IEC 60068-3-7

Edition 2.0 2020-07
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Environmental testing –
Part 3-7: Supporting documentation and guidance – Measurements in temperature chambers for tests A (Cold) and B (Dry heat) (with load)

IEC 60068-3-7:2020-07 RLV(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ENVIRONMENTAL TESTING –

Part 3-7: Supporting documentation and guidance – Measurements in temperature chambers for tests A (Cold) and B (Dry heat) (with load)

FOREWORD

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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.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60068-3-7 has been prepared by IEC technical committee TC 104: Environmental conditions, classification and methods of test.

This second edition cancels and replaces the first edition published in 2001. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) verbal forms have, in many parts, been changed to express requirements instead of recommendations ('shall' instead of 'should');

b) Table 1 has been updated.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
104/868/FDIS	104/873/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60068 series, published under the general title *Environmental testing*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC 60068 (all parts) contains fundamental information on environmental testing procedures and severities.

The expression "environmental conditioning" or "environmental testing" covers the natural and artificial environments to which components or equipment may be exposed so that an assessment can be made of their performance under conditions of use, transport and storage to which they may be exposed in practice.

Temperature chambers used for "environmental conditioning" or "environmental testing" are not described in any publication, although the method of maintaining and measuring temperature and/or humidity has great influence on test results. The physical characteristics of temperature chambers can also influence test results.

ENVIRONMENTAL TESTING –

Part 3-7: Supporting documentation and guidance – Measurements in temperature chambers for tests A (Cold) and B (Dry heat) (with load)

1 Scope

This part of IEC 60068 ~~provides~~ specifies a uniform and reproducible method of confirming that temperature test chambers conform to the requirements specified in the climatic test procedures of IEC 60068-2-1 and IEC 60068-2-2, when loaded with either heat-dissipating or non heat-dissipating specimens under conditions which take into account air circulation inside the working space of the chamber. This document is ~~destined~~ intended primarily for users when conducting regular chamber performance monitoring.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-2-1, *Environmental testing – Part 2: Tests – Test A: Cold*~~

~~IEC 60068-2-2, *Basic environmental testing procedures – Part 2: Tests. Test B: Dry heat*~~

~~IEC 60068-3-1, *Basic environmental testing procedures – Part 3: Background information – Section one: Cold and dry heat tests*~~

IEC 60068-3-5:2018, *Environmental testing – Part 3-5: Supporting documentation and guidance – Confirmation of the performance of temperature chambers*

~~IEC 60068-3-6, *Environmental testing – Part 3-6: Supporting documentation and guidance – Confirmation of the performance of temperature/humidity chambers*~~

~~IEC 60584-1, *Thermocouples – Part 1: Reference tables*~~

~~IEC 60751, *Industrial platinum resistance thermometer sensors*~~

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
test specification
procedure applied to test chambers with or without forced air circulation, suitable for a wide range of chamber sizes

Note 1 to entry: A summary of test conditions in IEC 60068-2-1 and IEC 60068-2-2 is given in Table 1; conditions including sudden change of temperature have been removed from earlier versions of these documents.

Table 1 – Test conditions

~~Temperature range~~	~~Test~~	~~Heat-dissipating~~		~~Change of temperature~~	
		~~None~~	~~With~~	~~Sudden~~	~~Gradual~~
~~–65 °C to +5 °C~~	~~Aa~~	~~○~~		~~○~~	
	~~Ab~~	~~○~~			~~○~~
	~~Ad~~		~~○~~		~~○~~
~~+30 °C to +400 °C~~	~~Ba~~	~~○~~		~~○~~	
	~~Bb~~	~~○~~			~~○~~
	~~Bc~~		~~○~~	~~○~~	
	~~Bd~~		~~○~~		~~○~~

Temperature range	Test	Specimen heat-dissipation		Specimen power status		Change of temperature	Preferred air velocity	
		None	With	After stabilization	Throughout test	Gradual	High	Low
−65 °C to +5 °C	Ab	○				○	○	
	Ad		○	○		○		○
	Ae		○		○	○		○
+30 °C to +1 000 °C	Bb	○				○	○	
	Bd		○	○		○		○
	Be		○		○	○		○

3.2
confirmation method ~~(procedure 1)~~
specified method of making continuous measurements in order to establish whether the performance of a test chamber conforms to the requirements detailed in IEC 60068-2-1, test A and/or IEC 60068-2-2, test B

3.3
routine monitoring method ~~(procedure 2)~~
specified method of making measurements, continuously or at intervals, to ensure that the test chamber performance is being maintained

3.4
test load
test specimen that is installed in the test chamber for the confirmation measurements

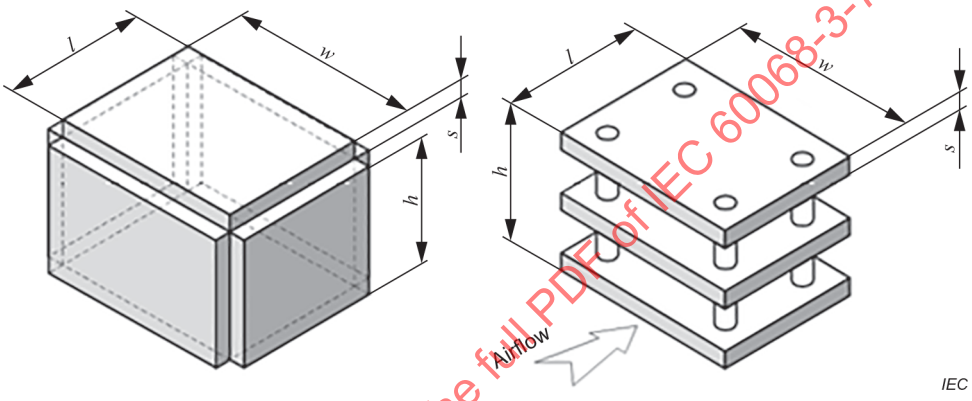
Note 1 to entry: The test load is defined by geometric dimensions and by thermal properties.

3.5
artificial load
test load made in accordance with IEC 60068-3-7 with dimensions and thermal properties related to the geometric dimensions and thermal capacity of the specimens intended to be tested in the chamber

Note 1 to entry: Table 2 provides values for an artificial load and an example is given in Figure 1.

Table 2 – Artificial load – Values

Dimensions	Volume approximately 20 % of working space
Heat transmission	Approximately 10 kJ/m2K
Heat radiation emissivity	> 0,7
Heat dissipation	In accordance with ~~appendix C of~~ IEC 60068-2-2:2007, 4.1.



Key

h height
l length
w width
s thickness of material

NOTE *s* = 3 mm stainless steel or 4 mm aluminium (*h*, *l* and *w* should be smaller than the relevant dimensions of the working space).

Figure 1 – Examples of artificial loads

4 Measuring system

4.1 General description

The system used for the confirmation and routine monitoring measurements, either built-in or independent of the chamber, should comply with the following requirements. Measurement devices other than those listed may be used when their performance is shown to be technically equivalent or when practical concerns require alternative techniques. Deviations from these requirements shall be documented.

4.2 Temperature

4.2.1 General

Platinum resistance thermometers (in accordance with IEC 60751) or thermocouples (in accordance with IEC 60584-1) should be used.

4.2.2 Temperature sensor

In a temperature range from −200 °C to ~~+200~~ +650 °C the sensor measurement uncertainty should be in accordance with class A of IEC 60751.

4.3 Humidity

4.3.1 General

The humidity test is required for confirmation of IEC 60068-2-2 tests only.

Place the independent humidity sensor as near as practical to the centre of the working space.

Types of humidity monitoring sensors are described in 4.~~3~~4 of IEC 60068-3-6:2018.

4.3.2 Humidity sensor

Sensor measurement uncertainty should not exceed ±3 % RH.

4.4 Wall emissivity

Emissivity of the chamber enclosure should be in accordance with ~~table IV of appendix J of~~ IEC 60068-3-1.

4.5 Air velocity

4.5.1 General

An airflow sensor should be installed such that the maximum air velocity impinging on the load can be monitored.

4.5.2 Air velocity sensor

The air velocity sensor measurement uncertainty should be compatible with IEC 60068-2-1 and 60068-2-2 tolerances.

4.5.3 Air velocity sensor response time

The air velocity sensor response time should be greater than 5 s to avoid any influence on it by airflow fluctuation.

4.6 Recording device

For confirmation monitoring, data should be recorded at least once per minute. For routine monitoring, data should be recorded at least once every 5 min. For the purpose of chamber verification, the device utilized for recording data ~~from the chamber monitoring sensors~~ should be independent of the chamber control system.

5 Determination of temperature performances

5.1 Test area environment

The environment in the test area shall be in accordance with 4.1 of IEC 60068-3-5:2018.

5.2 Chamber loading

5.2.1 General

Provision is made for measurement of test chamber performance with different loading conditions.

Test loads:	heat-dissipating
	non heat-dissipating
Artificial loads:	heat-dissipating
	non heat-dissipating

NOTE However, when testing large, high heat dissipating specimens, it ~~may~~ can be desirable to allow the specimen to develop thermal gradients by using 'free air' chambers or those with a low airflow (typically less than ~~1~~ 0,5 m/s). In such cases it is possible that the chamber ~~may~~ will not have a uniform temperature within the working space and it is ~~necessary~~ important to monitor the temperatures of the air entering and exiting the specimen.

5.2.2 Location of test load

The test load ~~should always~~ shall be located in the enclosure so that it is entirely within the working space.

~~For heat dissipating multiple loads, heating effects should be minimized in accordance with the following subclauses of IEC 60068-2-2:~~

~~no forced air circulation 29.1.1.2 and 40.1.1.2,~~

~~forced air circulation 29.1.2.2 and 40.1.2.2.~~

When testing multiple heat dissipating specimens, any heating effects between specimens and on the overall chamber temperature gradient shall be minimized.

5.3 Installation of temperature sensors

5.3.1 General

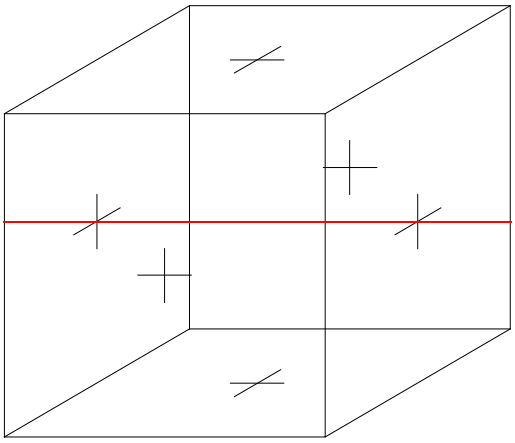
The temperature sensors ~~should~~ shall be protected from heating and cooling sources and from direct heat radiation. In addition, the wall and load sensors ~~should~~ shall be protected from convection heat transfer from the surrounding air by suitable insulation.

5.3.2 Position of temperature sensors

Position of temperature sensors shall be in accordance with 4.4 of IEC 60068-3-5:2018.

~~**5.3.2 Position of wall sensors**~~

~~When chamber walls are directly heated and/or cooled, additional sensors located in accordance with figure 2 are necessary.~~



IEC 1552/01

~~Figure 2 – Location of wall sensors~~

5.3.3 Position of load sensors

Test load temperature sensors ~~should~~ shall be positioned on representative points of the load to indicate that temperature stability is reached.

6 Test procedures

6.1 Confirmation methods

6.1.1 General

Tests ~~should~~ shall be conducted at temperatures and with loads which are representative of the intended use of the chamber.

6.1.2 Test without load

Tests without load shall be conducted in accordance with IEC 60068-3-5.

6.1.3 Test with load

– Install and operate the test load.

– Repeat test sequence as in 6.1.2 above.

6.2 Routine monitoring methods

Routine monitoring ~~should~~ shall be conducted at regular intervals for control purposes. Additional monitoring ~~should~~ shall be conducted whenever the chamber undergoes repair/maintenance to the heating/cooling system, the air circulating system or to the chamber control system. Sensors used for routine monitoring should be selected from locations identified in 4.4 of IEC 60068-3-5:2018.

Monitor the temperature at the selected points at 5 min intervals or more frequently.

Routine monitoring is used to determine that the chamber is working within its tolerances for a given test load. However, the temperature tolerance on a single monitoring point will be different from that given for confirmation monitoring, i.e. ±1,5 K (cold test) and ±1,0 K (dry heat test).

7 Evaluation criteria

The performance of the temperature test chamber is confirmed if all results are within the specification limits of the appropriate part of the IEC 60068-2 series.

8 Information to be given in the performance report

As a minimum, the test report shall contain the following information:

– Atmospheric conditions (temperature and relative humidity) in the test area.
– Size and volume of chamber enclosure and working space.
– Temperature fluctuation, temperature gradient, and temperature ~~gradient~~ variation in space at each temperature stage of Clause 5 of IEC 60068-3-5:2018.
– Temperature rate of change, heating and/or cooling.
– Temperature extremes.
– Any deviations such as overshoot.
– Details of test load.
– Details of data acquisition system.
– Air flow speed.
– Evaluation of measurement uncertainties.

Bibliography

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-3-1, *Environmental testing – Part 3-1: Supporting documentation and guidance – Cold and dry heat tests*

IEC 60068-3-6:2018, *Environmental testing – Part 3-6: Supporting documentation and guidance – Confirmation of the performance of temperature/humidity chambers*

IEC 60584-1, *Thermocouples – Part 1: EMF specifications and tolerances*

IEC 60751, *Industrial platinum resistance thermometers and platinum temperature sensors*

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INTERNATIONAL STANDARD

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Part 3-7: Supporting documentation and guidance – Measurements in temperature chambers for tests A (Cold) and B (Dry heat) (with load)

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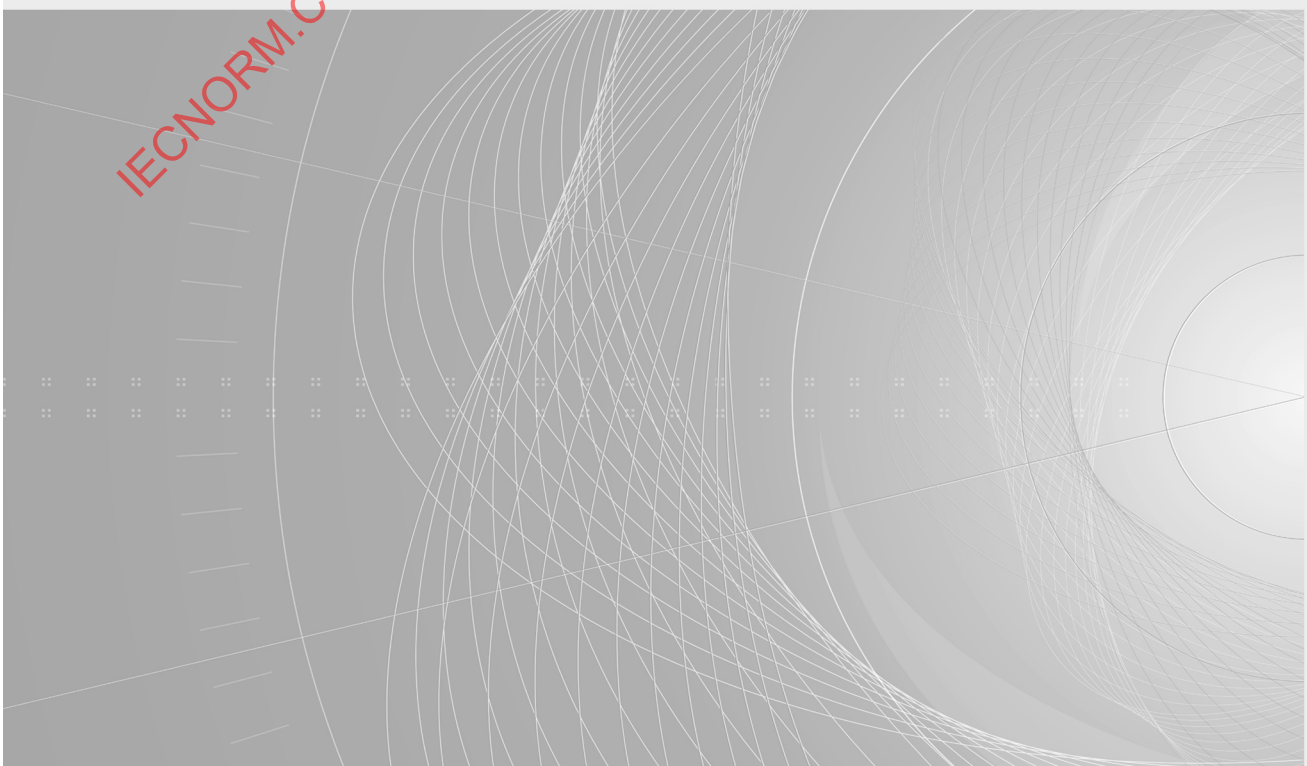
Partie 3-7: Documentation d'accompagnement et recommandations – Mesurages dans les chambres d'essai en température pour les essais A (froid) et B (chaleur sèche) (avec charge)



IEC 60068-3-7:2020-07(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ENVIRONMENTAL TESTING –

Part 3-7: Supporting documentation and guidance – Measurements in temperature chambers for tests A (Cold) and B (Dry heat) (with load)

1 Scope

This part of IEC 60068 specifies a uniform and reproducible method of confirming that temperature test chambers conform to the requirements specified in the climatic test procedures of IEC 60068-2-1 and IEC 60068-2-2, when loaded with either heat-dissipating or non heat-dissipating specimens under conditions which take into account air circulation inside the working space of the chamber. This document is intended primarily for users when conducting regular chamber performance monitoring.

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The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-3-5:2018, *Environmental testing – Part 3-5: Supporting documentation and guidance – Confirmation of the performance of temperature chambers*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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procedure applied to test chambers with or without forced air circulation, suitable for a wide range of chamber sizes

Note 1 to entry: A summary of test conditions in IEC 60068-2-1 and IEC 60068-2-2 is given in Table 1; conditions including sudden change of temperature have been removed from earlier versions of these documents.

Table 1 – Test conditions

Temperature range	Test	Specimen heat-dissipation		Specimen power status		Change of temperature	Preferred air velocity	
		None	With	After stabilization	Throughout test	Gradual	High	Low
−65 °C to +5 °C	Ab	○				○	○	
	Ad		○	○		○		○
	Ae		○		○	○		○
+30 °C to +1 000 °C	Bb	○				○	○	
	Bd		○	○		○		○
	Be		○		○	○		○

3.2
confirmation method
specified method of making continuous measurements in order to establish whether the performance of a test chamber conforms to the requirements detailed in IEC 60068-2-1, test A and/or IEC 60068-2-2, test B

3.3
routine monitoring method
specified method of making measurements, continuously or at intervals, to ensure that the test chamber performance is being maintained

3.4
test load
test specimen that is installed in the test chamber for the confirmation measurements

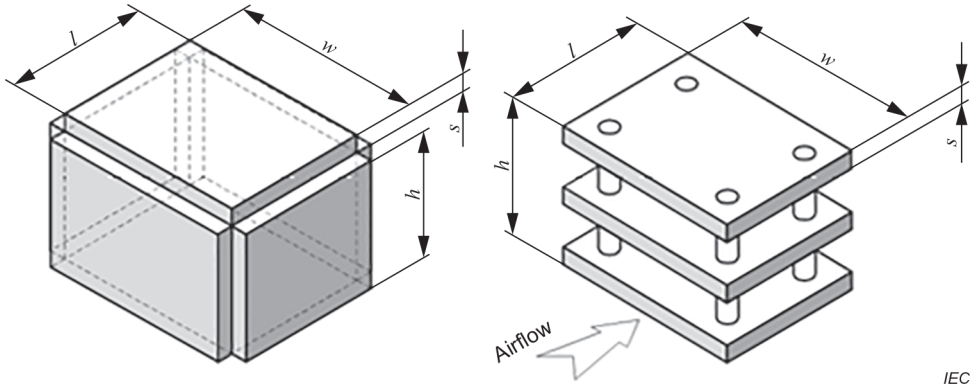
Note 1 to entry: The test load is defined by geometric dimensions and by thermal properties.

3.5
artificial load
test load made in accordance with IEC 60068-3-7 with dimensions and thermal properties related to the geometric dimensions and thermal capacity of the specimens intended to be tested in the chamber

Note 1 to entry: Table 2 provides values for an artificial load and an example is given in Figure 1.

Table 2 – Artificial load – Values

Dimensions	Volume approximately 20 % of working space
Heat transmission	Approximately 10 kJ/m2K
Heat radiation emissivity	> 0,7
Heat dissipation	In accordance with IEC 60068-2-2:2007, 4.1.



Key

h height

l length

w width

s thickness of material

NOTE *s* = 3 mm stainless steel or 4 mm aluminium (*h*, *l* and *w* should be smaller than the relevant dimensions of the working space).

Figure 1 – Examples of artificial loads

4 Measuring system

4.1 General description

The system used for the confirmation and routine monitoring measurements, either built-in or independent of the chamber, should comply with the following requirements. Measurement devices other than those listed may be used when their performance is shown to be technically equivalent or when practical concerns require alternative techniques. Deviations from these requirements shall be documented.

4.2 Temperature

4.2.1 General

Platinum resistance thermometers (in accordance with IEC 60751) or thermocouples (in accordance with IEC 60584-1) should be used.

4.2.2 Temperature sensor

In a temperature range from −200 °C to +650 °C the sensor measurement uncertainty should be in accordance with class A of IEC 60751.

4.3 Humidity

4.3.1 General

The humidity test is required for confirmation of IEC 60068-2-2 tests only.

Place the independent humidity sensor as near as practical to the centre of the working space.

Types of humidity monitoring sensors are described in 4.4 of IEC 60068-3-6:2018.

4.3.2 Humidity sensor

Sensor measurement uncertainty should not exceed ±3 % RH.

4.4 Wall emissivity

Emissivity of the chamber enclosure should be in accordance with IEC 60068-3-1.

4.5 Air velocity

4.5.1 General

An airflow sensor should be installed such that the maximum air velocity impinging on the load can be monitored.

4.5.2 Air velocity sensor

The air velocity sensor measurement uncertainty should be compatible with IEC 60068-2-1 and 60068-2-2 tolerances.

4.5.3 Air velocity sensor response time

The air velocity sensor response time should be greater than 5 s to avoid any influence on it by airflow fluctuation.

4.6 Recording device

For confirmation monitoring, data should be recorded at least once per minute. For routine monitoring, data should be recorded at least once every 5 min. For the purpose of chamber verification, the device utilized for recording data should be independent of the chamber control system.

5 Determination of temperature performances

5.1 Test area environment

The environment in the test area shall be in accordance with 4.1 of IEC 60068-3-5:2018.

5.2 Chamber loading

5.2.1 General

Provision is made for measurement of test chamber performance with different loading conditions:

Test loads:	heat-dissipating
	non heat-dissipating
Artificial loads:	heat-dissipating
	non heat-dissipating

NOTE However, when testing large, high heat dissipating specimens, it can be desirable to allow the specimen to develop thermal gradients by using 'free air' chambers or those with a low airflow (typically less than 0,5 m/s). In such cases it is possible that the chamber will not have a uniform temperature within the working space and it is important to monitor the temperatures of the air entering and exiting the specimen.

5.2.2 Location of test load

The test load shall be located in the enclosure so that it is entirely within the working space.

When testing multiple heat dissipating specimens, any heating effects between specimens and on the overall chamber temperature gradient shall be minimized.

5.3 Installation of temperature sensors

5.3.1 General

The temperature sensors shall be protected from heating and cooling sources and from direct heat radiation. In addition, the wall and load sensors shall be protected from convection heat transfer from the surrounding air by suitable insulation.

5.3.2 Position of temperature sensors

Position of temperature sensors shall be in accordance with 4.4 of IEC 60068-3-5:2018.

5.3.3 Position of load sensors

Test load temperature sensors shall be positioned on representative points of the load to indicate that temperature stability is reached.

6 Test procedures

6.1 Confirmation methods

6.1.1 General

Tests shall be conducted at temperatures and with loads which are representative of the intended use of the chamber.

6.1.2 Test without load

Tests without load shall be conducted in accordance with IEC 60068-3-5.

6.1.3 Test with load

– Install and operate the test load.
– Repeat test sequence as in 6.1.2 above.

6.2 Routine monitoring methods

Routine monitoring shall be conducted at regular intervals for control purposes. Additional monitoring shall be conducted whenever the chamber undergoes repair/maintenance to the heating/cooling system, the air circulating system or to the chamber control system. Sensors used for routine monitoring should be selected from locations identified in 4.4 of IEC 60068-3-5:2018.

Monitor the temperature at the selected points at 5 min intervals or more frequently.

Routine monitoring is used to determine that the chamber is working within its tolerances for a given test load. However, the temperature tolerance on a single monitoring point will be different from that given for confirmation monitoring, i.e. ±1,5 K (cold test) and ±1,0 K (dry heat test).

7 Evaluation criteria

The performance of the temperature test chamber is confirmed if all results are within the specification limits of the appropriate part of the IEC 60068-2 series.

8 Information to be given in the performance report

As a minimum, the test report shall contain the following information:

– Atmospheric conditions (temperature and relative humidity) in the test area.
– Size and volume of chamber enclosure and working space.
– Temperature fluctuation, temperature gradient, and temperature variation in space at each temperature stage of Clause 5 of IEC 60068-3-5:2018.
– Temperature rate of change, heating and/or cooling.
– Temperature extremes.
– Any deviations such as overshoot.
– Details of test load.
– Details of data acquisition system.
– Air flow speed.
– Evaluation of measurement uncertainties.

Bibliography

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-3-1, *Environmental testing – Part 3-1: Supporting documentation and guidance – Cold and dry heat tests*

IEC 60068-3-6:2018, *Environmental testing – Part 3-6: Supporting documentation and guidance – Confirmation of the performance of temperature/humidity chambers*

IEC 60584-1, *Thermocouples – Part 1: EMF specifications and tolerances*

IEC 60751, *Industrial platinum resistance thermometers and platinum temperature sensors*

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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ESSAIS D'ENVIRONNEMENT –

Partie 3-7: Documentation d'accompagnement et recommandations – Mesurages dans les chambres d'essai en température pour les essais A (froid) et B (chaleur sèche) (avec charge)

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Cette deuxième édition annule et remplace la première édition parue en 2001. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) dans plusieurs parties, les formes verbales ont été remplacées par des exigences explicites en lieu et place des recommandations ("devoir" au lieu de "il convient");

b) le Tableau 1 a été mis à jour.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
104/868/FDIS	104/873/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

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INTRODUCTION

La série IEC 60068 (toutes les parties) compile des informations fondamentales concernant les procédures d'essai d'environnement et les niveaux de gravité associés.

L'expression "conditionnement climatique" ou "essais d'environnement" couvre les environnements naturels et artificiels auxquels peuvent être exposés les composants ou matériels, afin de pouvoir réaliser une évaluation de leurs performances dans les conditions d'utilisation, de transport et de stockage qui peuvent être rencontrées dans la pratique.

Aucune publication ne décrit les chambres d'essai en température utilisées pour le "conditionnement climatique" ou les "essais d'environnement" alors que les méthodes employées pour maintenir et mesurer la température et/ou l'humidité ont une incidence importante sur les résultats d'essai. Les caractéristiques physiques des chambres d'essai en température peuvent également influencer les résultats d'essai.