the part of an impulse which occurs prior to the peak

2.21**tail of an impulse**

the part of an impulse which occurs after the peak