PUBLICLY AVAILABLE SPECIFICATION

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2004-04

Surge arresters –

Part 7: Glossary of terms and definitions from IEC publications 60099-1, 60099-4, 60099-6, 61643-1, 61643-12, 61643-21, 61643-311, 61643-321, 61643-331 and 61643-341

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CONTENTS

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IEC-PAS 60099-7 has been processed by IEC technical committee 37: Surge arresters.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
37/291/NP	37/296/RVN

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SURGE ARRESTERS –
Part 7: Glossary of terms and definitions from IEC publications 60099-1, 60099-4, 60099-6, 61643-1, 61643-12, 61643-21, 61643-311, 61643-321, 61643-331 and 61643-341

1 Scope

This PAS compiles a list of terms and definitions relative to IEC publications from IEC technical committee 37: Surge arresters, and subcommittees 37A: Surge protective devices, and 37B: Surge protective components, current at the date of this publication.

2 Surge arresters – Non-linear resistor type gapped surge arresters for a.c. systems (IEC 60099-1:1991+A1:1999)

2.1
surge arrester*
device designed to protect electrical apparatus from high transient voltage and to limit the duration and frequently the amplitude of follow-current. The term "surge arrester" includes any external series gap which is essential for the proper functioning of the device as installed for service, regardless of whether or not it is supplied as an integral part of the device

NOTE Surge arresters are usually connected between the electrical conductors of a network and earth although they may sometimes be connected across the windings of apparatus or between electrical conductors.

2.2
non-linear resistor type gapped arrester:
arrester having a single or a multiple spark-gap connected in series with one or more non-linear resistors

2.3
series gap of an arrester:
intentional gap or gaps between spaced electrodes in series with the non-linear series resistor or resistors of the arrester

2.4
non-linear series resistor of an arrester
part of the surge arrester which, by its non-linear voltage-current characteristics, acts as a low resistance to the flow of high discharge currents thus limiting the voltage across the arrester terminals, and as a high resistance at normal power-frequency voltage thus limiting the magnitude of follow-current

2.5
section of an arrester
complete, suitably housed part of an arrester including series gaps and non-linear series resistors in such a proportion as is necessary to represent the behaviour of a complete arrester with respect to a particular test

2.6
unit of an arrester
completely housed part of an arrester which may be connected in series with other units to construct an arrester of higher voltage rating. A unit of an arrester is not necessarily a section of an arrester

———————
* This type of equipment may be called "surge diverter" in some countries.

2.7
pressure-relief device of an arrester
means for relieving internal pressure in an arrester and preventing explosive shattering of the housing following prolonged passage of follow-current or internal flashover of the arrester

2.8
rated voltage of an arrester
designated maximum permissible r.m.s. value of power-frequency voltage between its terminals at which it is designated to operate correctly. This voltage may be applied to the arrester continuously without changing its operating characteristics

2.9
rated frequency of an arrester
frequency of the power system on which the arrester is designed to be used

2.10
disruptive discharge
phenomena associated with the failure of insulation under electrical stress which include a collapse of voltage and the passage of current; the term applies to electrical breakdown in solid, liquid and gaseous dielectrics and combinations of these

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

2.11
puncture
disruptive discharge through a solid

2.12
flashover
disruptive discharge over a solid surface

2.13
sparkover of an arrester
disruptive discharge between the electrodes of the gaps of an arrester

2.14
impulse
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, loops 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
rectangular impulse
impulse which rises rapidly to a 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

2.16
peak (crest) value of an impulse
maximum value of voltage or current in an impulse. In case of superimposed oscillations (see 8.3.2, 8.5.2e), and 8.5.3.2c) of IEC 60099-1)

2.17
front of an impulse
that part of an impulse which occurs prior to the peak

2.18
tail of an impulse
that part of an impulse which occurs after the peak

2.19
full-wave voltage impulse
voltage impulse which is not interrupted by sparkover, flashover, or puncture

2.20
chopped voltage impulse
voltage impulse which is interrupted on the front, peak, or tail by sparkover, flashover or puncture causing a sudden drop in the voltage

2.21
prospective peak (crest) value of a chopped voltage impulse
peak (crest) value of the full-wave voltage impulse from which a chopped voltage impulse is derived

2.22
virtual origin of an impulse
point on a graph of voltage versus time or current versus time determined by the intersection between the time axis at zero voltage or zero current and a straight line drawn through two reference points on the front of the impulse

a) for voltage impulses with virtual front times equal to, or less than, 30 μs, the reference points are at 30 % and 90 % of the peak value;

b) for voltage impulses with virtual front times greater than 30 μs, the origin is generally well-defined and needs no artificial definition;

c) for current impulses, the reference points are 10 % and 90 % of the peak value

NOTE This definition applies only when scales of both ordinate and abscissa are linear. See also note to 3.23.

2.23
virtual front time of an impulse (T_1)
time, in μs, equal to:

a) for voltage impulses with front durations equal to, or less than, 30 μs, 1,67 times the time taken by the voltage to increase from 30 % to 90 % of its peak value;

b) for voltage impulses with front durations greater than 30 μs, 1,05 times the time taken by the voltage to increase from 0 % to 95 % of its peak value;

c) for current impulses, 1,25 times the time taken by the current to increase from 10 % to 90 % of its peak value

NOTE If oscillations are present on the front, the reference points at 10 %, 30 %, 90 % and 95 % should be taken on the mean curve drawn through the oscillations.

2.24
virtual steepness of the front of an impulse
quotient of the peak value and the virtual front time of an impulse

2.25
virtual time to half-value on the tail of an impulse (T_2)
time interval between the virtual origin and the instant when the voltage or current has decreased to half its peak value. This time is expressed in µs

2.26
designation of an impulse shape
combination of two numbers, the first representing the virtual front time (T_1) and the second the virtual time to half-value of the tail (T_2). It is written as T_1/T_2, both in µs, the sign "/" having no mathematical meaning

2.27
standard lightning voltage impulse
impulse voltage having a waveshape designation of 1,2/50.

2.28
switching voltage impulse
impulse having a virtual front time greater than 30 µs

2.29
virtual duration of the peak of a rectangular impulse
time during which the amplitude of the impulse is greater than 90 % of its peak value

2.30
virtual total duration of a rectangular impulse
time during which the amplitude of the impulse is greater than 10 % of its peak value. If small oscillations are present on the front, a mean curve should be drawn in order to determine the time at which the 10 % value is reached

2.31
peak (crest) value of opposite polarity of an impulse
maximum amplitude of opposite polarity reached by a voltage or current impulse when it oscillates about zero before attaining a permanent zero value

2.32
discharge current of an arrester
surge or impulse current which flows through the arrester after a sparkover of the series gaps

2.33
nominal discharge current of an arrester
peak value of discharge current, having an 8/20 waveshape, which is used to classify an arrester. It is also the discharge current which is used to initiate follow-current in the operating duty test

2.34
follow-current of an arrester
current from the connected power source which flows through an arrester following the passage of discharge current

2.35
residual voltage (discharge voltage) of an arrester
voltage that appears between the terminals of an arrester during the passage of discharge current

2.36
impulse sparkover voltage of an arrester
highest value of voltage attained before sparkover during an impulse of given waveshape and polarity applied between the terminals of an arrester

2.37
front-of-wave impulse sparkover of an arrester:
impulse sparkover voltage obtained on the wavefront the voltage of which increases linearly with time

2.38
standard lightning impulse sparkover voltage of an arrester
lowest prospective peak value of a standard lightning voltage impulse which, when applied to an arrester, causes sparkover on every application

2.39
time to sparkover of an arrester
time interval between virtual origin and the instant of sparkover of the arrester. The time is expressed in µs

2.40
impulse sparkover-voltage/time curve
curve which relates the impulse sparkover voltage to the time to sparkover

2.41
prospective current
current which would flow at a given location in a circuit if it were short-circuited at that location by a link of negligible impedance

2.42
type tests (design tests)
tests which are made upon the completion of the development of a new arrester design to establish representative performance and to demonstrate compliance with this part of the standard. Once made, these tests need not be repeated unless the design is so changed as to modify its performance

2.43
routine tests
tests made on each arrester or on parts and materials as required to ensure that the product meets the design specifications

2.44
acceptance tests
selected tests which are made when it has been agreed between the manufacturer and the purchaser that the arresters or representative samples of an order are to be tested

2.45
protective characteristics of an arrester
combination of the following:

a) lightning impulse sparkover-voltage/time curve as determined in 8.3.3 of IEC 60099-1;

b) the residual-voltage/discharge-current curve as determined in 8.4 of IEC 60099-1;

c) for 10 000 A arresters rated 100 kV and higher, the switching-voltage impulse sparkover-voltage/time curve as determined in 8.3.5 of IEC 60099-1

2.46
arrester disconnector
device for disconnecting an arrester from the system in the event of arrester failure to prevent a persistent fault on the system and to give visible indication of the failed arrester

NOTE Clearing of the fault current through the arrester during disconnection generally is not a function of the device, and it may not prevent explosive shattering of the housing following internal flashover of the arrester on high fault currents.

3 Surge arresters – Metal-oxide surge arresters without gaps for a.c. systems (IEC 60099-4:1991+A1:1998+A2:2001)

3.1
metal-oxide surge arrester without gaps
arrester having non-linear metal-oxide resistors connected in series and/or in parallel without any integrated series or parallel spark gaps

3.2
non-linear metal-oxide resistor
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

3.3
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

3.4
grading ring of an arrester
metal part, usually circular in shape, mounted to modify electrostatically the voltage distribution along the arrester

3.5
section of an arrester
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

3.6
unit of an arrester
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

3.7
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

3.8
rated voltage of an arrester (U_r)
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 of IEC 60099-4). 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 established rating do not necessarily produce equivalent values. (A resolution to this discrepancy is under consideration.)

3.9
continuous operating voltage of an arrester (U_c)
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 of IEC 60099-4

3.10
rated frequency of an arrester
frequency of the power system on which the arrester is designed to be used

3.11
disruptive discharge
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.

3.12
puncture (breakdown)
disruptive discharge through a solid

3.13
flashover
disruptive discharge over a solid surface

3.14
impulse
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

3.15
designation of an impulse shape
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 µs, the sign "/" having no mathematical meaning

3.16
steep current impulse
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 of IEC 60099-4).

3.17
lightning current impulse
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 of IEC 60099-4).

3.18
long-duration current impulse
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

3.19
peak (crest) value of an impulse
maximum value of a voltage or current impulse. Superimposed oscillations may be disregarded (see 7.4.2c) and 7.5.4.2e) of IEC 60099-4)

3.20
front of an impulse
part of an impulse which occurs prior to the peak

3.21
tail of an impulse
part of an impulse which occurs after the peak

3.22
virtual origin of an impulse
point on a graph of voltage versus time or current versus time determined by the intersection between the time axis at zero voltage or zero current and the straight line drawn through two reference points on the front of the impulse. For current impulses, the reference points shall be 10 % and 90 % of the peak value

NOTE 1 This definition applies only when scales of both ordinate and abscissa are linear.

NOTE 2 If oscillations are present on the front, the reference points at 10 % and 90 % should be taken on the mean curve drawn through the oscillations.

3.23
virtual front time of a current impulse (T_1)
time in µs equal to 1,25 multiplied by the time in µs for the current to increase from 10 % to 90 % of its peak value

NOTE If oscillations are present on the front, the reference points at 10 % and 90 % should be taken on the mean curve drawn through the oscillations.

3.24
virtual steepness of the front of an impulse
quotient of the peak value and the virtual front time of an impulse

3.25
virtual time to half-value on the tail of an impulse (T_2)
time interval between the virtual origin and the instant when the voltage or current has decreased to half its peak value. This time is expressed in µs

3.26
virtual duration of the peak of a rectangular impulse
time during which the amplitude of the impulse is greater than 90 % of its peak value

3.27
virtual total duration of a rectangular impulse
time during which the amplitude of the impulse is greater than 10 % of its peak value. If small oscillations are present on the front, a mean curve should be drawn in order to determine the time at which the 10 % value is reached

3.28
peak (crest) value of opposite polarity of an impulse
maximum amplitude of opposite polarity reached by a voltage or current impulse when it oscillates about zero before attaining a permanent zero value

3.29
discharge current of an arrester
impulse current which flows through the arrester

3.30
nominal discharge current of an arrester (I_n)
peak value of lightning current impulse (see 3.17) which is used to classify an arrester

3.31
high current impulse of an arrester
peak value of discharge current having a 4/10 impulse shape which is used to test the stability of the arrester on direct lightning strokes

3.32
switching current impulse of an arrester
peak value of discharge current having a virtual front time greater than 30 µs but less than 100 µs and a virtual time to half-value on the tail of roughly twice the virtual front time

3.33
continuous current of an arrester
continuous current is the current flowing through the arrester when energized at the continuous operating voltage

NOTE The continuous current, which consists of a resistive and a capacitive component, may vary with temperature, stray capacitance and external pollution effects. The continuous current of a test sample may, therefore, not be the same as the continuous current of a complete arrester.

The continuous current is, for comparison purposes, expressed either by its r.m.s. or peak value.

3.34
reference current of an arrester
peak value (the higher peak value of the two polarities if the current is asymmetrical) of the resistive component of a power-frequency current used to determine the reference voltage of the arrester. The reference current shall be high enough to make the effects of stray capacitances at the measured reference voltage of the arrester units (with designed grading system) negligible and shall be specified by the manufacturer

NOTE Depending on the nominal discharge current and/or line discharge class of the arrester, the reference current will be typically in the range of 0,05 mA to 1,0 mA per m^2 of disc area for single column arresters.

3.35
reference voltage of an arrester (U_{ref})
peak value of power-frequency voltage divided by $\sqrt{2}$ which shall be applied to the arrester to obtain the reference current. The reference voltage of a multi-unit arrester is the sum of the reference voltages of the individual units

NOTE Measurement of reference voltage is necessary for the selection of a correct test sample in the operating duty test (see 7.5 of IEC 60099-4).

3.36
residual voltage of an arrester (U_{res})
peak value of voltage that appears between the terminals of an arrester during the passage of discharge current

NOTE The term "discharge voltage" is used in some countries.