



BSI Standards Publication

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

National foreword

This Published Document is the UK implementation of IEC TS 61245:2015, incorporating corrigendum August 2018. It supersedes BS 7744:1994, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/36, Insulators for power systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2018
Published by BSI Standards Limited 2018

ISBN 978 0 539 02335 0

ICS 29.080.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 April 2015.

Amendments/corrigenda issued since publication

Date	Text affected
30 September 2018	Implementation of corrigendum August 2018: Figure 3 replaced



IEC TS 61245

Edition 2.0 2015-03

TECHNICAL SPECIFICATION

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.080.10

ISBN 978-2-8322-2546-2

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	8
2 Normative references.....	8
3 Terms and definitions	8
4 General test requirements.....	11
4.1 General.....	11
4.2 Test methods	12
4.3 Arrangement of insulator for test.....	12
4.3.1 Test configuration	12
4.3.2 Insulator cleaning.....	12
4.4 Requirements for the test circuit	13
4.4.1 Test voltage.....	13
4.4.2 Atmospheric corrections	13
4.4.3 Characteristics of the measuring systems	13
4.4.4 Identification of flashover	13
5 Salt fog method	14
5.1 General information.....	14
5.2 Salt solution	14
5.3 Spraying system	16
5.4 Conditions before starting the test	19
5.5 Preconditioning process	19
5.6 Withstand test.....	20
5.7 Acceptance criteria for the withstand test.....	20
6 Solid layer method.....	20
6.1 General information.....	20
6.2 Main characteristics of inert materials.....	21
6.3 Composition of the contaminating suspension.....	21
6.4 Application of the pollution layer	22
6.5 Determination of the degree of pollution of the test insulator	23
6.6 Test procedure.....	23
6.7 Withstand test and acceptance criteria.....	24
Annex A (informative) Method for checking the uniformity of the layer	25
Annex B (informative) Determination of the withstand characteristics of insulators.....	27
B.1 General.....	27
B.2 Determination of the maximum withstand degree of pollution at a given test voltage.....	27
B.3 Determination of the maximum withstand voltage at a given degree of pollution.....	27
B.4 Determination of the 50 % withstand voltage at a given degree of pollution.....	28
Annex C (informative) Additional recommendations concerning the solid layer method procedures	29
C.1 General.....	29
C.2 Contamination practice.....	29
C.3 Drying of the pollution layer	29
C.4 Checking the wetting action of the fog	29

C.5	Checking fog uniformity for large or complex test objects	30
C.6	Fog input to the test chamber	30
C.7	Duration of the withstand test	31
C.8	Evaluation of the reference salt deposit density (<i>SDD</i>).....	31
Annex D (informative)	Information to check equipment for artificial pollution tests	32
Annex E (informative)	Supplementary information on artificial pollution tests on insulators for voltage systems of ± 600 kV and above (solid layer method procedure B)	34
E.1	General.....	34
E.2	Test chamber	34
E.3	Fog generator	34
E.4	Wetting action and uniformity of fog density	34
E.5	Test of very large insulators	34
Annex F (informative)	Further investigation	35
Bibliography		36
Figure 1	– Ripple amplitude and actual mean voltage, measured on a resistive load absorbing 100 mA.....	9
Figure 2	– Voltage drop and voltage overshoot and leakage current.....	14
Figure 3	– Value of factor <i>b</i> versus solution temperature θ	16
Figure 4	– Typical construction of fog spray nozzle	18
Figure 5	– Test layout for inclined insulators.....	19
Figure A.1	– Arrangement of the probe electrodes	25
Figure A.2	– Circuit diagram of the meter	26
Figure C.1	– Determination of layer conductance and evaluation of its rise time $T_C = t_2 - t_1$	31
Table 1	– Salt-fog method: correspondence between the value of salinity and volume conductivity of the solution at a temperature of 20 °C	15
Table 2	– Main characteristics of the inert materials used in solid layer suspensions	21
Table 3	– Kaolin (or Tonoko) composition: approximate correspondence between the reference degrees of pollution on the insulator and the volume conductivity of the suspension at a temperature of 20 °C.....	22
Table D.1	– (Provisional)	33

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- 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 $\leq 1\,000$ 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 $\pm 1\,000\text{ V}$.

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.