BS EN 60212:2011

BSI Standards Publication

Standard conditions for use prior to and during the testing of solid electrical insulating materials

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National foreword

This British Standard is the UK implementation of EN 60212:2011. It is identical to IEC 60212:2010. It supersedes BS 2844:1995, which is withdrawn.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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EN 60212

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Supersedes HD 437 S1:1984

English version

Standard conditions for use prior to and during the testing of solid electrical insulating materials
(IEC 60212:2010)

Conditions normales à observer avant et pendant les essais de matériaux isolants électriques solides
(CEI 60212:2010)

Standardbedingungen für die Anwendung vor und während der Prüfung von festen Elektroisolierstoffen
(IEC 60212:2010)

CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Foreword

The text of document (112/148/CDV), future edition 3 of IEC 60212, 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 60212 on 2011-01-19.

This European Standard supersedes HD 437 S1:1984.

The significant technical changes with respect to HD 437 S1:1984 are as follows:

– the scope and normative references have been updated and terms and definitions completely reviewed;

– technical details in Table 2 have been aligned to today's usage.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

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)	2011-10-19
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-01-19

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 60212:2010 was approved by CENELEC as a European Standard without any modification.

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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 60068-1 + corr. October + A1	1988 1988 1992	Environmental testing - Part 1: General and guidance	EN 60068-1[1)]	1994
IEC 60216-4-1	-	Electrical insulating materials - Thermal endurance properties - Part 4-1: Ageing ovens - Single-chamber ovens	EN 60216-4-1	-
ISO 62	2008	Plastics - Determination of water absorption	EN ISO 62	2008

[1)] EN 60068-1 includes A1 to IEC 60068-1 + corr. October .

CONTENTS

INTRODUCTION

Many electrical insulating materials have properties which are affected by the temperature or humidity, or both, of the atmospheres to which they are subjected. It is usually necessary, therefore, when testing these materials, to control both temperature and humidity prior to testing, as well as the conditions in which the specimens are actually tested. The selection of appropriate conditions and tests should be decided according to the materials specification and the intended application. Unless otherwise specified, specimens should be conditioned and measured in the same climate as that in which they are to be tested.

When giving results of tests on electrical insulating materials likely to be affected by those factors, it is important that the relevant conditions to which the test specimens were exposed are reported. Specifications for such materials should, therefore, identify the atmospheres to which the test specimens should be exposed before testing and the conditions under which the tests are to be made.

STANDARD CONDITIONS FOR USE PRIOR TO AND DURING THE TESTING OF SOLID ELECTRICAL INSULATING MATERIALS

1 Scope

This International Standard gives the accepted conditions of exposure time, temperature, atmospheric humidity and liquid immersion for use in testing solid electrical insulating materials. The range is sufficiently wide to enable suitable conditions to be selected so that either of the primary objects, set out below as a) and b), of conditioning can be achieved. These objectives aim to obtain greater reproducibility of test results by:

a) partly counteracting the variations of the properties of the material due to the past history of the test specimens (often known as "normalizing", here called preconditioning), and

b) ensuring uniformity of conditions during the testing.

This standard is not intended to be applied for determining the influence of exposure to certain temperatures and humidity or immersions in liquids, on the properties of a material. Procedures pertaining to the effect of an environment on a material are given in various parts of IEC 60068.

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 60068-1:1988, *Environmental testing – Part 1: General and guidance*
Amendment 1 (1992)

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

ISO 62:2008: *Plastics – Determination of water absorption*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
insulating material
solid with negligibly low electric conductivity, used to separate conducting parts at different electrical potentials

NOTE 1 In English, the term "insulating material" is sometimes used in a broader sense to also designate insulating liquids and gases.

NOTE 2 An insulating material may be a solid, a liquid or a gas, or a mixture of these. This standard refers only to a solid insulating material.

3.2
specimen
typical sample of the insulating material under test, as described in the relevant test specification

3.3
preconditioning
treatment of a specimen with the object of removing or partly counteracting the effect of its previous history with respect, principally, to the temperature and humidity to which it has been exposed

NOTE 1 This treatment is sometimes known as "normalizing".

NOTE 2 Preconditioning usually precedes conditioning of a specimen. When the combination of temperature and humidity for conditioning is the same as that prescribed for preconditioning, the preconditioning may be said to take the place of conditioning.

NOTE 3 Preconditioning may be effected by subjecting the specimen to climatic, electrical or any other conditions required by the relevant test specification.

3.4
conditioning (of a specimen)
subjection of a specimen for a specified duration to specific climatic conditions (usually a specified temperature and a specified relative humidity) or to an atmosphere of specified relative humidity or to complete immersion in water or other liquid at a specified temperature

NOTE 1 When the combination of temperature and humidity for conditioning is the same as that prescribed for preconditioning, the preconditioning and conditioning may be merged and the preconditioning may be said to take the place of conditioning.

NOTE 2 According to circumstances, the space used for conditioning may be a whole laboratory room in which the specified conditions are maintained within the prescribed tolerances, or a special chamber.

3.5
chamber
enclosure or space in some part of which the specified conditions can be achieved

3.6
working space
part of the chamber in which the specified conditions can be maintained within the specified tolerances

3.7
period of conditioning
time that a specimen is subjected to conditioning

3.8
recovery
treatment of a specimen, after conditioning, in order that the properties remain stable before measurement

3.9
test conditions
temperature and humidity of the atmosphere surrounding the specimen, or temperature and kind of liquid (for liquid immersion), at the time tests are carried out

3.10
standard reference atmosphere
atmosphere to which values measured under any other atmospheric conditions are corrected by calculation

3.11
relative humidity
ratio of the actual vapour pressure (which indicates the amount of water vapour present in the air) to the theoretical maximum (saturation) vapour pressure at the same temperature, expressed as a percentage

3.12
vapour pressure
pressure exerted by a vapour in equilibrium with its solid or liquid phase

3.13
saturation vapour pressure
maximum possible pressure exerted by a vapour in equilibrium with its solid or liquid phase, such that any increase will initiate within the vapour a change to a more condensed state

3.14
ageing
irreversible changes in one or more properties of a material as a result of its normal use or as a result of time through the action of an electrical, thermal, mechanical and/or environmental stress

4 Temperature and humidity (or liquid immersion) recommended for preconditioning, conditioning and testing

The recommended standard conditions of temperature and humidity (or liquid immersion) for preconditioning, conditioning and testing are given in Tables 2 and 3. Parameters should be carefully chosen so that treatment does not cause ageing in a test specimen.

When preconditioning is required, one of the standard atmospheres or one of the dry-hot conditions given in Table 2 may be used for a time specified in the material specification, (e.g. 24 h ± 2 h). It is usual to specify (55 ± 2) °C with a relative humidity of less than 20 %.

Preconditioning can be necessary in order to eliminate the effects of stress appearing after the moulding process of some plastic materials or as a drying treatment before the test procedure starts. The preconditioning shall normally be handled in a different environment.

The environment surrounding the sample (such as oil) shall be defined such that it does not have a deleterious effect on the sample's properties. There may be more than one preconditioning environment required to remove previous history and maximize reproducibility of results. Immersion in oil/liquid is only needed if testing is required to be undertaken in a liquid. A preconditioning fluid will have an influence on the test properties so further conditioning may be needed before testing and a recovery procedure required, as given in IEC 60068-1. The property of the sample will change through the time frame of the test unless it is correctly prepared beforehand.

5 Period of conditioning

The period of conditioning should be specified in the relevant material standard or test method. The period of conditioning will usually depend upon the type of material being tested.

In general, it is not intended that the period of conditioning shall be sufficient to enable the specimens to reach equilibrium with the surrounding atmosphere. The rate at which equilibrium is reached depends largely upon the nature and dimensions of the test specimens. Consequently, the period of exposure necessary to obtain equilibrium may in some cases (e.g. thin paper) be only a matter of a few minutes, but in others (such as hard rubber) it may be many months.

It is recommended that periods of conditioning be selected from the list given in Table 4.

6 Procedures for atmospheric preconditioning, conditioning and testing

It is strongly recommended that, whenever possible, tests should be made on specimens in a room or in a suitable chamber in which the required conditions are maintained throughout the test.

The test specimens may be conditioned (e.g. in a suitable chamber) and rapidly transferred to the testing room atmosphere, provided that the conditions in the testing room do not differ materially from the required conditions. This is admissible only when the property of the material under test is unlikely to be affected appreciably by transfer from the required conditioning atmosphere to the testing atmosphere. The maximum period allowed between the transfer and the test should be indicated in the test specification. The tests should be made within a few minutes of such a transfer if the maximum period allowable is not given.

Any technique may be used for obtaining the required conditions for the test specimens prior to, and during, testing (e.g. controlling temperature and humidity in the room or chamber). The required conditions shall be maintained throughout the preconditioning, conditioning and testing operations.

Care should be taken to allow free access of the conditioning atmosphere to all the specimens, and to ensure uniform conditions throughout the conditioning atmosphere in the neighbourhood of the specimens.

Where assisted drying is required before commencing testing, the hot dry atmosphere at 55 °C, given in Table 2, may be used for at least 4 h, unless otherwise prescribed in the relevant materials standard and test specification.

When dry-hot conditions are used, the oven should be ventilated. Information on oven ventilation is given in IEC 60216-4-1.

When certain types of materials are being conditioned, harmful products may develop and it is important to prevent these from contaminating specimens of other materials.

When measuring leads are passed through the wall of a chamber, care should be taken to prevent significant leakage paths in parallel with the electrodes or measuring instrument, e.g. over the surfaces of the insulation of the leads.

7 Liquid immersion, conditioning and testing

The recommended temperatures for liquid immersion, conditioning and testing are given in Table 3. Specimens should be preconditioned, if specified, and immersed in the liquid at the specified temperature for the required time given in the material specification.

Care should be taken to allow free access of the liquid to all the specimens and to ensure uniform conditions throughout the liquid in the neighbourhood of the specimens.

When some materials are being conditioned, harmful products may develop and it is important to prevent contamination of specimens of other materials.

If the specimen cannot be tested in the liquid, it should be taken from the liquid and the surface liquid removed by pressing with a clean, dry filter, or blotting paper, or by wiping with a clean absorbent cloth before testing. The test should be commenced immediately after the surplus liquid has been removed, and completed as soon as possible. The maximum time between the removal of the specimen from the liquid and the measurement should be specified in the material specification.

8 Standard reference atmosphere

The standard atmosphere (B) of 23 °C ±2 °C and 50 % ±10 % relative humidity, see Table 2, is the preferred ambient atmosphere for conditioning and testing and should be used unless otherwise prescribed in the test specification. It is recommended that no other atmospheres are used if the insulating material is to be used at ambient conditions.

Results of tests which have been obtained at different temperatures and/or humidities cannot be correlated to a standard atmosphere.

9 Code for specifying preconditioning, conditioning and testing

Where it is desired to use a code for describing the conditions used for preconditioning, conditioning and testing, the following codes, shown in Table 1, should be used.

Table 1 – Codes for preconditioning, conditioning and testing

Conditioning	Code
As received	R
Atmospheric preconditioning and conditioning	(Hours) h/(temperature) °C/(r.h.) %
Immersion conditioning	(Hours) h/(temperature) °C/liquid
Testing (M)	M/(temperature) °C/(r.h.) %

When the conditioning time is in weeks, the time portion of the code may be expressed as weeks (w).

When preconditioning is used before conditioning, the two codes should be connected with a plus sign (+). A semicolon should separate the conditioning code from the testing code. Thus, if a specimen is to be preconditioned for 48 h at 55 °C and less than 20 % r.h., conditioned 96 h at 23 °C and 50 % r.h. and tested in the same atmosphere, the code would read:

48 h/55 °C/<20 % + 96 h/23 °C/50 %; M/23 °C/50 %.

If preconditioning is not foreseen, the first part of the code is omitted.

If the required tolerances are different from those designated in Tables 2 and 3, the tolerance should be included in the code as, for instance, 96 h/20 ± 0,5 °C/93 ± 1 %.

10 Report

The reporting procedure, as set out in the test specification, shall be followed and should include a reference to this standard and the preconditioning, conditioning and test conditions that the specimens were exposed to – in the form of the code described above.

Table 2 – Standard atmospheric conditions for testing and conditioning

Condition designation (See Note 1)	Title	Temperature °C (See Note 2)		Relative humidity % (See Notes 2 and 3)	
R	As received	–		–	
(Hours) h/15–35°C/ 45-75 %	Standard ambient (Note 4, 5)	15 to 35		45 to 75	
(Hours)h/20°C/65 %	Standard atmosphere A	20	± 2	65	± 10
(Hours)h/23°C/50 %	Standard atmosphere B	23		50	
(Hours)h/27°C/65 %	Standard atmosphere C	27		65	
(Hours)h/23°C/93 %	Damp	23		93	± 3
(Hours)h/40 °C/93 %	Damp-warm	40		93	
(Hours)h/55 °C/93 %	" "	55		93	
(Hours)h/15–35 °C/<1,5 %	Dry (Notes 4, 5)	15 to 35	±2	Less than 1,5	
(Hours)h/55 °C/<20 %	Dry hot	55	± 2	Low (less than 20)	
(Hours)h/70 °C/<20 %	" "	70		"	
(Hours)h/90 °C/<20 %	" "	90		"	
(Hours)h/105 °C/<20 %	" "	105		"	
(Hours)h/120 °C/<20 %	" "	120		"	
(Hours)h/130 °C/<20 %	" "	130		"	
(Hours)h/155 °C/<20 %	" "	155		"	
(Hours)h/180 °C/<20 %	" "	180		"	
(Hours)h/200 °C/<20 %	" "	200	± 3	"	
(Hours)h/220 °C/<20 %	" "	220		"	
(Hours)h/250 °C/<20 %	" "	250		"	
(Hours)h/275 °C/<20 %	" "	275	± 5	"	
(Hours)h/320 °C/<20 %	" "	320		"	
(Hours)h/400 °C/<20 %	" "	400		"	
(Hours)h/500 °C/<20 %	" "	500	± 10	"	
(Hours)h/630 °C/<20 %	" "	630		"	
(Hours)h/800 °C/<20 %	" "	800	± 20	"	
(Hours)h/1 000 °C/<20 %	" "	1 000		"	
(Hours)h/–10 °C/–	Cold	–10	± 3	"	
(Hours)h/–25 °C/–	"	–25		"	
(Hours)h/–40 °C/–	"	–40		"	
(Hours)h/–55 °C/–	"	–55		"	
(Hours)h/–65 °C/–	"	–65		"	

NOTE 1 The periods for preconditioning and conditioning (represented by "Hours" in column 1) should be specified in the material specification and should be selected from Table 4.

NOTE 2 In special cases, closer tolerances may be used, e.g. ±1 °C and ±2 r.h. %

NOTE 3 When the testing specification requires a period of preconditioning or conditioning, it is important to distinguish between the overall limits of the temperatures within which it may be carried out, and the limits within which the temperature should be maintained in order to keep within the specified relative humidity limits, e.g. the temperature tolerances in column 3 will not in themselves ensure the close relative humidity control required by column 4.

NOTE 4 When the range of 15 °C to 35 °C is considered too wide, the range may be reduced to 18 °C to 28 °C.

NOTE 5 When a temperature (t) is chosen in this range it should be specified in the designation, (Hours) h/t °C /r.h. %.

Table 3 – Standard liquid immersion conditions for testing and conditioning

Condition designation (See Note 1)	Title	Liquid	Temperature °C (See Note 2)
(Hours)h/23±0,5°C/water	Standard water immersion[a]	Distilled water or water of equivalent purity (de-ionized water)	23 ± 0,5
(Hours)h/20 °C/liquid	Liquid immersion	As designated	20
(Hours)h/23 °C/liquid	" "	"	23
(Hours)h/27 °C/liquid	" "	"	27
(Hours)h/55 °C/liquid	" "	"	55
(Hours)h/70 °C/liquid	" "	"	70 ± 2
(Hours)h/90 °C/liquid	" "	"	90
(Hours)h/105 °C/liquid	" "	"	105
(Hours)h/120 °C/liquid	" "	"	120
(Hours)h/130 °C/liquid	" "	"	130
NOTE 1 The period of immersion (represented by "Hours" in column 1) should be specified in the material specification and selected from Table 3. NOTE 2 For special tests, closer tolerances may be required, for instance ±0,5 ° C in place of ±2 ° C.			
* This is the immersion condition given in ISO 62:2008: Plastics — Determination of water absorption			

Table 4 – List of preferred periods for preconditioning and conditioning

Hours	1	2	4	8	16	24		48		96
Hours	168	336	672	1 344	2 688		4 368		8 736	
(Weeks)	(1)	(2)	(4)	(8)	(16)		(26)		(52)	

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