SLOVENSKI STANDARD
SIST EN 60099-5:1998/A1:2002

01-november-2002

Prenapetostni odvodniki - 5. del: Izbira in priporočila za uporabo (IEC 60099-5:1996/A1:1999)

Surge arresters -- Part 5: Selection and application recommendations

Überspannungsableiter -- Teil 5: Anleitung für die Auswahl und die Anwendung

Parafoudres -- Partie 5: Recommandations pour le choix et l'utilisation

Ta slovenski standard je istoveten z: EN 60099-5:1996/A1:1999

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29.240.10	Transformatorske postaje. Prenapetostni odvodniki	Substations. Surge arresters

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EUROPEAN STANDARD

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EUROPÄISCHE NORM

EN 60099-5/A1

December 1999

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English version

Surge arresters
Part 5: Selection and application recommendations
(IEC 60099-5:1996/A1:1999)

Parafoudres
Partie 5: Recommandations pour le choix et l'utilisation
(CEI 60099-5:1996/A1:1999)

Überspannungsableiter
Teil 5: Anleitung für die Auswahl und die Anwendung
(IEC 60099-5:1996/A1:1999)

This amendment A1 modifies the European Standard EN 60099-5:1996; it was approved by CENELEC on 1999-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this amendment the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This amendment exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 37/224/FDIS, future amendment 1 to IEC 60099-5, prepared by IEC TC 37, Surge arresters, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 60099-5:1996 on 1999-12-01.

The following dates were fixed:

– latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2000-09-01
– latest date by which the national standards conflicting with the amendment have to be withdrawn	(dow)	2002-12-01

Endorsement notice

The text of amendment 1:1999 to the International Standard IEC 60099-5:1996 was approved by CENELEC as an amendment to the European Standard without any modification.

NORME INTERNATIONALE
INTERNATIONAL STANDARD

CEI
IEC
60099-5

1996

AMENDEMENT 1
AMENDMENT 1
1999-10

Amendement 1

Parafoudres –

Partie 5:
Recommandations pour le choix et l'utilisation –
Section 1: Généralités

Amendment 1

Surge arresters –

Part 5:
Selection and application recommendations –
Section 1: General

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International Electrotechnical Commission
Международная Электротехническая Комиссия

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FOREWORD

This amendment has been prepared by IEC technical committee 37: Surge arresters.

The text of the amendment is based on the following documents:

FDIS	Report on voting
37/224/FDIS	37/230/RDV

Full information of the voting of the approval of this amendment can be found in the report on voting indicated in the above table.

Page 73

Section 6: Monitoring (supervision)

Replace the title and text of this section by the following:

Section 6: Diagnostic indicators of metal-oxide surge arresters in service

6.1 General

Apart from brief occasions when a surge arrester is functioning as an overvoltage-limiting device, it is expected to behave as an insulator. The insulating properties are essential for the length of life of the arrester and for the operation reliability of the power system.

Various diagnostic methods and indicators for revealing possible deterioration or failure of the insulating properties have been utilized since the introduction of surge arresters. The diagnostic methods range from fault indicators and disconnectors for indication of complete arrester failures, to instruments that are able to measure slight changes in the resistive leakage current or the power loss of metal-oxide arresters.

The aim of this section is to provide guidance to the user if use of any diagnostic method is considered, and to present an overview of common diagnostic methods. It also gives detailed information about leakage current measurements on metal-oxide arresters.

NOTE 1 – Diagnostic devices should be designed and handled in order to provide personal safety during measurement. Permanently installed devices should be designed and installed with the operational and short-circuit stresses taken into consideration.

NOTE 2 – For several diagnostic methods, an insulated earth terminal is required on the arrester. The earth terminal should have a sufficiently high withstand voltage level to account for the inductive voltage drop appearing between the terminal and the earthed structure during an impulse discharge.

6.1.1 Fault indicators

Fault indicators give a clear visual indication of a failed arrester, without disconnecting the arrester from the line. The device may be an integrated part of the arrester, or a separate unit installed in series with the arrester. The working principle is usually based on the amplitude and duration of the arrester current, or on the temperature of the non-linear metal-oxide resistors.

6.1.2 Disconnectors

Disconnectors, often used on medium-voltage arresters, give a visual indication of a failed arrester by disconnecting it from the system. The typical working principle is an explosive device triggered by the fault current; however, the disconnector is not intended to extinguish the fault current. The disconnector may be an integral part of the arrester or insulating bracket, or a separate unit installed in series with the arrester. The advantage of the device is that the line remains in operation after disconnection of the arrester. The major disadvantage is the lack of overvoltage protection until the failed arrester has been discovered and replaced.

6.1.3 Surge counters

Surge counters operate at impulse currents above a certain amplitude, or above certain combinations of current amplitude and duration. If the interval between discharges is very short (less than 50 ms), surge counters may not count every current impulse. Some counters require power follow current and may not count the short impulse currents through metal-oxide arresters.

Depending on the operating principle and sensitivity of the counter, it may give an indication about overvoltages appearing in the system, or it may provide information on the number of discharges corresponding to significant arrester energy stresses. The counter provides no specific information about the condition of the arrester.

For safety reasons, the surge counter should be installed beyond easy reach of personnel, It shall be located where it can be read from ground level with the arrester in service. The installation should be done without considerably lengthening the earth connection or reducing its cross-section. The arrester shall be equipped with an insulated earth terminal and a conductor between the arrester and counter that is insulated from earth.

6.1.4 Monitoring spark gaps

Monitoring spark gaps are used to indicate the number and estimate the amplitude and duration of discharge currents through the arrester. Special experience is necessary to properly interpret the marks on the gap. Some spark gaps can be examined with the arrester in service, while other types require that the arrester is de-energized. It is required that the arrester be equipped with an insulated earth terminal. Alternatively, the device may be an integrated part of the arrester. Spark gaps give no direct information about the actual condition of the arrester, but may help to make decisions about continued operation.

6.1.5 Temperature measurements

Remote measurement of the arrester temperature can be carried out by means of thermal imaging methods. The measurements are only indicative with regard to the condition of the arrester, since the temperature drop between the resistors and the housing surface may be substantial. Nevertheless, comparative measurements made on adjacent arresters or arrester units may indicate excessive heating.

Direct measurements of the metal-oxide resistor temperature give an accurate indication of the condition of the arrester, but require that the arrester be equipped with special transducers at the time of manufacturing. Therefore, this method is used only in special arrester applications.

6.1.6 Leakage current measurements of metal-oxide arresters

Any deterioration of the insulating properties of a metal-oxide arrester will cause an increase in the resistive leakage current or power loss at given values of voltage and temperature. The majority of diagnostic methods for determining the condition of gapless metal-oxide arresters are based on measurements of the leakage current.

The measuring procedures can be divided into two groups: on-line measurements, when the arrester is connected to the system and energized with the service voltage during normal operation, and off-line measurements, when the arrester is disconnected from the system and energized with a separate voltage source on site or in a laboratory.

Measurements off-line can be made with voltage sources that are specially suited for the purpose, e.g. mobile a.c. or d.c. test generators. Good accuracy may be obtained by using the off-line methods, provided that a sufficiently high test voltage is used. The major disadvantages are the cost of the equipment and the need for disconnecting the arrester from the system.

Measurements carried out on-line under normal service voltage is the most common method. For practical and safety reasons, the leakage current is normally accessed only at the earthed end of the arrester. To allow measurements of the leakage current flowing in the earth connection, the arrester must be equipped with an insulated earth terminal.

NOTE – The insulation of the earth terminal must, also after long-term degradation, be sufficient to prevent circulating currents caused by electromagnetic induction, since these currents may interfere with the measurement of the leakage current.

On-line leakage current measurements are usually made on a temporary basis using portable or permanently installed instruments. Portable instruments are usually connected to the earth terminal of the arrester by means of a clip-on, or permanently installed, current transformer. Long-term measurements of the leakage current may be necessary for closer investigations, especially if significant changes in the condition of an arrester are revealed by temporary measurements. Remote measurements may be implemented in computerized systems for supervision of substation equipment.

6.1.6.1 Properties of the leakage current of non-linear metal-oxide resistors

The a.c. leakage current can be divided into a capacitive and a resistive part, with a pre-dominant capacitive component and a significantly smaller resistive part. This can be seen in figure 3, which shows a typical laboratory measurement of the leakage current of a single non-linear metal-oxide resistor when energized at a voltage equivalent to U_c for the complete arrester. In figure 4 are shown the results of leakage current measurements carried out on two different arresters in service at voltage levels slightly below U_c. Figure 4 also illustrates the influence of different levels of harmonic content in the system voltage.

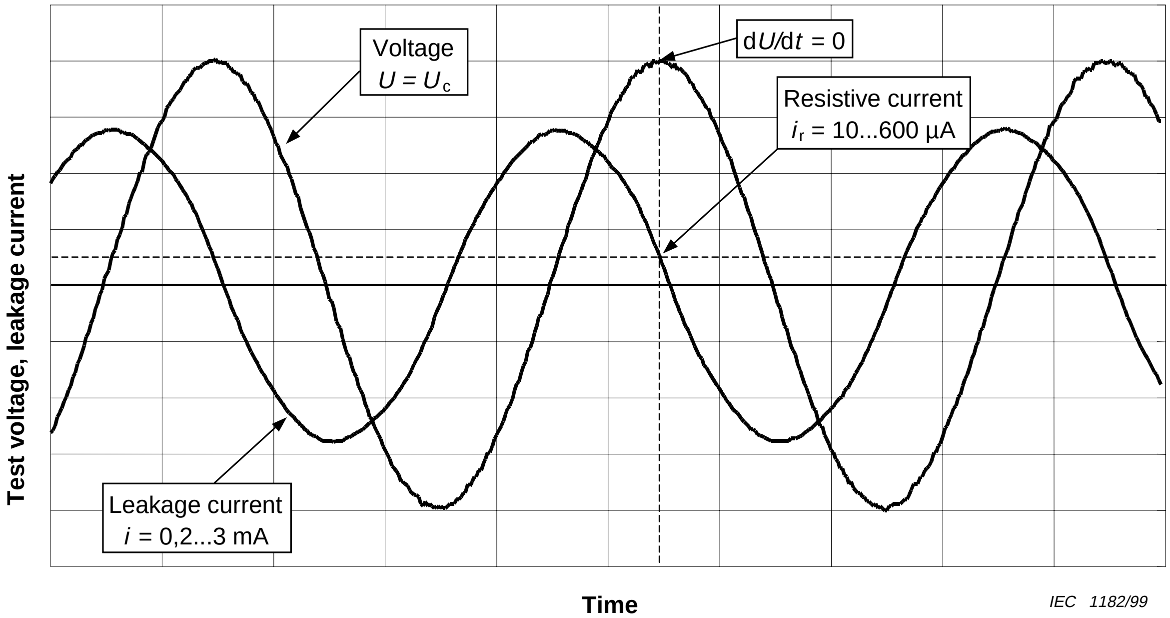

Figure 3 – Typical leakage current of a non-linear metal-oxide resistor in laboratory conditions

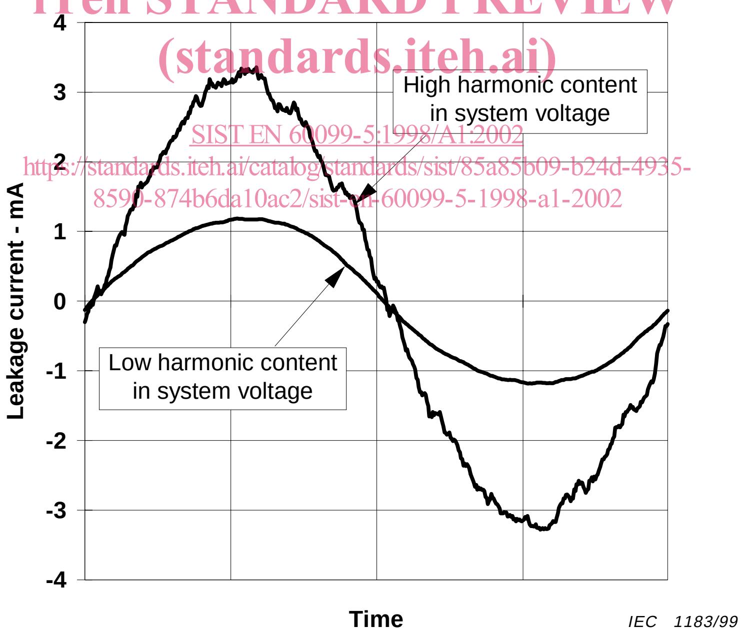

Figure 4 – Typical leakage currents of arresters in service conditions

6.1.6.1.1 Capacitive leakage current

The capacitive leakage current measured at the earth terminal of an arrester is caused by the permittivity of the non-linear metal-oxide resistors, the stray capacitances and the grading capacitors, if applied. The specific capacitance of a resistor element is typically 60 pF.kV/cm^2 to 150 pF.kV/cm^2 (rated voltage), resulting in a capacitive peak leakage current of about 0,2 mA to 3 mA under normal service conditions.

There is no evidence that the capacitive current would change significantly due to deterioration of the voltage-current characteristic of the non-linear metal-oxide resistors. Therefore, it is unlikely that measurements of capacitive current can reliably indicate the condition of metal-oxide arresters.

6.1.6.1.2 Resistive leakage current

At given values of voltage and temperature, the resistive component of the leakage current is a sensitive indicator of changes in the voltage-current characteristic of non-linear metal-oxide resistors. The resistive current can, therefore, be used as a tool for diagnostic indication of changes in the condition of metal-oxide arresters in service. Typical resistive and capacitive voltage-current characteristics for a.c. voltages are shown in figure 5. For comparison, typical characteristics for d.c. voltages are also shown in figure 5.

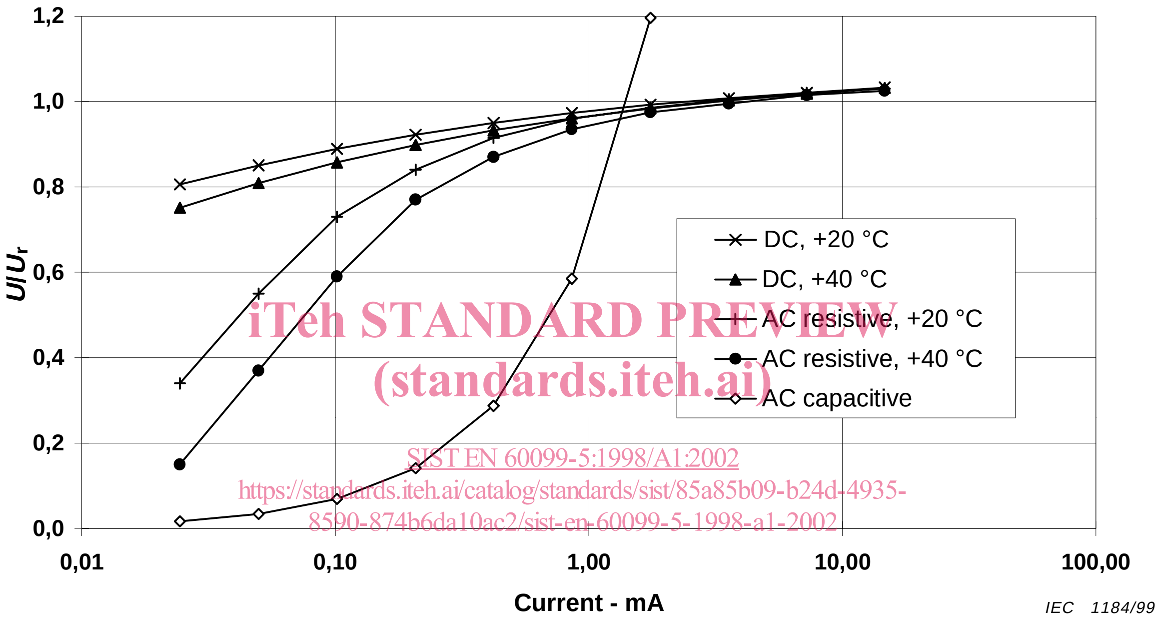

Figure 5 – Typical voltage-current characteristics for non-linear metal-oxide resistors

The resistive component under a.c. voltage is defined as the current level at the instant of voltage maximum (dU/dt = 0), as indicated in figure 3. The resistive leakage current of a non-linear metal-oxide resistor is in the order of 5 % to 20 % of the capacitive current under normal operating conditions, corresponding to about 10 µA to 600 µA peak resistive current at a temperature of +20 °C.

In the leakage current region, the resistive current depends on the voltage and temperature. Typical values of voltage and temperature dependencies under a.c. voltage are indicated in figures 6 and 7, normalized to U_c and at +20 °C, respectively.

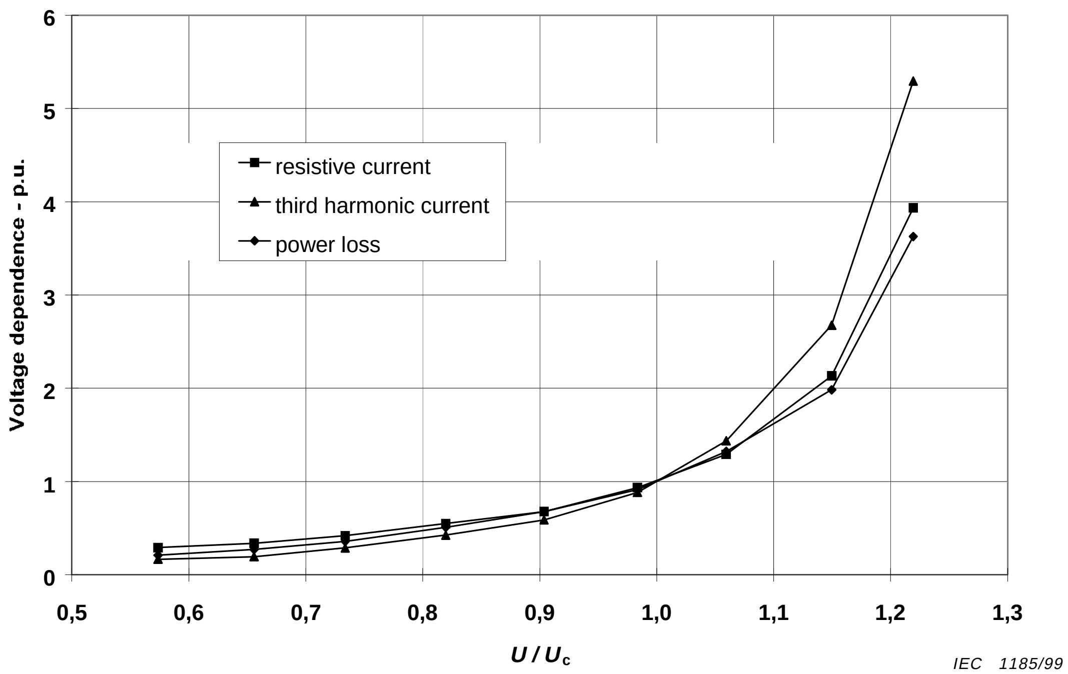

Figure 6 – Typical normalized voltage dependence at +20 °C

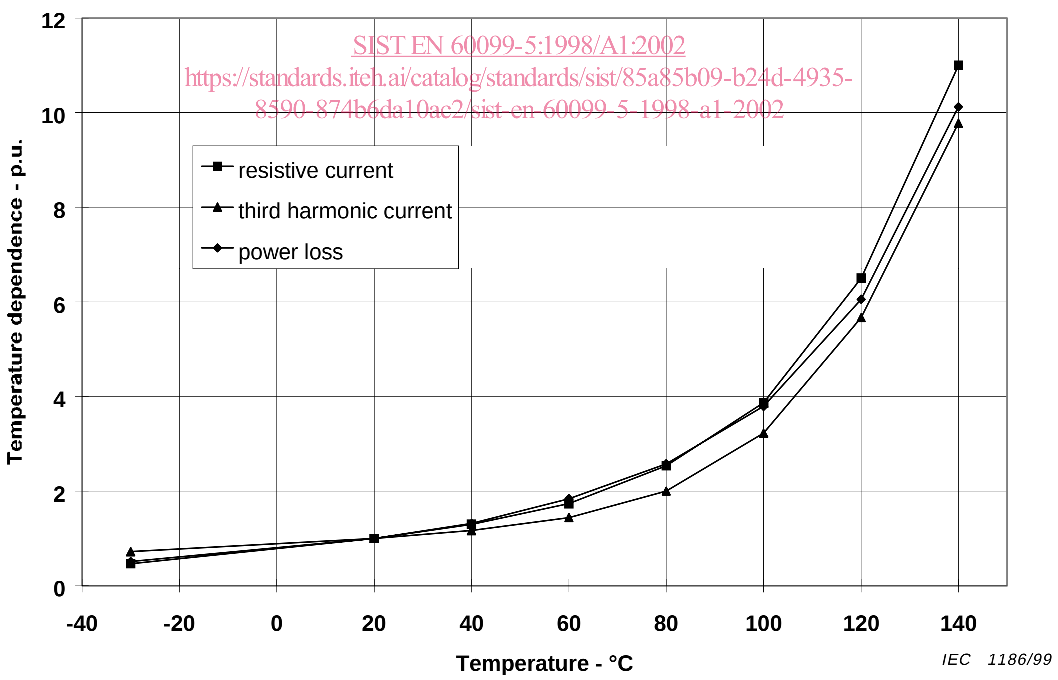

Figure 7 – Typical normalized temperature dependence at U_c