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Edition 2.0 2015-03

TECHNICAL SPECIFICATION

Artificial pollution tests on high-voltage ceramic and glass insulators to be used on d.c. systems

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COMMISSION

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FOREWORD

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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 61245, which is a technical specification, has been prepared by IEC technical committee 36: Insulators.

This second edition cancels and replaces the first edition published in 1993. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Corrections and the addition of explanatory material;
b) The addition of Clause 4.4.2 on atmospheric correction;
c) The change of upper limit of volume conductivity of tap water for insulator cleaning to 0,1 S/m;
d) The extension to UHV voltages; and
e) The addition of Annex B "Determination of the withstand characteristics of insulators" and Annex E "Supplementary information on artificial pollution tests on insulators for voltage systems of ± 600 kV and above (solid layer method procedure B)

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
36/352/DTS	36/359/RVC

Full information on the voting for the approval of this technical specification 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.

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

The contents of the corrigendum of August 2018 have been included in this copy.

INTRODUCTION

The electrical strength of d.c. insulation under pollution conditions determines, in many cases, the dimensions and the design of the insulation.

The d.c. test procedures as specified in this technical specification follow closely the ones established for a.c. by IEC 60507. This does not exclude the possibility that at a later time other d.c. test procedures will be defined.

The main differences between this technical specification and IEC 60507 are:

– test circuit requirements include ripple factor, voltage drop and voltage overshoot. No requirements are made for the minimum short circuit current or ratio between short circuit and leakage currents;
– different criteria for the identification of flashover are given;
– for the salt fog test, a pre-conditioning process with d.c. voltage may be used by agreement;
– the wetting rate, rather than the steam injection rate, is prescribed; the measurement of the layer conductance is used to check the wetting action of the fog;
– as regards the solid layer methods, only the test procedure type "B" is considered due to the high scatter of the results obtained with tests carried out according to the type "A" procedure.

The tests are deemed to be not a suitable measure to prove the insulation performance of polymeric or special types of insulators (e.g. insulators with semiconducting glaze or covered with any organic insulating material) under polluted conditions. The test procedures given in this standard do not take account of the different properties of insulators such as surface hydrophobicity and hydrophobicity transfer through the pollution layer etc. These questions are under consideration by CIGRE SC D1.

For the test methods described in this technical specification, it is recommended that the voltage for the withstand voltage tests be specified as the highest value of operating voltage which occurs under normal operating conditions. Other test voltages may be agreed upon. If not otherwise specified and agreed between the parties, voltage of the negative polarity will be applied.

Only those test methods in which the voltage is held constant during the whole test are considered suitable for standardization. Variants in which the voltage is raised continuously to flashover are not included in this technical specification.

The leakage current may be used for interpretation of the test results, and therefore it is recommended that this current be continuously measured during the artificial pollution tests.

To achieve repeatable results, the artificial layer for d.c. pollution tests should be as uniform as possible, since non-uniformity can influence d.c. withstand and flashover voltages.

The amount of non-soluble material on the insulator surface may affect the test results. Although this matter is under consideration and no requirements can be given, the definition of non-soluble deposit density has been introduced into this technical specification for reference.

The type and quantity of non-soluble material, the steam rate and the preconditioning procedure with salt fog (either by a.c. or d.c. voltage) may affect the test results.

The standard results are intended as results obtained in laboratories close to sea level (altitude ≤ 1 000 m). Test results obtained at higher altitude or in test chambers with non-standard air densities are to be corrected for air density.

ARTIFICIAL POLLUTION TESTS ON HIGH-VOLTAGE CERAMIC AND GLASS INSULATORS TO BE USED ON D.C. SYSTEMS

1 Scope

This technical specification is applicable for the determination of the d.c. withstand characteristics of ceramic and glass insulators to be used outdoors and exposed to polluted atmospheres, on d.c. systems with the highest voltage of the system greater than ± 1 000 V.

These tests are not applicable to polymeric insulators, to greased insulators or to special types of insulators (e.g. insulators with semiconducting glaze or covered with any organic insulating material).

The object of this technical specification is to prescribe procedures for artificial pollution tests applicable to insulators for overhead lines, substations and traction lines and to bushings.

It may also be applied to hollow insulators with suitable precautions to avoid internal flashover. In applying these procedures to apparatus incorporating hollow insulators, the relevant technical committees should consider their effect on any internal equipment and the special precautions which may be necessary.

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 TS 60815-1, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles*

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

IEC 60060-2, *High-voltage test techniques – Part 2: Measuring systems*

3 Terms and definitions

For the purpose of this technical specification, the following terms and definitions apply.

3.1
individual test
one single process consisting in applying to the object a specified test voltage, for a specified time or until flashover occurs, at a specified degree of pollution

3.2
actual mean voltage
U_a
mean value of the voltage at a given instant over a time interval ending at the instant considered and having a duration equal to that of one cycle of the alternating voltage supplying the rectifier

Note 1 to entry: When it is not possible to determine the cycle of the supply voltage, the time interval is 20 ms.

3.3
test voltage
U_t
actual mean voltage at the beginning of an individual test

3.4
ripple
periodic deviation from the arithmetic mean value of the test voltage

3.5
ripple amplitude
U_r
half the difference between maximum and minimum values

3.6
ripple factor
ratio of the ripple amplitude to the actual mean voltage

See: U_r/U_a in Figure 1

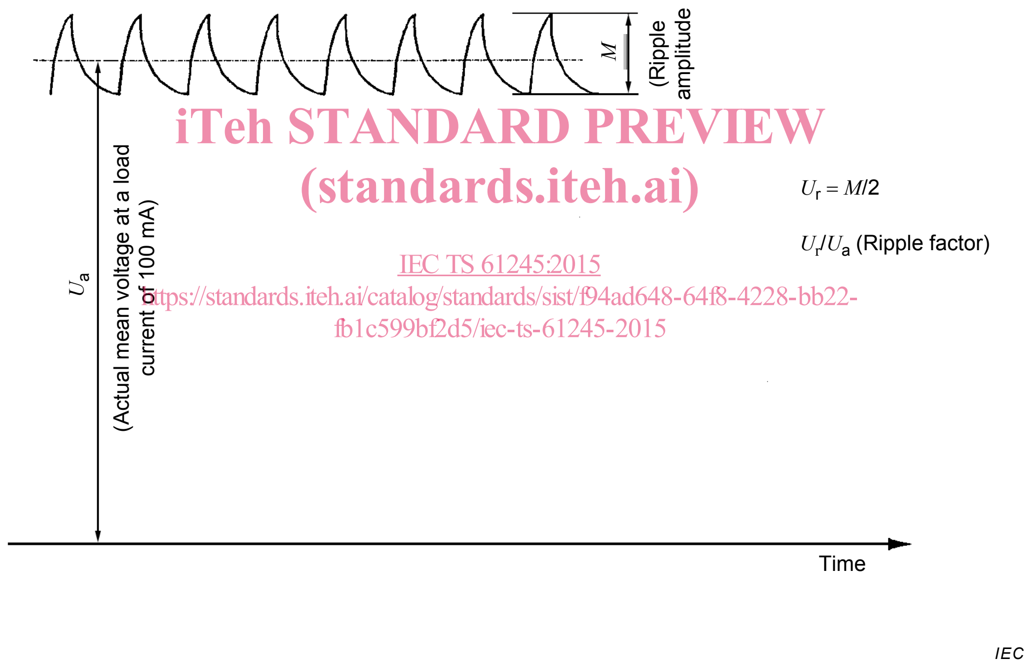

Figure 1 – Ripple amplitude and actual mean voltage, measured on a resistive load absorbing 100 mA

3.7
voltage drop
Δu_t
difference between the test voltage and the actual mean voltage

See: Figure 2

3.8
relative voltage drop
ratio of the voltage drop Δu_t to the test voltage (U_t) usually expressed as a percentage

3.9
voltage overshoot
difference between the actual mean voltage and the test voltage

See: Figure 2

3.10
relative voltage overshoot
ratio of the voltage overshoot to the test voltage U_t, usually expressed as a percentage

3.11
leakage current
current measured in series with the insulator surface at its earth end during a pollution test

3.12
short circuit current
current delivered by the complete testing circuit, when the test object is energized at the test voltage and then short- circuited

3.13
salinity
S_a
concentration of the solution of salt in tap water, expressed by the amount of salt divided by the volume of solution

Note 1 to entry: This is generally expressed in kg/m^3.

3.14
pollution layer
conducting electrolytic layer on the insulator surface, composed of salt plus non-soluble materials

3.15
layer conductance
G_L
ratio current/voltage measured as specified in Annex C.3

3.16
salt deposit density
SDD
amount of salt in the deposit on a given surface of the insulator (metal parts and assembling materials are not to be included in this surface), divided by the area of this surface

Note 1 to entry: See 6.5.

Note 2 to entry: This is generally expressed in mg/cm^2.

3.17
non-soluble deposit density
NSDD
amount of non-soluble material in the deposit on a given surface of the insulator (metal parts and assembling materials are not to be included in this surface), divided by the area of this surface

Note 1 to entry: This is generally expressed in mg/cm^2.

3.18
degree of pollution
value of the quantity (salinity, salt deposit density) which characterizes the artificial pollution applied to the test insulator

3.19
reference salinity
value of the salinity used to characterize an individual test

3.20
reference salt deposit density
value of the salt deposit density used to characterize an individual test

Note 1 to entry: This is defined as the average of the salt deposit density values measured on a few insulators (or on parts of them), which are chosen for this purpose from among the contaminated ones prior to their submission to any test.

3.21
specified withstand degree of pollution
reference degree of pollution at which an insulator shall withstand the specified test voltage in at least three individual tests out of four, under the conditions described in the relevant Subclauses 5.6 or 6.7

3.22
maximum withstand degree of pollution
highest degree of pollution at which an insulator has withstood at least three individual tests out of four at the specified test voltage, under the conditions described in Clause B.1

3.23
maximum withstand voltage
highest test voltage at which an insulator has withstood at least three individual withstand tests out of four at the specified degree of pollution, under the conditions described in Clause B.2

3.24
50 % withstand voltage
test voltage at which an insulator has 50 % probability to withstand one individual test

Note 1 to entry: See Clause B.3.

4 General test requirements

4.1 General

Pollution tests can be carried out for two main objectives:

– to obtain information about the pollution performance of insulators e.g. for comparison of different insulator types/profile;

– to check the performance in a configuration as close as possible to the in-service conditions.

To reach the first objective, tests on relatively short insulator sets (e.g. arcing distance ≥ 1,5 m – if representative of the full set in terms of radial geometry and profile) may be sufficient.

Tests to reach the second objective may be agreed between the manufacturer and the user whenever optimisation of the design is necessary and/or whenever it is expected that the mounting condition or the inner active parts in apparatus can affect the performance. Such tests shall be made simulating the relevant service conditions as closely as possible. In particular tests in other positions from the vertical (inclined, horizontal) duplicating actual service conditions may be agreed between the supplier and the user.

Tests at higher system voltages (of ± 600 kV and above) may present particular requirements as reported in Annex E.