IEC 60068-3-5

Edition 2.0 2018-01
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INTERNATIONAL STANDARD

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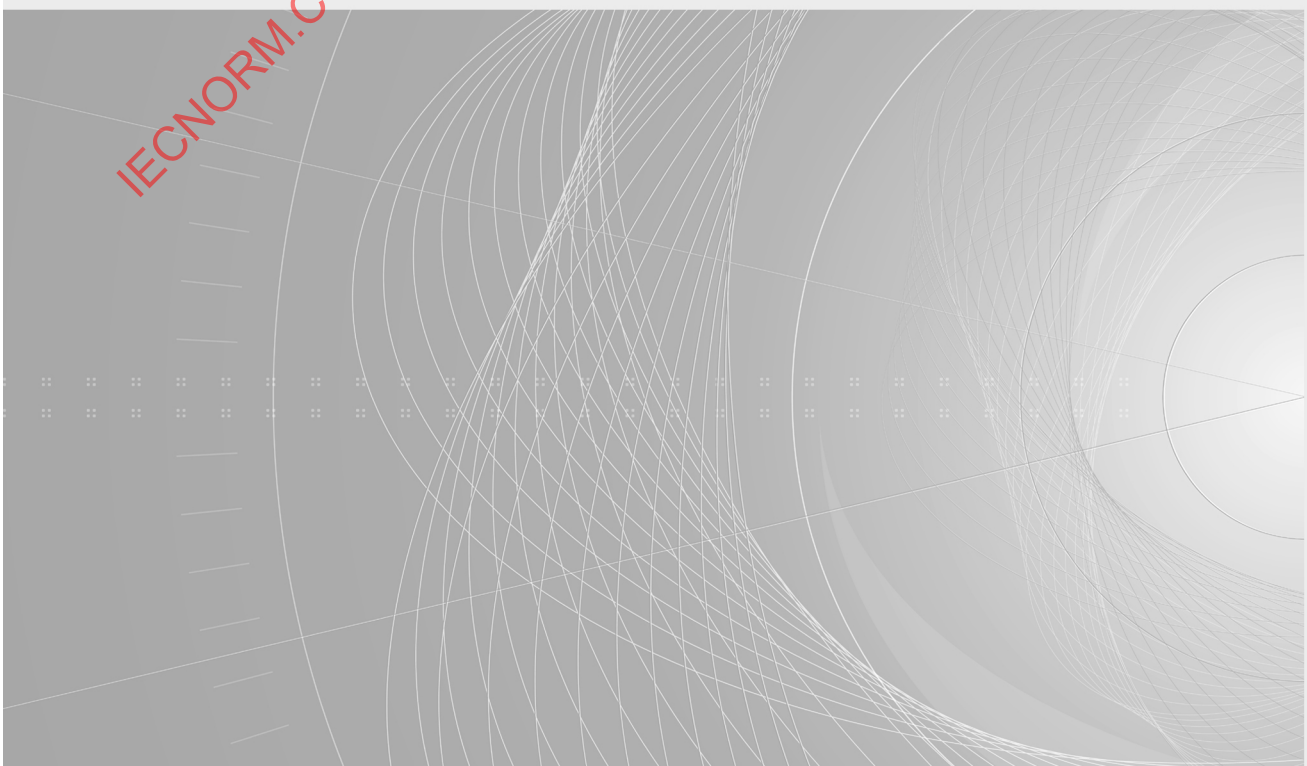
Environmental testing –
Part 3-5: Supporting documentation and guidance – Confirmation of the performance of temperature chambers



IEC 60068-3-5:2018-01 RLV(en)

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IEC 60068-3-5

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INTERNATIONAL STANDARD

Environmental testing –
Part 3-5: Supporting documentation and guidance – Confirmation of the performance of temperature chambers

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ENVIRONMENTAL TESTING –

Part 3-5: Supporting documentation and guidance – Confirmation of the performance of temperature chambers

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60068-3-5 has been prepared by IEC technical committee 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) Confirmation procedures are clarified.

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

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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 a great influence on test results. The physical characteristics of temperature chambers can also influence test results.

ENVIRONMENTAL TESTING –

Part 3-5: Supporting documentation and guidance – Confirmation of the performance of temperature chambers

1 Scope

This part of IEC 60068 provides a uniform and reproducible method of confirming that temperature test chambers, without ~~load~~ specimens, conform to the requirements specified in climatic test procedures of IEC 60068-2 (all parts) and other standards. This document is intended 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 60068-1, *Environmental testing – Part 1: General and guidance*~~

IEC 60068-2 (all parts), *Environmental testing – Part 2: Tests*

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

IEC 60068-3-7, *Environmental testing – Part 3-7: Supporting documentation and guidance – Measurements in temperature chambers for tests A and B (with load)*

IEC 60068-3-11, *Environmental testing – Part 3-11: Supporting documentation and guidance – Calculation of uncertainty of conditions in climatic test chambers*

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

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

~~ISO 10012-1, *Quality assurance requirements for measuring equipment – Part 1: Metrological confirmation system for measuring equipment*~~

~~ISO 10012-2, *Quality assurance for measuring equipment – Part 2: Guidelines for control of measurement processes*~~

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
temperature test chamber
enclosure or space in some parts of which the temperature conditions, specified in IEC 60068-2 (all parts), can be achieved

3.2
temperature setpoint
desired temperature as set by the chamber controls

3.3
achieved temperature
stabilized temperature ~~in the chamber at any point within the working space after stabilization~~ which desired temperature at the centre of the working space achieves within specified tolerance

3.4
temperature stabilization
~~temperature at which all points in the working space have reached and maintained the setpoint temperature within a given tolerance~~ state of maintaining temperature within specified tolerance during specified time at specified points in the working space

3.5
temperature fluctuation
difference, after stabilization, between the maximum and minimum temperatures at ~~any~~ specified point in the working space during a specified interval of time

Note 1 to entry: For calibration, the centre point of working space may be used.

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

Note 1 to entry: See Figure 1 and Table 1.

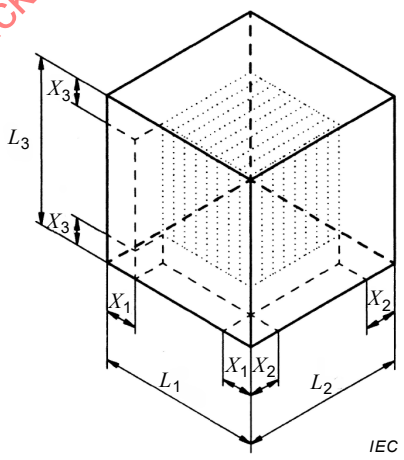


Figure 1 – Working space

Table 1 – Practical dimensions

Size	Volume l	Distance X mm	X (min.) mm
Small	Up to 1 000	$L/10$	50
Medium	1 000 to 2 000	$L/10$	100
Large	More than 2 000	$L/10$	150
NOTE Not all chambers are cubic in construction.			

3.7
temperature gradient
maximum difference in mean value, after stabilization, at any moment in time between two separate points in the working space

3.8
temperature variation in space
difference in mean value, after stabilization, at any moment in time between the temperature at the centre of the working space and at any other point in the working space

3.9
temperature rate of change
rate, in ~~degrees~~ kelvin per minute, for the transition between two specified temperatures measured at the centre of the working space

Note 1 to entry: See Figure 2.

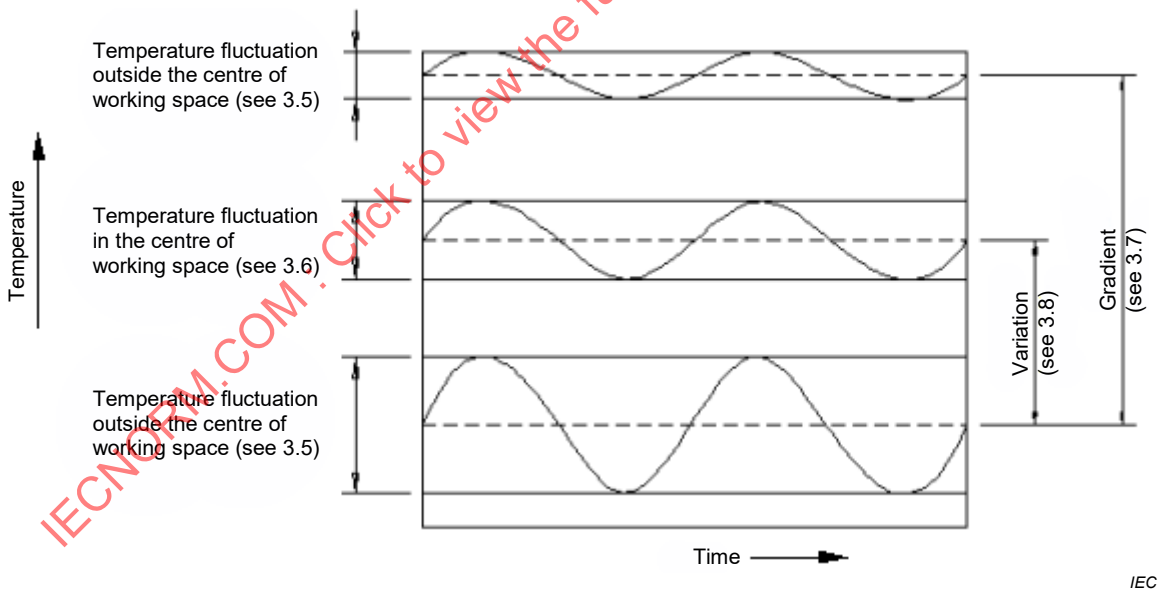


Figure 2 – Example of temperature differences

~~**3.10**~~
~~**temperature extremes**~~

~~maximum and minimum measured temperatures achieved in the working space after stabilization~~

4 Measuring chamber performances

4.1 Test area environment

The environment around a temperature test chamber may influence the conditions inside the test chamber.

The confirmation of performance of temperature chambers should be carried out under standard atmospheric conditions specified in IEC 60068-1.

~~The following items should be taken into consideration:~~

- ~~the ambient conditions described in IEC 60068-1 should be satisfied in principle;~~
- ~~the chamber should not be exposed to direct solar radiation;~~
- ~~the chamber should not be exposed to electromagnetic interference;~~
- ~~the chamber should be levelled;~~
- ~~the chamber should be fixed in a location free from any mechanical and acoustic vibration interference.~~

~~Manufacturer's advice on electrical power requirements and the environmental conditions should be taken into consideration.~~

~~Abnormal conditions should be recorded.~~

4.2 Temperature measurement system

The uncertainty of measurement of the output of the measurement system should be determined by calibration of the system, traceable to international standards (see ISO 10012~~-1 and ISO 10012-2~~).

~~Normally sensors should be either the resistance type (in accordance with IEC 60751) or the thermocouple type (in accordance with IEC 60584-1). The 50 % response time in air of the sensor shall be between 10 s and 40 s. The response time of the overall system should be less than 40 s.~~

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

The temperature sensors may be either calibrated platinum resistors or a thermocouple. The thermal response time of the sensors shall be within a minimum of 10 s and a maximum of 40 s for 50 % of response. It is preferred that the thermal response time of the entire measurement system to be less than 40 s. The use of sensors that are compliant to IEC 60584-1 tolerance class 1 (for thermocouples) or IEC 60751 tolerance class A (for resistors) is recommended.

4.3 Temperature chamber test ~~load~~ specimens

All measurements described in 4.5 are performed with an empty working space. ~~If it is not possible to empty the chamber totally this should be recorded.~~ For measuring with test ~~load~~ specimens (with or without heat dissipation), see IEC 60068-3-7.

4.4 ~~Installation~~ Specified location of temperature sensors in working space

Temperature measuring sensors are located in each corner and in the centre of the working space (see Figure 3, minimum 9 sensors). For temperature chambers over 2 000 l, additional sensors should be located in front of the centre of each wall (see Figure 4, minimum 15 sensors). The measuring system is to be arranged in such a way that the temperature

distribution of the empty test chamber will not be affected. For a large capacity chamber, there may be a significant difference between the temperature control sensor(s) and the temperature at the centre of the working space. It may be necessary to adjust the temperature setting to achieve the necessary tolerance.

~~Recording of the achieved temperature should be effected.~~

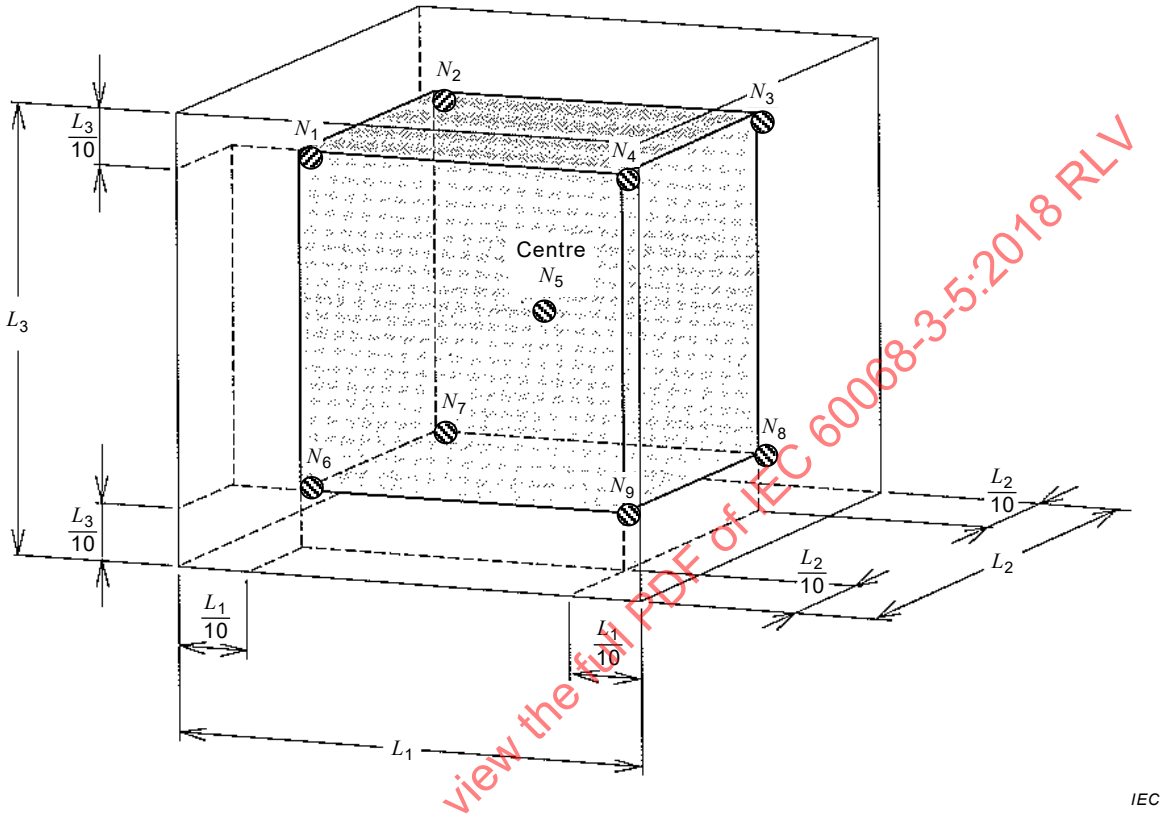


Figure 3 – Location of ~~air temperature~~ sensors for temperature chambers up to 2 000 l

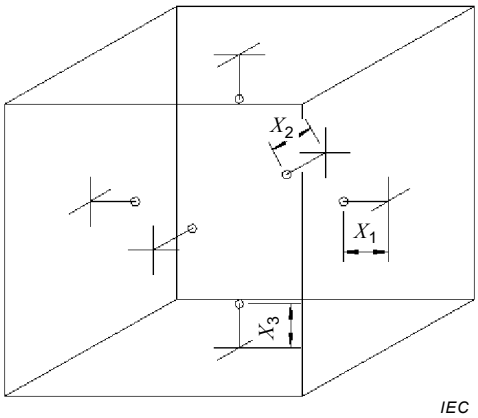


Figure 4 – Location of minimal additional ~~air temperature~~ sensors for temperature chambers over 2 000 l

For confirmation monitoring, data should be recorded at least once a minute. The device used for recording data from the chamber monitoring sensors should be independent of the chamber control system.

4.5 ~~Determination of temperature performance~~ Measurement method

~~4.5.1 Achieved temperature, temperature fluctuation, temperature variation in space, temperature gradient~~

~~The output of the temperature measuring system (see figure 3 or figure 4) determine, after chamber stabilization, the achieved temperature, temperature fluctuation and temperature gradient of the working space. Uncertainty of measurement of the temperature measuring system should be taken into account and the allowable tolerance reduced by the magnitude of the uncertainty.~~

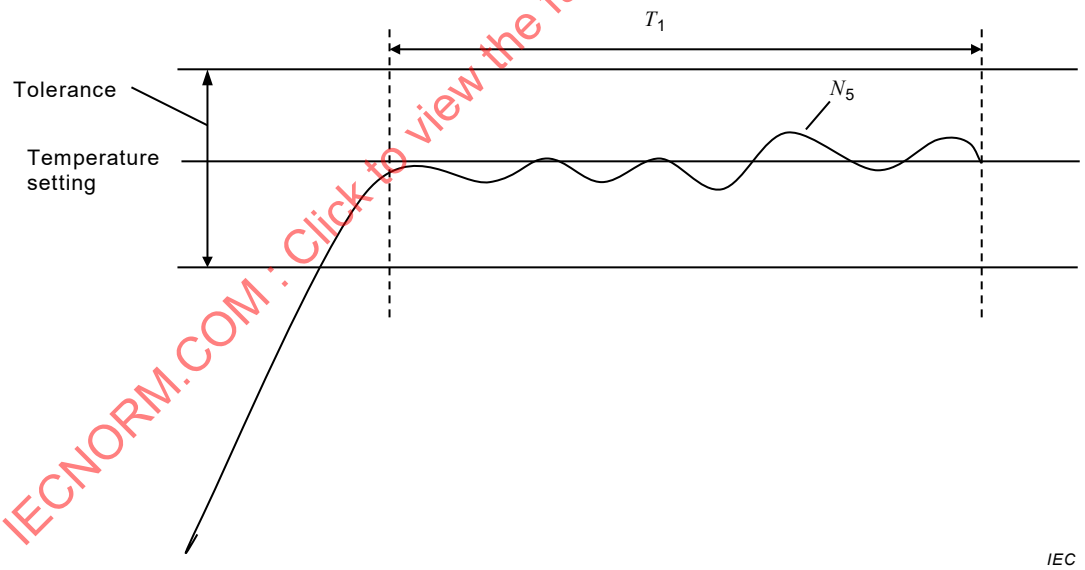
4.5.1 General

The temperature output of the temperature measuring system (see Figure 3 or Figure 4) determines, after chamber stabilization, the achieved temperature, temperature fluctuation and temperature gradient of the working space. For tolerance, the specification of the temperature/humidity chamber or, as necessary, tolerance specified in IEC 60068-2 (all parts), is required to maintain at the centre of the working space. Location of sensor is minimum 9 points or 15 points. This depends on the test chamber size. The measurement method is explained based on 9 points.

Uncertainty of measurement of the temperature measuring system shall be according to IEC 60068-3-11.

4.5.2 Achieved temperature

Temperature is achieved when the centre of the working space maintains the tolerance as required by IEC 60068-2 (all parts). An example is shown in Figure 5.



For tolerance, check the specification of the temperature chamber, or, as necessary, use tolerance specified in IEC 60068-2 which is required to maintain at the centre of the working space.

T_1 must be minimum 30 min. N_5 is the temperature at the centre of the working space.

Figure 5 – Example of achieved temperature

4.5.3 Temperature stabilization

Temperature reached and maintained within the allowable range in the working space is shown in Figure 6. Allowable range is based on the temperature fluctuation, temperature variation in space, and temperature gradient as the temperature chamber specification.

Specified time T_2 is minimum 30 min after the measurement points (e.g. N_1 to N_9) are within the allowable range.

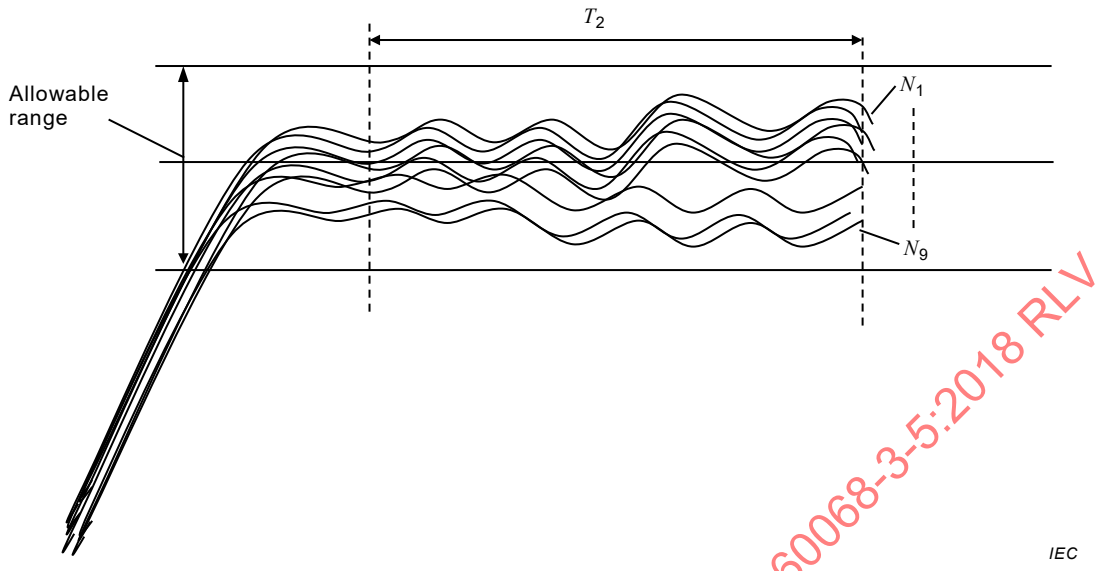


Figure 6 – Example of temperature stabilization for chambers up to 2 000 l

4.5.4 Temperature fluctuation

The fluctuation during a specified interval of time at specified temperature points in the working space, after temperature stabilization, is shown in Figure 7.

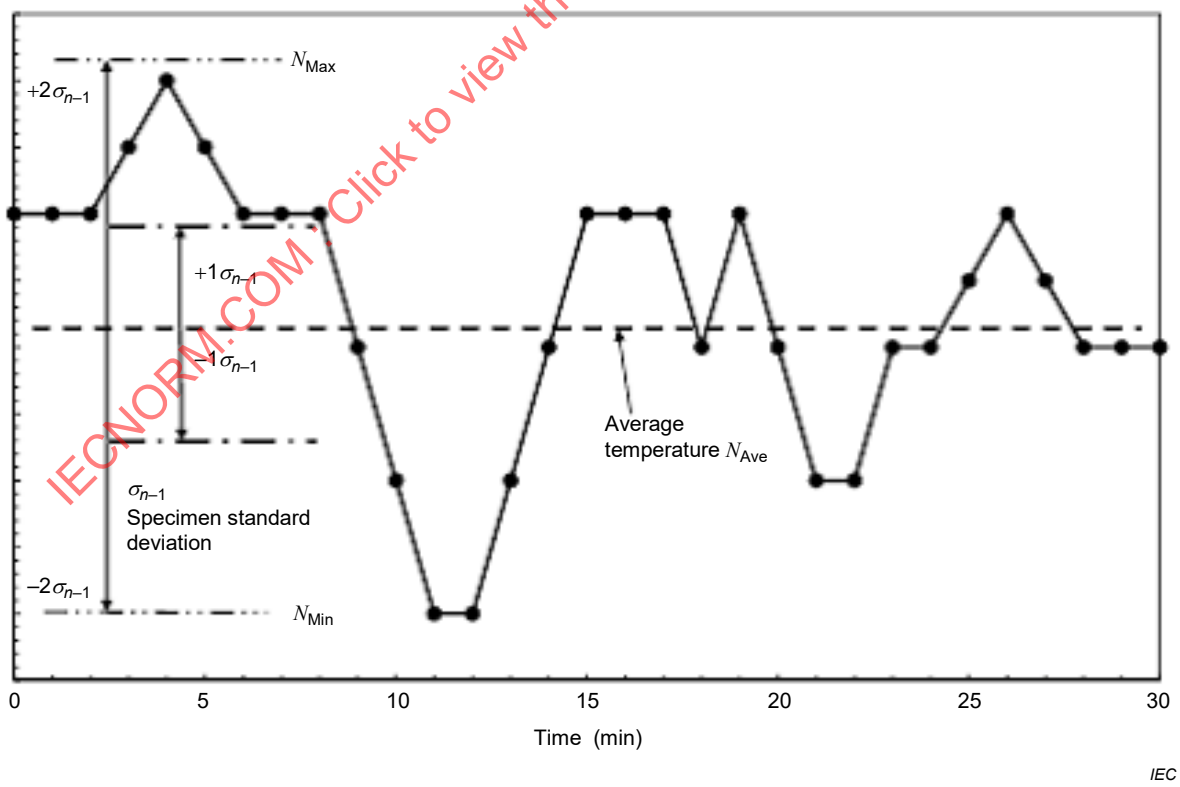


Figure 7 – Example of temperature fluctuation

Measurements are actually made at a certain sampling interval. It is not guaranteed that data captures the fluctuation peak. For that reason, the sample standard deviation, σ_{n-1}shall be obtained from the data measured in each measurement point after temperature has stabilized, and the temperature fluctuation shall be within $\pm 2\sigma_{n-1}$.

The temperatures measured in a certain measurement point, after stabilization, over a 30-minute period 10 or more times at even intervals shall be as follows.

$$N_1, N_2, \ldots, N_i, \ \ldots \ N_n \ (n \geqq 10)$$

The mean of N shall be N_{Ave}.

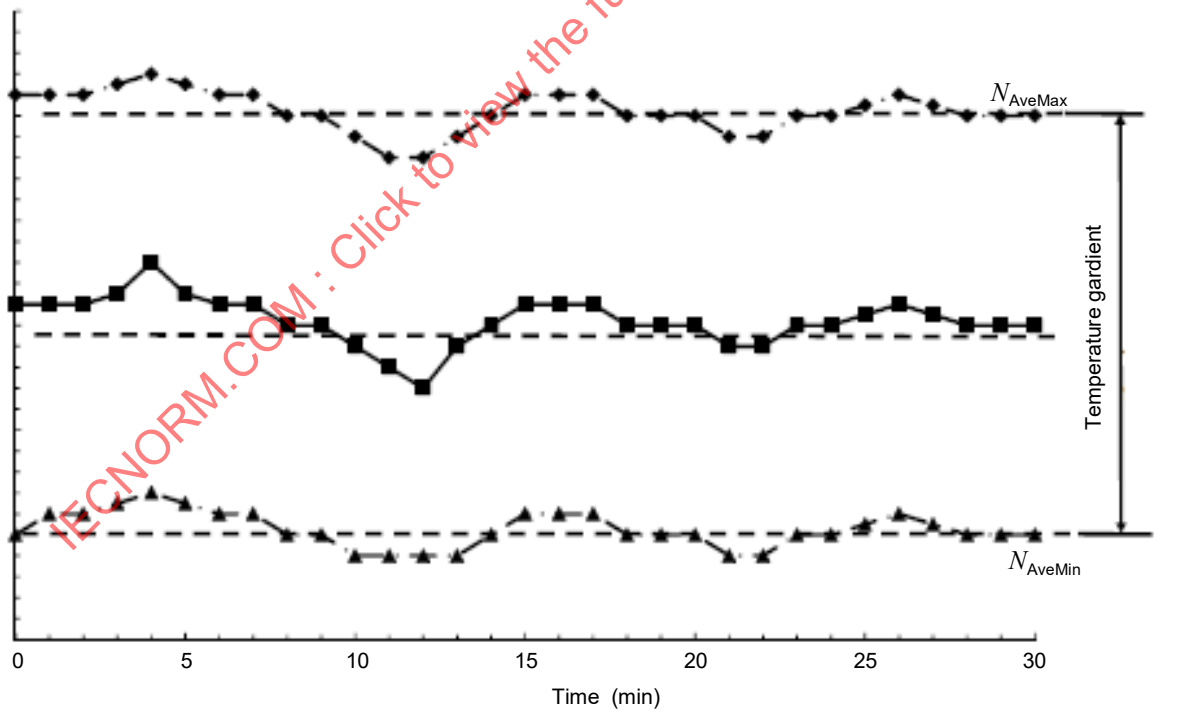
The specimen standard deviation, σ_{n-1}shall be defined as follows.

$$\sigma_{n-1} = \sqrt{\frac{\sum(X_i - N_{Ave})^2}{n-1}}$$

Temperature fluctuation $\pm 2\sigma_{n-1}$ shall be obtained in all 9 measurement points, and the highest value within that shall be annotated as the temperature fluctuation.

4.5.5 Temperature gradient

As shown in Figure 8, the maximum difference in mean temperature in all measurement points of the effective space shall be the temperature gradient.



N_{AveMax}: Mean highest temperature in each of 9 measurement points

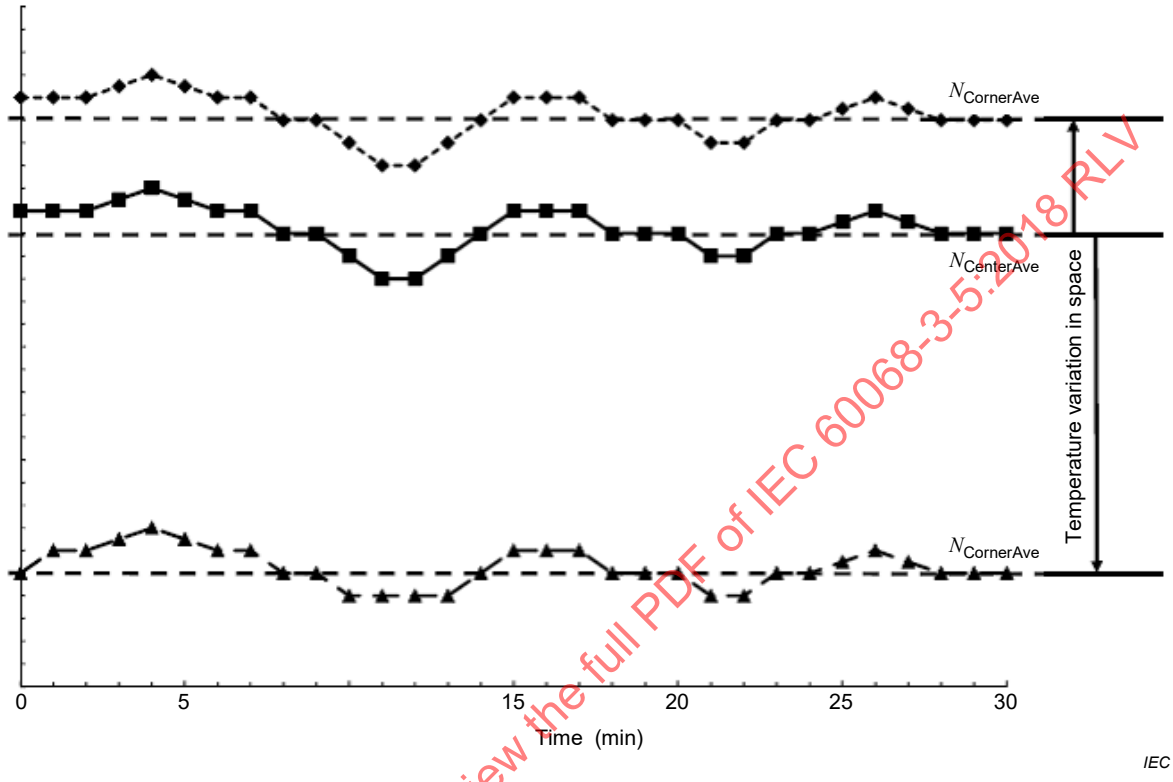
N_{AveMin}: Mean lowest temperature in each of 9 measurement points

Temperature gradient = $N_{AveMax} - N_{AveMin}$

Figure 8 – Example of temperature gradient for chambers up to 2 000 l

4.5.6 Temperature variation in space

As shown in Figure 9, temperature variation in space is the difference of the mean temperature at the centre of the working space and the mean temperature of another measurement point. The maximum difference between the centre of the working space and each measuring point shall be stated.



$N_{CenterAve}$: Mean temperature at chamber center

$N_{CornerAve(j)}$ j=1 to 8: Mean temperature at corner of working space

Temperature variation in space = | Max($N_{CornerAve[j]} - N_{CenterAve}$) |

The value obtained as the temperature variation in space shall be ($N_{CornerAve(j)} - N_{CenterAve}$), and the absolute value of the highest difference obtained for the 8 corners shall be annotated as the temperature variation in space

Figure 9 – Example of temperature gradient for chambers <2 000 L

4.5.7 Temperature rate of change

As shown in Figure 10, temperature rate of change between specified temperatures shall be calculated with the following method, and indicated in K/min.

Temperature heat-up rate = $\Delta t/T_1$

Temperature cool-down rate = $\Delta t/T_2$

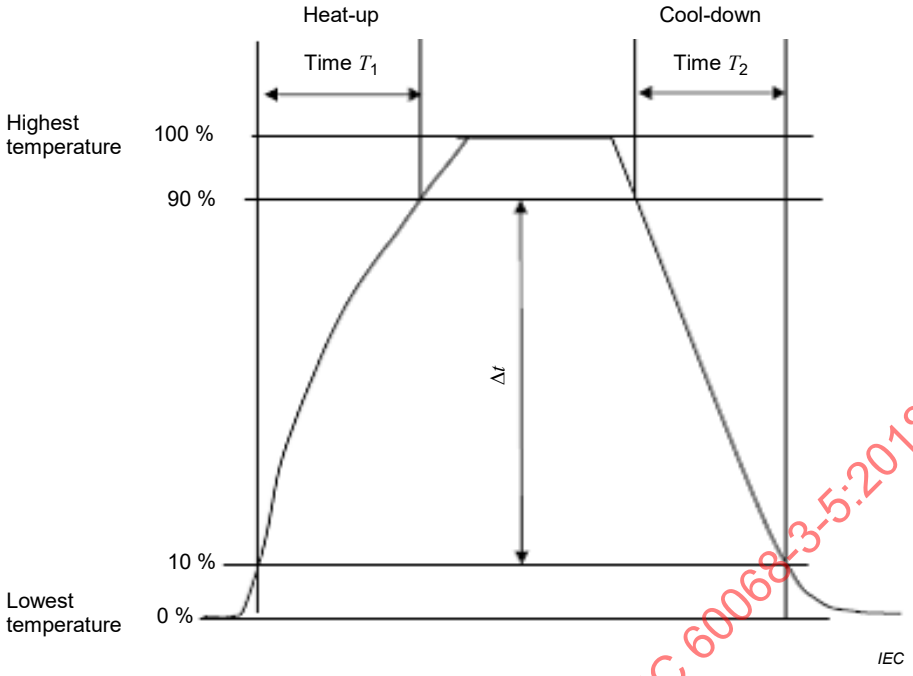


Figure 10 – Example of temperature rate of change ~~for heating and cooling of a test chamber~~

To ~~determine~~ measure temperature rate of change:

- adjust chamber to lowest specified temperature and allow to stabilize;
- adjust chamber to highest specified temperature, monitoring the time between the 10 % and the 90 % points of the temperature range;
- allow chamber to stabilize at the highest specified temperature;
- adjust chamber to lowest specified temperature, monitoring the time between the 90 % and 10 % points of temperature range.

~~This will determine the temperature rates of change for heating and cooling in K/min.~~

4.6 Standard temperature sequence

The following test sequence is considered to be the minimum recommended to obtain the necessary data for confirmation of the performance of a temperature chamber.

~~Test area conditions should be in accordance with 4.1 of this standard.~~ The test sequence is as follows:

- start at ambient conditions;
- adjust chamber to highest specified temperature and allow chamber to stabilize;
- measure performance at highest temperature;
- adjust chamber to lowest specified temperature, monitoring rate of change and allow chamber to stabilize;
- measure performance at lowest temperature;
- adjust chamber to highest specified temperature, monitoring rate of change;
- adjust chamber to atmospheric conditions and allow chamber to stabilize;
- measure performance at atmospheric conditions.

~~6 Evaluation criteria~~

~~The performance of the temperature test chamber is confirmed if all results are within the specification limits of relevant IEC 60068-2 standards.~~

5 Information to be given in the performance test report

As a minimum, the following information shall be contained in the test report.

~~– Temperature extremes.~~

~~– Any deviations such as overshoot.~~

~~– Test load if any.~~

a) Atmospheric conditions in the test area for measurement.

b) Size and volume of chamber enclosure and working space.

c) Temperature fluctuation, temperature variation in space and temperature gradient ~~at each temperature stage of clause 5~~.

d) Temperature rate of change~~, heating and cooling~~.

e) Highest/Lowest temperature.

f) Measurement results from each measurement position.

g) Details of data acquisition systems.

h) ~~Evaluation of~~ Measurements uncertainties.

i) Fixtures used for measurement.

Bibliography

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

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: EMF specifications and tolerances*

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

ISO 10012, *Measurement management systems – Requirements for measurement processes and measuring equipment*

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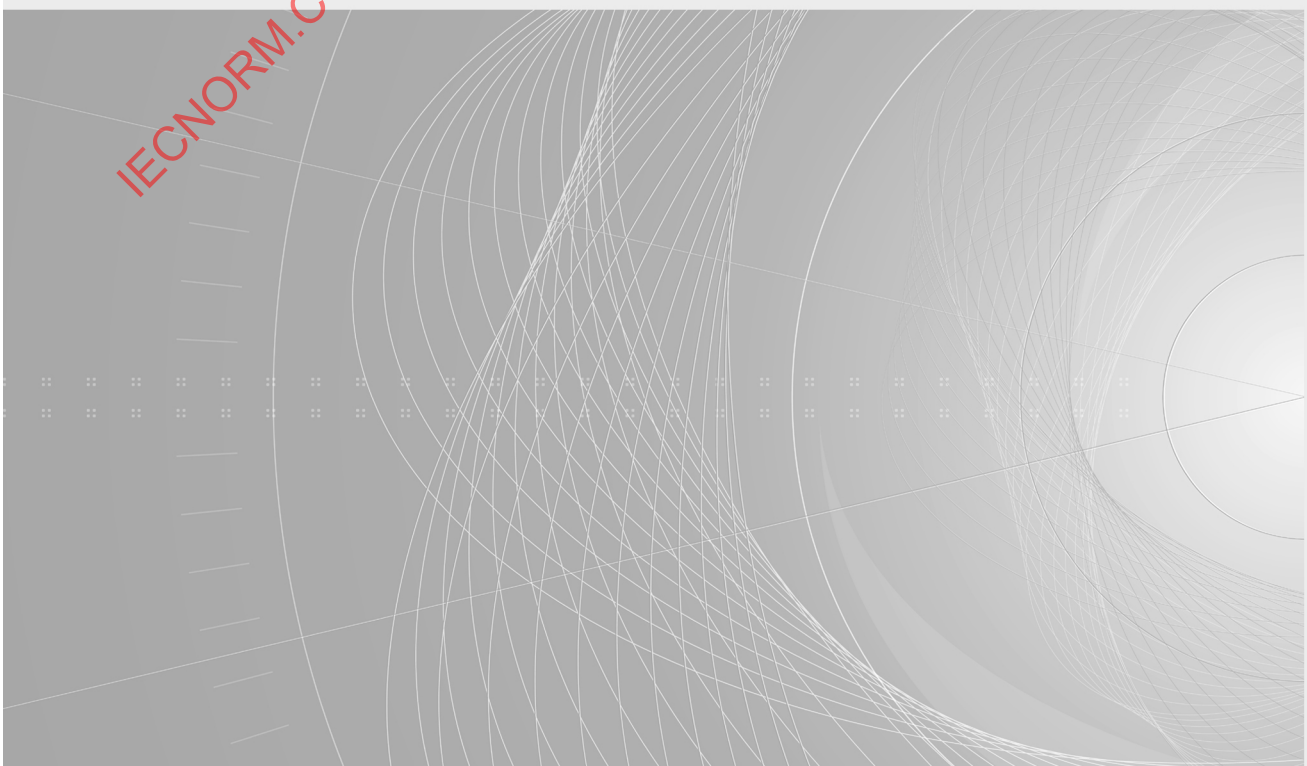
INTERNATIONAL STANDARD

NORME INTERNATIONALE

Environmental testing –
Part 3-5: Supporting documentation and guidance – Confirmation of the performance of temperature chambers

Essais d'environnement –
Partie 3-5: Documentation d'accompagnement et guide – Confirmation des performances des chambres d'essai en température



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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 a great influence on test results. The physical characteristics of temperature chambers can also influence test results.

ENVIRONMENTAL TESTING –

Part 3-5: Supporting documentation and guidance – Confirmation of the performance of temperature chambers

1 Scope

This part of IEC 60068 provides a uniform and reproducible method of confirming that temperature test chambers, without specimens, conform to the requirements specified in climatic test procedures of IEC 60068-2 (all parts) and other standards. This document is intended 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 (all parts), *Environmental testing – Part 2: Tests*

IEC 60068-3-7, *Environmental testing – Part 3-7: Supporting documentation and guidance – Measurements in temperature chambers for tests A and B (with load)*

IEC 60068-3-11, *Environmental testing – Part 3-11: Supporting documentation and guidance – Calculation of uncertainty of conditions in climatic test 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:

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

3.1
temperature test chamber
enclosure or space in some parts of which the temperature conditions, specified in IEC 60068-2 (all parts), can be achieved

3.2
temperature setpoint
desired temperature as set by the chamber controls

3.3
achieved temperature
stabilized temperature which desired temperature at the centre of the working space achieves within specified tolerance

3.4
temperature stabilization
state of maintaining temperature within specified tolerance during specified time at specified points in the working space

3.5
temperature fluctuation
difference, after stabilization, between the maximum and minimum temperatures at specified point in the working space during a specified interval of time

Note 1 to entry: For calibration, the centre point of working space may be used.

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

Note 1 to entry: See Figure 1 and Table 1.

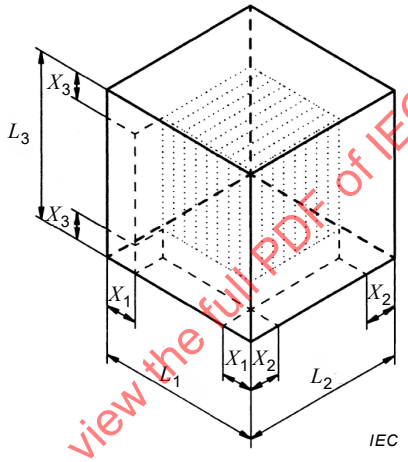


Figure 1 – Working space

Table 1 – Practical dimensions

Size	Volume l	Distance X mm	X (min.) mm
Small	Up to 1 000	$L/10$	50
Medium	1 000 to 2 000	$L/10$	100
Large	More than 2 000	$L/10$	150
NOTE Not all chambers are cubic in construction.			

3.7
temperature gradient
maximum difference in mean value, after stabilization, at any moment in time between two separate points in the working space

3.8
temperature variation in space
difference in mean value, after stabilization, at any moment in time between the temperature at the centre of the working space and at any other point in the working space

3.9
temperature rate of change
rate, in kelvin per minute, for the transition between two specified temperatures measured at the centre of the working space

Note 1 to entry: See Figure 2.

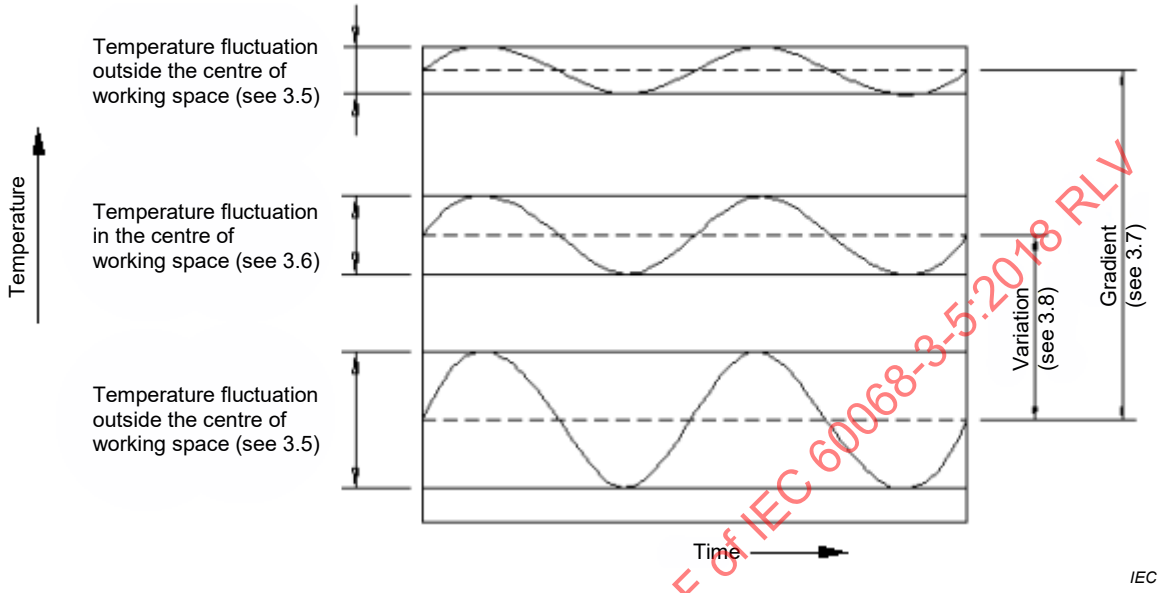


Figure 2 – Example of temperature differences

4 Measuring chamber performances

4.1 Test area environment

The environment around a temperature test chamber may influence the conditions inside the test chamber.

The confirmation of performance of temperature chambers should be carried out under standard atmospheric conditions specified in IEC 60068-1.

4.2 Temperature measurement system

The uncertainty of measurement of the output of the measurement system should be determined by calibration of the system, traceable to international standards (see ISO 10012).

The temperature sensors may be either calibrated platinum resistors or a thermocouple. The thermal response time of the sensors shall be within a minimum of 10 s and a maximum of 40 s for 50 % of response. It is preferred that the thermal response time of the entire measurement system to be less than 40 s. The use of sensors that are compliant to IEC 60584-1 tolerance class 1 (for thermocouples) or IEC 60751 tolerance class A (for resistors) is recommended.

4.3 Temperature chamber test specimens

All measurements described in 4.5 are performed with an empty working space. For measuring with test specimens (with or without heat dissipation), see IEC 60068-3-7.

4.4 Specified location of temperature sensors in working space

Temperature measuring sensors are located in each corner and in the centre of the working space (see Figure 3, minimum 9 sensors). For temperature chambers over 2 000 l, additional sensors should be located in front of the centre of each wall (see Figure 4, minimum 15 sensors). The measuring system is to be arranged in such a way that the temperature distribution of the empty test chamber will not be affected. For a large capacity chamber, there may be a significant difference between the temperature control sensor(s) and the temperature at the centre of the working space. It may be necessary to adjust the temperature setting to achieve the necessary tolerance.

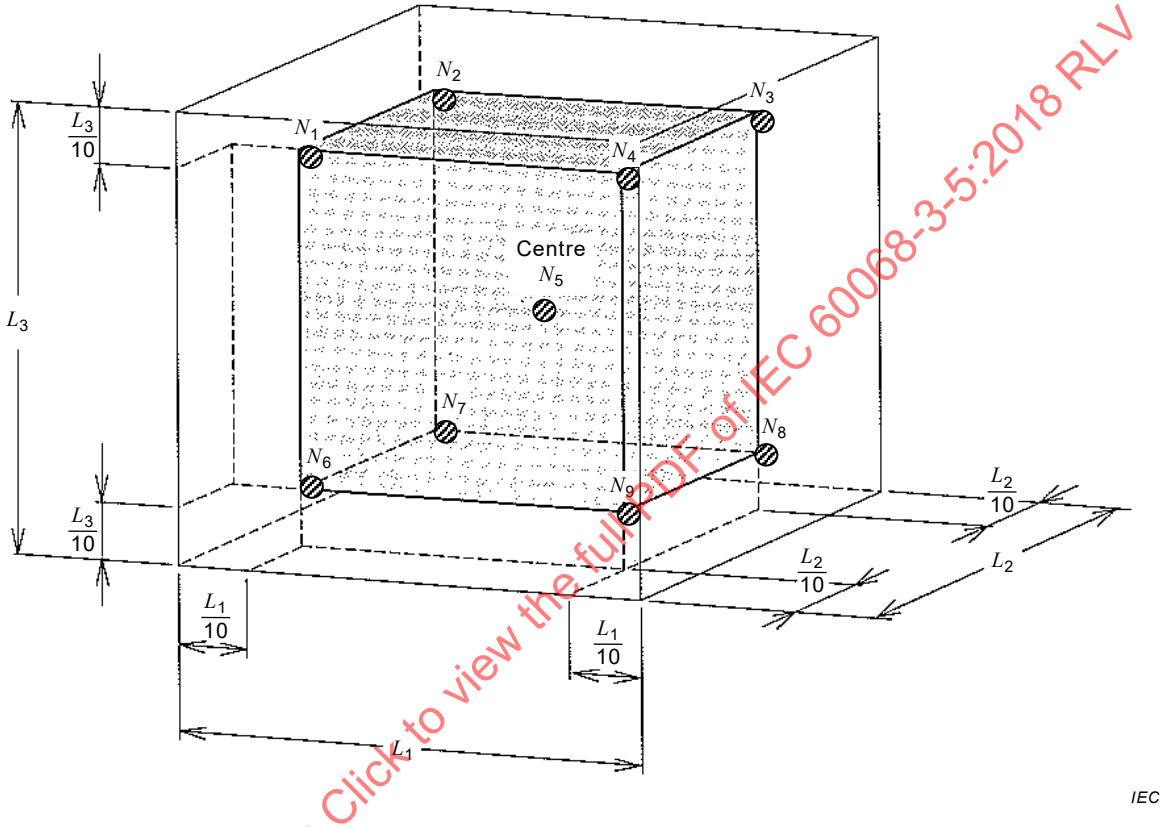


Figure 3 – Location of sensors for temperature chambers up to 2 000 l

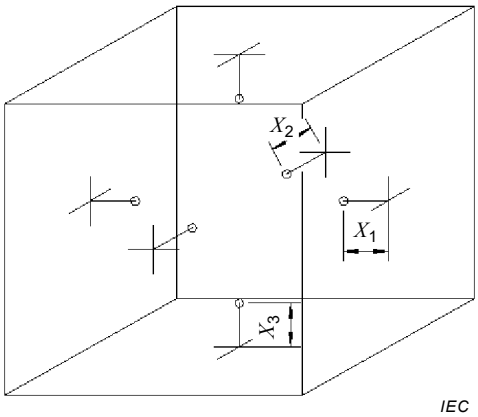


Figure 4 – Location of minimal additional sensors for temperature chambers over 2 000 l

For confirmation monitoring, data should be recorded at least once a minute. The device used for recording data from the chamber monitoring sensors should be independent of the chamber control system.

4.5 Measurement method

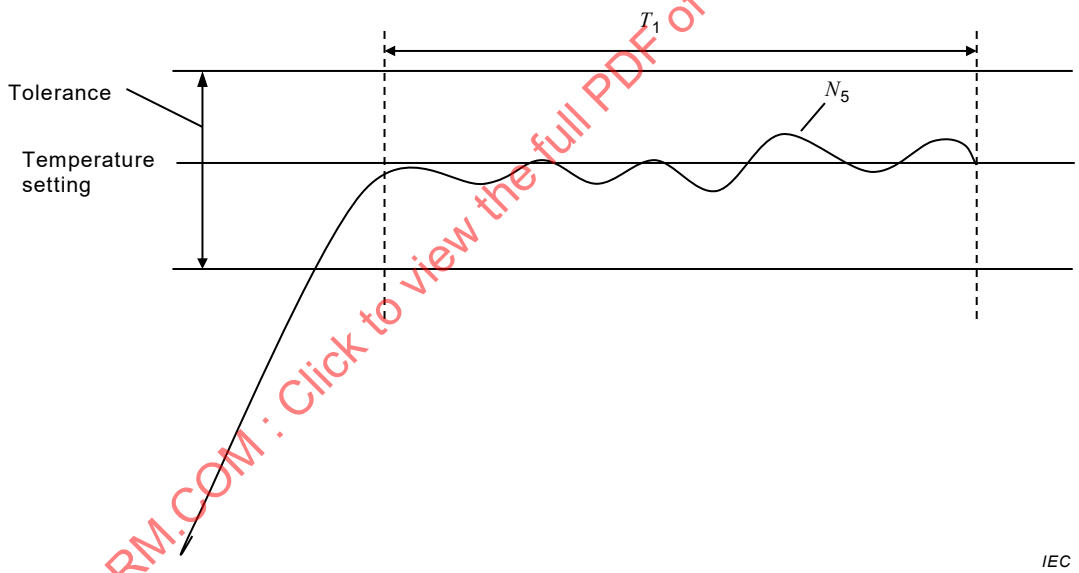
4.5.1 General

The temperature output of the temperature measuring system (see Figure 3 or Figure 4) determines, after chamber stabilization, the achieved temperature, temperature fluctuation and temperature gradient of the working space. For tolerance, the specification of the temperature/humidity chamber or, as necessary, tolerance specified in IEC 60068-2 (all parts), is required to maintain at the centre of the working space. Location of sensor is minimum 9 points or 15 points. This depends on the test chamber size. The measurement method is explained based on 9 points.

Uncertainty of measurement of the temperature measuring system shall be according to IEC 60068-3-11.

4.5.2 Achieved temperature

Temperature is achieved when the centre of the working space maintains the tolerance as required by IEC 60068-2 (all parts). An example is shown in Figure 5.



For tolerance, check the specification of the temperature chamber, or, as necessary, use tolerance specified in IEC 60068-2 which is required to maintain at the centre of the working space.

T_1 must be minimum 30 min. N_5 is the temperature at the centre of the working space.

Figure 5 – Example of achieved temperature

4.5.3 Temperature stabilization

Temperature reached and maintained within the allowable range in the working space is shown in Figure 6. Allowable range is based on the temperature fluctuation, temperature variation in space, and temperature gradient as the temperature chamber specification. Specified time T_2 is minimum 30 min after the measurement points (e.g. N_1 to N_9) are within the allowable range.

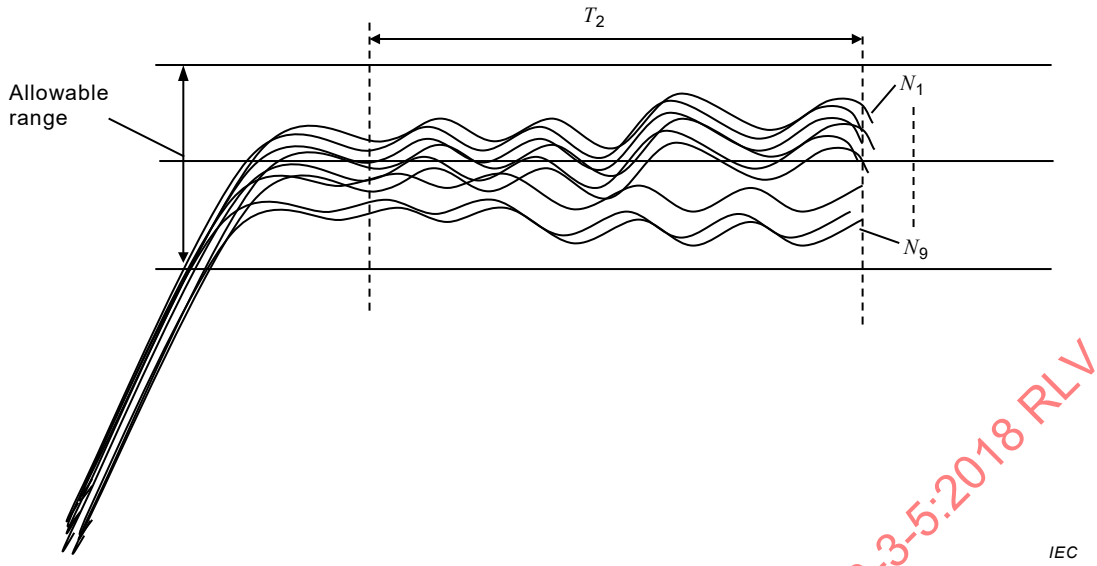


Figure 6 – Example of temperature stabilization for chambers up to 2 000 l

4.5.4 Temperature fluctuation

The fluctuation during a specified interval of time at specified temperature points in the working space, after temperature stabilization, is shown in Figure 7.

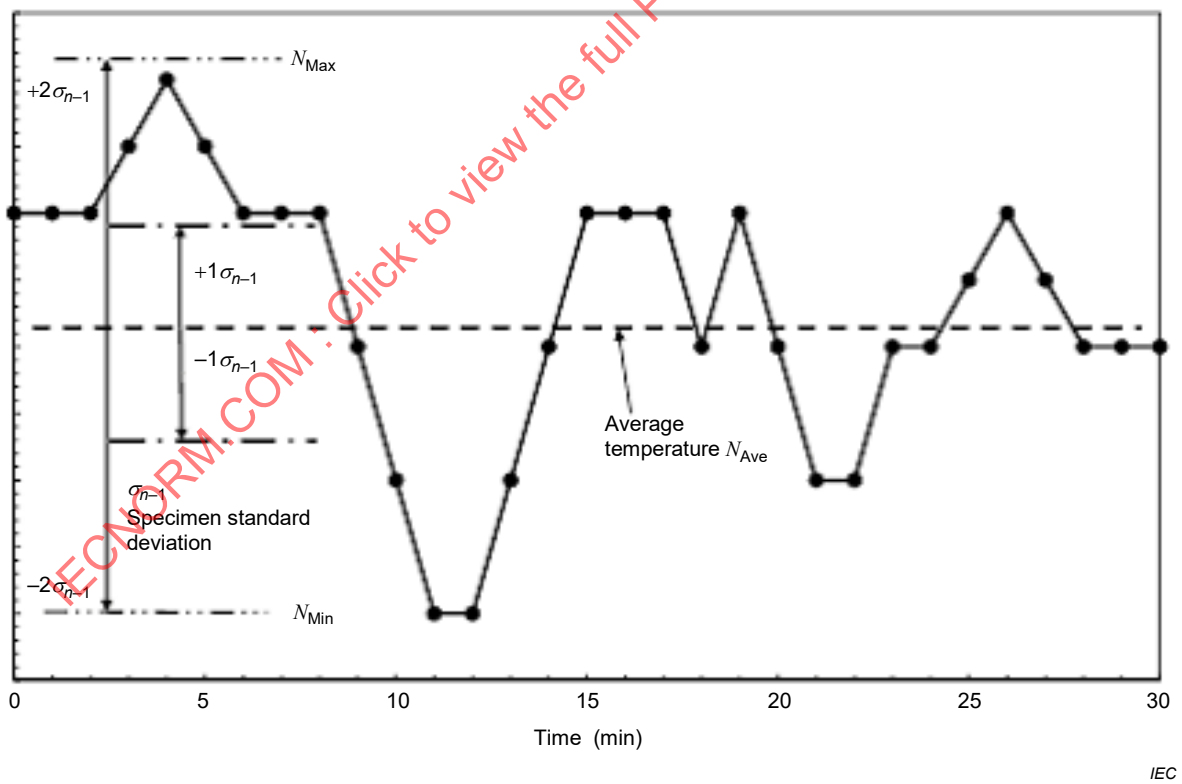


Figure 7 – Example of temperature fluctuation

Measurements are actually made at a certain sampling interval. It is not guaranteed that data captures the fluctuation peak. For that reason, the sample standard deviation, σ_{n-1}shall be obtained from the data measured in each measurement point after temperature has stabilized, and the temperature fluctuation shall be within $\pm 2\sigma_{n-1}$.

The temperatures measured in a certain measurement point, after stabilization, over a 30-minute period 10 or more times at even intervals shall be as follows.

$$N_1, N_2, \ldots, N_i, \ \ldots \ N_n \ (n \geqq 10)$$

The mean of N shall be N_{Ave}.

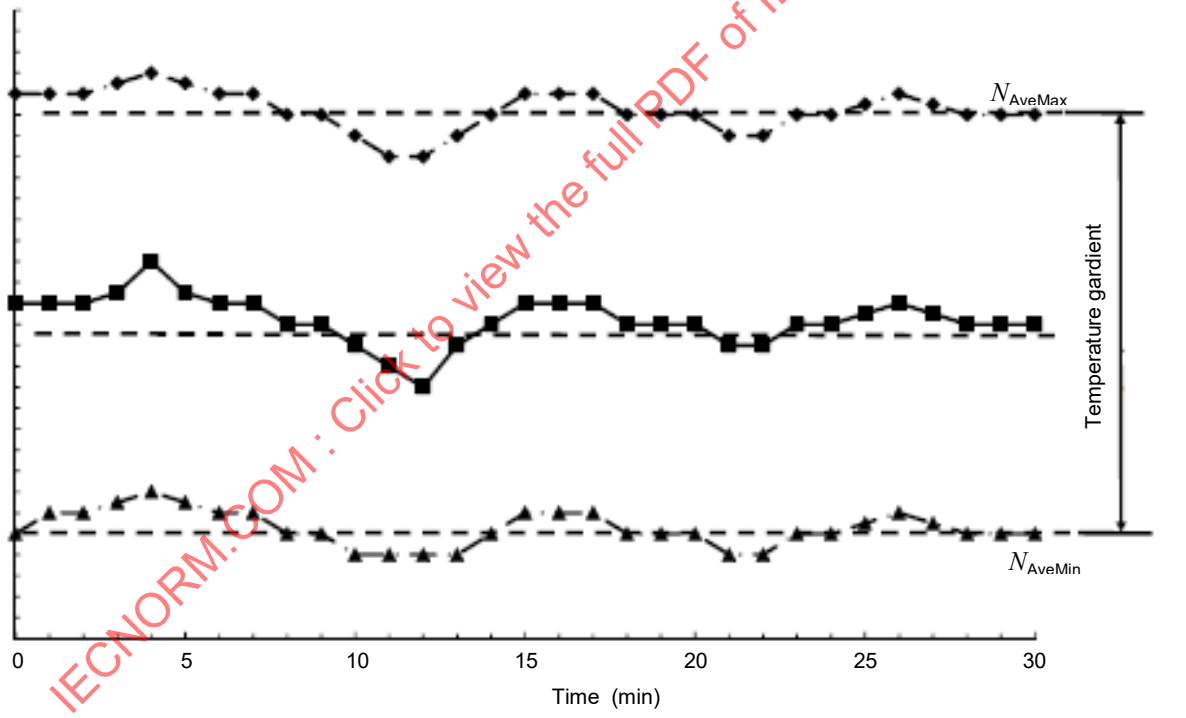
The specimen standard deviation, σ_{n-1} shall be defined as follows.

$$\sigma_{n-1} = \sqrt{\frac{\sum(X_i - N_{Ave})^2}{n-1}}$$

Temperature fluctuation $\pm 2\sigma_{n-1}$ shall be obtained in all 9 measurement points, and the highest value within that shall be annotated as the temperature fluctuation.

4.5.5 Temperature gradient

As shown in Figure 8, the maximum difference in mean temperature in all measurement points of the effective space shall be the temperature gradient.



N_{AveMax}: Mean highest temperature in each of 9 measurement points

N_{AveMin}: Mean lowest temperature in each of 9 measurement points

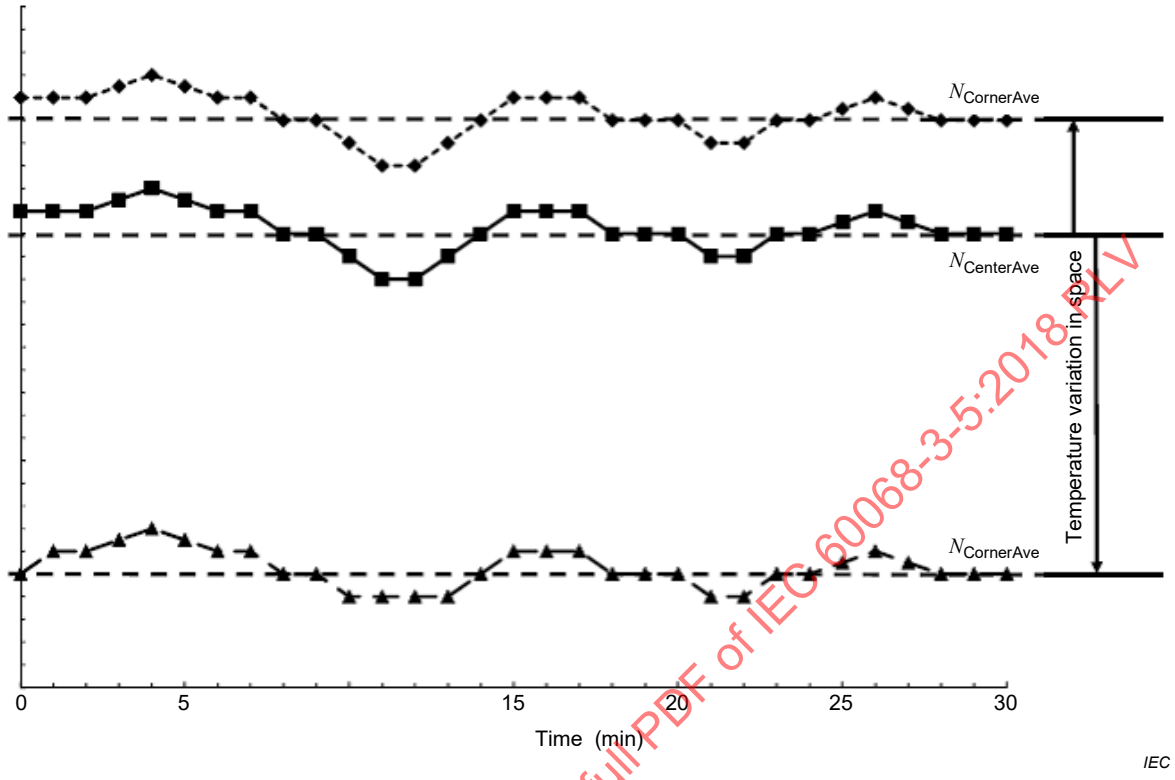
Temperature gradient = $N_{AveMax} - N_{AveMin}$

Figure 8 – Example of temperature gradient for chambers up to 2 000 l

4.5.6 Temperature variation in space

As shown in Figure 9, temperature variation in space is the difference of the mean temperature at the centre of the working space and the mean temperature of another

measurement point. The maximum difference between the centre of the working space and each measuring point shall be stated.



$N_{CenterAve}$: Mean temperature at chamber center

$N_{CornerAve(j)}$ j=1 to 8: Mean temperature at corner of working space

Temperature variation in space = | Max($N_{CornerAve[j]} - N_{CenterAve}$) |

The value obtained as the temperature variation in space shall be ($N_{CornerAve(j)} - N_{CenterAve}$), and the absolute value of the highest difference obtained for the 8 corners shall be annotated as the temperature variation in space

Figure 9 – Example of temperature gradient for chambers <2 000 L

4.5.7 Temperature rate of change

As shown in Figure 10, temperature rate of change between specified temperatures shall be calculated with the following method, and indicated in K/min.

Temperature heat-up rate = $\Delta t/T_1$

Temperature cool-down rate = $\Delta t/T_2$

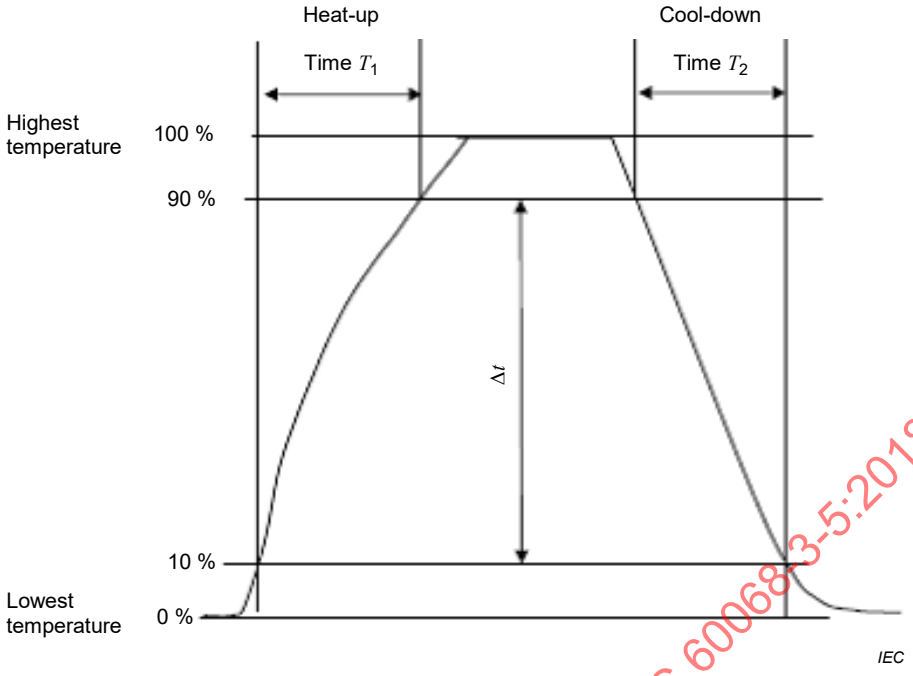


Figure 10 – Example of temperature rate of change

To measure temperature rate of change:

- adjust chamber to lowest specified temperature and allow to stabilize;
- adjust chamber to highest specified temperature, monitoring the time between the 10 % and the 90 % points of the temperature range;
- allow chamber to stabilize at the highest specified temperature;
- adjust chamber to lowest specified temperature, monitoring the time between the 90 % and 10 % points of temperature range.

4.6 Standard temperature sequence

The following test sequence is considered to be the minimum recommended to obtain the necessary data for confirmation of the performance of a temperature chamber.

The test sequence is as follows:

- start at ambient conditions;
- adjust chamber to highest specified temperature and allow chamber to stabilize;
- measure performance at highest temperature;
- adjust chamber to lowest specified temperature, monitoring rate of change and allow chamber to stabilize;
- measure performance at lowest temperature;
- adjust chamber to highest specified temperature, monitoring rate of change;
- adjust chamber to atmospheric conditions and allow chamber to stabilize;
- measure performance at atmospheric conditions.

5 Information to be given in the performance test report

As a minimum, the following information shall be contained in the test report.

a) Atmospheric conditions in the test area for measurement.
b) Size and volume of chamber enclosure and working space.
c) Temperature fluctuation, temperature variation in space and temperature gradient.
d) Temperature rate of change.
e) Highest/Lowest temperature.
f) Measurement results from each measurement position.
g) Details of data acquisition systems.
h) Measurements uncertainties.
i) Fixtures used for measurement.

Bibliography

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

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: EMF specifications and tolerances*

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

ISO 10012, *Measurement management systems – Requirements for measurement processes and measuring equipment*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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ESSAIS D'ENVIRONNEMENT –

Partie 3-5: Documentation d'accompagnement et guide – Confirmation des performances des chambres d'essai en température

AVANT-PROPOS

1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
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La Norme internationale IEC 60068-3-5 a été établie par le comité d'études 104 de l'IEC: Conditions, classification et essais d'environnement.

La présente version bilingue (2019-05) correspond à la version anglaise monolingue publiée en 2018-01.

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

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

a) Les procédures de confirmation sont clarifiées.

Le texte anglais de cette norme est issu des documents 104/759/FDIS et 104/778/RVD.

Le rapport de vote 104/778/RVD donne toute information sur le vote ayant abouti à l'approbation de cette norme.

La version française de cette norme n'a pas été soumise au vote.

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

Une liste de toutes les parties de la série IEC 60068, publiées sous le titre général *Essais d'environnement*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

L'IEC 60068 (toutes les parties) contient des informations fondamentales sur les méthodes d'essai d'environnement et les sévérités d'essai.

L'expression «conditionnement climatique» ou «essai d'environnement» couvre les environnements naturels et artificiels auxquels les composants ou les matériels peuvent être exposés dans le but qu'une évaluation de leurs performances puisse être réalisée dans les conditions d'utilisation, de transport et de stockage qu'ils peuvent rencontrer dans la pratique.

Les chambres d'essai en température utilisées pour les «conditionnements climatiques» ou les «essais d'environnement» ne sont décrites dans aucune publication, alors que les méthodes pour maintenir et mesurer la température et/ou l'humidité ont une grande importance sur les résultats d'essai. Les caractéristiques physiques des chambres d'essai en température peuvent également influencer les résultats d'essai.

ESSAIS D'ENVIRONNEMENT –

Partie 3-5: Documentation d'accompagnement et recommandations – Confirmation des performances des chambres d'essai en température

1 Domaine d'application

La présente partie de l'IEC 60068 fournit une méthode uniforme et reproductible pour confirmer que les chambres d'essai en température, sans spécimens, sont conformes aux exigences spécifiées dans les méthodes d'essai climatique de l'IEC 60068-2 (toutes les parties) et d'autres normes. Ce document est destiné à aider les utilisateurs lorsqu'ils réalisent des contrôles réguliers des performances de leur chambre d'essai.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2 (toutes les parties), *Essais d'environnement – Part 2: Essais*

IEC 60068-3-7, *Essais d'environnement – Partie 3-7: Documentation d'accompagnement et guide – Mesures dans les chambres d'essai en température pour les essais A et B (avec charge)*

IEC 60068-3-11, *Essais d'environnement – Partie 3-11: Documentation d'accompagnement et guide – Calcul de l'incertitude des conditions en chambres d'essais climatiques*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
chambre d'essai en température
enveloppe ou espace dans une partie de laquelle les conditions de température spécifiées dans l'IEC 60068-2 (toutes les parties), peuvent être obtenues

3.2
température du point de consigne
température souhaitée telle que fixée par le système de régulation de la chambre d'essai

3.3
température obtenue
température stabilisée, correspondant à la température souhaitée, obtenue au centre de l'espace de travail avec une tolérance spécifiée

3.4
stabilisation de la température
état de maintien de la température avec une tolérance spécifiée durant un temps spécifié au niveau de points spécifiés de l'espace de travail

3.5
fluctuation de la température
différence, après stabilisation, entre les températures maximale et minimale, en un point spécifié de l'espace de travail, au cours d'un intervalle de temps spécifié

Note 1 à l'article: Le point central de l'espace de travail peut être utilisé pour l'étalonnage.

3.6
espace de travail
partie de la chambre dans laquelle les conditions spécifiées peuvent être maintenues dans les tolérances spécifiées

Note 1 à l'article: Voir la Figure 1 et le Tableau 1.

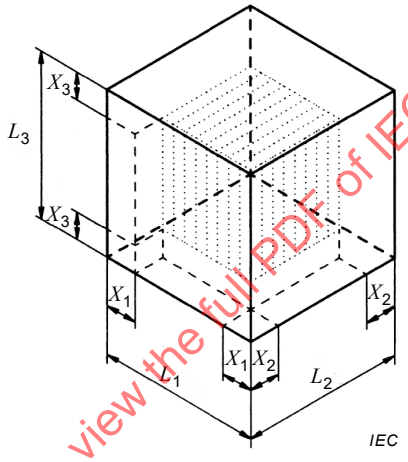

Figure 1 – Espace de travail

Tableau 1 – Dimensions pratiques

Taille	**Volume** l	**Distance *X*** mm	***X* (min.)** mm
Petite	Jusqu'à 1 000	*L*/10	50
Moyenne	1 000 à 2 000	*L*/10	100
Grande	Supérieur à 2 000	*L*/10	150
NOTE Les chambres ne sont pas toutes de forme cubique.			

3.7
gradient de température
différence maximale en valeur moyenne, après stabilisation et à tout moment, entre deux points distincts situés dans l'espace de travail

3.8
écart de température dans l'espace
différence des valeurs moyennes, après stabilisation et à tout moment, entre la température au centre de l'espace de travail et celle en un autre point quelconque de cet espace de travail