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British Standard

Basic environmental testing procedures

Part 2.1 Tests

Tests B. Dry heat

Essais fondamentaux climatiques et de robustesse mécanique
Partie 2.1 Essais. Essais B. Chaleur sèche

Grundsätzliche Umweltprüfverfahren
Teil 2.1 Prüfungen. Prüfungen B. Trockene Hitze

(This Part should be read in conjunction with Part 1.1 General)

Foreword

This British Standard has been prepared under the direction of the General Electrotechnical Engineering Standards Committee. It is identical with IEC Publication 68-2-2: 1974 'Basic environmental testing procedures. Part 2 : Tests - Tests B : Dry heat'.

This British Standard supersedes BS 2011 : Part 2B : 1966 'Methods for the environmental testing of electronic components and electronic equipment' Part 2B 'Dry heat', which is therefore withdrawn.

Amendment No. 1 to BS 2011 : Part 2.1B was issued to implement Supplement A (July 1976) to IEC Publication 68-2-2.

Terminology and conventions. The text of the IEC Publication has been accepted as suitable for publication, without deviation, as a British Standard. Certain terminology and conventions are used, however, that are not identical with those used in British Standards. Attention is therefore drawn to the following.

Wherever the word 'publication', relating to this document, appears, it should be interpreted as 'British Standard'.

Wherever page numbers are quoted in connection with references to block diagrams in this publication, they are IEC page numbers.

Cross references. For each of the following references to other IEC Publications that are given in the text, there is an equivalent British Standard; these are listed below.

Reference to IEC Publication

IEC 68-3-1 Basic environmental testing procedures
Part 3 Background information — Section one Cold and dry heat tests

IEC 68-1 Basic environmental testing procedures
Part 1 General

Equivalent British Standard

BS 2011 : Part 3A and B Basic environmental testing procedures
Part 3 Background information : Tests A and B
Cold and dry heat

BS 2011 : Part 1.1 Basic environmental testing procedures
Part 1.1 General

The relationship of suffixes between Tests A : Cold, and Tests B : Dry heat, is shown in the table on page 3.

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Suffix letter	Tests A: Cold			Tests B: Dry heat		
	Specimen type	Temperature change	Specimen temperature at commencement of test duration	Specimen type	Temperature change	Specimen temperature at commencement of test duration
a	non heat	sudden	stabilized*	non heat	sudden	stabilized*
b	non heat	gradual	stabilized*	non heat	gradual	stabilized*
c	—	—	—	heat	sudden	stabilized*
d	heat	gradual	stabilized*	heat	gradual	stabilized*

* The specimens will normally reach temperature stability before commencement of test duration. In exceptional cases, this will not be so, and additional information will be required in the relevant specification. See Clause 1 of the Introduction and IEC Publication 68-3-1. (Amendments to cover these cases are under consideration.)

INTRODUCTION

1. General

This publication deals with dry heat tests applicable both to heat-dissipating and non heat-dissipating specimens. For non heat-dissipating specimens, Tests Ba and Bb do not deviate essentially from earlier issues.

The object of the dry heat test is limited to the determination of the ability of components, equipment or other articles to be used or stored at high temperature.

These dry heat tests do not enable the ability of specimens to withstand or operate during temperature variations to be assessed. In this case, it would be necessary to use Test N: Change of temperature.

The dry heat tests are subdivided as follows:

Dry heat tests for non heat-dissipating specimens

- with sudden change of temperature, Ba;
- with gradual change of temperature, Bb.

Dry heat tests for heat-dissipating specimens

- with sudden change of temperature, Bc;
- with gradual change of temperature, Bd.

The procedures given in this publication are normally intended for specimens which achieve temperature stability during the performance of the test procedure.

The duration of the test commences at the time when temperature stability of the specimen has been reached.

For the exceptional cases when the specimen does not reach temperature stability during the performance of the test procedure, the duration of the test commences at the time when the test chamber reaches the test temperature.

The relevant specification shall define:

- a) the rate of change of temperature in the test chamber;
- b) the time at which the specimens are introduced into the test chamber;
- c) the time at which the exposure commences;
- d) the time at which the specimens are energized.

For these cases, the specification writer will find guidance on choosing the above four parameters in IEC Publication 68-3-1. (Amendments to cover these cases are under consideration.)

2. Application of tests for non heat-dissipating specimens versus tests for heat-dissipating specimens

A specimen is considered heat-dissipating only if the hottest point on its surface, measured in free air conditions (i.e. with no forced air circulation), is more than 5 deg C above the ambient temperature of the surrounding atmosphere after temperature stability has been reached (see IEC Publication 68-1, Sub-clause 4.6).

It is obvious that when the relevant specification calls for a storage test or does not specify an applied load during the test, the Dry Heat Tests Ba and Bb will apply.

3. For non heat-dissipating specimens: Application of tests with sudden change of temperature versus tests with gradual change of temperature

In Test Ba with sudden change of temperature, the specimen is introduced into the test chamber, the latter being at the temperature specified for the test. It has been introduced as a convenient and time-saving method. Test Ba shall be used only when it is known that the effects of a sudden change of temperature are not detrimental to the test specimen.

In Test Bb with gradual change of temperature, the specimen is introduced into the test chamber, the latter being at the laboratory temperature. The temperature in the chamber is then increased gradually so as to cause no detrimental effects on the test specimen due to the temperature change.

4. Testing of heat-dissipating specimens with and without forced air circulation

The preferable method of testing heat-dissipating specimens is that which does not use forced air circulation. If this is impracticable, however, Tests Bc and Bd envisage also procedures for testing heat-dissipating specimens with forced air circulation.

Two methods for testing with air circulation are given (Method A, Method B). Method A applies to the cases where the chamber is large enough to comply with the requirements for testing without forced air circulation, but where the high temperature cannot be maintained without circulating the air in the chamber.

Method B applies to the cases where the chamber is too small to comply with the requirements for testing without forced air circulation.

5. Diagrammatic representations

To facilitate the choice of test method, a diagrammatic representation of the various procedures is given on page 15.

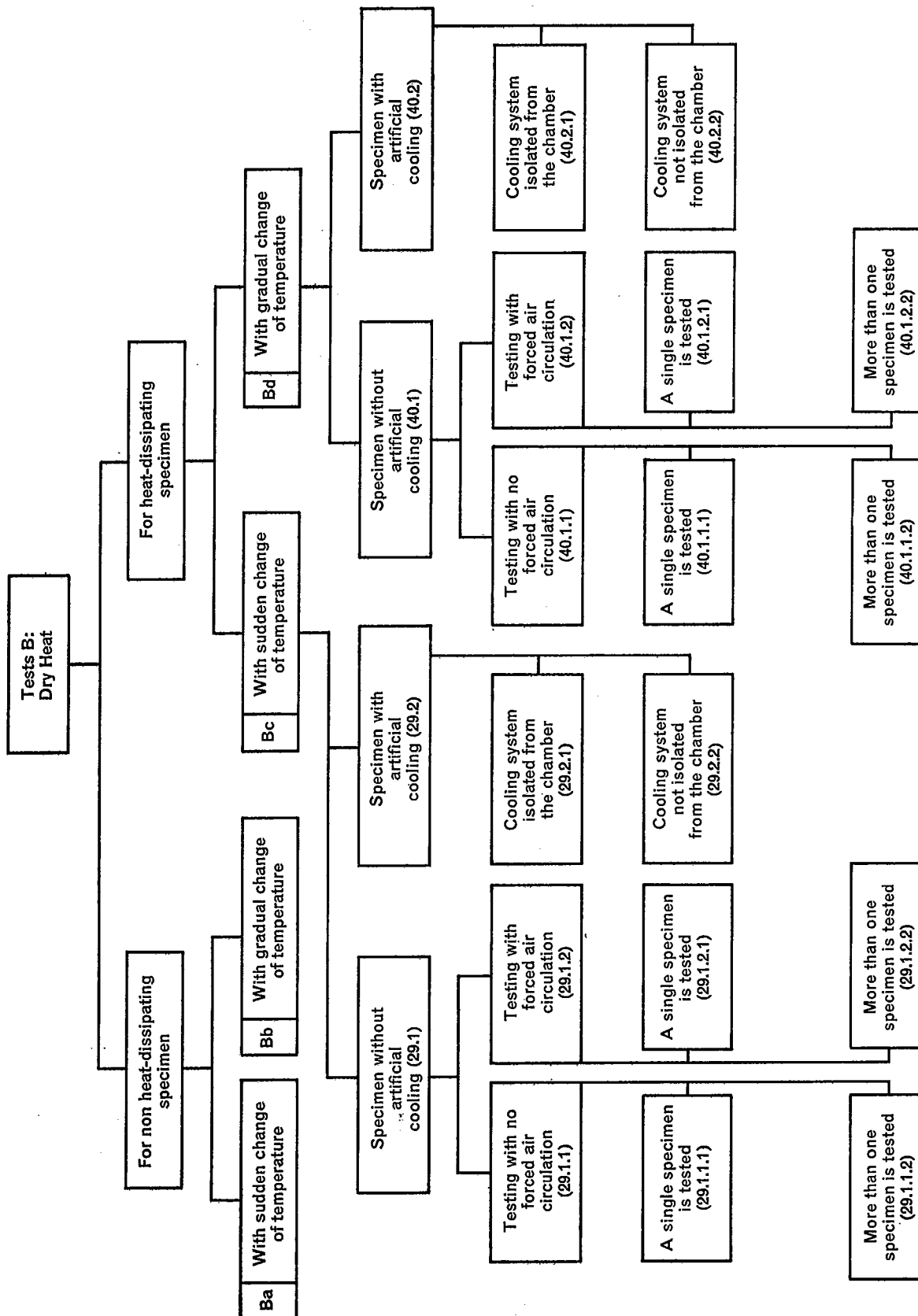
For the convenience of the user of this publication, a complete text without cross-references for each testing procedure is given.

Several clauses are therefore identical, especially in Tests Ba and Bb and in Tests Bc and Bd.

A block diagram showing which clauses are identical and which are different is given on page 16.

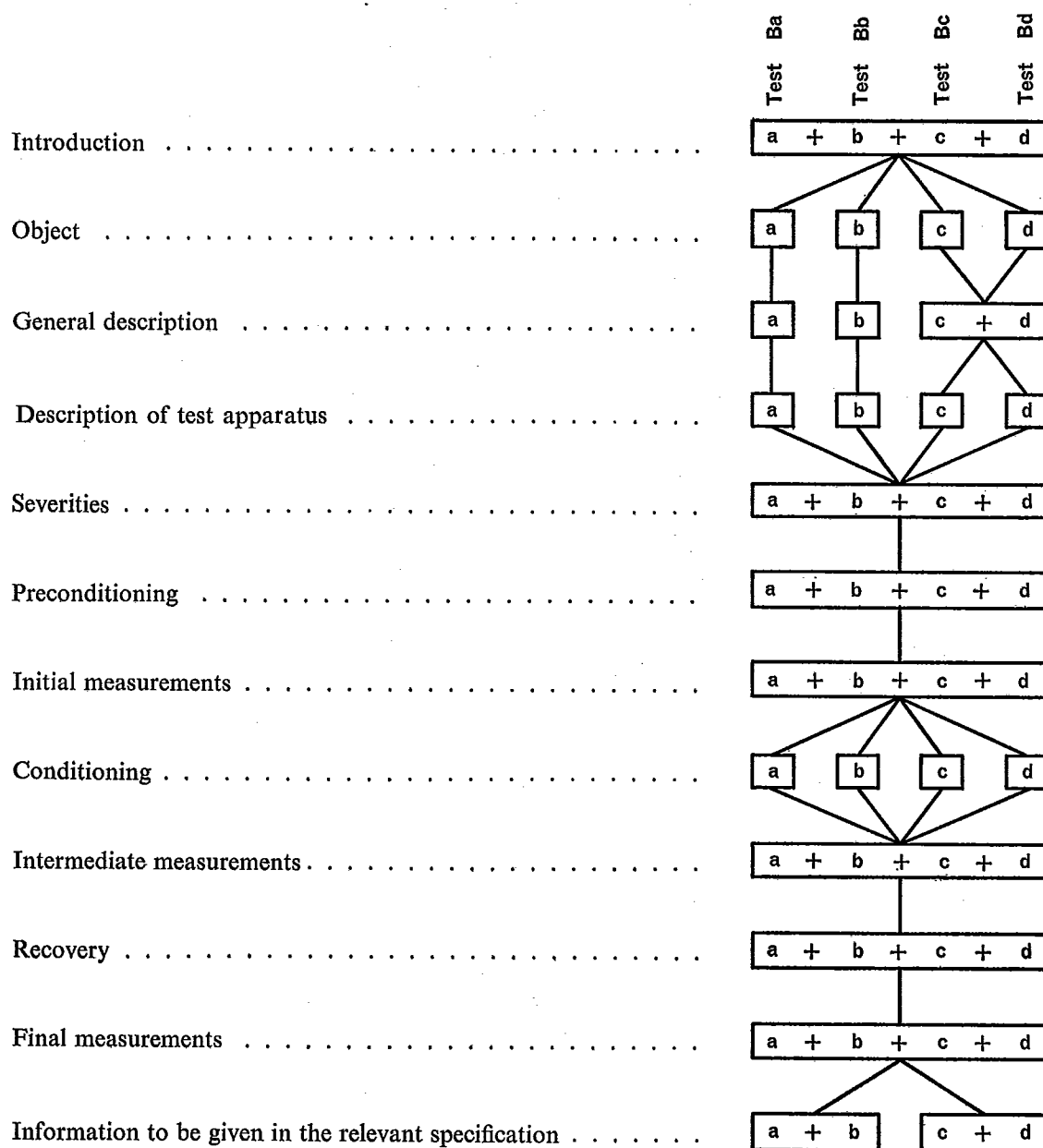
BLOCK DIAGRAM OF TESTS B: DRY HEAT

DIAGRAMMATIC REPRESENTATION OF THE VARIOUS TEST PROCEDURES



BLOCK DIAGRAM OF TESTS B: DRY HEAT

Identical and different clauses of the Tests Ba, Bb, Bc and Bd are shown in this diagram



SECTION ONE — TEST Ba: DRY HEAT FOR NON HEAT-DISSIPATING SPECIMEN WITH SUDDEN CHANGE OF TEMPERATURE

1. Object

To provide a standard test procedure to determine the suitability of non heat-dissipating components, equipment or other articles for use and/or storage under conditions of high temperature and for which the subjection to a sudden change of temperature has no detrimental effect.

This procedure is for specimens which are subjected to an elevated temperature for a time long enough for the specimen to achieve temperature stability.

In this procedure, the test duration is normally measured from the time when the specimen achieves temperature stability. For cases where this does not apply, see Introduction, Clause 1.

2. General description

In this test, the specimen while being at the ambient temperature of the laboratory is introduced into the chamber, the latter being at the temperature appropriate to the degree of severity as specified in the relevant specification.

After temperature stability of the test specimen has been reached, the specimen is exposed to these conditions for the specified duration.

Specimens under test are normally in non-operating conditions.

Forced air circulation is normally used for this test.

3. Description of test apparatus

3.1 The chamber shall be capable of maintaining the specified temperature in the working space within the tolerances given in Sub-clause 4.1. Forced air circulation may be used to maintain homogeneous conditions.

3.2 In order to limit radiation problems, the temperature of the walls of the chamber shall not differ by more than 3% of the specified ambient temperature of the test, expressed in K. This requirement applies to all parts of the chamber walls and the specimens shall be unable to "see" any heating or cooling elements which do not comply with this requirement.

3.3 The absolute humidity shall not exceed 20 g of water vapour per cubic metre of air (corresponding approximately to 50% relative humidity at 35 °C). When testing is performed at a temperature lower than 35 °C, the relative humidity shall not exceed 50%.

4. Severities

The severities, as indicated by temperature and duration of exposure, shall be specified in the relevant specification. The values shall be selected from those given in Sub-clauses 4.1 and 4.2.

4.1 Temperature

- + 200 ± 2 °C
- + 175 ± 2 °C
- + 155 ± 2 °C
- + 125 ± 2 °C
- + 100 ± 2 °C

- + 85 ± 2 °C
- + 70 ± 2 °C
- + 55 ± 2 °C
- + 40 ± 2 °C
- + 30 ± 2 °C

Notes 1. — In the absence of other considerations, temperatures above 200 °C and up to 1 000 °C should be chosen from the following values:

250 °C 315 °C 400 °C 500 °C 630 °C 800 °C 1 000 °C.

The tolerance in each case should be ± 2% of the above temperatures in °C.

2. — Where due to the size of the chamber it is not feasible to maintain these tolerances, the tolerance may be widened to ± 3 °C up to 100 °C and ± 5 °C up to 200 °C. When this is done, the tolerance used shall be specified in the test report.

4.2 *Duration*

- 2 h
- 16 h
- 72 h
- 96 h

Where this testing procedure is used in connection with tests associated with endurance or reliability, due note shall be taken of IEC publications which give particular recommendations for durations for such tests.

If the only intention of the testing procedure is to show whether the specimen will function at high temperature, the conditioning may be limited to a time such that the specimen under the test has reached temperature stability. In no case shall the duration be less than 30 min.

5. **Preconditioning**

The relevant specification may call for a preconditioning.

6. **Initial measurements**

The specimen shall be visually inspected and electrically and mechanically checked as required by the relevant specification.

7. **Conditioning**

7.1 The chamber shall be at the temperature of the specified severity.

The specimen, while being at the ambient temperature of the laboratory, shall be introduced into the chamber in the unpacked, switched off, "ready for use" state, in its normal position or as otherwise specified.

When the test specimen is intended for use with specific mounting devices, these should be used for testing.

The test (ambient) temperature shall be measured as in Sub-clause 4.4 of IEC Publication 68-1.

7.2 Time shall then be allowed for the chamber conditions to be re-established and for the specimen to reach temperature stability. (Temperature stability is defined in Sub-clause 4.6 of IEC Publication 68-1.)

7.3 For operational tests only:

The specimen shall be switched on or electrically loaded and checked to ascertain whether it is capable of functioning in accordance with the relevant specification.

If required by the relevant specification, the specimen shall remain in operating condition in accordance with the duty cycle and at the loading condition (if applicable) as prescribed by the relevant specification, or be switched off.

Note. — A specimen, even under operating or loaded conditions shall be considered as non heat-dissipating as long as its surface temperature rise is not more than 5 deg C above the ambient temperature.

- 7.4 The specimen shall then be exposed to the high temperature conditions for a duration as specified in the relevant specification.

The duration shall be measured from the time when temperature stability has been reached.

Note. — In the case of small specimens, it is not necessary to check by measurement that temperature stability has been reached. See IEC Publication 68-1, Sub-clause 4.6, Note 2.

- 7.5 If required by the relevant specification, intermediate measurements shall be performed in accordance with Clause 8.

- 7.6 At the end of this period, the specimen shall be subjected to the recovery procedure. In case the specimen remains in operating or loaded conditions during the test, it shall be switched off or unloaded before being subjected to the recovery procedure.

8. Intermediate measurements

The relevant specification may call for loading and/or measurements during or at the end of conditioning while the specimen is still in the chamber. If such measurements are required, the relevant specification shall define the measurements and the period or periods after which they shall be carried out. For these measurements, the specimen shall not be removed from the chamber.

Note. — Measurements preceded by recovery, which would require removal and reintroduction of the specimens into the chamber, are not permissible during the conditioning.

If it is desired to know the performance of the type of specimen before the end of the prescribed duration, one additional lot will be required for each specified duration. Recovery and final measurements shall be performed separately for each lot.

9. Recovery

- 9.1 The specimen shall then remain under standard atmospheric conditions for recovery for a period adequate for the attainment of temperature stability, with a minimum of 1 h.

When several specimens are tested simultaneously and where the 1 h recovery period is adequate, the maximum period for recovery shall be 2 h and all measurements shall be completed at the end of this period.

- 9.2 If required by the relevant specification, the specimen shall be switched on or loaded and measured continuously during the recovery period.

- 9.3 If the standard conditions given above are not appropriate for the specimen to be tested, the relevant specification may call for other recovery conditions.

10. Final measurements

The specimen shall be visually inspected and electrically and mechanically checked as required by the relevant specification.

11. Information to be given in the relevant specification

When this test is included in the relevant specification, the following details shall be given as far as they are applicable:

- a) preconditioning;
- b) initial measurements;