SLOVENSKI STANDARD
SIST EN 60068-2-33:2001

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Environmental testing - Part 2: Tests - Guidance on change of temperature tests

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Umweltprüfungen -- Teil 2: Prüfungen - Leitfaden zur Prüfgruppe N: Temperaturwechsel

Essais d'environnement -- Partie 2: Essais - Guide pour les essais de variations de température

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Environmental testing
Part 2: Tests - Guidance on change of temperature tests
(IEC 60068-2-33:1971 + A1:1978)

Essais d'environnement
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This European Standard 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.

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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

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Foreword

The text of the International Standard IEC 60068-2-33:1971 and its amendment 1:1978, prepared by SC 50B (transformed into IEC TC 104 "Environmental conditions, classification and methods of test), was approved by CENELEC as HD 323.2.33 S1 on 1988-03-01.

This Harmonization Document was submitted to the formal vote for conversion into a European Standard and was approved by CENELEC as EN 60068-2-33 on 1999-10-01.

The following date was 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) 2000-10-01

Endorsement notice

The text of the International Standard IEC 60068-2-33:1971 and its amendment 1:1978 was approved by CENELEC as a European Standard without any modification.

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Essais fondamentaux climatiques et de robustesse mécanique

Deuxième partie:
Essais
Guide pour les essais de variations de température

Basic environmental testing procedures

Part 2:
Tests
Guidance on change of temperature tests

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

BASIC ENVIRONMENTAL TESTING PROCEDURES

Part 2: Tests — Guidance on change of temperature tests

FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

3) In order to promote this international unification, the IEC expresses the wish that all National Committees having as yet no national rules, when preparing such rules, should use the IEC recommendations as the fundamental basis for these rules in so far as national conditions will permit.

4) The desirability is recognized of extending international agreement on these matters through an endeavour to harmonize national standardization rules with these recommendations in so far as national conditions will permit. The National Committees pledge their influence towards that end.

PREFACE

This Recommendation has been prepared by Sub-Committee 50B, Climatic Tests, of IEC Technical Committee No. 50, Environmental Testing.

It is intended to give guidance for Test N: Change of Temperature (IEC Publication 68-2-14).

A first draft was discussed at the meeting held in Stockholm in 1968, as a result of which a new draft was submitted to the National Committees for approval under the Six Months' Rule in January 1969.

The following countries voted explicitly in favour of publication:

Australia
Austria
Belgium
Czechoslovakia
Denmark
Finland
Germany
Hungary
Israel
Japan
Korea (Republic of)
Netherlands
Norway
Romania
South Africa
Switzerland
Turkey
United Kingdom
United States of America

BASIC ENVIRONMENTAL TESTING PROCEDURES

Part 2: Tests — Guidance on change of temperature tests

1. Introduction

This Recommendation gives guidance to designers and testing personnel on the specification and use of change of temperature tests.

A change of temperature test is intended to determine the effect on the specimen of a change of temperature or a succession of changes of temperature.

It is not intended to show effects which are due only to the high or low temperature. For these effects, the dry heat test or the cold test should be used.

The effect of such tests is determined by:

— values of high and low conditioning temperature between which the change is to be effected;

— the conditioning times for which the test specimen is kept at these temperatures;

— the rate of change between these temperatures;

— the number of cycles of conditioning;

— the amount of heat transfer into or from the specimen.

2. Field conditions of changing temperature

In electronic equipment and components, only gradual changes of temperature usually occur. Parts inside an equipment will undergo slower changes of temperature than those on an external surface of the equipment when it is not switched on.

Rapid changes of temperature may be expected:

— when equipment is transported from warm indoor environments into cold open air conditions or vice versa;

— when equipment is suddenly cooled by rainfall or immersion in cold water;

— in externally mounted airborne equipment;

— or under certain conditions of transportation and storage.

Components will undergo stresses due to changing temperature when high temperature gradients build up in an equipment after switching on; e.g. in the neighbourhood of high wattage resistors, radiation can cause rise of surface temperature in neighbouring components while other portions are still cool.

Artificially cooled components may be subjected to rapid temperature changes when the cooling system is switched on.

Rapid changes of temperature in components may also be induced during manufacturing processes of equipment.

The number and amplitude of temperature changes, and the time interval between them, are important.

When a transfer time of 2 min to 3 min is applied, the magnitude of the thermal stresses experienced by the specimen will be less for very small items than for large ones. The thermal stresses, however, will bear a relationship to that which would be experienced by such a specimen when it was transported within a few minutes from an atmosphere at one extreme of temperature to one at the other extreme.

The effects on components and equipment of temperature rise and temperature fall may be different. Dew or frost appearing on components or equipment may cause additional stresses and, where these additional stresses are not desired, humidity should be suitably controlled to minimize these effects.

3. Basic philosophy

3.1 *Design of change of temperature tests*

The change of temperature tests, Tests Na, Nb and Nc (IEC Publication 68-2-14), comprise alternate periods at a high and at a low temperature with well defined transitions from one temperature to the other. The conditioning run from room temperature to the first conditioning temperature, then to the second conditioning temperature, and back to room temperature, is called one test cycle.

3.1.1 *Test parameters*

— Room temperature.

— High temperature.

— Low temperature.

— Duration of exposure.

— Interval between exposure to the two extremes of temperature.

— Number of test cycles.

The high and low temperatures are understood to be ambient temperatures which will be reached by most specimens with a certain time-lag.

Only in exceptional cases may they be specified outside the normal storage or operating temperature range of the object under test.

The test is accelerated because the number of severe changes of temperature in a given period is greater than that which will occur under field conditions.

3.2 *Purpose and choice of the tests*

A change of temperature test is not intended to simulate field conditions exactly. The purpose of a change of temperature test is to stress specimens in order to determine whether they are properly designed or made.

3.2.1 Change of temperature testing is recommended in the following cases :

3.2.1.1 Evaluation of electrical performance during a change of temperature, Test Nb.

3.2.1.2 Evaluation of mechanical performance during a change of temperature, Test Nb.

3.2.1.3 Evaluation of electrical performance after a specified number of rapid changes of temperature, Test Na or Test Nc.

3.2.1.4 Evaluation of the suitability of mechanical components, and of materials and combinations of materials to withstand rapid changes of temperature, Test Na or Test Nc.

3.2.1.5 Evaluation of the suitability of construction of components to withstand artificial stressing, Test Na or Test Nc.

3.2.2 The change of temperature tests specified in IEC Publication 68 are not intended to evaluate the difference in material constants or electrical performance when operating under temperature stability at the two extremes of temperature.

3.3 *Choice of the duration of the exposure*

The duration of the exposure should be related in such a way to the temperature time constant of the specimens (or of their critical parts) that they would reach the approximate ambient temperature of the space or of the bath. It is, therefore, important to know the temperature time constant of the specimen. As the temperature time constant of the outside and inside parts of large specimens (equipment) may differ considerably from each other, it is preferable to take into consideration the temperature time constant of the innermost or most critical part.

The time constant depends upon the nature and movement of the surrounding medium (air in Tests Na and Nb, water in Test Nc, etc.), and it is desirable, therefore, to determine experimentally the time constant in the actual ambient conditions of test. When choosing the duration of the exposure, the following should be considered (see Figure 1) :

if $t_1 \geqq 5\,\tau$ then $d < 0.01\ D$

and if $t_1 \geqq 2.5\,\tau$ then $d < 0.1\ D$

where :

t_1 is the duration of the exposure

τ is the temperature time constant of the specimen

d is the difference between the temperatures of the test medium and the specimen

D is the difference between the hot and cold conditioning temperatures $|T_B| - |T_A|$

3.4 *Choice of the duration of the change-over time*

If, in the case of the two-chamber method, in consequence of the large size of the specimens the change over cannot be made in 2 min to 3 min, the change-over time may be increased without an appreciable influence on the test results as follows :

$$t_2 \leqq 0.05\,\tau$$

where :

t_2 is the duration of the change-over time

τ is the temperature time constant of the specimen

3.5 *Applicability limits of change of temperature tests*

3.5.1 Inside a specimen, the rate of change of temperature depends on the heat conduction of its materials, on the spatial distribution of its heat capacity and on its dimensions.

The change of temperature at a point on the surface of a specimen follows approximately an exponential law. Inside large specimens, the superposition of such alternate exponential rises and