BS EN 61857-1:2009

BSI British Standards

Electrical insulation systems – Procedures for thermal evaluation —

Part 1: General requirements – Low-voltage

National foreword

This British Standard is the UK implementation of EN 61857-1:2009. It is identical to IEC 61857-1:2008. It supersedes BS EN 61857-1:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/112, Evaluation and qualification of electrical insulating materials and 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.

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Foreword

The text of document 112/92/CDV, future edition 3 of IEC 61857-1, prepared by IEC TC 112, Evaluation and qualification of electrical insulating materials and systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61857-1 on 2008-12-01.

This European Standard supersedes EN 61857-1:2005 and constitutes editorial revisions to make EN 61857-1:2009 compatible with Parts 21 and 22.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2009-09-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2011-12-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61857-1:2008 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60034-18-1	NOTE	Harmonized as EN 60034-18-1:1994 (not modified).
IEC 60034-18-21	NOTE	Harmonized as EN 60034-18-21:1994 (not modified).
IEC 60034-18-31	NOTE	Harmonized as EN 60034-18-31:1994 (not modified).
IEC 62114	NOTE	Harmonized as EN 62114:2001 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60085	2004	Electrical insulation - Thermal classification	EN 60085 [1)]	2004
IEC 60216-4-1	- [2)]	Electrical insulating materials - Thermal endurance properties - Part 4-1: Ageing ovens - Single-chamber ovens	EN 60216-4-1	2006 [3)]
IEC 60216-5	- [2)]	Electrical insulating materials - Thermal endurance properties - Part 5: Determination of relative thermal endurance index (RTE) of an insulating material	EN 60216-5	2008 [3)]
IEC 60493-1	- [2)]	Guide for the statistical analysis of ageing test data - Part 1: Methods based on mean values of normally distributed test results	-	-
IEC 60505	2004	Evaluation and qualification of electrical insulation systems	EN 60505	2004

[1)] EN 60085 is superseded by EN 60085:2008, which is based on IEC 60085:2007.

[2)] Undated reference.

[3)] Valid edition at date of issue.

CONTENTS

INTRODUCTION

This International Standard establishes a standardized test procedure for estimating by comparison the life expectancy of electrical insulation systems (EIS) in accordance with IEC 60505.

An EIS contains many different components selected to withstand the varying electrical, mechanical, and thermal stresses occurring in the different parts of the structure of an electrotechnical product. The useful life of an EIS depends upon the way that its individual components are arranged, their interactions upon each other, and the contribution of each component to the electrical and mechanical integrity of the EIS. Therefore, it is impossible to specify one test object to represent all electrotechnical products. It is incumbent upon the IEC equipment technical committees to address the test objects and application of this test procedure that will meet their specific needs. This work is intended to proceed by cooperation between this technical committee and other IEC technical committees to develop a series of parts, each part to address a specific test object and/or application.

This procedure permits approximate comparisons only, and cannot be relied upon to completely determine the merits of any particular EIS. Such information can be obtained only from extended service experience.

ELECTRICAL INSULATION SYSTEMS – PROCEDURES FOR THERMAL EVALUATION –

Part 1: General requirements – Low voltage

1 Scope

This part of IEC 61857 specifies a general test procedure for the thermal evaluation and qualification of electrical insulation systems (EIS) and establishes a procedure that compares the performance of a candidate EIS to that of a reference EIS.

This standard is applicable to existing or proposed EIS used in electrotechnical products with an input voltage of up to 1 000 V where the thermal factor is the dominating ageing factor.

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 60085:2004, *Electrical insulation – Thermal evaluation and designation*

IEC 60216-4-1, *Electrical insulating materials – Thermal endurance properties – Part 4-1: Ageing ovens –Single chamber ovens*

IEC 60216-5, *Electrical insulating materials – Thermal endurance properties – Part 5: Determination of relative thermal endurance index (RTE) of an insulating material*

IEC 60493-1, *Guide for the statistical analysis of ageing test data – Part 1: Methods based on mean values of normally distributed test results*

IEC 60505:2004, *Evaluation and qualification of electrical insulation systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60505, as well as the following definitions, apply.

3.1
electrical insulation system
EIS
insulating structure containing one or more electrical insulating materials (EIM) together with associated conducting parts employed in an electrotechnical device

[IEC 60505, definition 3.1.1]

NOTE EIM with different temperature indices (ATE/RTE according to IEC 60216-5) may be combined to form an EIS which has a thermal class that may be higher or lower than that of any of the individual components according to IEC 60505.

3.2
candidate EIS
EIS under evaluation to determine its service capability (thermal)

3.3
reference EIS
established EIS evaluated on the basis of either a known service experience record or a known comparative functional evaluation

3.4
thermal class
designation of an EIS that is equal to the numerical value of the maximum use temperature in degrees Celsius (°C) for which the EIS is appropriate (see IEC 60085)

NOTE The EIS may be subjected to operating temperatures exceeding its thermal class which can result in shorter expected life.

3.5
EIS assessed thermal endurance index
EIS ATE
numerical value of temperature in degrees Celsius for the reference EIS as derived from known service experience or a known comparative functional evaluation

3.6
EIS relative thermal endurance index
EIS RTE
numerical value of the temperature in degrees Celsius for the candidate EIS which is relative to the known EIS ATE of a reference EIS, when both EIS are subjected to the same ageing and diagnostic procedures in a comparative test

3.7
test object
sample of original equipment or part thereof, or model representing the equipment completely or partially, including the EIS, to be used in a functional test

3.8
thermal ageing factor
thermal stress that causes irreversible changes of the properties of an EIS

3.9
prediagnostic conditioning
variable or fixed stresses, which can be applied continuously or periodically to an EIS to enhance the ability of a functional test to detect the degree of ageing

NOTE Prediagnostic conditioning may cause additional ageing.

3.10
diagnostic test
periodic or continuous application of a specified level of a diagnostic factor to a test object to determine whether or when the end-point criterion has been reached

3.11
end-point criterion
value of either a property or change of property defining the end of life of a test object in a functional test

3.12
end-of-life
end of a test object’s life as determined by meeting its end-point criterion

4 General information

4.1 Overview of test procedure

This thermal ageing test procedure is based on the fact that, for most materials, thermal ageing is accelerated when temperature is raised, and that often the degree of acceleration obeys the Arrhenius law on chemical reaction rates. Based on this relationship, acceptable extrapolation of the ageing test results may be used to determine the anticipated thermal performance of the candidate EIS. Accelerated thermal testing requires the verification of an identical or equivalent ageing mechanism compared under operating service conditions.

Test objects consisting of the candidate EIS are exposed to thermal ageing cycles at selected temperatures. Each cycle consists of a specific time exposure at elevated temperature and a subcycle of exposure to prediagnostic conditioning and diagnostic tests. Prediagnostic conditioning may include mechanical stress, cold shock and moisture exposure. A dielectric diagnostic test is used to determine test life. A reference EIS is tested using the same test procedure. At each ageing temperature, the test life of the EIS is determined. Based on these test life values, the thermal class of the candidate EIS is estimated relative to the performance of the reference EIS in its thermal class.

4.2 Basis of evaluation and qualification

The functional testing and evaluation, according to this test procedure, shall be made on a comparative basis, using an established EIS as a reference which is tested with the candidate EIS in equivalent fashion.

If the thermal classes for the candidate and reference EIS differ, then appropriate ageing temperatures are used for each.

4.3 Specific requirements

Separate Parts in the IEC 61857 series address specific test objects and/or applications and test procedures.

Test objects are unique to each part because testing of specific electrotechnical products, or representations thereof, may yield results that are not applicable to other electrotechnical products.

Different electrotechnical products may also require alternative methods of thermal ageing and/or diagnostic tests due to design considerations or end-use requirements.

Each Part shall specify the following:

– scope: electrotechnical products that this test object represents;
– construction of the test object (5.2);
– number of test objects required (5.3);
– test procedures: specific requirements and means of testing for
  - initial dielectric diagnostic test (6.7.1);
  - prediagnostic mechanical stress (6.4);
  - other prediagnostic conditioning, as required (6.5);
  - moisture exposure (6.6);
  - dielectric diagnostic test (6.7.2), or other diagnostic test (6.8); and the end-point criterion;
  - thermal ageing: the means of heating, if other than ovens.

5 Test objects

5.1 General

Test objects may be actual electrotechnical products, components thereof, or non-functional models representing the products. Components and non-functional models should embody all the essential elements of the EIS used in the electrotechnical product. Identical test objects shall be used for the reference and candidate EIS.

5.2 Description

Specific test objects are described in each Part[1]. Insulation thickness, creepage distances and discharge protection, where required, shall be appropriate for the intended maximum rated voltage and equipment standards in practice.

Particular types of non-functional test objects and alternative test procedures for specific electrotechnical products that have been used successfully may be found in the applicable Part.

Test objects shall be subjected to the quality control of the normal or intended production process.

5.3 Number of test objects

The number of test objects (representative of the EIS) in a group for each ageing temperature shall not be less than five.

NOTE A minimum of five test objects is required to obtain a good statistical average for the end-point analysis of the EIS under consideration.

The actual number of test objects shall be specified in the applicable part.

6 Test procedures

6.1 General

All test objects shall be subjected to initial screening tests followed by repeated thermal endurance test cycles in the following order:

– a thermal ageing subcycle;

– a subcycle of prediagnostic mechanical stress, other prediagnostic requirements and moisture exposure, in that order;

– a dielectric diagnostic test, or other diagnostic test.

It is recognized that, depending on the test facilities available, the type of equipment employed, and other factors, slight variations in the methods of exposing the test objects may be necessary. It is all important that when any two different EIS are compared, the test objects of each shall be subjected to identical exposures and other conditions of test. Unless otherwise specified, prediagnostic conditioning and diagnostic tests shall be carried out at room temperature (25 ± 5) °C and (50 ± 10) % relative humidity.

6.2 Initial screening tests

Prior to exposure to an elevated temperature on the first thermal ageing subcycle, all test objects shall be subjected to a visual inspection and initial screening tests in order to eliminate

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[1] The technical committees responsible for equipment may use this test procedure to evaluate the candidate EIS for specific electrotechnical products, or for general purposes through use of an appropriate non-functional model.

defective test objects. The initial screening tests shall consist of the following steps and shall be conducted in the order given:

– initial dielectric diagnostic test (see 6.7.1 for details);
– prediagnostic mechanical stress (see 6.4 for details);
– other prediagnostic conditioning, as required (see 6.5 for details);
– moisture exposure (see 6.6 for details);
– dielectric diagnostic test (see 6.7.2), or other diagnostic test (see 6.8).

6.3 Thermal ageing

6.3.1 General

The thermal ageing portion of the cycle shall be conducted at a minimum of three different ageing temperatures. Greater precision may be obtained if tests are carried out at more than three temperatures. Additional test temperatures may be required to meet the criteria set forth in 6.3.2.

The ageing temperatures and the duration of exposure at each temperature are selected so as to reach the anticipated average test life in 5 to 10 test cycles for each set of test objects. Suggested ageing temperatures and ageing periods are given in Table 1.

Table 1 – Suggested ageing temperatures and ageing periods

Ageing period per cycle h	Ageing temperature for EIS with anticipated thermal classes of °C								
	90	105	120	130	155	180	200	220	250
504 to 840	105	120	135	145	170	195	215	235	265
48 to 336	120	135	150	160	185	215	235	255	285
24 to 72	135	150	165	175	200	235	255	275	305

Table 1 is intended to guide the selection of ageing temperatures and times. These suggested ageing temperatures and ageing periods do not describe any actual EIS and cannot be expected to result in the same end-points for all EIS. The life-temperature relationship for a specific EIS is relative and it should be compared to similar data for an EIS of known reliability and service life to be significant.

If the anticipated thermal class for the candidate EIS differs from the thermal class of the reference EIS, different ageing temperatures and ageing periods should be selected.

A preliminary ageing test at a given temperature may be performed to indicate the anticipated thermal class and other ageing temperatures and periods.

6.3.2 Ageing temperatures

To minimize the uncertainty introduced by extrapolation, the lowest test temperature should not exceed the temperature to which the results will be extrapolated by more than 25 K. The lowest ageing temperature shall result in a minimum log mean test life of 5 000 h. In addition, at least two higher ageing temperatures shall be selected, separated by intervals of 10 K or more. The highest ageing temperature shall result in a minimum log mean test life of 100 h. For EIM with a known melting point, the highest ageing temperature shall be at least 5 K below the melting point temperature.

6.3.3 Ageing periods

For each ageing temperature, there will be an assigned period of exposure. Suggested ageing periods are 24 h to 72 h for the highest ageing temperature, 48 h to 336 h for the intermediate ageing temperature, and 504 h to 840 h for the lowest ageing temperature. Based on the test data produced as the testing proceeds, the exposure period for the remaining test cycles may be doubled if less than one-half of the test objects reach end-of-life after completion of five cycles; it may be halved if one-third or more of the test objects reach end-of-life after completion of three cycles.

6.3.4 Means of heating

Thermal ageing may be carried out by placing the test objects in an accurately controlled and monitored oven with forced circulation as described in IEC 60216-4-1. The temperature throughout the oven shall be within ±2 K for ageing temperatures up to 180 °C, and ±3 K for ageing temperatures from 180 °C to 300 °C. Above 300 °C additional agreements on the required temperature accuracy should be made between parties.

Despite some evident disadvantages, ovens have been shown by experience to be a convenient and economical method of obtaining ageing temperatures. The oven method subjects all components of the EIS to the full ageing temperature.

However, the use of ovens for heating is not mandatory. Where the size of the electrotechnical product under test limits the use of ovens, or where there are other special considerations, a more direct means that more closely simulates service conditions may be used as specified in the applicable part, e.g. by means of current through windings in the test object.

6.3.5 Ageing procedure

For oven ageing, the test objects shall be placed directly into the preheated ageing oven at the beginning of the thermal ageing cycle, and removed from the oven directly to room temperature at the end of the ageing period. In order to diminish the effects of differences in actual ageing temperatures between individual test objects, the locations of the test objects in the ageing ovens should be randomized in successive thermal ageing cycles.

For other means of heating, test objects shall be brought to the ageing temperature in a minimum amount of time as described in the applicable Part.

NOTE Decomposition products should not influence the test significantly in any way other than normal operating conditions.

For all methods of thermal ageing, the test objects shall be immediately removed from the heating source and allowed to cool to room temperature at a natural rate prior to applying prediagnostic conditioning treatments.

6.4 Prediagnostic mechanical stress

Unless specified in the applicable part, each test object shall be subjected to a period of mechanical stress following each thermal ageing period. The procedure for applying this stress may vary with each type of test object and intended service, and should be specified in the applicable part. When applicable, the candidate and reference EIS shall be exposed to the same stress and duration of exposure at room temperature and humidity, and without any applied voltage.

6.5 Other prediagnostic conditioning

Exposure to other prediagnostic conditioning, such as thermal shock, may be performed according to end-use requirements, as specified in the applicable Part.

6.6 Moisture exposure

When specified in the applicable part, after thermal ageing, mechanical stress and other conditioning requirements, the test objects shall be exposed for 48 h in 95 % to 100 % relative humidity at 5 K to 10 K above room temperature with surface moisture present.

A suitable humidity chamber capable of maintaining the specified level of humidity shall be used.

6.7 Dielectric diagnostic tests

6.7.1 Initial dielectric diagnostic test

Initial dielectric diagnostic tests shall consist of the application of voltage stresses under conditions and at voltages consistent with the intended use of the electrotechnical product under test as specified in the applicable part.

6.7.2 Dielectric diagnostic test during ageing cycle

In order to check the condition of the test objects and determine end-of-life, the dielectric diagnostic test shall be applied after each successive exposure to moisture while the test objects are still in the humidity chamber or immediately after removal while still wet with moisture.

In certain cases, the presence of surface moisture may cause surface arcing or tracking; in such cases, the surface of the test object may be wiped free of water droplets immediately before application of the voltage.

6.8 Other diagnostic tests

Other diagnostic tests, such as insulation resistance, may also be used to determine end-of-life of a test object, e.g. by complementing the dielectric diagnostic tests. An end-point criterion may be established for each diagnostic test, with a suitable justification reported in the applicable part.

7 Analysing, reporting and classification

7.1 End-point criterion

The criterion by which a test object is considered to have failed shall be fully defined prior to the start of the test. An adequate test shall be included in the test cycle to detect when a failure occurs denoting end-of-life for each test object. The use of more than one end-point criterion will tend to make the interpretation of the test results more difficult. It is recommended that only one end-point criterion be used.

Failure of any component in the EIS constitutes failure of the entire test object and fixes the end-of-life.

NOTE Test objects may continue to be exposed to the thermal endurance test cycle in order to evaluate other components of the EIS.

The cause of all test object failures should be determined. End-of-life that can be attributed to a cause other than failure of the EIS should be disregarded. If a failure is not within the EIS, such as an open electrical connection, and can be repaired without disturbing the EIS, the test object may be put back on test.

7.2 Method of determining life

7.2.1 End-of-life

The end-of-life of a test object is assumed to have occurred at the midpoint of the ageing period between the last two consecutive applications of diagnostic tests: the one during which failure was observed and the last prior application of diagnostic tests with no failure.

7.2.2 Average life

The total number of hours of thermal ageing to end-of-life shall be recorded for each test object at each ageing temperature. The average life in hours at each ageing temperature shall be calculated as a geometric mean.

7.3 Extrapolation of data

Linear regression analysis in Arrhenius coordinates (log life versus reciprocal of the absolute temperature) shall be carried out in accordance with IEC 60216-5. Using the reference EIS test results, calculate the life in hours (t_R) at the EIS ATE (T_R) of the reference EIS. Using the test results for the candidate EIS, calculate the temperature (T_C) at the number of hours corresponding to t_R. T_C is the EIS RTE of the candidate EIS. The thermal class assigned to the candidate EIS shall be that which is equal to or less than T_C as shown in Table 2. If the EIS ATE (T_R) of the reference EIS is not available, the value in degrees Celsius of its thermal class shall be used.

Table 2 – Thermal class assignment

ATE or RTE °C		Thermal class °C	Letter designation[a]
≥90	<105	90	Y
≥105	<120	105	A
≥120	<130	120	E
≥130	<155	130	B
≥155	<180	155	F
≥180	<200	180	H
≥200	<220	200	N
≥220	<250	220	R
≥250[b]	<275	250	–

[a] If desired, the letter designation may be added in parentheses, e.g. Class 180 (H). Where space is a factor, such as on a nameplate, the product TC may elect to use only the letter designation.

[b] Designations of thermal classes over 250 shall increase by increments of 25 and be designated accordingly.

Results may be represented on a thermal endurance graph by plotting the mean life points (log means) as shown in Figure 1. Plot the reference EIS test results and extrapolate the line to its EIS ATE (T_R) and read the corresponding life in hours (t_R). Plot the test results for the candidate EIS. Extrapolate the line to t_R and read the corresponding temperature (T_C). T_C is the EIS RTE of the candidate EIS.

IEC 60493-1 describes how to test data for linearity. If the coefficient of correlation is greater than or equal to 0,95, the data is assumed to be linear. If the coefficient of correlation is greater than or equal to 0,90 but less than 0,95, it may indicate that ageing is being influenced by more than one chemical process or failure mechanism. Nevertheless, if very similar EIS belonging to the same thermal class are being compared, a valid classification of the candidate EIS may still be made. However, if the coefficient of correlation is less than 0,90, this may

indicate a significant change in the dominating ageing mechanism. Then the classification can be based only on the lower temperature portion of the curve, which shall be confirmed by an additional test point at a lower or intermediate temperature. It may be necessary to make a judgement on the basis of experience as to whether the time and cost of this further testing is justified, or can be abandoned.

7.4 Report of results

The report of the results of this test shall include all records, relevant details of the test, and analysis, including:

– reference to this IEC test standard and applicable part;
– description of the EIS tested (the reference and candidate EIS);
– ageing temperatures and ageing periods for each EIS;
– prediagnostic conditioning and diagnostic tests used with applied test or stress levels, for each EIS;
– detailed description of the test objects;
– number of test objects at each temperature for each EIS;
– method of obtaining the ageing temperatures (including oven type, etc.);
– rate of air replacement, if applicable;
– individual times to end-of-life, and mode of failure;
– mean log times to end-of-life for each ageing temperature, for each EIS;
– regression line with log mean points;
– regression equation and coefficient of correlation;
– EIS ATE/thermal class of the reference EIS;
– EIS RTE/thermal class of the candidate EIS.

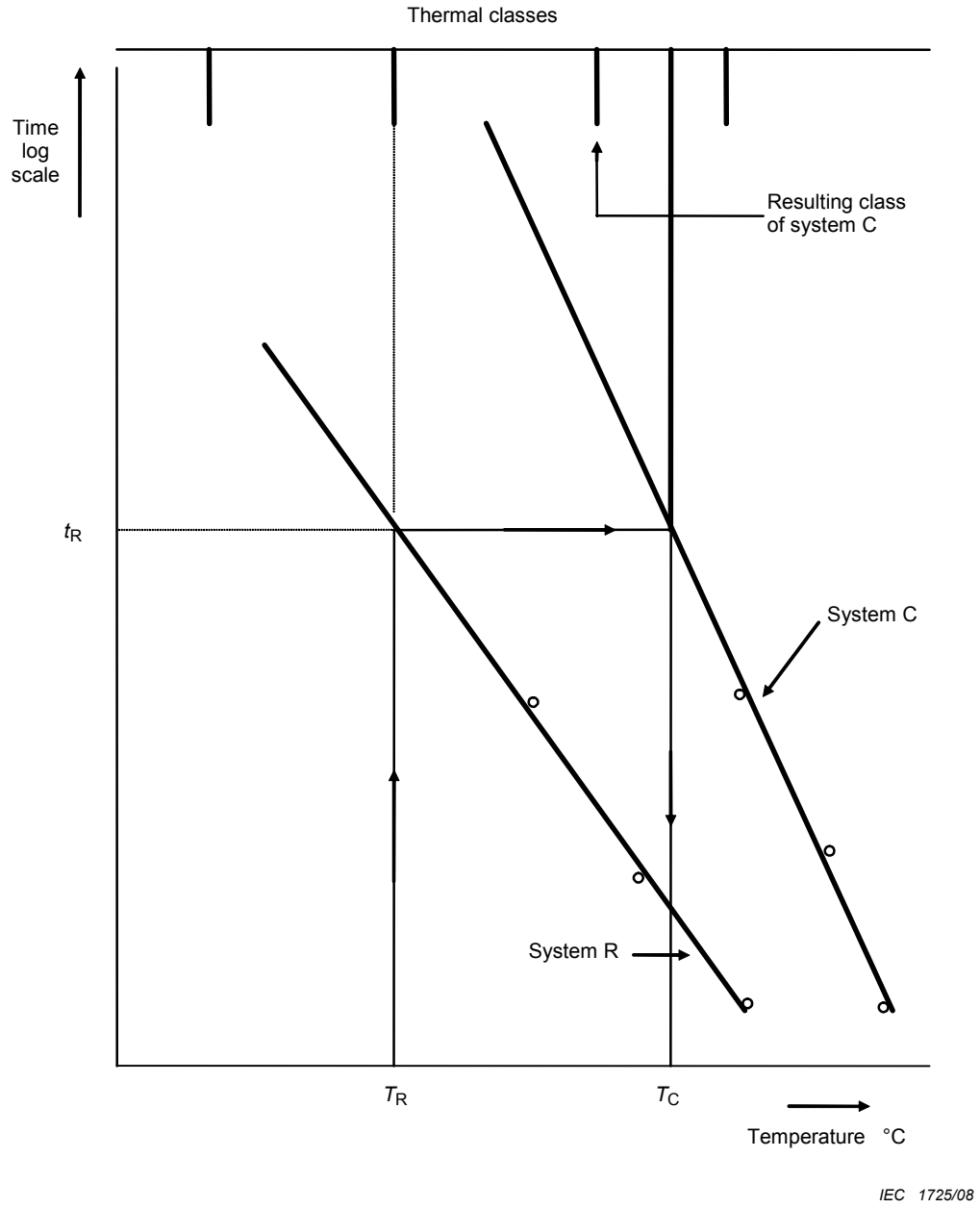

Figure 1 – Arrhenius graph for comparing a candidate system C with a reference system R

Bibliography

IEC 60034-18-1:1992, *Functional evaluation of insulation systems for rotating electrical machines – Part 18-1:General guidelines*

IEC 60034-18-21:1992, *Rotating electrical machines – Part 18: Functional evaluation of insulation systems – Section 21: Test procedures for wire-wound windings – Thermal evaluation and classification*

IEC 60034-18-31:1992, *Rotating electrical machines – Part 18: Functional evaluation of insulation systems – Section 31: Test procedures for form-wound windings – Thermal evaluation and classification of insulation systems used in machines up to and including 50 MVA and 15 kV*

IEC 60611:1978, *Guide for the preparation of test procedures for evaluating the thermal endurance of electrical insulation systems* (this publication was withdrawn in 2000)

IEC 60791:1984, *Performance evaluation of insulation systems based on service experience and functional tests* (this publication was withdrawn in 2004 and replaced by IEC 60505)

IEC 62114:2001, *Electrical insulation systems (EIS) – Thermal classification tests* (this publication was withdrawn in 2007 and replaced by 60085)

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